Heim, A. (1921): Geologie der Schweiz, Bd. II. Tauchniz, Leipzig.

Hunziker, J.C. (1987): Radiogenic isotopes in very low grade metamorphism. In: Frey, M. (ed) Low grade metamorphism, Blacke, Glasgow, 200-226.

Hunziker, J.C., Frey, M., Clauer, N., Dallmeyer, R.D., Friedrichsen, H., Flehmig, W., Hochstrasser, K., Roggwiler, P., Schwander, H. (1986): The evolution of illite to muscovite: mineralogical and isotopic data from the Glarus Alps, Switzerland. Contrib. Mineral. Petrol., **92**, 157-180.

Kerrich, R. (1986): Fluid infiltration into fault zones: chemical, isotopic and mechanical effects. PAGEOPH, **124**, 225-268.

Kerrich, R., La Tour, T.E., Willmore, L. (1984): Fluid participation in deep fault zones: evidence from geological, geochemical and $^{18}O/^{16}O$ relations. J. Geophys. Res., **89**, 4331-4343.

Kiely, P.V., Jackson, M.L. (1964): Selective dissolution of micas from potassium feldspars by sodium pyrosulfate fusion of soils and sediments. Am. Mineral., **49**, 1648-1659.

Kirschner, D.L., Sharp, Z.D., Masson, H. (1995): Oxygen isotope thermometry of quartz-calcite veins; unraveling the thermal-tectonic history of the subgreenschistfacies Morcles Nappe (Swiss Alps). Geol. Soc. Am. Bull., **107**, 1145-1157.

Lapidus, L., and Amundson, N.R. (1952): Mathematics of Adsorption in beds IV. The effect of longitudinal diffusion in ion exchange and chromatographic columns. J. Phys. Chem., **56**, 984-998.

Lassey, K.R. & Blattner, P. (1988): Kinetically controlled oxygen isotope exchange between fluid and rock in one-dimensional advective flow. Geochim. Cosmochim. Acta, **52**, 2169-2175.

Matthews, A., Goldsmith, J.R., Clayton, R.N. (1983): Oxygen isotope fractionation involving pyroxenes: The calibration of mineral-pair geothermometers. Geochim. Cosmochim. Acta, **47**, 631-644.

McCaig, A.M. (1989): Fluid flow through fault zones. Nature, **340**, 600.

Milnes, A.G. & Pfiffner, O.A. (1980): Tectonic evolution of the central Alps in the cross section St. Gallen Como. Eclogae Geol. Helv., **73**, 619-633.

Nabelek, P.L. (1991): Stable isotope monitors. In: Kerrick, D.M., Ed., Contact metamorphism, Rev. Mineral., **26**, 395-435.

Oberholzer, J. (1933): Geologie der Glarner Alpen. Beiträge Geologische Karte Schweiz, NF 28, Schweizerische Geologische Kommission.

Pfiffner, O.A. (1985): Displacements along thrust faults. Eclogae Geologicae Helvetiae, **78**, 313-333.

Oliver, J. (1986): Fluids expelled tectonically from orogenic belts, their role in hydrocarbon migration and other geologic phenomena. Geology, **14**, 99-102.

Pfiffner, O.A. (1986): Evolution of the north Alpine foreland basin in the Central Alps. Special Publication of the International Association of Sedimentologists, No. 8, 219-228.

Price, R.A. (1988): The mechanical paradox of large overthrusts. Geol. Soc. Am. Bull., **100**, 1898-1908.

Rahn, M., Mullis, J., Erdelbrock, K., Frey. M. (1995): Alpine metamorphism in the North Helvetic Flysch of the Glarus Alps, Switzerland. Eclogae geol. Helv., **88**, 157-178.

Rimstidt, J.D.(1997): Gangue mineral transport and deposition. In: Barnes, H.L. (ed) Geochemistry of hydrothermal ore deposits, John Wyley & sons, Inc., New York, 487-516.

Rothpletz, A. (1883): Der Gebirgsbau der Alpen beiderseits des Rheins. Zeitschrift der Deutschen geol. Ges., 167-168.

Schmid, S.M. (1975): The Glarus overthrust: field evidence and mechanical model. Eclogae Geol. Helv., **68**, 247-283.

Schmid, S.M., Pfiffner, O.A., Froitzheim, N., Schonborn, G., Kissling, E. (1996): Geophysical-geological transsect and tectonic evolution of the Swiss-Italian Alps. Tectonics, **15**, 1036-1064.

Sharp, Z.D. (1990): In situ laser microprobe techniques for stable isotope analysis. Chem. Geol., **101**, 3-19.

Sibson, R.H. (1986): Earthquakes and rock deformation in crustal fault zones. Ann. Rev. Earth Planet. Sci., **14**, 149-175.

Syers, J.K., Chapman, S.L., Jackson, M.L. (1968): Quartz isolation from rocks, sediments and soils for determination of oxygen isotopes composition. Geochim. Cosmochim. Acta, **32**, 1022-1025.

Valley, J.W., Kitchen, N., Kohn, M.J., Niendorf, C.R., Spicuzza, M.J. (1995): UWG-2, a garnet standard for oxygen isotope ratios: strategies for high precision and accuracy with laser heating. Geochim. Cosmochim. Acta, **59**, 5223-5231.

Zheng, Y.F. (1993): Calculation of oxygen isotope fractionations in anhydrous silicate minerals. Geochim. Cosmochim. Acta, **57**, 1079-1091.

Figure captions

Figure 1: (a) Simplified cross section of the Glarus thrust, modified from Badertscher et al. (2001); (b) regional south to north ^{18}O enrichment trend of calcites from the Lochseiten calc-mylonite as documented by Burkhard and Kerrich (1990); dashed line schematically illustrates the model interpretation of Bowman et al. (1994) as an oxygen isotope front produced by combined northward directed, thrust parallel flow and diffusion/dispersion in the pore fluid.

Figure 2: (a) footwall limestone from 65 centimeters below the thrust contact at Grauberg (sample G029), pure carbonate layers alternate with more mica rich domains on a millimeter scale, the mica rich parts represent low ^{18}O domains and contain abundant rotated dolomite blasts, scale bar 500 μm; (b) hangingwall Verrucano from 30 centimeter above the thrust contact at Lochseite (sample LS03), microscopic fracture filled with ankerite (dark) and fibrous quartz, scale bar 50 μm; (c) hangingwall Verrucano from 10 centimeters above the thrust contact at Lochseite (sample LS01), fibrous quartz in pressure fringes around pyrite, crossed polars, scale bar 500 μm.

Figure 3: Bulk rock H_2O and CO_2 contents of selected samples from sampling profiles across the Glarus thrust at the Grauberg and Lochseite localities.

Figure 4: Oxygen-, carbon- and strontium isotope compositions of calcite from the two sampling profiles across the thrust contact at the Grauberg and Lochseite localities, grey bars indicate isotopic compositions of corresponding unaltered reference lithologies.

Figure 5: (a) Oxygen isotope compositions of calcite from a sampling profile through the Lochseiten calc-mylonite and the footwall limestone at Grauberg; (b) small scale oxygen isotope variations in a polished slab from the footwall limestone taken at 65 centimeters below the thrust contact (sample G029); 60 microsamples were taken with a dentist drill from a polished rock surface, sampling positions approximately coincide with the grid intersection points.

Figure 6: Oxygen isotope compositions of calcite and coexisting quartz (and albite) and corresponding inter-mineral oxygen isotope fractionations from the hangingwall Verrucano at the Grauberg and Lochseite localities.

Figure 7: (a) Model oxygen- and carbon isotope fronts fitted to the data from the Lochseite locality assuming constant isotopic composition buffered by the pore fluid of the flysch at the thrust contact ("pinned boundary model" of Bickle and Baker, 1990). (b) Model oxygen- and carbon isotope fronts fitted to the data from the Grauberg locality, solid line: "uniform flow model", dashed line: "composite medium model", see text for the corresponding model assumptions.

Figure 8: Qualitative model of syn-deformative fluid flow along the Glarus thrust; small downwards pointing solid arrows at the southern section of the thrust represent lateral dispersion and seepage associated with subhorizontal flow in the Verrucano aquifer into the footwall; upwards directed solid arrows in the footwall of the northern section indicate upwards fluid migration due to dewatering and compaction of the N-Helvetic flysch; dashed arrows indicate the supposed regional flow pattern; insets illustrate the effect of vertical transport components on the oxygen isotope composition of the Lochseiten calc-mylonite.

Tables

Table 1: Number of oxygen and carbon atoms per formula unit and molar volumes of the rock forming minerals and possible pore fluids; thermodynamic data taken form Holland and Powell (1998), fluid molar volumes calculated from the Kerrick and Jakobs (1981) fluid equation of state.

	mineral					$H_2O - CO_2$ fluid *				
mineral	qtz	ab	mus	chl	cc					
X_{CO_2}						0	0.005	0.05	0.25	0.5
oxygen a.p.f.u.	2	8	12	18	3	1	1.015	1.05	1.25	1.5
carbon a.p.f.u.	0	0	0	0	1	0	0.005	0.05	0.25	0.5
molar volume $[cm^3/mol]$	22.7	100.4	140.8	210.9	37.0	19	19	20	24	30

* For the calculation of the fluid molar volumes conditiosn of 300°C and 300 to 450 MPa were assumed.

Table 2: κ factors expressing the fluid/solid partitioning of oxygen and carbon for the different rock types and a variety of fluid compositions; the κ factors enter the calculation of time integrated volumetric fluid fluxes from $v \cdot t$ estiamtes obtained from curve fitting.

rock type *	X_{CO_2}	κ^O	κ^C
footwall limestones Grauberg	0.000	1.54	$\rightarrow \infty$
local equilibrium	0.005	1.54	93.2
	0.050	1.55	9.8
	0.250	1.56	2.3
	0.500	1.62	1.5
Verrucano Grauberg	0.000	1.56	$\rightarrow \infty$
local equilibrium	0.005	1.57	5.130
	0.050	1.60	0.540
	0.250	1.62	0.130
	0.500	1.69	0.008
Verrucano Grauberg	0.000	1.17	$\rightarrow \infty$
inert quartz	0.005	1.17	5.130
	0.050	1.19	0.540
	0.250	1.20	0.130
	0.500	1.25	0.008
Verrucano Lochseite	0.000	1.56	$\rightarrow \infty$
local equilibrium	0.005	1.57	5.130
	0.050	1.60	0.540
	0.250	1.62	0.130
	0.500	1.68	0.008
Verrucano Lochseite	0.000	0.64	$\rightarrow \infty$
inert quartz and albite	0.005	0.64	2.565
	0.050	0.65	0.270
	0.250	0.65	0.065
	0.500	0.68	0.004
Verrucano Lochseite	0.000	0.07	$\rightarrow \infty$
only calicte reactive	0.005	0.07	2.565
	0.050	0.08	0.270
	0.250	0.08	0.065
	0.500	0.08	0.004

* modal proportions were taken as:
footwall limestones: 95% calcite, 2.5 % quartz, 2.5 % muscovite
Verrucano Grauberg: 25% quartz, 25% albite, 25% muscovite, 20% chlorite, 5% calcite
Verrucano Lochseite: 30% quartz, 30% albite, 25% muscovite, 10% chlorite, 2.5% calcite

Table 3: Effective oxygen diffusivities/dispersivities in m^2/s calculated from $\sqrt{D^O \cdot t}$ as obtained from curve fitting.

	Lochseite		Grauberg			
	pinned boundary model		uniform flow model	composite medium model		
				footwall	hangingwall	
	min.	max.			min.	max.
$\sqrt{D^O \cdot t}$ [m]	0.55	0.9	3.3	5.2	50	57.6
time [years]						
10^5	$9.5 * 10^{-14}$	$2.5 * 10^{-13}$	$3.4 * 10^{-12}$	$8.7 * 10^{-12}$	$7.9 * 10^{-10}$	$1.1 * 10^{-9}$
10^6	$9.5 * 10^{-15}$	$2.5 * 10^{-14}$	$3.4 * 10^{-13}$	$8.7 * 10^{-13}$	$7.9 * 10^{-11}$	$1.1 * 10^{-10}$
10^7	$9.5 * 10^{-16}$	$2.5 * 10^{-15}$	$3.4 * 10^{-14}$	$8.7 * 10^{-14}$	$7.9 * 10^{-12}$	$1.1 * 10^{-11}$

Fig. 1

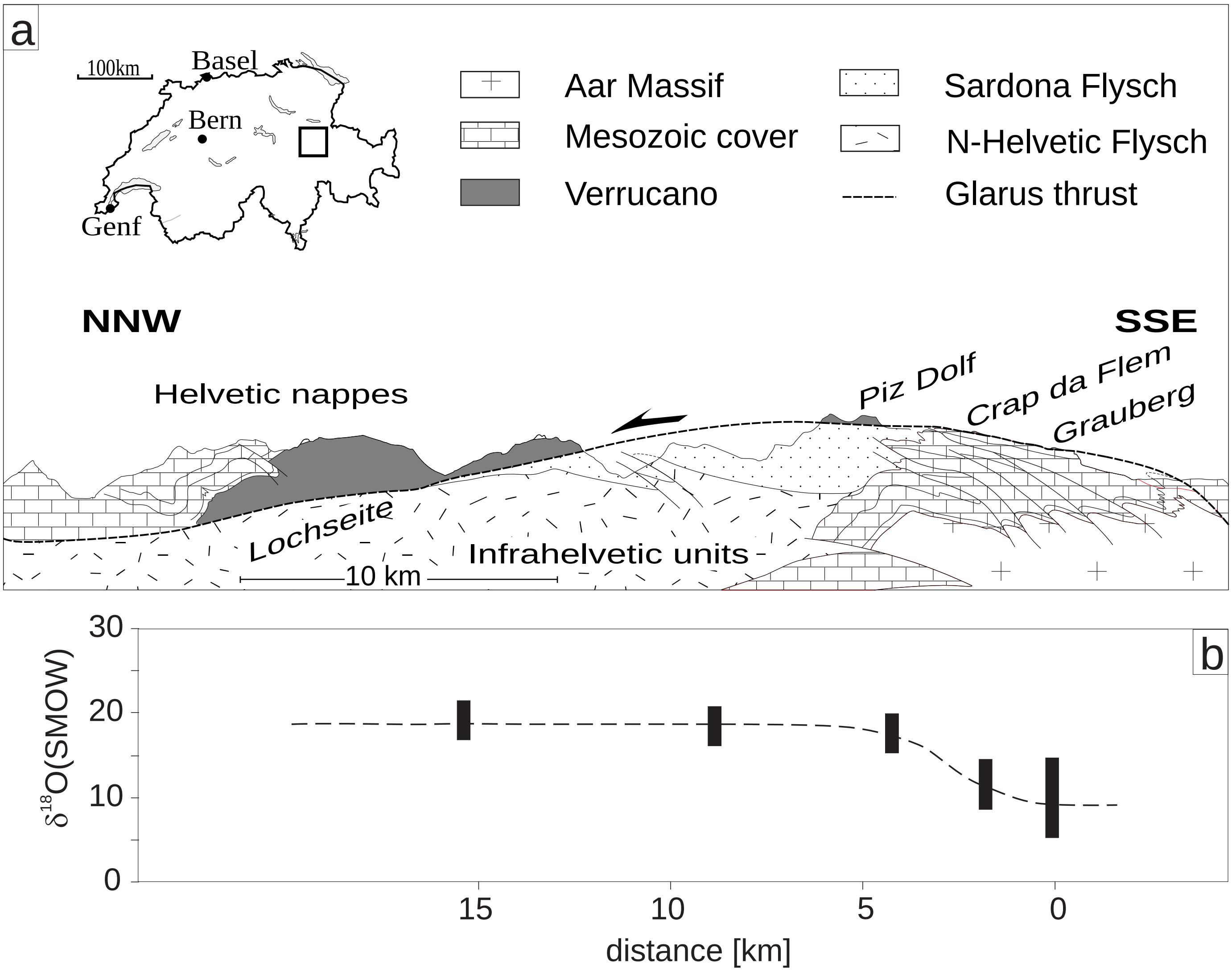

a
100km
Basel
Bern
Genf
Aar Massif
Mesozoic cover
Verrucano
Sardona Flysch
N-Helvetic Flysch
Glarus thrust
NNW
SSE
Helvetic nappes
Piz Dolf
Crap da Flem
Grauberg
Lochseite
Infrahelvetic units
10 km
b
30
20
10
0
δ18O(SMOW)
15
10
5
0
distance [km]

Fig. 2

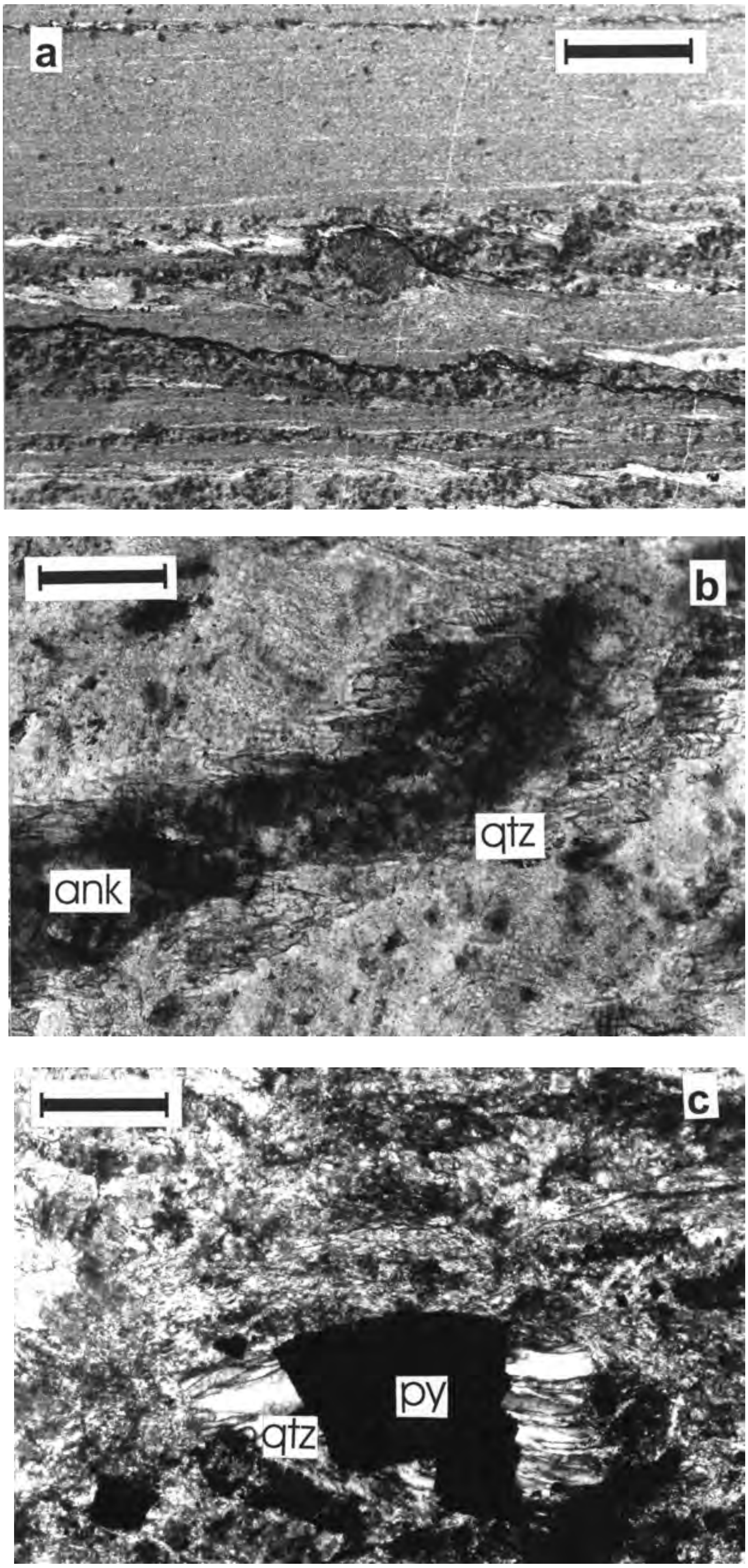


Fig. 3

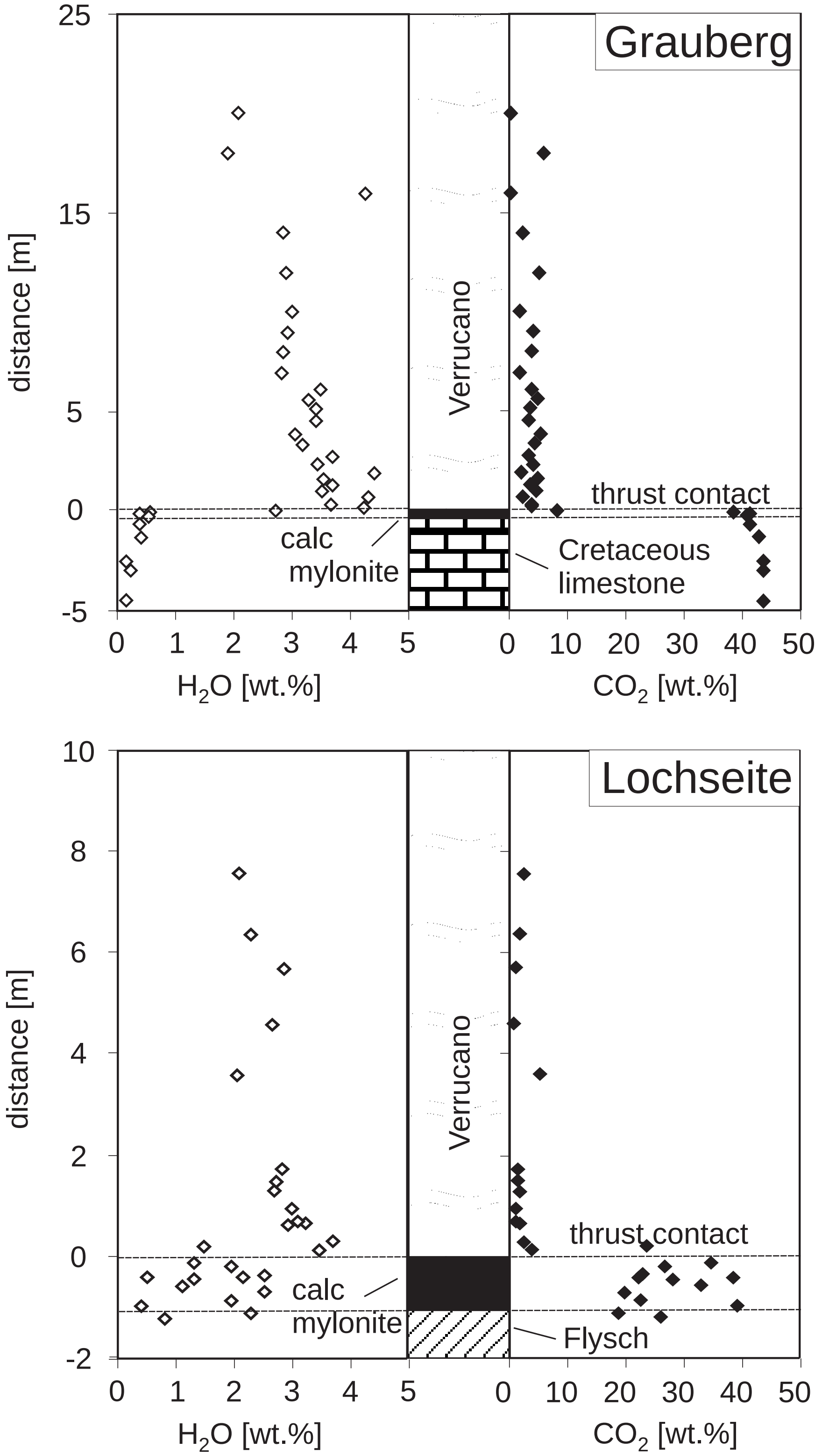

Grauberg
25
15
5
0
-5
distance [m]
Verrucano
thrust contact
calc
mylonite
Cretaceous
limestone
0 1 2 3 4 5
H_2O [wt.%]
0 10 20 30 40 50
CO_2 [wt.%]
Lochseite
10
8
6
4
2
0
-2
distance [m]
Verrucano
thrust contact
calc
mylonite
Flysch
0 1 2 3 4 5
H_2O [wt.%]
0 10 20 30 40 50
CO_2 [wt.%]

Fig. 4

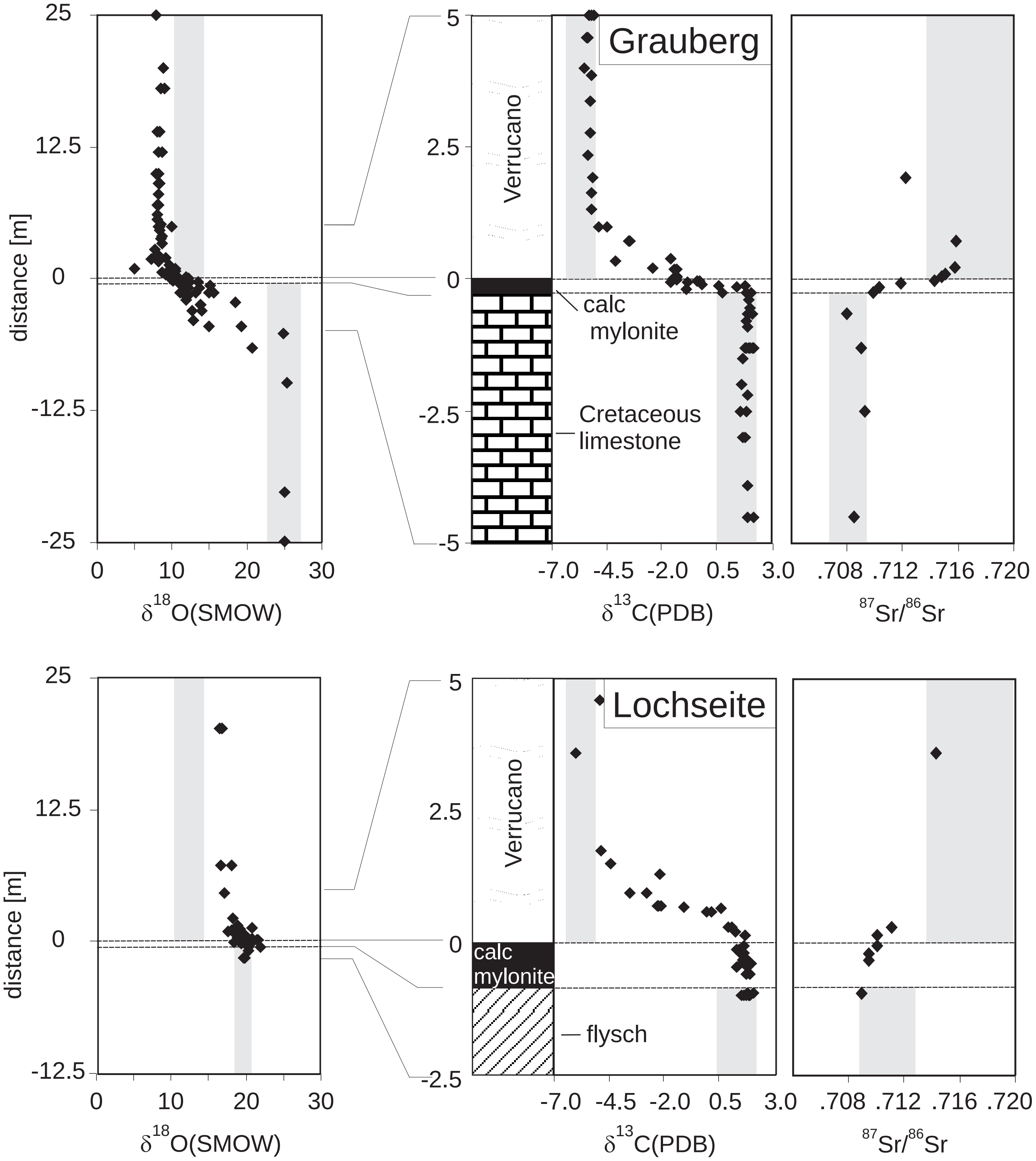

Grauberg
distance [m]
25
12.5
0
-12.5
-25
0
10
20
30
δ18O(SMOW)
5
2.5
0
-2.5
-5
Verrucano
calc mylonite
Cretaceous limestone
-7.0
-4.5
-2.0
0.5
3.0
δ13C(PDB)
.708
.712
.716
.720
87Sr/86Sr
Lochseite
distance [m]
25
12.5
0
-12.5
0
10
20
30
δ18O(SMOW)
5
2.5
0
-2.5
Verrucano
calc mylonite
flysch
-7.0
-4.5
-2.0
0.5
3.0
δ13C(PDB)
.708
.712
.716
.720
87Sr/86Sr

Fig. 5

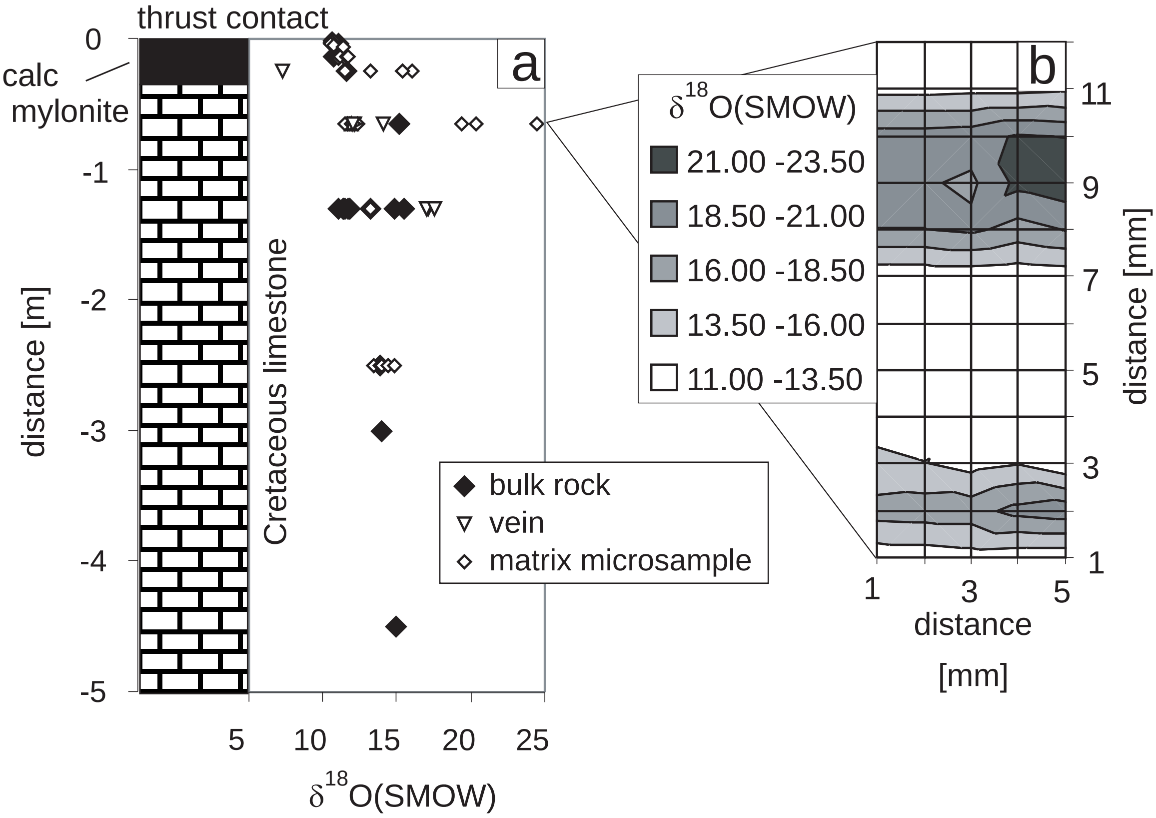

thrust contact
calc mylonite
Cretaceous limestone
a
b
0
-1
-2
-3
-4
-5
distance [m]
5
10
15
20
25
δ^{18}O(SMOW)
◆ bulk rock
▽ vein
◇ matrix microsample
δ^{18}O(SMOW)
21.00 -23.50
18.50 -21.00
16.00 -18.50
13.50 -16.00
11.00 -13.50
11
9
7
5
3
1
distance [mm]
1
3
5
distance
[mm]

Fig. 6

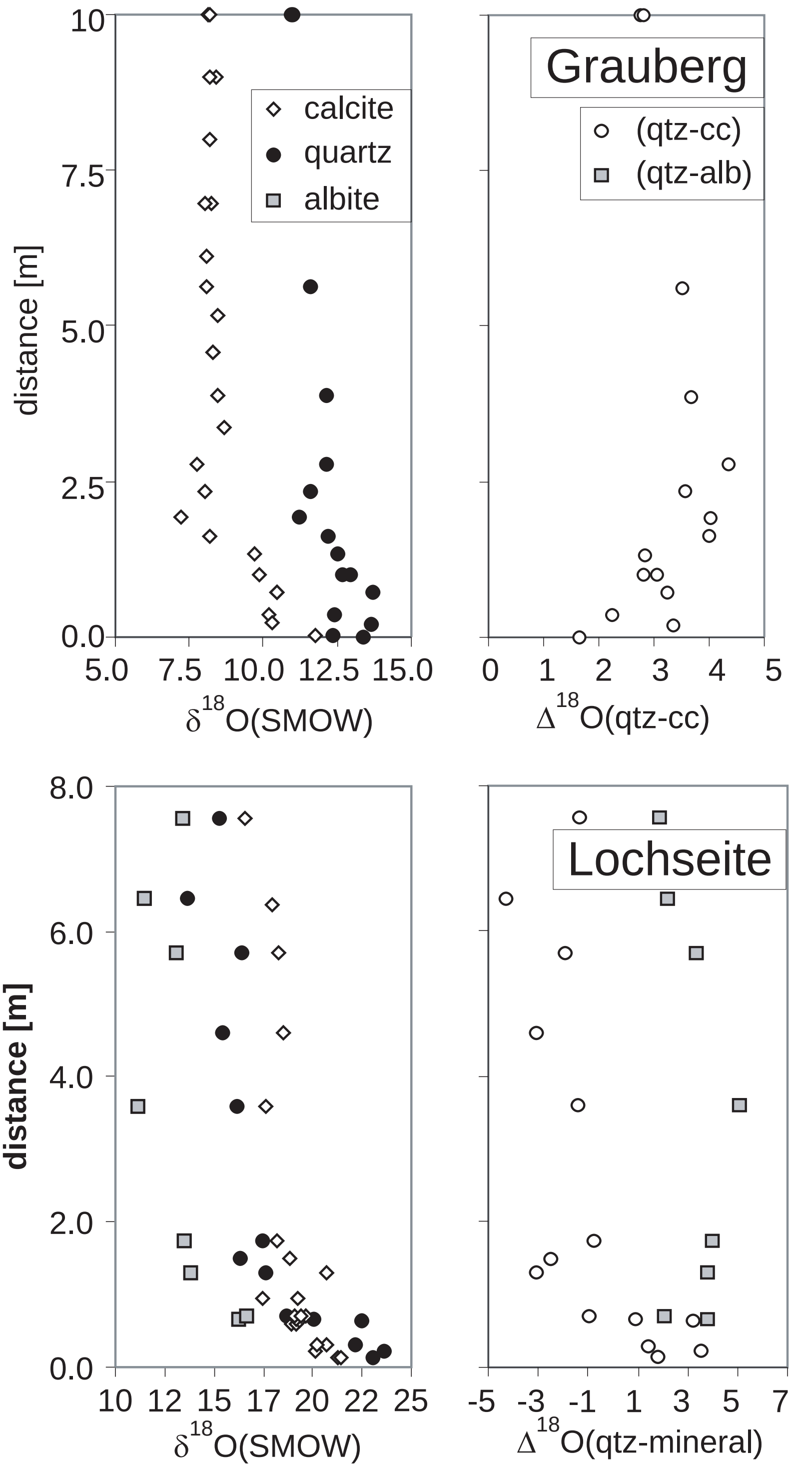
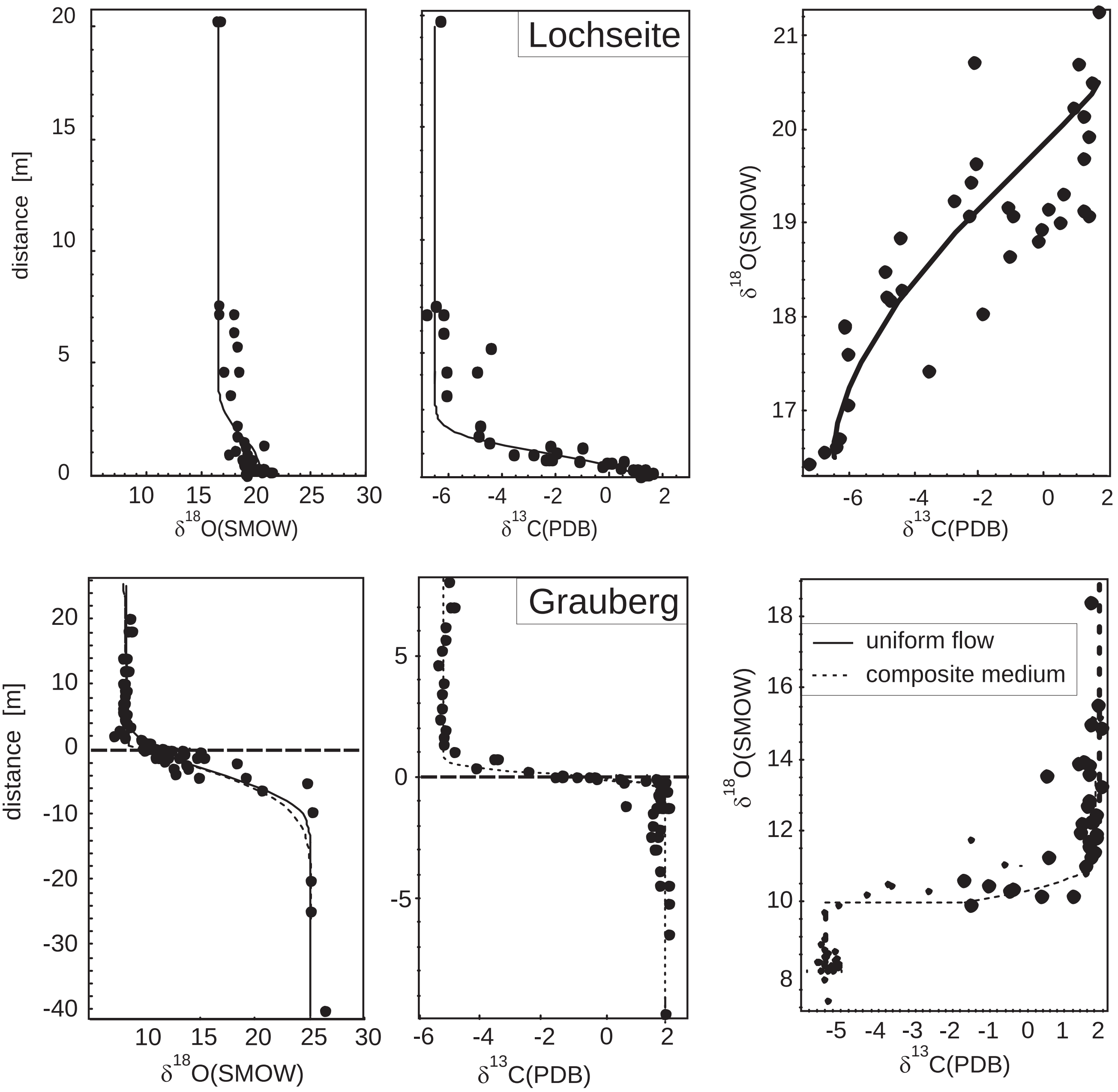
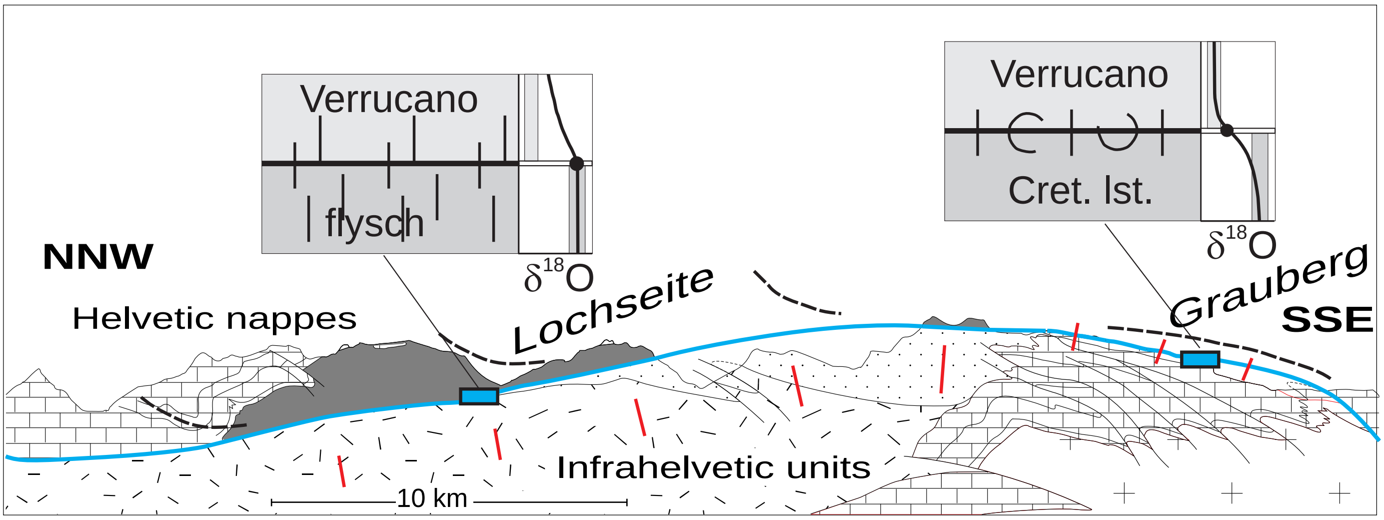

10
7.5
5.0
2.5
0.0
distance [m]
calcite
quartz
albite
5.0
7.5
10.0
12.5
15.0
δ18O(SMOW)
Grauberg
(qtz-cc)
(qtz-alb)
0
1
2
3
4
5
Δ18O(qtz-cc)
8.0
6.0
4.0
2.0
0.0
distance [m]
10
12
15
17
20
22
25
δ18O(SMOW)
Lochseite
-5
-3
-1
1
3
5
7
Δ18O(qtz-mineral)

Fig. 7



Lochseite
Grauberg
distance [m]
20
15
10
5
0
10 15 20 25 30
δ^{18}O(SMOW)
-6 -4 -2 0 2
δ^{13}C(PDB)
21
20
19
18
17
δ^{18}O(SMOW)
-6 -4 -2 0 2
δ^{13}C(PDB)
distance [m]
20
10
0
-10
-20
-30
-40
10 15 20 25 30
δ^{18}O(SMOW)
5
0
-5
-6 -4 -2 0 2
δ^{13}C(PDB)
uniform flow
composite medium
18
16
14
12
10
8
δ^{18}O(SMOW)
-5 -4 -3 -2 -1 0 1 2
δ^{13}C(PDB)

Fig. 8



Verrucano
flysch
δ^{18}O
Verrucano
Cret. lst.
δ^{18}O
NNW
Helvetic nappes
Lochseite
Grauberg
SSE
Infrahelvetic units
10 km

The Glarus overthrust: example of a major fault that pierced the brittle-ductile transition of the alpine accretionary prism

paper submitted to Geology

Nicolas P. Badertscher[1], Georges Beaudoin[2], René Therrien[2] and Martin Burkhard[1]

[1]Institut de Géologie, Université de Neuchâtel, Emile-Argand 11, 2007 Neuchâtel, Switzerland
[2]MEDEF, Département de Géologie et de Génie Géologique, Université Laval, Québec G1K7P4, Canada

ABSTRACT

Fluid flow 3D numerical modeling, based on advective-diffusive transport coupled with isotopic fluid/rock exchange, is applied to reproduce regional oxygen isotope zonation in the Lochsitenkalk-mylonite along the Helvetic Glarus thrust plane in the eastern Swiss Alps in order to constrain parameters that governed the flow geometry. For internal, southern parts of the thrust, high permeability contrasts in excess of 100:1 between the mylonite and surrounding rock and a high hydraulic head in the hinterland/root zone are required in order to reproduce channelized flow along the thrust and associated downward infiltration into footwall rocks evident from steep isotopic gradients. Further north, fluids are drained upward from the footwall flysch across the thrust. We conclude that the advancing Glarus thrust cuts up-section across the brittle-ductile transition of the alpine accretionary prism. In the hinterland, the Glarus thrust evolves in the ductile regime under lithostatic fluid pressure beneath the low-permeability brittle-ductile transition. Toward the foreland, the Glarus thrust has pierced the low-permeability brittle-ductile transition and overpressured fluids escape into the hydrostatic domain. This situation is compared to the Barbados-, Nankai- and Peru- accretionary prisms where similar flow patterns have been observed "in situ".

INTRODUCTION

The Glarus overthrust is a classical example of a floor thrust advancing in an accretionnary complex that formed above the southern European margin during the Alpine collision. Stable isotope systematics along the Glarus overthrust document fluid flow pathways (Badertscher et al., 2001; Burkhard and Kerrich, 1990; Burkhard et al., 1992). Fluid flow in active accretionary prism such as the Nankai, the Barbados (Henry, 2000; Saffer and Bekins, 1999; Sample, 1996) the Peru and the Cascadia (Sample, 1996) convergent margins is well documented, yet flow pathways and the relative importance of channelized and diffuse flow remain controversial; parameters that governed the geometry of flow pathways are mostly unknown. This paper presents numerical simulations of fluid flow along the Glarus overthrust that allow to constrain the critical parameters responsible for flow geometry and discuss their application to active accretionary systems.

Interactions between rock matrix and fluids that flow in pores and fractures can be documented through oxygen isotope systematics investigations, providing that the fluids and the rocks are not in isotopic equilibrium. Due to highly contrasted oxygen isotope compositions of the different lithologies involved, the Glarus overthrust is ideal to study fluid flow and isotope exchange between different oxygen isotope reservoirs (see below, Table 1). Because fluid flow in geological materials is responsible for the displacement and distortion of initially sharp isotope fronts depending on the fluid transport processes (Abart and Pozzorini, 2000; Baker and Spiegelman, 1995; Bickle and Baker, 1990), the spatial distribution of isotopes in a region provides insights into the hydraulic properties of ancient flow systems.

We present here the application of a finite element model that simulates three-dimensional fluid flow and advective transport of oxygen coupled with isotope fractionation between the fluid and the rock matrix. These simulations are designed to reproduce the oxygen isotope zonation along the Glarus thrust in order to constrain the parameters that governed the flow geometry in the Glarus area and, by extension, in other active accretionary prisms.

THE GLARUS OVERTHRUST

In the Eastern Helvetic Alps of Switzerland, Permian Verrucano siltstones ($\delta^{18}O_i$ 10‰), shales and sandstones have been thrust along the Glarus overthrust over the parautochthonous cover of the Aar Massif crystalline basement consisting of Mesozoic limestones ($\delta^{18}O_i$ 25‰) in the south, and, further north, over a kilometer-thick sequence of para- and allochthonous marly shales and sandstones flysch ($\delta^{18}O_i$ 19‰) (Fig. 1A). The Glarus thrust plane is lined with the Lochsitenkalk (LK), a thin layer (<1-5 m thick) of intensely deformed calc-mylonite, (Heim, 1921), that accommodated a significant part of the 35 km thrust-translation towards the north (Badertscher and Burkhard, 2001; Pfiffner, 1985; Schmid, 1975; Schmid et al., 1977). Metamorphism ranges from anchizone conditions in the north and in the footwall flysch to lower greenschist-facies conditions in the south and in the Verrucano hanging-wall (Frey, 1988; Rahn et al., 1995). The "anchi/epizone" boundary is offset along the Glarus thrust by about 2 km to the north (Groshong et al., 1984, Fig. 3; Frey, 1988) as the result of post-peak-metamorphic thrusting between 25 and 20 Ma (Hunziker et al., 1986). The metamorphic zonation is reflected in the structural style, with brittle structures being much more conspicuous in the north (Badertscher and Burkhard, 2001).

OXYGEN ISOPLETHS ALONG THE THRUST PLANE

The Lochsitenkalk displays several generations of veins in different states of ductile overprinting that document fluid infiltration contemporaneous with thrusting (Badertscher and Burkhard, 2001; Burkhard et al., 1992). The LK $\delta^{18}O$ calcite is invariably lowered with respect to the value of the presumed Helvetic carbonate protolith (25‰) (Burkhard and Kerrich, 1988). Two regional trends can be identified on the $\delta^{18}O$ spatial distribution, interpolated by kriging the mean LK $\delta^{18}O$ value measured at sampling sites (Fig. 1B): a rapid northward increase in $\delta^{18}O$ values exists in the southern part ($\delta^{18}O$ 11-19‰) whereas flat-

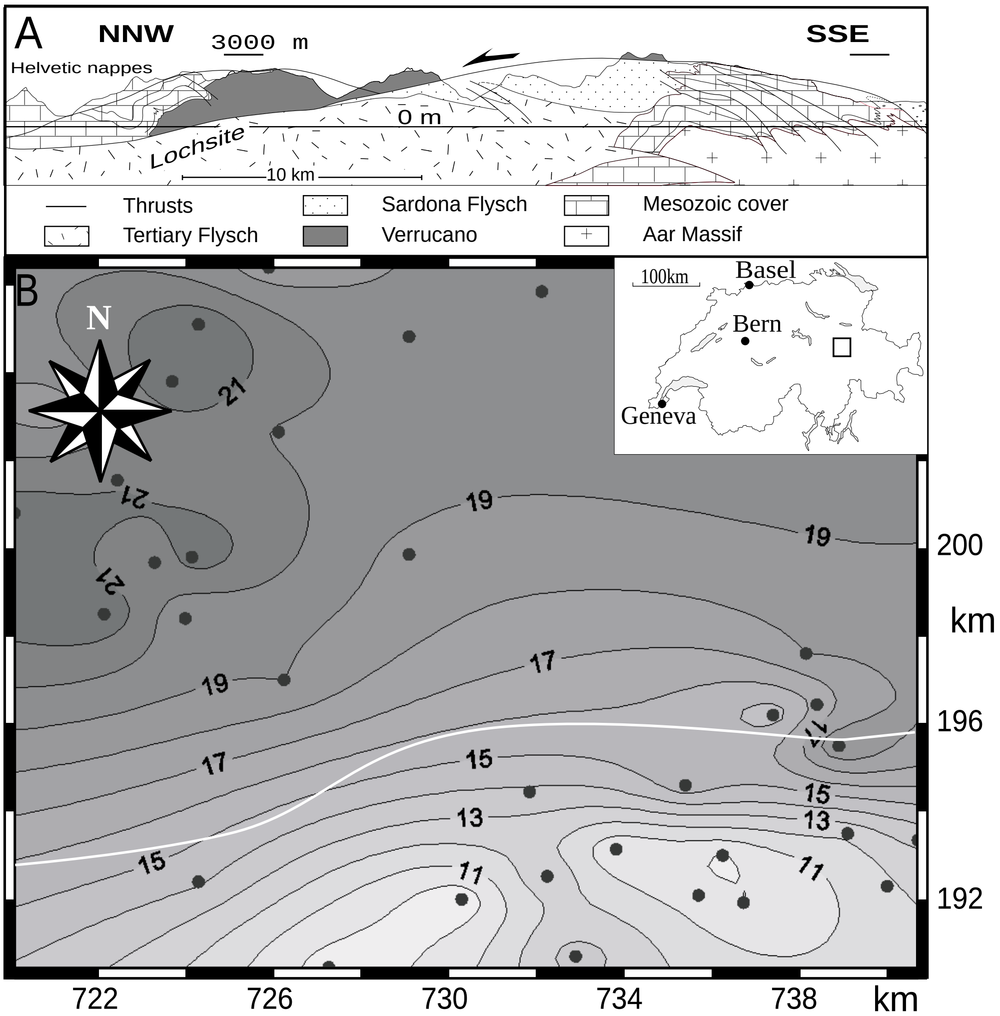


Fig. 1
(A) Cross section of the Glarus Alps in eastern Switzerland (according to Oberholzer, 1933) (B) Map of mean $\delta^{18}O$ (‰ V-SMOW) measured in the LK horizon along the Glarus overthrust of the eastern Helvetic Alps, Switzerland. The swiss coordinates give localisation on the simplified map of Switzerland and. Interpolation between the sampling sites (black dots) has been obtained by kriging. The white line represents the carbonate-flysch boundary in the footwall of the thrust. Note the steep $\delta^{18}O$ gradient in the southern portion and the flattening out of O-isopleths in the north.

tening out at around 19‰ prevails north of the carbonate-flysch boundary in the footwall (see also Badertscher et al., 2001). A region with slightly higher values of up to 22‰ is found in the northwest, where the hangingwall consists of slices of Mesozoic carbonates. The $\delta^{18}O$ increase along a N-S profile has been interpreted as an isotope exchange front due to the northward advection of ^{18}O depleted, metamorphic fluids in a pre-existing carbonate along the thrust fault (Bowman et al., 1994; Burkhard and Kerrich, 1990; Burkhard et al., 1992). From cross-section balancing considerations it is clear that the root zone of the Glarus thrust must extend backward to mid-crustal levels in the crystalline basement (Pfiffner, 1985). Metamorphic fluids were most likely derived from devolatilization reactions in the Aar massif basement further south and had a $\delta^{18}O$ of 4-7‰ (Burkhard et al., 1992).

$\delta^{18}O$ vertical profiles across the thrust document an important component of cross-thrust flow from the flysch into the LK and Verrucano in the northern part of the thrust resulting in homogeneous calcite $\delta^{18}O$ values in the LK (Badertscher et al., 2001). These fluids were derived from dewatering of the footwall flysch and had a $\delta^{18}O$ around 13-14‰, the unaltered calcite Tertiary flysch $\delta^{18}O$ value being 19‰. In the south, a minor downward flow component into the footwall carbonates is documented, but it is much weaker than channelized flow along the thrust (Badertscher et al., 2001).

SIMULATION OF FLUID FLOW ALONG THE GLARUS OVERTHRUST

The three-dimensional model developed by Therrien and Sudicky (1996) is used to simulate fluid flow and advective-dispersive transport of the oxygen isotope, coupled with isotopic fractionation between the fluid and the rock matrix. Mass transfer is described using partial differential equations derived from mass and momentum conservation laws. Solutions to these equations are obtained numerically, using finite element methods (Steefel and Lasaga, 1994). In the model, the rock matrix is discretized in three dimensions and two-dimensional planes of high permeability can also be included in the model, to represent fault zones for example (Beaudoin and Therrien, 1999). The model assumes that Darcy’s law is valid to describe fluid flow in the system and, hence, fluid flux is considered as a linear function of the hydraulic head. For the Glarus thrust, fluid flow has occurred at a depth between 7-12 km and a temperature ranging from 250 to 350°C (Frey, 1988). Because no pronounced vertical or lateral temperature gradient has been documented in the Glarus area, isothermal conditions are assumed. Kinetic oxygen isotope exchange between fluid and calcite is computed at each time step using a first order reaction rate law. For a complete description of the model, see Beaudoin and Therrien (1999) and Therrien and Sudicky (1996). The model is built in order to simulate oxygen isotope transport and exchange in the calc-mylonite along the Glarus overthrust.

A block of the Glarus Helvetic Alps with dimensions 21 km E-W by 18 km N-S and a vertical thickness of 2 km (Fig. 2A) is considered to model fluid flow and oxygen isotope exchange. The porous rock matrix is discretized into 250 m by 250 m parallelepiped elements with a vertical thickness that decreases towards the thrust, from 250 m at the top and bottom of the model to 1 m close to the thrust. Footwall and hangingwall matrix are composed of heterogeneous lithologies modeled as simple parallelepiped slabs (Fig. 2A) with different hydraulic properties (Table 1). Hydraulic conductivities range from 0.01 to 6 m/year, corresponding to permeabilities of 10^{-14} to 10^{-17} m^2. These are typical permeabilities for upper crustal rocks (10^{-17} to 10^{-14} m^2) inferred from regional-scale flow and heat transport analyses (Manning and Ingebritsen, 1999). The permeability of each lithology varies in the X, Y and Z directions (Table 1) in order to account for the orientations of structures such as mylonitic foliations (Burkhard et al., 1992). The LK is modeled as a 2 m thick high permeability plane, the horizontal permeability being higher than the vertical one to account for structural anisotropy (Badertscher and Burkhard, 2001; Burkhard et al., 1992)(Table 1). For each simulation described below, steady-state fluid flow is first computed for the prescribed boundary conditions. From the flow solution, fluid velocities are computed and then used for the transient simulation of advective-dispersive transport of the oxygen isotope. The transport simulation is terminated when a steady-state distribution of oxygen isotope is reached. For the transport simulation, the initial concentration of the oxygen isotope varies from unit to unit, and is obtained by assuming that the fluid initially present in each lithological unit is in isotopic equilibrium with the surrounding rock material at 300°C (the initial concentrations are shown in Fig. 2A). The isothermal oxygen isotope fractionation between the fluids and rock calcite (α_k) at 300°C is assumed to be equal to 1.0049 (O'Neil et al., 1969). A reaction rate of 10^{-4} year-1 is assumed for the LK to account for the observation of ubiquitous veins.

Figures 2B-F present the results of a series of simulations, showing the effect of varying the flow boundary conditions. The boundary conditions for the fluid flow simulation consist of prescribed hydraulic heads at inflow boundaries (blue and green arrows, Fig. 2B-F), zero hydraulic head

Lithology	Kxx	Kyy	Kzz	∅	Xkk	$\delta^{18}O_{rock}$
Verrucano	0.0309	0.0309	0.01	0.03	1E-7	10.5
Flysch	0.15	0.15	0.15	0.06	1E-6	19
LK	6 (5)	1	0.5	0.05	1E-4	26
Foot. carb.	0.01 (0.02)	0.01 (0.02)	0.005	0.03	1E-7	26
Hang. carb.	0.03091	0.03091	0.0309	0.04	1E-6	26

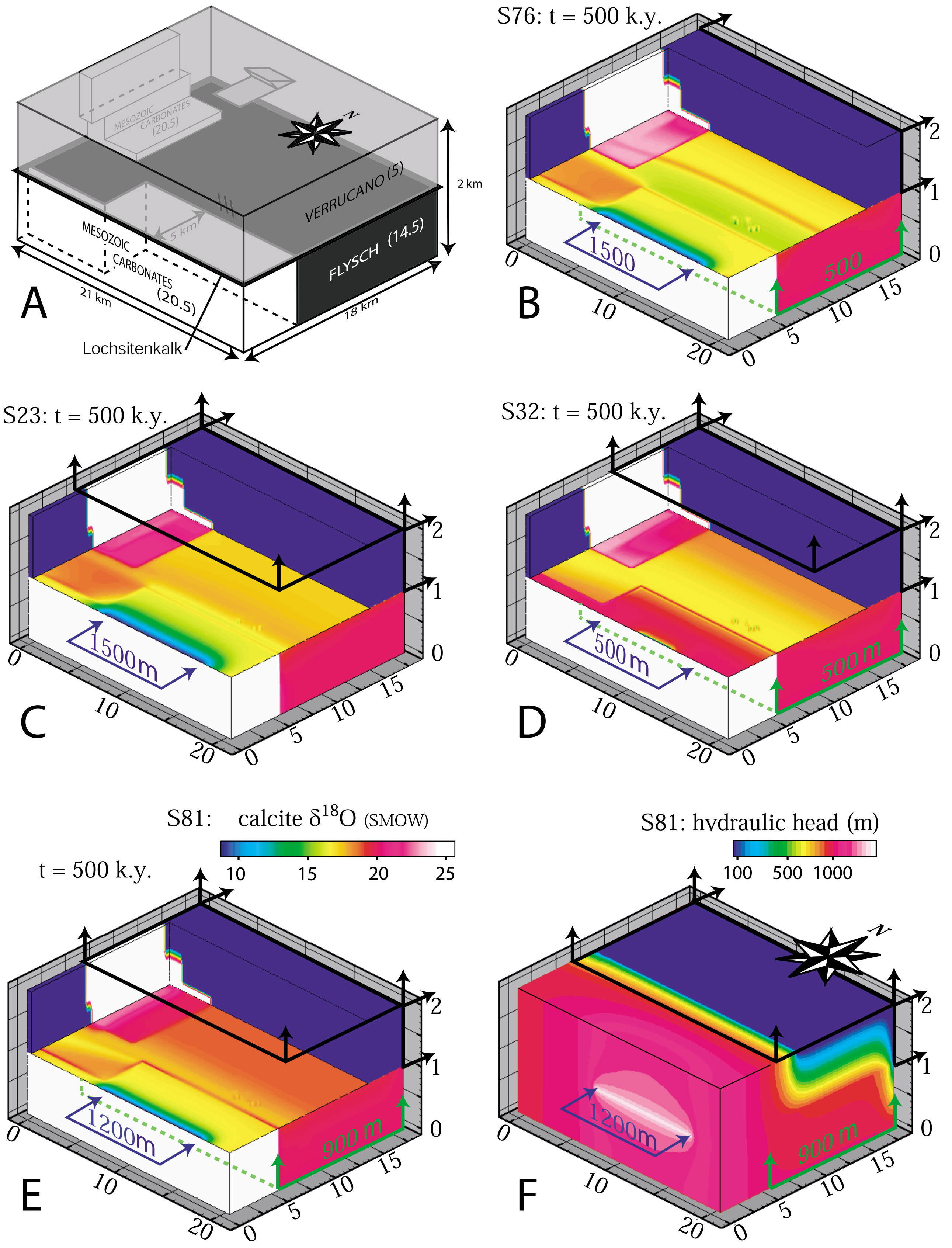
Table 1

Physical properties of each lithology used for numerical simulations. Numbers in brackets have been used for the simulation S32 only. The Glarus overthrust, namely the LK, is modeled as a high conductivity plane. Kxx is the hydraulic conductivity parallel to X (to the north), Kyy is the hydraulic conductivity parallel to Y…. ∅ is porosity and Xkk is the inverse rate of reaction. The initial $\delta^{18}O$ value of the rock is given in ‰ V-SMOW (Burkhard et al., 1992).

at outflow boundaries (black arrows, Fig. 2B-F) and impermeable boundaries elsewhere. For the transport simulation, the isotopic composition of the fluid is imposed at the inflow boundary and a zero-dispersive flux is assigned at the outflow boundary where the isotope can leave the domain by advection. Two types of hydrothermal fluids infiltrate the system: 1) Fluid I with a δ^{18}O of 4.5 ‰ produced by devolatilization reactions in the crystalline basement in the root zone of the thrust (Pfiffner, 1985) infiltrates the LK from the south (blue arrow on Fig. 2B-F) (Bowman et al., 1994; Burkhard et al., 1992); 2) Fluid II with a δ^{18}O of 14.5 ‰, a product of dewatering of the footwall flysch under increasing tectonic load during thrusting that squeezes out fluids upwards towards and across the thrust as documented on δ^{18}O vertical profiles (Badertscher et al., 2001) (green arrow on Fig. 2B-F). In a first model run (Fig. 2B), Fluid I infiltrates along a linear source at the southern termination of the LK with a hydraulic head of 1500 m whereas Fluid II infiltrates across a planar source at the base of the flysch where a lower hydraulic head equal to 500 m is specified. Outflow boundaries at the northern end of the LK and Verrucano minimize downward flow from the Verrucano into the LK as documented on vertical profiles (Badertscher et al., 2001). As can be seen on Fig. 2B, calcite values in the south display a steep gradient similar to measured values (Fig. 1). In the north, values are low compared to measured values, increasing regularly from south to north with a narrow E-W band of higher values. The lower values simulated in the northern part (Fig. 2B) result from downward flow from the Verrucano into the LK and the flysch due to the permeability contrast north of the carbonate-flysch boundary (Table 1). This simulation also yields high values (19‰) at the northernmost part of the model due to upward flow of Fluid II. This, however, is inadequate to reproduce the oxygen isopleths displayed on Fig. 1. It is therefore concluded that the presence of a hydraulic head at the base of the flysch is not sufficient to induce massive upward flow to counteract the high hydraulic head along the thrust.

In a second boundary conditions configuration (Fig. 2C), the same inflow boundaries for Fluids I are maintained. An additional drain is added at the top boundary from 6 km to 18 km north compared to the configuration of Fig. 2B, by imposing a hydraulic head equal to 0 m. In the south, oxygen isopleth's values and positions remain identical to

Fig. 2
(A) Block-diagram representing the disposition of the different rock slabs used for modeling. Numbers in brackets give the initial δ^{18}O value (‰ V-SMOW) of the pore fluid in isotopic equilibrium with the surrounding rock. (B-F) Numerical simulations of infiltrations of fluids with different source and drain geometries. Numbers close to the arrow of sources indicates the pressure head of each source. Color is coding δ^{18}O value of the infiltrating fluid. Black arrows indicate the geometry of drains. t= time. (B) Results of infiltration from the south along the Glarus overthrust and from the base of the flysch in the footwall. (C) Oxygen isotope isopleths resulting from infiltration of fluids from the south along the Glarus overthrust only. (D) Results of infiltration from the south along the Glarus overthrust and from the base of the flysch in the footwall. (E) The best possible zonation results from infiltration from the south along the Glarus overthrust and from the base of the flysch in the footwall. (F) Hydraulic pressure isopleths resulting from the same geometric configuration of sources and drains.


A
MESOZOIC
CARBONATES
(20.5)
N
VERRUCANO (5)
2 km
FLYSCH (14.5)
5 km
MESOZOIC
CARBONATES
(20.5)
21 km
18 km
Lochsitenkalk
S76: t = 500 k.y.
B
1500
500
0
10
20
0
5
10
15
0
1
2
S23: t = 500 k.y.
C
1500m
S32: t = 500 k.y.
D
500 m
500 m
S81: calcite δ18O (SMOW)
10
15
20
25
t = 500 k.y.
E
1200m
900 m
S81: hydraulic head (m)
100
500
1000
F
1200m
900 m
N

the previous simulation. Flow pathways in this part of the thrust are not influenced by a drain at the top of the model. In the north, δ^{18}O values are uniform due to the upward flow of Fluid II. However, the δ^{18}O values remain too low because the upward flow component is not important enough.

In a third configuration (Fig. 2D), Fluid I still infiltrates along a linear source at the southern termination of the LK but the hydraulic head at that boundary is reduced to 500 m. The inflow boundary for Fluid II are similar to Fig. 2B. The outflow boundaries are similar to Fig. 2C but the drain at the top ranges from 10 to 18 km north. This configuration simulates channelized flow along the thrust in the south plus upward flow from the dewatering flysch in the north, with the fluids escaping upward and forelandward. Very high δ^{18}O values and a quasi absence of gradient results in the south, because Fluid I equilibrates with the underlying carbonates. In the northern part, the LK displays increasing δ^{18}O values from south to north, to values as high as 18‰. This reflects an increasing upward "pumping" of Fluid II towards the north caused by the drain located in the Verrucano.

Figure 2E shows the results for the last simulation, which best reproduces the observed distribution of δ^{18}O. For that simulation, Fluid I still infiltrates in the south along the LK, where the hydraulic head is fixed at 1200 m, and Fluid II infiltrates along the base of the flysch, where the hydraulic head is fixed at 900 m. Fluid drains are located at the northern end of the modeled system and on the top, the southern extension of the latter, corresponding to the southern extension of flysch. For this geometry, flow is parallel to the thrust in the southern portion, whereas it is mostly upward in the northern part (Fig. 2F) and it results in oxygen isotope isopleths that are very similar to measured values (Fig. 1).

We have tested the sensitivity of model parameters by changing porosity, reaction rate and hydraulic head. Except in the case of higher reaction rates in the Verrucano (10^{-5} y^{-1}), this series of simulations yielded only different times for reaching isotopic equilibrium and different values of oxygen isopleths, but resulted in minimal changes in the patterns of oxygen isopleths. High reaction rate in the Verrucano results in lower δ^{18}O values over the whole extent of the LK. High reaction rates are not justified, however, because calcite content is very low in the Verrucano. Different permeabilities have been tested for each lithology. It appears that the permeability of the LK must be at least 100X higher than the permeability of the Verrucano, for an isotope front to develop in the south.

DISCUSSION

In light of these simulations, some critical parameters responsible for fluid flow pathways along the Glarus overthrust can be inferred. For an oxygen isotope exchange front to develop in the southern part of the LK, fluids must be channelized in the LK and transported by a coupled advective-dispersive process that induces distension of the isotope front. This situation can only be reached if the contrast of permeability between the LK and the surrounding rocks is high, i.e. at least 100:1 or

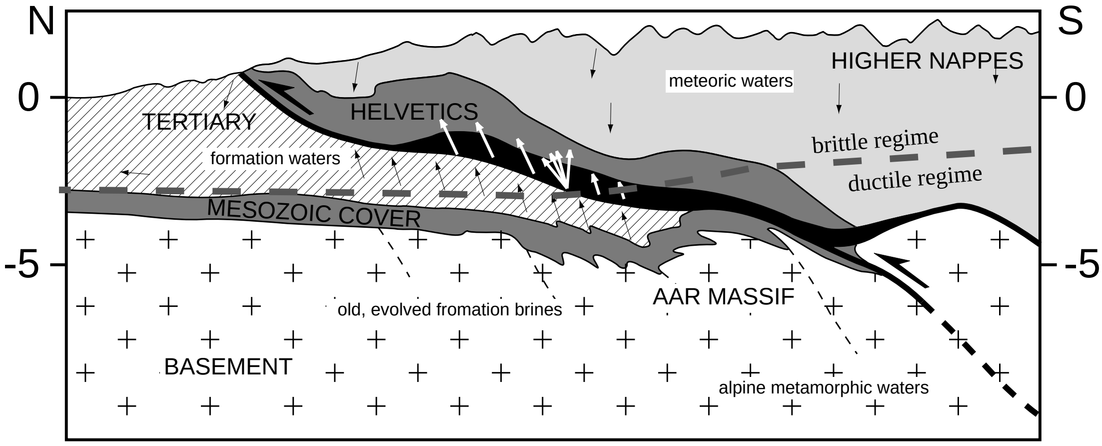


Fig. 3
Schematic cross-section of the Glarus thrust during thrusting. The different sources of fluids are indicated as well as the boundary between brittle and ductile regime. The piercement of this boundary by the advancing thrust has strongly influenced the fluid flow pathways observed along the Glarus overthrust. Modified after (Burkhard et al., 1992).

higher. An additional condition necessary for the development of an isotope front is a high hydraulic head for the fluids infiltrating from the root zone along the LK. Devolatilization reactions in the basement produce large amounts of fluids that are channelized along crustal shear zones before reaching shallower thrusts that behave as conduits toward the earth’s surface (Larroque et al., 1996; Marquer and Burkhard, 1992). A high hydraulic head in the hinterland also helps preserving the LK from vertical infiltrations and exchange with the footwall or hangingwall.

In the north where measured calcite δ^{18}O values within the LK cluster around 19‰, a vertical flux of Fluid II from the flysch into the LK and their outflow through Verrucano is necessary to reproduce the flat δ^{18}O isopleths surface. This upward flow component can only exist if fluids can escape through a drain located at the top of the domain, and if the top of the hangingwall in the southern portion of the domain is modelled as an impermeable boundary. At the scale of the Alpine accretionary prism, such a situation occurs when an advancing thrust pierces the "impermeable cap" or ductile-brittle boundary (Fig. 3), separating a hydrostatic regime in frontal upper parts from a lithostatic regime in the lower southern part of the orogen. In this case, very steep pressure gradients provoke the upward loss of fluids. A drain above the thrust and the brittle-ductile transition forces fluids to migrate upward and forelandward but its presence alone cannot be responsible for the vertical fluid flow (e.g. Fig. 2C). The drain has to be coupled with hydraulic head at the base of the flysch that accounts for its dewatering under an increasing tectonic load during thrusting (Burkhard et al., 1992).

In active accretionary prisms such as the Barbados, Nankai convergent margins, channelized fluid flow along basal décollement is explained by enhanced permeabilities as high as 10^{-14} m^2 within such fault conduits (Henry, 2000; Henry and Le Pichon, 1991). Based on numerical models of fluid budgets at convergent margins, Saffer and Bekins (1999) proposed that flow is channelized along thrust faults in deep portions of accretionary wedges, whereas in shallower portions flow is rather diffuse. He suggested that the boundary between these two hydrologic regimes could be the depth at which the rheological behavior of sediments changes from ductile to brittle. Moreover, rapid upward flow of deep seated fluids along thrust faults associated with seismic activity has been proposed as a major process to explain geochemical and geothermal anomalies detected in the Barbados and Cascadian accretionary wedges (Sample, 1996). The features observed in active convergent margins are quite similar to those observed at the Glarus overthrust.

CONCLUSIONS

The numerical simulations presented here show that the flow boundary conditions, which correspond to the configuration of sources and drains, are controlling the $\delta^{18}O$ zonation observed at the Glarus thrust. In contrast, the simulated oxygen isotope distribution is insensitive to porosity and reaction rate (Beaudoin and Therrien, 1999). Fluid flow along faults conduits with transiently enhanced permeabilities as in the southern part of the Glarus thrust is now well established in several accretionary prisms (Henry, 2000; Saffer and Bekins, 1999; Sample, 1996). Saffer and Bekins (1999) suggested that channelized flow only occurs below a critical depth above which sediments behave brittely. Our results yield similar conclusions that indicate that the fluid flow regimes of the Glarus thrust can be applied to active accretionary systems and that the parameters governing the flow patterns should be the same. When the floor thrust pierces the brittle-ductile transition, massive upward diffuse flow is induced by extremely high hydraulic gradients.

REFERENCES

Abart, R., and Pozzorini, D., 2000, Implications of kinetically controlled mineral-fluid exchange on the geometry of stable-isotope fronts: European Journal of Mineralogy, v. 12, p. 1069-1082.

Badertscher, N.P., and Burkhard, M., 2001 (in press), Brittle-Ductile deformations in the Glarus thrust Lochsitenkalk (LK) mylonite: Terra Nova.

Badertscher, N.P., Burkhard, M., and Abart, R., 2001, Fluid flow pathways along the Glarus overthrust deduced from stable and Sr-Isotope patterns, EUG XI, Volume 6: Strasbourg, Cambridge Publications, p. 276.

Baker, J., and Spiegelman, M., 1995, Modelling an infiltration-driven geochemical front: Earth and Planetary Science Letters, v. 136, p. 87-96.

Beaudoin, G., and Therrien, R., 1999, Sources and drains: Major controls of hydrothermal fluid flow in the Kokanee Range, British Columbia, Canada: Geology, v. 27, p. 883-886.

Bickle, M.J., and Baker, J., 1990, Advective-diffusive transport of isotopic fronts; an example from Naxos, Greece: Earth and Planetary Science Letters, v. 97, p. 78-93.

Bowman, J.R., Willett, S.D., and Cook, S.J., 1994, Oxygen isotopic transport and exchange during fluid flow; one-dimensional models and applications: American Journal of Science, v. 294, p. 1-55.

Burkhard, M., and Kerrich, R., 1988, Fluid regimes in the deformation of the Helvetic Nappes, Switzerland, as inferred from stable isotope data: Contributions to Mineralogy and Petrology, v. 99, p. 416-429.

—, 1990, Fluid-rock interactions during thrusting of the Glarus Nappe; evidence from geochemical and stable isotope data: Schweizerische Mineralogische und Petrographische Mitteilungen = Bulletin Suisse de Minéralogie et Pétrographie, v. 70, p. 77-82.

Burkhard, M., Kerrich, R., Maas, R., and Fyfe, W.S., 1992, Stable and Sr-isotope evidence for fluid advection during thrusting of the Glarus nappe (Swiss Alps): Contributions Mineralogy Petrology, v. 112, p. 293-311.

Frey, M., 1988, Discontinuous inverse metamorphic zonation, Glarus Alps, Switzerland; evidence from illite "crystallinity" data: Schweizerische Mineralogische und Petrographische Mitteilungen = Bulletin Suisse de Mineralogie et Petrographie, v. 68, p. 171-183.

Groshong, R.H., Jr., Pfiffner, O.A., and Pringle, L.R., 1984, Strain partitioning in the Helvetic thrust belt of eastern Switzerland from the leading edge to the internal zone: Journal of Structural Geology, v. 6, p. 5-18.

Heim, A., 1921, Geologie der Schweiz. Band 2: Die Schweizer Alpen 1. Hälfte: Leipzig, Tauchniz.

Henry, P., 2000, Fluid flow at the toe of the Barbados accretionary wedge constrained by thermal, chemical, and hydrogeologic observations and models: Journal of Geophysical Research, v. 105, p. 25,855-25,872.

Henry, P., and Le Pichon, X., 1991, Fluid flow along a decollement layer; a model applied to the 16 degrees N section of the Barbados accretionary wedge: Journal of Geophysical Research, B, Solid Earth and Planets, v. 96, p. 6507-6528.

Hunziker, J.C., Frey, M., Clauer, N., Dallmeyer, R.D., Friedrichsen, H., Flehmig, W., Hochstrasser, K., Roggwiler, P., and Schwander, H., 1986, The evolution of illite to muscovite; mineralogical and isotopic data from the Glarus Alps, Switzerland: Contributions to Mineralogy and Petrology, v. 92, p. 157-180.

Larroque, C., Guilhaumou, N., Stephan, J.-F., and Roure, F., 1996, Advection of fluids at the front of the Sicilian Neogene subduction complex: Tectonophysics, v. 254, p. 41-55.

Manning, C.E., and Ingebritsen, S.E., 1999, Permeability of the continental crust: implicaitons of geo-thermal data and metamorphic systems: Reviews of Geophysics, v. 37, p. 127-150.

Marquer, D., and Burkhard, M., 1992, Fluid circulation, progressive deformation and mass-transfer processes in the upper crust; the example of basement-cover relationships in the External Crystalline Massifs, Switzerland: Journal of Structural Geology, v. 14, p. 1047-1057.

O'Neil, J.R., Clayton, R.N., and Mayeda, T.K., 1969, Oxygen isotope fractionation in divalent metal carbonates: The Journal of Chemical Physics, v. 51, p. 5547-5558.

Pfiffner, O.A., 1985, Displacements along thrust faults: Eclogae-Geologicae-Helvetiae, v. 78, p. 313-333.

Rahn, M., Mullis, J., Erdelbrock, K., and Frey, M., 1995, Alpine metamorphism in the North Helvetic flysch of the Glarus Alps, Switzerland: Eclogae Geologicae Helvetiae, v. 88, p. 157-178.

Saffer, D.M., and Bekins, B.A., 1999, Fluid budgets at convergent plate margins: Implicatons for the extent and duration of fault-zone dilatation: Geology, v. 27, p. 1095-1098.

Sample, J.C., 1996, Isotopic evidence from authigenic carbonates for rapid upward fluid flow in accretionary wedges: Geology (Boulder), v. 24, p. 897-900.

Schmid, S.M., 1975, The Glarus overthrust; field evidence and mechanical model: Eclogae Geol. Helv., v. 68, p. 247-280.

Schmid, S.M., Boland, J.M., and Paterson, M.S., 1977, Superplastic flow in finegrained limestone: Tectonophysics, v. 43, p. 257-291.

Steefel, C.I., and Lasaga, A.C., 1994, A coupled model fro transport of multiple chemical species and kinetic precipitation/dissolution reactions with application to reactive flow in single phase hydrothermal systems: American Joural of Science, v. 294.

Therrien, R., and Sudicky, E.A., 1996, Three-dimensional analysis of variably-saturated flow and solute transport in discretely-fracturated porous media: Journal of Contaminant Hydrology, v. 23, p. 1-44.

Conclusions

Quelles conclusions tirer de ces quatre années de dur labeur, que faire de toutes ces données sur les isotopes de l’oxygène, du carbone et du strontium, de ces observations sur des échantillons de Lochsitenkalk ? Bien sûr, avec le temps, la science ne retiendra que ce qu’elle voudra. Néanmoins, ce travail est porteur de quelques idées sur la géologie du chevauchement de Glaris qui, sans prétendre être définitives, sont pour le moins novatrices :

I. L’interprétation classique d’une mylonite extrêmement ductile (Lochsitenkalk), à l’interface de deux blocs rigides, accommodant les 35 km de déplacement par déformation dans un régime superplastique, est remise en question par l’analyse des microstructures dans la mylonite calcaire et les roches voisines. Un déplacement combiné de glissement sismique et de fluage ductile est proposé.

II. Les patrons de circulations de fluides et certains paramètres de flux sont déterminés en se basant sur un important jeu de données isotopiques, ce qui constitue un apport important en comparaison avec les études préliminaires.

III. Finalement, circulations de fluides et mécanismes de déformation sont liés dans une histoire tectono-métamorphique globale qui replace le chevauchement de Glaris dans un contexte de collision continentale.

I. L’activité cyclique syn-chevauchement de mécanismes de déformation plastique et cassant, ainsi que des processus de dissolution-cristallisation ont été mis en évidence dans la « mylonite » calcaire soulignant le chevauchement de Glaris par l’étude des microstructures et textures. L’observation de textures cristallographiques et parfois de fabriques de forme dans cette mylonite plaide pour une déformation ductile accommodée par des mécanismes de déformation intra-cristallins tels que glissements de dislocations. Sans pouvoir totalement exclure un rôle mineur des glissements aux joints de grains, ces observations paraissent incompatibles avec l’idée d’une mylonite se déformant de préférence dans le régime de la superplasticité par glissement aux joints de grains, comme l’a proposé Schmid en 1981 entre autres. Ainsi, il est proposé que des événements instantanés de fracturation, de cataclase et de glissement rapide lors de pics de pression de fluides concentrés dans la Lochsitenkalk alternent avec des périodes de fluage plastique dans la Lochsitenkalk et ses voisines directes. Même s'il est impossible de le prouver dans une mylonite calcaire, la vitesse de glissement atteinte lors de ces événements de fracturation les apparente à des tremblements de terre.

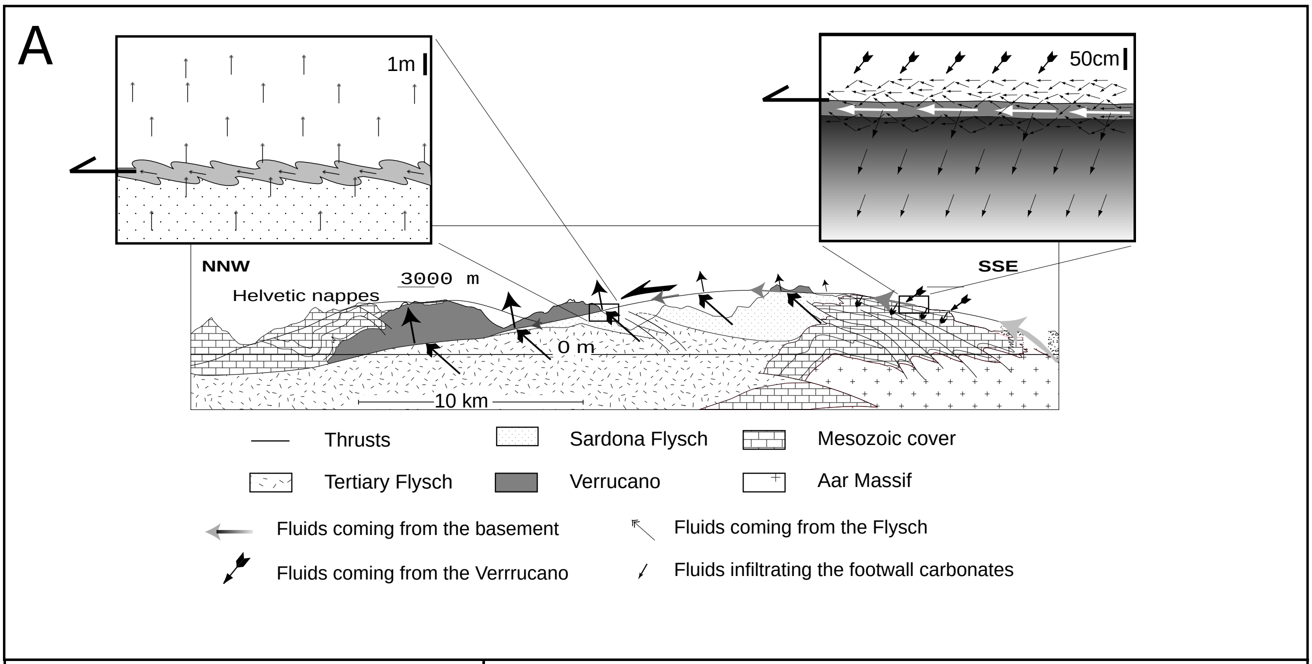
Il me semble évident que les structures ductiles telles que foliation mylonitique et bandes de cisaillement observées dans le Verrucano soient synchrones du chevauchement. En effet, elles sont asymptotiques par rapport au chevauchement maître, le gradient de déformation augmente en direction du chevauchement et les linéations N-S sont très cohérentes entre les fibres dans les franges de tension autour des pyrites, les linéations sur les bandes de cisaillement et les linéations d'étirement minérales. De nombreuses veines syntectoniques concentrées dans le Verrucano, proche du contact et plus ou moins parallèles à la foliation, se sont certainement formées par précipitation à partir des fluides qui ont circulés lors de la phase chevauchante. Ces traces de déformation ductile dans le Verrucano se retrouvent plus de 100 m au-dessus du chevauchement, ce qui prouverait que la déformation ductile liée au charriage de la nappe de Glaris n'est absolument pas restreinte à la zone de contact mais s'étale loin dans le toit, alors que dans le mur, elle est quasiment absente. La rotation des axes de crénulation parallèlement à la linéation de transport dans le Verrucano en direction du contact plaide aussi en faveur d'une simultanéité de ces structures avec l'événement de chevauchement. L'équipe de BAS DEN BROK, relecteur du chapitre II (*in* Terra Nova), arrive aux même conclusions en essayant de reproduire quantitativement le gradient de déformation ductile dans le toit.

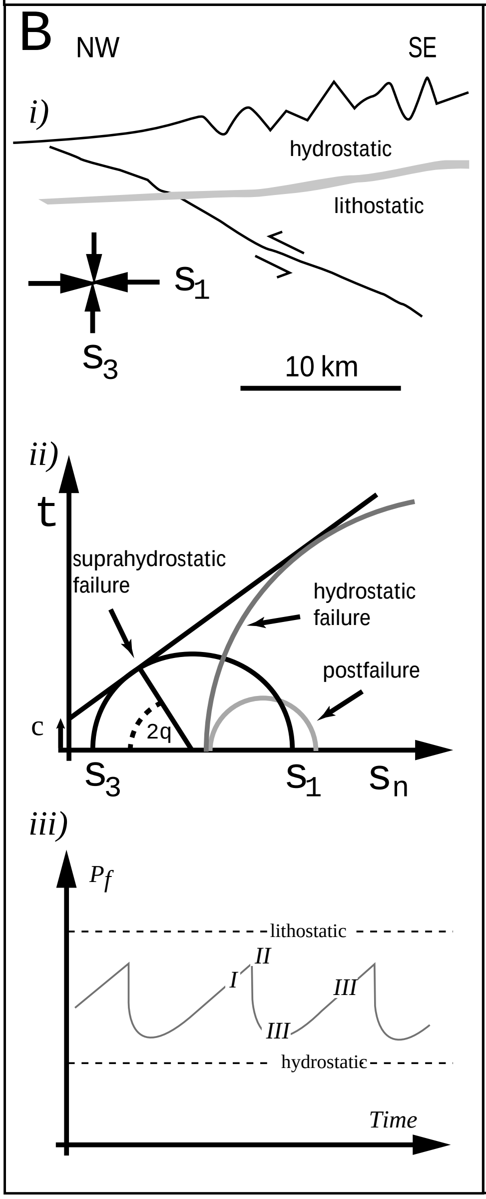
Il semble donc impossible de considérer la Lochsitenkalk comme un niveau de décollement ductile dans lequel se serait concentré toute la déformation liée au charriage de la nappe de Glaris. Les 35 km de déplacement seraient donc accommodés par une déformation progresssive dans le Verrucano d'une part et par de nombreux de mouvements sismiques instantanés alternant avec des périodes de fluage plastique dans la Lochsitenkalk d'autre part. Il reste néanmoins difficile de chiffrer les contributions relatives de ces différents mécanismes de déplacement en général et des mouvements sismiques en particulier. Les traces structurales de ces derniers étant progressivement effacées par la déformation ductile et la recristallisation dynamique, seuls les derniers incréments de déformation cassante restent visibles dans la Lochsitenkalk sous forme de veines et de niveaux discrets d'ultracataclasites.

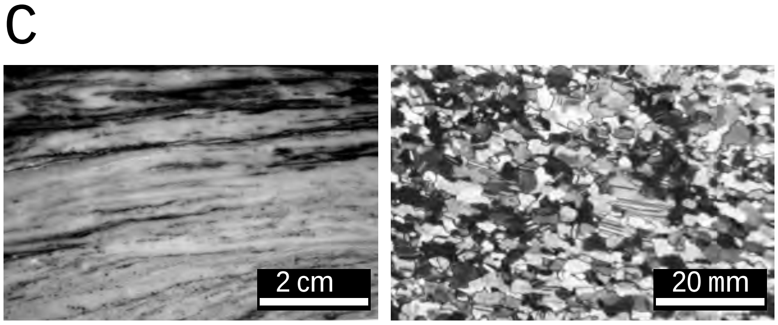
Par ailleurs, la complexité et le chaotisme des structures dans la Lochsitenkalk tels que les plis en fourreau, les plis replissés et l'intense foliation mylonitique qui affecte le Verrucano sur une épaisseur de plus de 100 au sud, requière qu'une grande quantité de déformation ductile ait affecté ces roches. Ainsi, il me paraît plausible d'articuler l'estimation de 30% minimum pour la contribution de la déformation plastique dans le déplacement de la nappe de Glaris au Miocène. Le calcul du gradient de déformation ainsi que l'estimation de la quantité de déformation dans le Verrucano vont peut-être permettre de mieux contraindre les rôles relatifs de la déformation cassante et ductile. Notons encore que cette importance relative peut varier du Sud au Nord, la foliation mylonitique dans le Verrucano étant nettement moins prononcée au Nord et la quantité de fluides piégés sous le Verrucano beaucoup plus importante, indiquant peut-être une augmentation de la contribution de la déformation fragile vers le Nord.

II. D'après les zonations isotopiques de l'oxygène du carbone et du strontium le long et à travers le chevauchement de Glaris, deux régions à patron de circulation de fluides différent peuvent être distinguées. Dans la partie Nord de la région étudiée, où le Verrucano repose sur du flysch, la migration vers le haut de fluides issus de la déshydratation de ce dernier est la seule interprétation possible des données isotopiques. Ces fluides saturés en calcite sont, lors de leur ascension, momentanément bloqués sous le Verrucano peu perméable et vont alors précipiter de la calcite dans des veines qui vont constituer la Lochsitenkalk. Même si un flux de fluides canalisé le long du contact ne peut être totalement exclu, il n’a en tout cas laissé aucune empreinte géochimique détectable, et la composition isotopique de l’oxygène et du carbone des roches au contact est entièrement contrôlé par le flux vertical de fluides. Le moteur de cette migration est le passage du régime lithostatique au régime hydrostatique induisant un gradient hydraulique extrême lors de la possible percée de cette limite par l’avancée de la nappe de Glaris dans le contexte collisionel alpin.

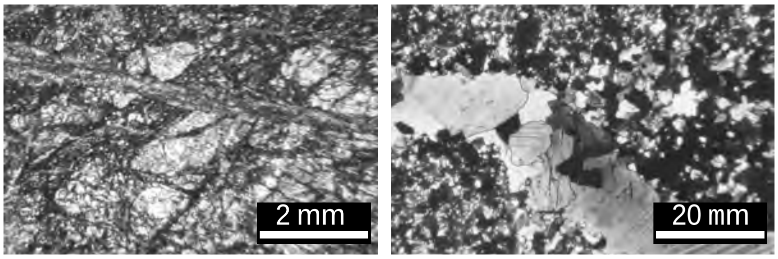
Dans la partie sud du chevauchement, où le Verrucano repose sur des carbonates mésozoïques, le patron de circulation de fluide n’est pas univoque selon les données considérées, un flou reflété par les deux interprétations données dans les chapitres III et IV. Dans le chapitre IV, seules sont considérées les variations des rapports isotopiques sur un profil vertical à travers le chevauchement. Ces données sont interprétées par un flux vertical du haut vers le bas de fluides depuis le Verrucano en direction des carbonates du mur, aucun flux horizontal parallèle au chevauchement n’étant requis pour expliquer les patrons isotopiques. Pourtant, afin d’expliquer l’hydratation des 20 m inférieurs de Verrucano, un flux de fluide parallèle au chevauchement et venant du socle est évoqué. La conclusion de ce chapitre est que la composition isotopique de la Lochsitenkalk est principalement contrôlée par le flux de fluides à travers le chevauchement depuis le Verrucano vers le bas. Cette conclusion n'apporte aucune explication au gradient régulier N-S, dorénavant bien documenté de la composition isotopique de la Lochsitenkalk. Selon le modèle d’infiltration vertical vers le bas , le gradient N-S du $\delta^{18}O$ serait le résultat d’une infiltration verticale décroissante vers le nord. Si, au contraire, l’augmentation des valeurs du $\delta^{18}O$ dans la Lochsitenkalk du sud au nord est considérée comme une véritable tendance régionale liée au développement d’un front isotopique dans un carbonate en partie pré-existant, alors un flux de fluides parallèle au chevauchement 1000 X plus important que le flux vertical est nécessaire dans la Lochsitenkalk. Une telle interprétation est proposée dans le chapitre III. Les variations isotopiques verticales au sud sont alors expliquées par une perte latérale de ces fluides dans les carbonates du mur et par une simple dispersion hydrodynamique transversale de ce système de flux dans le Verrucano sus-jacent au chevauchement. Aux vues de l’hydratation des vingt mètres inférieurs de Verrucano, ce flux pallèle au contact ne serait pas restreint à la Lochsitenkalk mais prendrait aussi place dans la partie inférieur du Verrucano. Il est donc très important de noter que ces deux interprétations des zonations isotopiques ne sont absolument pas contradictoires mais représentent plutôt deux alternatives complémentaires. Même si ma conviction profonde s’accorde mieux avec la présence d’un flux parallèle au contact, je ne peux scientifiquement pas exclure l’interprétation par flux verticaux uniquement. La solution au problème réside peut-être dans un échantillonage



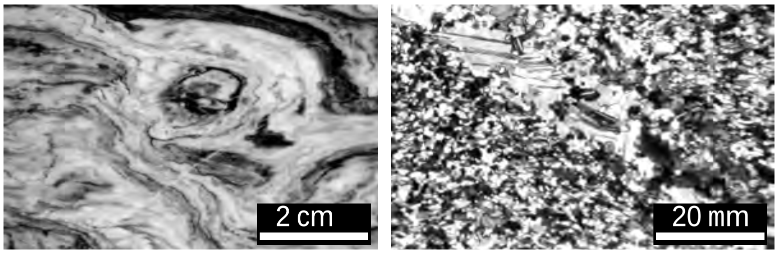




I) Meso- and microstructures observed just before hydrofracturing



II) Meso- and microstructures observed just after hydrofracturing



III) Meso- and microstructures observed after a certain time in the ductile intracrystalline deformation regime

Fig. 1
A. Profil géologique à travers les Alpes glaronnaises en Suisse orientale (d'aprés Oberholzer, 1933), sur lequel sont ajoutés les différents systèmes de flux de fluides (flèches). Les détails des patrons de circulations de fluides sont donnés sur deux vues agrandies de la zone de contact. La taille des flèches est proportionnelle au flux. B.i) Représentation schématique du chevauchement de Glaris et de la limite hydrostatique-lithostatique au Miocène; ii) Diagramme de Mohr illustrant les conditions de contrainte lors de et après la rupture; iii) illustation des variations cycliques de la pression de fluide qui accompagnent les ruptures sisimiques successives. Modifié d'après Sibson (1990). C. Textures et microstructures observées dans la Lochsitenkalk à différents stades des cycles de déformation ; i) peu avant la rupture, la Lochsitenkalk pouvait ressembler à une vraie mylonite foliée (à gauche), dont la matrice serait formée de grains microscopiques (à droite) ; ii) la fracturation et le glissement sismique induisent la déformation cataclastique de la matrice rocheuse (à gauche) et l'ouverture en une fois de veines où cristallisent des gros grains de calcite à joints droits (à droite) ; iii) entre deux événements de fracturation, la déformation plastique et la recristallisation dynamique associée provoque le remplacement des gros grains de veines en grains microscopiques à joints lobés (à droite) et le plissement du litage en une structure macroscopique chaotique.

précis de plusieurs profils verticaux dans le Verrucano jusqu'à 100 m au-dessus du contact. En effet, proche du contact, les valeurs de δ^{18}O les plus basses dans le Verrucano sont de 8-9‰ alors que 100 m au-dessus les valeurs les plus basses sont de 12‰. Les valeurs de 8-9‰ reflètent peut-être une interaction avec des fluides issus du socle, alors que les valeurs de 12‰ constitueraient les valeurs originelles. Un tel échantillonnage pourrait donc apporter la preuve d'une infiltration d'un fluide dépourvu en ^{18}O, d'origine extra-verrucano.

D'après les valeurs isotopiques dans la Lochsitenkalk, les fluides circulant parallèlemment au chevauchement sont caractérisés par un δ^{18}O d'environ 4-7‰ (SMOW), un δ^{13}C de -5‰ (PDB) et un $XCO_2 << 0.1$. Ils circulent du sud au nord par un processus couplé d'advection-diffusion/dispersion. De telles valeurs de δ^{18}O et δ^{13}C contraignent l'origine de ces fluides : ils ne peuvent être issus que du socle par des réactions de déshydratation dans la zone des racines du chevauchement ou par expulsion de vielles solutions évoluées piégées dans un socle fracturé avant l'orogenèse alpine. Les réactions de déshydratation nécessaires à la production des fluides évoquées plus haut, prennent place vers 500°C dans le faciès amphibolitique inférieur. De telles conditions peuvent aisément être atteintes dans la zone de racines. Pour que ces fluides atteignent le chevauchement, un réseau crustal de zones de cisaillement connectées est requis. De nombreuses zones de cisaillement recoupant le socle du massif de l'Aar peuvent avoir servi de conduit à ces fluides. Puisque les mylonites dans ces zones de cisaillement présentent des paragenèses alpines rétrogrades, une grande part des fluides produits dans la croûte moyenne ont dû être consommés lors de leur migration vers le chevauchement de Glaris. Ainsi, vu la grande quantité de fluides responsable de la zonation isotopique de l'oxgène le long du chevauchement, les fluides piégés dans le socle supérieur fracturés apparaîssent comme la source la plus probable des fluides qui ont circulé le long du chevauchement de Glaris.

Ainsi, on ne peut pas simplement traiter la Lochsitenkalk comme un carbonate pré-existant dans lequel des fluides venant du sud sont canalisés, car d'autres systèmes de flux existent et car la mylonite est en tout cas en partie formée de veines.

III. Lors de la collision alpine, le socle cristallin constituant le massif de l'Aar est soumis à une augmentation de température et de pression lors de son enfouissement. L'augmentation de température induit des réactions de dévolatilisation alors que l'augmentation de pression provoque l'expulsion de vieilles eaux de formation piégées dans un socle cristallin fracturé avant l'orogenèse alpine. Dans la partie sud de la région étudiée, ces deux processus sont responsables de l'expulsion d'une large quantité de fluides qui vont rejoindre le chevauchement de Glaris le long duquel ils seront canalisés à cause du fort contraste de perméabilité existant entre la Lochsitenkalk et ses voisines directes (Fig. 2A). Une partie de ces fluides s'échappe latéralement dans les carbonates du mur. Plus au nord, le flysch se déshydrate en réponse à une augmentation de la charge tectonique, entre autre par des réactions de type smectite-illite, illite-muscovite. Lors de son avancée, la nappe de Glaris passe progressivement du régime lithostatique au régime hydrostatique, induisant un gradient hydraulique extrême, favorisant l'expulsion de fluides en surpression, et issus du flysch, vers le haut (Fig. 2A). L'intersection de la limite hydro/lithostatique subhorizontal, avec le chevauchement de Glaris, penté vers le Sud, serait un endroit privilégié pour l'expulsion des fluides. Ainsi, le Verrucano, riche en minéraux phylliteux, se comporte comme une barrière de perméabilité à la percolation de fluides vers le haut, induisant une augmentation de la pression de fluides au contact jusqu'à ce que le seuil de fracturation, déformation cataclastique et peut-être glissement sismique, soit atteint (Fig. 2B). Lors de ces événements de fracturation, des veines vont s'ouvrir provoquant la chute locale de la pression de fluides, la précipitation de cristaux de calcite qui vont sceller ces vides et ainsi permettre une nouvelle augmentation de la pression de fluides. Les fluides migrent par succion dans ces vides ouverts en un unique événement sismique. Entre ces événements de fracturation, les roches se déforment de manière plastique par des mécanismes de déformation tels que le glissement aux joints et la montée de dislocations. Le mur, très peu affecté par la déformation lié au chevauchement, peut-être considéré comme un support passif et rigide lors du transport de la nappe de Glaris. Au contraire, le Verrucano, qui lors des événements de fracturation glisse tel un radeau sur des poches d'eau, est fortement affecté par les déformations ductiles liées au chevauchement et ne peut donc pas être considéré comme un bloc passif et rigide. L'idée du décollement entre deux blocs rigides est donc injustifiée et non justifiable.

Mais après quatre années de travail, revient et reviendra souvent la question fatidique et mortelle à ne se poser que sous lithium: quel est l'apport de ce travail à la science ? Hormis les points décrits ci-dessus, cette thèse a été l'occasion de démontrer qu'un concept n'est rien s'il ne peut être validé par une importante récolte de données. Bowman et ses collègues ont développé un système mathématique très complexe et solide pour modéliser les circulations de fluides le long du chevauchement de Glaris. Pourtant leurs conclusions et calculs sont erronés du fait d'un jeu de données trop maigre qui ne leur permit pas de détecter des composantes de flux verticales à travers le chevauchement. Ceci les a conduit à faire des simplifications incorrectes. Toute étude en Sciences de la Terre devrait donc disposer d'une large palette de données qui constituent la base du développement de concepts et de modèles.

Bien que ce travail apporte de nouvelles réponses à certains aspects immuables de la géologie des Alpes glaronnaises, beaucoup de questions restent en suspens. Les contributions relatives de la déformation ductile et fragile au déplacement de la nappe de Glaris ne sont pas chiffrées. Une étude du gradient de déformation et de la quantité de déformation dans le Verrucano au-dessus du contact pourrait être d'une aide substantielle pour mieux contraindre ces contributions relatives. Les sources des fluides ainsi que leur chimie pourraient être mieux définies par l'analyse d'inclusions fluides de veines dans le Verrucano et dans le Flysch. D'autres projets peuvent donc être lancés sur l'étude des circulations de fluides le long du chevauchement de Glaris.

Neuchâtel, décembre 2001

APPENDIXES

APPENDIXES

APPENDIXES

APPENDIXES

APPENDIXES

APPENDIXES

APPENDIXES

APPENDIXES

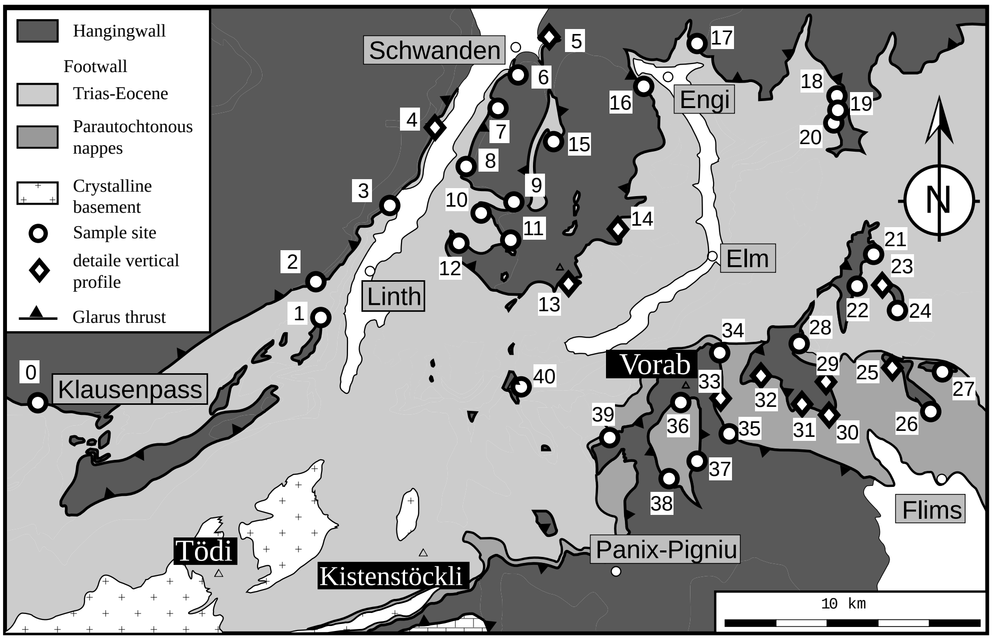
APPENDIXES

APPENDIXES

Appendix I is composed of one map and four tables that constitute the complete isotopic data set discussed in chapter III.

†. Map 1

Simplified tectonic map of the Glarus Alps (modified after Oberholzer, 1933). Sampling and structural measure sites are indicated. Their localizations are given according to the Swiss coordinate system.



0. Rustigen (705.700/192.250)
1. Prachtvollerwasserfall (717.250/196.400)
2. Nussbuel (717.100/197.450)
3. Schwändi ober Rüti (720.100/200.800)
4. Bächibach (721.050/203.150)
5. Lochsite (725.860/206.400)
6. Täli (723.300/203.800)
7. Schwander (724.300/205.100)
8. Rufirus (722.450/201.550)
9. Steinstossfürgeli (724.150/199.800)
10. Oberbodmenberg (723.300/199.675)
11. Türchle (724.000/198.400)
12. Bützi (722.150/198.500)
13. Kärpf (726.250/197.000)
14. Chuebodensee (729.100/199.860)
15. Mettmen (726.125/202.650)
16. Birchenchopf (729.100/204.825)
17. Oberfitteren (732.125/205.850)
18. Feldegg (737.000/204.925)
19. Risetenpass (737.275/204.000)
20. Risetenhoren (737.250/204.000)
21. Piz Sardona (738.150/197.600)
22. Piz Segnas (737.400/196.200, Burkhard et al. 1992)
23. Piz Dolf North (738.400/196.435)
24. Piz Dolf (738.900/195.500)
25. Crap da Flem West (739.100/193.500)
26. Crap da Flem South (740.000/192.300)
27. Crap da Flem East (740.700/193.350)
28. Laaxer Stöckl (735.400/194.600)
29. Grau Berg (736.250/192.700)
30. Nagiens (736.750/191.975)
31. Mutta Rodunda (735.700/192.010)
32. Eastern Vorab station (733.820/193.150)
33. Vorab Pign (732.250/192.520)
34. Point 2805 (731.850/194.450)
35. Fuorcla Sura (732.9000/190.700)
36. Plaun Grogn (730.250/192.000)
37. Alp da Ruschein (731.375/189.600)
38. Tegia Sura (730.350/189.000)
39. Rostock (727.275/190.450)
40. Hausstock (724.250/192.625)
41. Ringelspitz (745.200/195.800) not on the map

†. Table 1

Calcite oxygen and carbon isotope data measured in the Lochsitenkalk along the Glarus overthrust and on vertical profiles across the thrust. The vertical distance to an arbitrary reference is given together with the $\delta^{18}O$ (‰ V-SMOW) and $\delta^{13}C$ (‰ PDB) values. This reference can be the septum, the contact between the Lochsitenkalk and hangingwall or between the Lochsitenkalk and footwall. The lithologies in which the samples have been collected are also indicated. The labels of the samples are:

- In the samples labeled for example PW99.9 or GB98.8, the first number refers to the year of sampling, i.e. 1999 and 1998. The samples that do not have such a high first number have been collected during the first sampling mission in summer 1998.

- For a pair of samples labeled for example Lo2 and Lo2.1, the first one refers to bulk rock value, whereas the second refers to value of veins or matrix only. This last information can be found in table 4.

- When samples are labeled with a series such as Rus 2.1, Rus 2.2, Rus 2.3, Rus 2.4… or EVS 99.3a, EVS99.3b, EVS99.3c, … this means that the rock powders used for the isotope analysis have been extracted from a single rock slab with a small driller

- For samples labeled La9top, La9mid, La9bot or Met99.10t, Met99.10c, Met99.10b or something similar, the rock powders used for the isotope analysis have been extracted from a single rock slab with a small driller. Top or t refers to the top of the slab, mid or c refers to the middle of the slab and bot. or b refers to the bottom of the slab.

The analytical technique used for the determination of the $\delta^{18}O$ and $\delta^{13}C$ is explained at the beginning of chapter III.

Sample	δ^{13} C (‰PDB)	δ^{18}O (‰SMOW)	Vertical distance to Ref. (cm)	Lithology
Crap da Flem South (740.00/192.300)			**Ref: Top CS1**	
cs1	1.489	14.356	0.000	Lochsitenkalk
cs2	1.602	14.401	-5.000	Lochsitenkalk
cs3	1.584	12.665	-12.500	Lochsitenkalk
cs4	1.430	12.035	-20.000	Lochsitenkalk
cs5	1.289	11.850	-27.500	Lochsitenkalk
cs6	1.667	13.243	-50.000	Mesozoic carbonates
cs7	1.462	16.645	-90.000	Mesozoic carbonates
cs8	1.761	18.367	-130.000	Mesozoic carbonates
cs9	1.664	17.956	-200.000	Mesozoic carbonates
cs10	1.625	18.815	-560.000	Mesozoic carbonates
mean LK	1.479	13.061		
Lochsite (725.860/206.400)			**Ref: septum**	
Lo1	1.876	19.894	-21.000	Tertiary Flysch
Lo2	1.700	20.158	-50.000	Tertiary Flysch
Lo2.1	1.929	21.822	-50.000	Tertiary Flysch
Lo3	1.482	20.715	-10.000	Tertiary Flysch
Lo4	1.229	20.260	-90.625	Tertiary Flysch
Lo5	1.831	19.630	-156.000	Tertiary Flysch
Lo5.1	1.808	19.709	-156.000	Tertiary Flysch
Lo6	1.498	20.488	9.375	Lochsitenkalk
Lo7	1.198	18.317	-6.250	Lochsitenkalk
Lo8	1.207	19.126	0.000	Lochsitenkalk
Lo9	1.572	19.223	-16.000	Lochsitenkalk
Lo10	1.388	19.083	6.250	Lochsitenkalk
Lo11	1.112	19.498	-6.250	Lochsitenkalk
Lo12	1.242	19.686	20.000	Lochsitenkalk
Lo13	1.369	19.926	25.000	Lochsitenkalk
Lo14	0.467	18.997	35.000	Lochsitenkalk
Lo15	-0.195	18.796	45.000	Lochsitenkalk
Lo16	-1.079	18.651	65.000	Verrucano
Lo17	-1.922	18.035	105.000	Verrucano
Lo18	-0.989	19.070	125.000	Verrucano
Lo19	-4.783	18.176	220.000	Verrucano
Lo20	-6.047	17.061	460.000	Verrucano
Lo21	-6.803	16.549	720.000	Verrucano
Lo21.1	-6.170	17.890	720.000	Verrucano
Lo22	-7.229	16.431	2020.000	Verrucano
Lo22.1	-6.310	16.710	2020.000	Verrucano
Lo sept	1.573	20.063	0.000	
mean LK	1.323	19.418		
Schwander (724.300/205.100)				
SW1	1.920	21.865		Lochsitenkalk
SW2	2.028	22.456		Lochsitenkalk
SW3	1.964	21.968		Lochsitenkalk
SW4	2.049	22.855		Lochsitenkalk
SW5	2.029	22.647		Lochsitenkalk
mean LK	1.998	22.358		
Rufirus (722.450/201.550)			**Ref: Lochsitenkalk- Argovian limestones conatct**	
Ruf 2	0.827	20.721	-606.250	Tertiary Flysch
Ruf 3	0.981	20.580	-693.750	Tertiary Flysch
Ruf 3.1	0.488	20.229	-693.750	Tertiary Flysch
Ruf 4	-1.508	19.569	-931.250	Tertiary Flysch
Ruf 4.1	-1.364	20.151	-931.250	Tertiary Flysch

Sample	δ^{13} C (‰PDB)	δ^{18}O (‰SMOW)	Vertical distance to Ref. (cm)	Lithology
Ruf 5	-0.792	20.517	-1281.250	Tertiary Flysch
Ruf 5.1	-1.015	20.090	-1281.250	Tertiary Flysch
Ruf6	1.754	21.195	-525.000	Lochsitenkalk
Ruf7	1.782	21.299	-477.500	Lochsitenkalk
Ruf8	1.887	22.192	-456.250	Lochsitenkalk
Ruf9	1.877	22.477	-412.500	Lochsitenkalk
Ruf10	1.909	22.452	-362.500	Lochsitenkalk
Ruf11	1.941	22.687	-287.500	Lochsitenkalk
Ruf12	2.020	22.032	-168.750	Lochsitenkalk
Ruf13	1.786	21.609	-100.000	Lochsitenkalk
Ruf14	1.789	21.429	-68.750	Lochsitenkalk
Ruf15	1.482	20.941	0.000	Lochsitenkalk
Ruf 16.1	1.323	21.259	18.750	Mesozoic carbonates
Ruf 16	1.574	21.423	18.750	Mesozoic carbonates
Ruf 17	1.632	21.655	181.250	Mesozoic carbonates
Ruf 18	1.850	22.370	106.250	Mesozoic carbonates
Ruf 19	2.310	22.520	356.250	Mesozoic carbonates
Ruf 20	1.924	22.012	725.000	Mesozoic carbonates
RUF 99.1v	1.106	22.324	-640.000	Tertiary Flysch
RUF 99.1br	1.037	21.323	-640.000	Tertiary Flysch
RUF 99.2	1.154	20.922	-790.000	Tertiary Flysch
RUF 99.2v	0.840	21.023	-790.000	Tertiary Flysch
RUF 99.3	-0.707	20.826	-860.000	Tertiary Flysch
RUF 99.5	-0.228	21.926	-810.000	Tertiary Flysch
RUF 99.6	-0.804	20.626	-1010.000	Tertiary Flysch
RUF 99.7	1.834	22.222	2990.000	Mesozoic carbonates
RUF 99.8	1.910	23.023	3990.000	Mesozoic carbonates
RUF 99.9	2.366	24.824	7490.000	Mesozoic carbonates
RUF 99.10	-0.162	23.027		
RUF 99.11	-6.493	23.341		
RUF 99.12	-6.055	22.639		
mean LK	1.823	21.831		

Kärpf (726.250/197.000)			**Ref.: septum**	
Kä1	-0.132	19.329	6.250	Lochsitenkalk
Kä 2.1	0.636	20.291	-1.400	Lochsitenkalk
Kä 2.2	1.084	20.143	-3.000	Lochsitenkalk
Kä 2.3	1.806	19.272	-10.500	Lochsitenkalk
Kä 2.5	1.807	19.831	-18.500	Lochsitenkalk
Kä 2.4	1.925	19.777	-15.500	Lochsitenkalk
Kä3	2.441	21.516	-55.000	Lochsitenkalk
Kä4	2.407	22.731	-70.000	Lochsitenkalk
Kä5	2.476	21.948	-85.000	Lochsitenkalk
Kä6	2.376	21.927	-105.000	Lochsitenkalk
Kä7	2.345	21.245	-140.000	Lochsitenkalk
Kä8	-0.462	19.362	6.000	Lochsitenkalk
Kä9	-0.938	19.017	16.000	Lochsitenkalk
Kä10	-1.710	18.701	30.000	Verrucano
Kä11	-2.255	18.789	50.000	Verrucano
Kä12	-3.200	18.589	62.000	Verrucano
Kä13	-4.259	18.224	90.000	Verrucano
Kä14	-5.553	18.337	145.000	Verrucano
Kä15	-6.095	21.045	310.000	Verrucano
Ka sept	0.760	15.214	0.000	
mean LK	1.367	20.491		

Sample	δ^{13} C (‰PDB)	δ^{18}O (‰SMOW)	Vertical distance to Ref. (cm)	Lithology
Türchle (724.000/198.400)			**Ref.: Lochsitenkalk-Dolomite contact**	
Tü1	0.790	21.307	-233.750	Lochsitenkalk
Tü4	1.366	22.160	-206.250	Lochsitenkalk
Tü5	1.554	21.322	-156.250	Lochsitenkalk
Tü6	1.857	22.131	-147.500	Lochsitenkalk
Tü7	1.835	21.501	-85.000	Lochsitenkalk
Tü8	1.798	21.381	-58.750	Lochsitenkalk
Tü9	1.786	21.504	-27.500	Lochsitenkalk
Tü10	1.356	19.120	0.000	Lochsitenkalk
mean LK	1.543	21.303		
Rustigen (705.700/192.250)			**Ref: Lochsitenkalk-Dolomie contact**	
Rus1	1.125	23.318	-377.500	Lochsitenkalk
Rus 2.1	1.223	23.532	-354.300	Lochsitenkalk
Rus 2.2	1.213	23.480	-357.500	Lochsitenkalk
Rus 2.3	1.217	23.671	-357.500	Lochsitenkalk
Rus 2.4	1.274	23.689	-361.000	Lochsitenkalk
Rus 2.5	1.244	23.725	-365.000	Lochsitenkalk
Rus 2.6	1.227	23.794	-365.000	Lochsitenkalk
Rus3	1.202	22.753	-362.500	Lochsitenkalk
Rus4	1.133	21.783	-327.500	Lochsitenkalk
Rus5	0.912	20.849	-270.000	Lochsitenkalk
Rus6	1.114	22.882	-247.500	Lochsitenkalk
Rus7	1.078	23.172	-225.000	Lochsitenkalk
Rus8	1.125	23.459	-192.500	Lochsitenkalk
Rus9	1.088	23.161	-155.000	Lochsitenkalk
Rus10	1.075	23.387	-132.500	Lochsitenkalk
Rus11	1.140	23.720	-112.500	Lochsitenkalk
Rus12	0.169	23.207	-55.000	Lochsitenkalk
Rus13	0.763	22.960	-32.500	Lochsitenkalk
Rus14	-0.361	21.560	-17.500	Lochsitenkalk
Rus15	-0.196	21.395	0.000	Lochsitenkalk
mean LK	0.938	22.975		
Feldegg (737.000/204.925)			**Ref: Lochsitenkalk-Verrucano contact**	
FE4	-0.668	20.124	0.000	Lochsitenkalk
FE5	0.098	19.994	-32.500	Lochsitenkalk
FE6	-0.514	19.936	-15.000	Lochsitenkalk
FE7	0.815	20.375		Lochsitenkalk
FE8	-0.695	20.205	-95.000	Lochsitenkalk
FE9	0.008	20.421	-117.500	Lochsitenkalk
mean LK	-0.159	20.176		
Oberfitteren (732.125/205.850)			**No Ref**	
Of1	1.554	20.270	-765.625	Lochsitenkalk
Of2	1.791	20.411	-650.000	Lochsitenkalk
Of3	1.696	20.301	-520.000	Lochsitenkalk
Of4	1.722	20.309	-300.000	Lochsitenkalk
Of5	1.649	20.301	-120.000	Lochsitenkalk
Of6	1.528	19.877	0.000	Lochsitenkalk
mean LK	1.657	20.245		
Tegia Sura (730.350/189.00)			**Ref.:Lochsitenkalk-Verrucano contact**	
TS-1	-0.862	14.523	0.000	Lochsitenkalk
TS-2	-0.281	14.081	-1.000	Lochsitenkalk
TS-3	0.382	13.432	-4.000	Lochsitenkalk
TS-4	0.285	14.477	-16.000	Lochsitenkalk

Sample	δ^{13}C (‰PDB)	δ^{18}O (‰SMOW)	Vertical distance to Ref. (cm)	Lithology
TS-5	0.354	14.527	-22.000	Mesozoic carbonates
TS-6	0.383	15.511	-37.000	Mesozoic carbonates
TS-8	0.810	14.409	-12.000	Mesozoic carbonates
TS-8.1	1.054	15.323	-12.000	Mesozoic carbonates
TS-9	0.679	14.716	-24.000	Mesozoic carbonates
TS-7	-6.090	19.729	0.000	Mesozoic carbonates
TS-7 (2)	-6.617	19.183	0.000	Mesozoic carbonates
mean LK	-0.015	8.880		
Bächibach (721.050/203.150)			**Ref.: Lochsitenkalk-Flysch contact**	
BAE-1	1.476	22.027	-80.000	Tertiary Flysch
BAE-1.1	1.520	22.304	-80.000	Tertiary Flysch
BAE-2	1.376	21.879	-260.000	Tertiary Flysch
BAE-2.1	1.447	22.514	-260.000	Tertiary Flysch
BAE-3	1.463	21.272	-480.000	Tertiary Flysch
BAE-3.1	1.334	22.043	-480.000	Tertiary Flysch
BAE-4	-1.836	20.726	-940.000	Tertiary Flysch
BAE-4.1	-1.283	22.143	-940.000	Tertiary Flysch
BAE-5	0.804	21.659	-20.000	Tertiary Flysch
BAE-5.1	0.620	21.848	-20.000	Tertiary Flysch
BAE-6	1.433	21.945	0.000	Lochsitenkalk
BAE-7	0.814	21.977	30.000	Lochsitenkalk
BAE-8	0.886	21.096	70.000	Lochsitenkalk
BAE-9	1.576	21.915	135.000	Lochsitenkalk
BAE-10	1.611	22.462	175.000	Lochsitenkalk
BAE-11	1.296	21.798	200.000	Lochsitenkalk
BAE-12	1.377	22.945	220.000	Lochsitenkalk
BAE-13	1.052	22.097	250.000	Lochsitenkalk
BAE-14	-0.419	23.098	280.000	Lochsitenkalk
BAE-15	0.007	23.846	295.000	Lochsitenkalk
BAE-16	1.098	21.004	300.000	Lochsitenkalk
BAE-17	1.393	21.561	315.000	Lochsitenkalk
BAE-18	1.463	21.715	330.000	Lochsitenkalk
BAE-19	0.980	19.519	335.000	Lochsitenkalk
BAE-20	1.286	21.926	345.000	Lochsitenkalk
BAE-21	1.251	23.272	375.000	Mesozoic carbonates
BAE-22	1.120	24.712	420.000	Mesozoic carbonates
BAE-23	1.160	25.103	450.000	Mesozoic carbonates
BAE-24	1.327	23.892	510.000	Mesozoic carbonates
BAE-25	1.210	24.797	710.000	Mesozoic carbonates
BAE-26	1.709	25.843	1210.000	Mesozoic carbonates
BAE-27	2.021	24.699	1910.000	Mesozoic carbonates
Ba 99.1	1.566	22.505	-170.000	Tertiary Flysch
Ba 99.2	-0.158	21.408	-270.000	Tertiary Flysch
Ba 99.3	-0.047	21.208	-500.000	Tertiary Flysch
Ba 99.4	-1.062	20.609	-500.000	Tertiary Flysch
Ba 99.5	-0.444	20.708	-1500.000	Tertiary Flysch
Ba 99.6	0.581	19.522	297.000	Lochsitenkalk
Ba 99.7	0.412	21.424	303.000	Lochsitenkalk
Ba 99.8	0.623	18.321	297.000	Lochsitenkalk
Ba 99.9	0.322	21.024	303.000	Lochsitenkalk
Ba 99.10	1.393	21.505	312.000	Lochsitenkalk
Ba 99.11	1.390	21.605	315.000	Mesozoic carbonates
Ba 99.12	1.189	24.408	600.000	Mesozoic carbonates
Ba 99.13	1.468	25.308	1800.000	Mesozoic carbonates
Ba 99.14	2.307	25.006	2300.000	Mesozoic carbonates
Ba 99.15	2.321	24.605	5300.000	Mesozoic carbonates

Sample	δ^{13} C (‰PDB)	δ^{18}O (‰SMOW)	Vertical distance to Ref. (cm)	Lithology
Ba 99.16	2.846	24.404	5300.000	Mesozoic carbonates
Ba 99.17	-0.261	21.408	-8500.000	Tertiary Flysch
Ba 99.18	-0.686	21.710	-8500.000	Tertiary Flysch
mean LK	0.959	21.535		
Ba sept	-0.034	11.730	298.000	
Ba sept	-0.148	13.505	298.000	
Ba sept	-0.75	12.78852674	298.000	
Ba sept	0.05	10.02218344	298.000	
Schwändi ober Rütti (720.100/200.800)			**No Ref**	
SOR-8	1.673	22.293	-100.000	Lochsitenkalk
SOR-9	1.544	21.593	0.000	Lochsitenkalk
SOR-10	1.729	22.102	-62.500	Lochsitenkalk
SOR-11	1.679	22.039	-25.000	Lochsitenkalk
mean LK	1.656	22.007		
Vorab Pign (732.250/192.520)			**Ref.: Lochsitenkalk-Verrucano Contact**	
VP-1.2	-1.094	13.537	-2.000	Lochsitenkalk
VP-1.3	0.676	12.828	-3.000	Lochsitenkalk
VP-1.4	0.669	13.392	-4.000	Lochsitenkalk
VP-1.5	2.052	12.851	-6.000	Lochsitenkalk
VP-2	1.785	13.048	-6.500	Lochsitenkalk
VP-3	1.973	13.621	-13.000	Lochsitenkalk
VP-4	2.305	15.219	-18.000	Mesozoic carbonates
VP-5.1	2.347	16.806	-41.100	Mesozoic carbonates
VP-5.2	2.676	16.647	-42.800	Mesozoic carbonates
VP-5.3	2.613	16.619	-44.800	Mesozoic carbonates
VP-5.4	2.538	16.365	-47.500	Mesozoic carbonates
VP-5.5	2.557	16.809	-49.500	Mesozoic carbonates
VP-6	3.086	16.949	-100.000	Mesozoic carbonates
VP-7	3.336	18.893	-250.000	Mesozoic carbonates
VP-8	3.282	21.059	-390.000	Mesozoic carbonates
VP-9	2.440	25.878	-650.000	Mesozoic carbonates
VP-10	-3.156	13.741	2.000	Verrucano
VP-11	-4.367	13.728	35.000	Verrucano
VP-12	-4.730	14.283	50.000	Verrucano
VP-13	-4.525	11.867	100.000	Verrucano
VP-14	-4.855	11.700	200.000	Verrucano
VP-15	-5.190	11.773	410.000	Verrucano
VP-16	-3.556	12.385	800.000	Verrucano
VP-17	-1.993	12.688	1600.000	Verrucano
VP-17.1	-2.017	12.902	1600.000	Verrucano
VP-17.2	-2.080	12.700	1600.000	Verrucano
mean LK	1.010	13.213		
Rostock (727.275/190.450)			**Ref.: Lochsitenkalk-Verrucano Contact**	
ROS-1	0.286	13.965	0.000	Lochsitenkalk
ROS-2	0.744	13.697	0.000	Lochsitenkalk
ROS-3	1.178	13.785	-6.000	Lochsitenkalk
ROS-4	1.047	9.495	-11.000	Lochsitenkalk
ROS-5	1.723	13.814	-23.000	Lochsitenkalk
ROS-6	1.786	13.465	-56.000	Lochsitenkalk
ROS-7	1.813	12.883	-89.000	Lochsitenkalk
ROS-8	2.240	14.353	-120.000	Lochsitenkalk
ROS-9	2.337	14.725	-160.000	Lochsitenkalk
mean LK	1.462	13.354		

Sample	δ^{13} C (‰PDB)	δ^{18}O (‰SMOW)	Vertical distance to Ref. (cm)	Lithology
Piz Sardona (738.150/197.600)			**Ref.: Lochsitenkalk-Verrucano Contact**	
SAR-1	-0.170	18.008	0.000	Lochsitenkalk
SAR-2	-0.508	18.737	-5.000	Lochsitenkalk
SAR-3	-0.368	18.438	-7.000	Lochsitenkalk
SAR-4	-0.336	18.572	-4.000	Lochsitenkalk
SAR-5	0.199	19.290	-20.000	Lochsitenkalk
SAR-5.1	-0.070	19.246	-18.000	Lochsitenkalk
SAR-5.2	0.062	19.294	-19.500	Lochsitenkalk
SAR-5.3	0.129	19.308	-21.500	Lochsitenkalk
SAR-5.4	0.113	19.278	-22.700	Lochsitenkalk
SAR-5.5	0.163	19.120	-24.000	Lochsitenkalk
SAR-5.6	0.254	19.447	-27.000	Lochsitenkalk
SAR-5.7	0.341	19.452	-30.400	Lochsitenkalk
SAR-5.8	0.343	19.557	-32.000	Lochsitenkalk
SAR-6	1.023	19.944	-46.000	Lochsitenkalk
SAR-7	1.180	19.960	-56.000	Lochsitenkalk
SAR-8	1.308	20.060	-120.000	Tertiary Flysch
SAR-9	1.448	20.232	-190.000	Tertiary Flysch
SAR-10	-0.281	17.660	0.000	Verrucano
SAR-11	-1.272	17.311	60.000	Verrucano
SAR-12	-3.280	17.027	200.000	Verrucano
SAR sept	0.317	13.747	-10.000	
SAR sept	-0.160	13.796	-10.000	
mean LK	0.157	19.177		
Crap da Flem West (739.100/193.500)			**Ref.: Lochsitenkalk-Verrucano Contact**	
CW-1	-2.413	13.108	0.000	Lochsitenkalk
CW-2	-2.211	12.696	-7.000	Lochsitenkalk
CW-3	-2.258	12.876	-3.000	Lochsitenkalk
CW-4	-0.842	13.435	-10.000	Lochsitenkalk
CW-5	1.302	13.266	-30.000	Lochsitenkalk
CW-7	1.441	12.613	-40.000	Lochsitenkalk
CW-8	1.189	12.478	-50.000	Lochsitenkalk
CW-9	1.261	12.696	-70.000	Lochsitenkalk
CW-10	1.388	12.196	-80.000	Lochsitenkalk
CW-11	1.308	12.256	-90.000	Mesozoic carbonates
CW-12	1.548	13.136	-104.000	Mesozoic carbonates
CW-13	1.566	16.650	-230.000	Mesozoic carbonates
CW-14	1.634	14.322	-150.000	Mesozoic carbonates
CW-15	1.599	15.951	-370.000	Mesozoic carbonates
CW-16	1.646	19.273	-510.000	Mesozoic carbonates
CW-17	1.465	20.309	-515.000	Mesozoic carbonates
CW-17.1	1.397	20.605	-515.000	Mesozoic carbonates
CW-18	1.430	20.391	-540.000	Mesozoic carbonates
CW-19	1.111	20.376	-640.000	Mesozoic carbonates
CW-19.1	1.062	21.046	-640.000	Mesozoic carbonates
CW-20	-3.573	14.246	1.000	Verrucano
CW-21	-3.848	13.394	40.000	Verrucano
CW-21.1	-3.782	13.592	40.000	Verrucano
CW-22	-4.363	13.107	80.000	Verrucano
CW-22.1	-4.210	13.414	80.000	Verrucano
CW-23	-4.724	14.000	320.000	Verrucano
CW-24	-3.484	17.162	800.000	Verrucano
mean LK	-0.127	12.818		

Sample	δ^{13} C (‰PDB)	δ^{18}O (‰SMOW)	Vertical distance to Ref. (cm)	Lithology
Point 2805 (731.850/194.450)			**Ref.: Lochsitenkalk-Verrucano Contact**	
P-2.5	-0.271	13.827	0.000	Lochsitenkalk
P-2.6	0.623	13.933	-6.000	Lochsitenkalk
P-2.7	0.727	14.047	-12.000	Lochsitenkalk
P-2.8	0.805	14.034	-17.000	Lochsitenkalk
P-2.9	0.748	14.058	-19.000	Lochsitenkalk
P-2.10	-0.614	14.031	-26.000	Lochsitenkalk
mean LK	0.337	13.988		
Laaxer Stöckli (735.400/194.600)			**Ref.: Lochsitenkalk-Verrucano Contact**	
LA-1.1	-0.008	16.389	-1.500	Lochsitenkalk
LA-1.2	0.275	16.334	-4.300	Lochsitenkalk
LA-1.3	0.627	15.804	-5.400	Lochsitenkalk
LA-1.4	0.203	15.769	-6.200	Lochsitenkalk
LA-1.5	0.090	15.880	-8.500	Lochsitenkalk
LA-1.6	0.124	16.227	-9.700	Lochsitenkalk
LA-2	0.250	15.762	-10.300	Lochsitenkalk
LA-3	0.210	16.311	-10.800	Lochsitenkalk
LA-4	0.412	16.014	-11.000	Lochsitenkalk
LA-5	1.096	16.149	-35.000	Lochsitenkalk
LA-6	1.710	16.440	-55.000	Lochsitenkalk
LA-7	1.834	17.046	-95.000	Mesozoic carbonates
LA-8	1.726	18.328	-165.000	Mesozoic carbonates
La 9 top	1.819	17.039	-230.000	Mesozoic carbonates
La 9 mid.	1.923	15.835	-240.000	Mesozoic carbonates
La 9 bot.	2.004	16.281	-250.000	Mesozoic carbonates
La 10	2.052	21.310	-365.000	Mesozoic carbonates
La 11	-0.022	16.619	15.000	Verrucano
La 12	-0.589	18.833	25.000	Verrucano
La 13	-1.272	17.569	65.000	Verrucano
La 14	-3.760	15.797	175.000	Verrucano
La 15	-5.199	10.959	525.000	Verrucano
La sept	0.11	15.67190934	-10.600	
mean LK	0.45	16.09810186		
Grau Berg (736.250/193.000)			**Ref.: Lochsitenkalk-Verrucano Contact**	
GB-98.0	-1.507	10.587	0.000	Lochsitenkalk
GB-98.1	-1.309	9.903	-1.000	Lochsitenkalk
GB-98.2	-0.258	10.296	-3.000	Lochsitenkalk
GB-98.3	-0.820	10.412	-5.000	Lochsitenkalk
GB-98.4	-0.177	10.318	-10.000	Lochsitenkalk
GB-98.5	0.604	10.136	-12.500	Lochsitenkalk
GB-98.6	1.441	10.122	-15.100	Lochsitenkalk
GB-98.7	2.046	12.430	-25.000	Mesozoic carbonates
GB-98.8	1.946	12.241	-40.000	Mesozoic carbonates
GB-98.9	2.039	11.864	-55.000	Mesozoic carbonates
GB-98.10	1.928	11.207	-65.000	Mesozoic carbonates
GB-98.11	1.865	13.577	-80.000	Mesozoic carbonates
GB-98.12	1.902	12.229	-90.000	Mesozoic carbonates
GB-98.13	0.788	11.219	-120.000	Mesozoic carbonates
GB-98.14	1.678	12.151	-150.000	Mesozoic carbonates
GB-98.15	1.642	11.915	-200.000	Mesozoic carbonates
GB-98.16	1.593	13.862	-250.000	Mesozoic carbonates
GB-98.17	1.785	12.671	-300.000	Mesozoic carbonates

Sample	δ^{13} C (‰PDB)	δ^{18}O (‰SMOW)	Vertical distance to Ref. (cm)	Lithology
GB-98.18	1.884	12.843	-390.000	Mesozoic carbonates
GB-98.19	2.170	19.232	-450.000	Mesozoic carbonates
GB-98.20	2.170	20.762	-650.000	Mesozoic carbonates
GB 99.1	0.739	13.500	-25.000	Mesozoic carbonates
GB 99.2	1.915	18.401	-220.000	Mesozoic carbonates
GB 99.3	2.211	24.806	-520.000	Mesozoic carbonates
GB 99.4	2.090	25.306	-1020.000	Mesozoic carbonates
GB 99.5	1.993	25.107	-2020.000	Mesozoic carbonates
GB 99.6	1.889	25.107	-2720.000	Mesozoic carbonates
GB 99.7	1.430	26.409	-4020.000	Mesozoic carbonates
mean LK	-0.290	10.253		
Crap da Flem East (740.700/193.350)			**Ref.: Lochsitenkalk-Verrucano Contact**	
CE 1	-0.585	18.732	-1.000	Lochsitenkalk
CE 2	-0.065	17.299	-3.000	Lochsitenkalk
CE 3	0.736	18.488	-6.000	Lochsitenkalk
CE 4	1.057	18.286	-10.000	Lochsitenkalk
CE 5bot.	1.537	17.315	-12.000	Mesozoic carbonates
CE 5top	1.639	16.512	-25.000	Mesozoic carbonates
CE 6	1.328	17.075	-65.000	Mesozoic carbonates
CE 7	1.766	22.888	-90.000	Mesozoic carbonates
CE 8	1.901	24.788	-135.000	Mesozoic carbonates
CE 9	1.810	25.578	-195.000	Mesozoic carbonates
CE 10	1.991	24.244	-285.000	Mesozoic carbonates
CE 11	2.030	25.124	-545.000	Mesozoic carbonates
CE 12	2.023	25.555	-845.000	Mesozoic carbonates
CE 99.1	-3.232	18.929	1000.000	Verrucano
CE 99.2	-3.746	18.830	2000.000	Verrucano
CE 99.3	1.872	24.124	-2000.000	Mesozoic carbonates
CE 99.4	2.120	25.926	-3500.000	Mesozoic carbonates
CE 99.5	-0.032	13.317	-5.000	Lochsitenkalk
mean LK	0.222	17.225		
Plaun Grogn (730.250/192.000)			**Ref.: Lochsitenkalk-Verrucano Contact**	
PG 1.1	-2.554	10.995	-1.200	Lochsitenkalk
PG 1.2	-1.837	10.937	-1.800	Lochsitenkalk
PG 1.3	0.157	10.753	-2.300	Lochsitenkalk
PG 1.4	1.783	11.113	-6.300	Lochsitenkalk
PG 1.5	1.890	11.289	-12.000	Lochsitenkalk
PG 2.1	1.792	10.831	-15.200	Lochsitenkalk
PG 2.2	1.758	11.074	-24.000	Lochsitenkalk
PG 2.3	1.627	10.885	-27.800	Lochsitenkalk
PG 3 top	1.847	10.656	-37.000	Lochsitenkalk
PG 3 bot.	0.963	11.098	-50.000	Lochsitenkalk
PG4 top	-1.108	9.452	-70.000	Lochsitenkalk
PG4 bot.	-0.298	9.205	-75.000	Lochsitenkalk
PG 6	0.896	14.606	-85.000	Mesozoic carbonates
PG 7	1.151	14.966	-110.000	Mesozoic carbonates
PG 8	1.219	16.276	-180.000	Mesozoic carbonates
PG 9	1.310	16.897	-260.000	Mesozoic carbonates
PG 10	1.471	21.659	-580.000	Mesozoic carbonates
mean LK	0.502	10.691		

Sample	δ^{13} C (‰PDB)	δ^{18}O (‰SMOW)	Vertical distance to Ref. (cm)	Lithology
Nagiens West (736.725/191.925)			**Ref.: Lochsitenkalk-Verrucano Contact**	
NW 1.1	-3.045	11.418	-0.500	Lochsitenkalk
NW 1.2	-3.050	10.410	-1.400	Lochsitenkalk
NW 1.3	-1.953	10.096	-2.400	Lochsitenkalk
NW 1.4	-0.593	10.087	-4.600	Lochsitenkalk
NW 1.5	0.282	9.976	-4.500	Lochsitenkalk
NW 1.6	1.904	12.820	-9.200	Lochsitenkalk
NW 2	1.943	13.236	-12.000	Lochsitenkalk
NW 3	2.352	15.315	-22.000	Lochsitenkalk
NW 4	2.350	15.170	-32.000	Mesozoic carbonates
NW 5	2.394	17.690	-42.000	Mesozoic carbonates
NW 6	2.473	16.992	-72.000	Mesozoic carbonates
NW 7	2.458	23.853	-100.000	Mesozoic carbonates
NW 8	2.515	23.898	-136.000	Mesozoic carbonates
NW 9	2.484	24.838	-2226.000	Mesozoic carbonates
NW 10	2.426	24.451	-406.000	Mesozoic carbonates
NW 11	-4.275	13.804	20.000	Verrucano
NW 12	-3.845	13.832	60.000	Verrucano
mean LK	-0.270	11.670		
Nussbuel-Unterstafel (717.100/197.450)			**Ref.: Lochsitenkalk-Flysch Contact**	
UN-1	0.914	20.057	0.000	Lochsitenkalk
UN-2	0.865	21.787	110.000	Lochsitenkalk
UN-3	1.407	20.609	310.000	Lochsitenkalk
UN-4	1.303	20.448	535.000	Lochsitenkalk
UN-5	0.886	19.795	710.000	Lochsitenkalk
UN-6	0.504	20.092	750.000	Lochsitenkalk
UN-7	0.542	19.196	960.000	Lochsitenkalk
UN-8	0.416	18.749	1060.000	Lochsitenkalk
mean LK	0.855	20.092		
Täli (723.300/203.800)			**Ref.: Lochsitenkalk-Flysch Contact**	
Tä 1	1.978	22.761	0.000	Lochsitenkalk
Tä 2	2.034	22.830	100.000	Lochsitenkalk
Tä 3	1.870	21.815	250.000	Lochsitenkalk
Tä 4	2.186	23.458	350.000	Lochsitenkalk
mean LK	2.017	22.716		
Bützi (722.150/198.500)			**Ref.: Lochsitenkalk-Flysch contact**	
BZ-1	1.608	21.916	0.000	Lochsitenkalk
BZ-2	1.695	23.127	120.000	Lochsitenkalk
BZ-3	1.699	22.609	220.000	Lochsitenkalk
BZ-4	1.653	23.025	420.000	Lochsitenkalk
BZ-5	1.699	23.964	530.000	Lochsitenkalk
BZ-6	1.309	22.650	-600.000	Tertiary Flysch
BZ-7	1.303	22.256	-630.000	Tertiary Flysch
BZ-8	1.146	22.165	-680.000	Tertiary Flysch
BZ-9	1.201	21.761	-1080.000	Tertiary Flysch
BZ-10	1.209	21.800	-1200.000	Tertiary Flysch
mean LK	1.671	22.928		

Sample	δ^{13} C (‰PDB)	δ^{18}O (‰SMOW)	Vertical distance to Ref. (cm)	Lithology
Oberbodemenberg (723.300/199.675			**Ref.: Lochsitenkalk-Flysch Contact**	
OB-4	1.783	22.092	0.000	Lochsitenkalk
OB-5	1.783	22.175	40.000	Lochsitenkalk
OB-6	1.812	22.097	90.000	Lochsitenkalk
OB-7	1.737	21.559	160.000	Lochsitenkalk
OB-8	1.796	19.845	190.000	Lochsitenkalk
OB-9	1.397	20.648	210.000	Lochsitenkalk
mean LK	1.718	21.403		
Ristenhoren (737.250/204.000)			**Ref.: Lochsitenkalk-Verrucano Contact**	
Ris 4.top	-0.327	20.673	-5.000	Lochsitenkalk
Ris 4.mid.	0.182	20.566	-15.000	Lochsitenkalk
Ris 4.bot	-0.032	20.819	-35.000	Lochsitenkalk
Ris 5	-0.420	20.865	-60.000	Lochsitenkalk
Ris 6	-0.227	20.551	-10.000	Lochsitenkalk
Ris 7	-1.091	20.021	-55.000	Lochsitenkalk
mean LK	-0.319	20.582		
Fuorcla Sura (732.900/190.700)			**Ref.: Lochsitenkalk-Verrucano Contact**	
FS 1.top	0.016	13.744	-1.000	Lochsitenkalk
FS 1.1	0.989	15.097	-2.700	Lochsitenkalk
FS 1.2	1.036	15.605	-4.500	Lochsitenkalk
FS 1.3	1.257	17.315	-7.000	Lochsitenkalk
FS 1.4	1.192	16.967	-8.800	Lochsitenkalk
FS 1.5	1.125	18.177	-10.100	Lochsitenkalk
FS 2	1.427	14.410	-13.000	Lochsitenkalk
FS 4	1.909	15.979	-33.000	Lochsitenkalk
FS 5	1.794	15.431	-45.000	Lochsitenkalk
FS 6	1.673	14.670	-62.000	Lochsitenkalk
FS 7	1.605	15.500	-65.000	Lochsitenkalk
FS 8	0.469	13.591	-60.000	Lochsitenkalk
FS 9	1.067	14.460	-65.000	Lochsitenkalk
mean LK	1.197	15.457		
Nagiens East (736.825/192.050)			**Ref.: Lochsitenkalk-Verrucano Contact**	
NE 1	-3.183	14.096	10.000	Contact Veruca.
NE 2	-3.509	9.619	2.000	Lochsite
NE 3	-1.446	10.602	-4.500	Lochsitenkalk
NE 4	-1.096	10.275	0.000	Lochsitenkalk
NE 5	-1.428	10.549	-6.000	Lochsitenkalk
NE 6	2.022	12.329	-15.000	Lochsitenkalk
NE 7	2.382	21.656	-70.000	Mesozoic carbonates
NE 8	2.411	21.666	112.000	Verrucano
NE 9	-3.545	14.932	16.000	Verrucano
NE 10	-4.960	11.975	50.000	Verrucano
mean LK	-1.323	10.475		
Piz Dolf Nord (738.400/196.435)			**Ref.: septum**	
pdn99.1	1.181	19.109	-40.000	Tertiary Flysch
pdn99.2	1.348	19.333	-110.000	Tertiary Flysch
pdn99.3	1.547	19.832	-210.000	Tertiary Flysch
pdn99.4	1.115	19.150	-36.000	Lochsitenkalk
pdn99.5	0.518	18.484	-24.000	Lochsitenkalk
pdn99.6	0.096	18.014	-3.000	Lochsitenkalk
pdn99.7	-0.005	17.219	0.000	Lochsitenkalk
pdn99.8	0.010	17.670	0.000	Lochsitenkalk

Sample	δ^{13} C (‰PDB)	δ^{18}O (‰SMOW)	Vertical distance to Ref. (cm)	Lithology
pdn99.9	-0.146	16.986	12.000	Lochsitenkalk
pdn99.10a	-0.123	16.233	9.000	Lochsitenkalk
pdn99.10b	-0.108	16.494	6.500	Lochsitenkalk
pdn99.10c	-0.257	16.663	4.000	Lochsitenkalk
pdn99.10d	0.116	17.489	1.000	Lochsitenkalk
pdn99.11	-1.430	16.886	24.000	Verrucano
pdn99.12	-2.326	16.523	45.000	Verrucano
pdn99.13	-3.378	15.323	150.000	Verrucano
pdn99.14	-4.640	13.273	250.000	Verrucano
pdn99.15	-5.458	11.046	500.000	Verrucano
PDN sept	-0.110	13.659	0.000	
PDN sept	-0.178	13.895	0.000	
mean LK	0.122	17.440		
Eastern Vorab Station (733.820/193.150)			**Ref.: Lochsitenkalk-Verrucano Contact**	
evs99.1t	-1.309	10.468	-1.000	Lochsitenkalk
evs99.1b	-0.227	10.039	-5.000	Lochsitenkalk
evs99.2	2.115	17.904	-7.000	Lochsitenkalk
evs99.3a	0.115	11.204	-21.000	Lochsitenkalk
evs99.3b	0.211	11.515	-24.000	Lochsitenkalk
evs99.3c	0.919	10.713	-24.000	Lochsitenkalk
evs99.3d	1.046	10.742	-26.000	Lochsitenkalk
evs99.3e	1.193	14.172	-28.500	Lochsitenkalk
evs99.3f	1.273	14.879	-31.000	Lochsitenkalk
evs99.4	-0.067	12.063	-27.000	Lochsitenkalk
evs99.5	0.401	11.244	-33.000	Lochsitenkalk
evs99.6	-0.890	10.449	-22.000	Lochsitenkalk
evs99.7a	0.223	10.111	-26.500	Lochsitenkalk
evs99.7b	0.601	10.374	-30.000	Lochsitenkalk
evs99.7c	0.643	11.162	-34.500	Lochsitenkalk
evs99.8	1.219	15.708	-52.000	Lochsitenkalk
evs99.9	-3.299	14.622	20.000	Verrucano
evs99.10	-3.819	11.488	50.000	Verrucano
evs99.11	-2.841	17.066	100.000	Verrucano
evs99.12	-5.061	11.748	300.000	Verrucano
evs99.13	-5.695	9.153	600.000	Verrucano
evs99.14	-6.447	6.631	1000.000	Verrucano
evs99.15	-4.508	11.612	1500.000	Verrucano
evs99.16	1.367	17.825	-90.000	Mesozoic carbonates
evs99.17	1.389	18.671	-140.000	Mesozoic carbonates
evs99.18	1.692	18.607	-200.000	Mesozoic carbonates
evs99.19	1.773	20.774	-300.000	Mesozoic carbonates
evs99.20	1.606	23.045	-500.000	Mesozoic carbonates
mean LK	0.467	12.047		
Ringelspitz ((745.200/195.800)			**Ref.: septum**	
rz99.1cat	-0.699	14.982	0.000	Lochsitenkalk
rz99.1ble	-0.590	15.492	5.000	Verrucano
rz99.2a	-0.010	17.037	-4.000	Lochsitenkalk
rz99.2b	-0.038	17.160	-8.000	Lochsitenkalk
rz99.2c	0.044	17.836	-10.000	Lochsitenkalk
rz99.2d	0.142	17.758	-15.000	Lochsitenkalk
rz99.2e	0.046	17.179	-11.500	Lochsitenkalk
rz99.4	0.339	17.718	-30.000	Lochsitenkalk
rz99.5	0.367	17.549	-35.000	Tertiary Flysch
rz99.6	-1.076	15.797	10.000	Verrucano
rz99.7	-2.682	13.914	110.000	Verrucano

Sample	δ^{13} C (‰PDB)	δ^{18}O (‰SMOW)	Vertical distance to Ref. (cm)	Lithology
rz99.8	-2.685	14.675	500.000	Verrucano
rz99.9	-2.075	18.269	1000.000	Verrucano
rz99.10	0.394	20.943	-1000.000	Tertiary Flysch
rz99.11	0.683	21.326	-20000.000	Tertiary Flysch
mean LK	0.087	17.448		
Metmmen (726.125/202.650)			**Ref.: septum**	
met99.7	0.755	18.324	-140.000	Tertiary Flysch
met99.8	0.882	20.247	-160.000	Tertiary Flysch
met99.9	-5.621	17.848	-230.000	Tertiary Flysch
met99.10t	1.361	19.933	3.000	Lochsitenkalk
met99.10c	1.338	20.205	7.000	Lochsitenkalk
met99.10b	1.283	19.913	12.000	Lochsitenkalk
met99.11	1.067	20.384	-2.000	Lochsitenkalk
met99.12	1.094	19.875	-25.000	Lochsitenkalk
met99.13	1.367	19.897	38.000	Lochsitenkalk
met99.14	1.261	19.830	70.000	Lochsitenkalk
met99.15	-7.126	16.533	80.000	Verrucano
met99.16	-0.177	19.267	170.000	Verrucano
met99.17	-5.698	12.575	1000.000	Verrucano
mean LK	1.253	20.005		
Birchenchopf (729.100/204.825)			**Ref.: Lochsitenkalk-Flysch Contact**	
bi99.1	0.312	19.708	-1.000	Tertiary Flysch
bi99.2	1.658	19.772	3.000	Lochsitenkalk
bi99.3	1.554	19.705	5.000	Lochsitenkalk
bi99.4a	1.579	19.310	35.000	Lochsitenkalk
bi99.4b	1.755	19.377	33.000	Lochsitenkalk
bi99.4c	1.596	19.423	30.500	Lochsitenkalk
bi99.4d	1.703	19.525	27.000	Lochsitenkalk
bi99.4e	1.581	19.620	22.000	Lochsitenkalk
bi99.5	1.418	19.525	60.000	Lochsitenkalk
bi99.6	0.443	19.312	75.000	Lochsitenkalk
bi99.7	-4.154	19.159	90.000	Verrucano
bi99.8	-4.180	19.150	230.000	Verrucano
bi99.9	-5.169	17.314	500.000	Verrucano
bi99.11	-5.015	17.156	700.000	Verrucano
bi99.12	-0.065	20.154	-400.000	Tertiary Flysch
mean LK	1.476	19.508		
Chuebodensee (729.100/199.860)			**Ref.: Lochsitenkalk-Flysch Contact**	
chu99.1	-0.744	18.877	-9.000	Tertiary Flysch
chu99.2	-0.827	19.120	-3.000	Tertiary Flysch
chu99.3	-0.678	18.867	-25.000	Tertiary Flysch
chu99.4	-0.717	18.864	-25.000	Tertiary Flysch
chu99.5	-0.518	18.967	-45.000	Tertiary Flysch
chu99.6	-0.740	19.139	-100.000	Tertiary Flysch
chu99.7	-0.542	18.884	-160.000	Tertiary Flysch
chu99.8a	-0.228	18.983	24.800	Lochsitenkalk
chu99.8b	0.405	18.772	20.000	Lochsitenkalk
chu99.8c	0.154	18.742	15.000	Lochsitenkalk
chu99.8d	-0.025	18.721	10.000	Lochsitenkalk
chu99.8e	-0.029	18.673	7.000	Lochsitenkalk
chu99.8f	-0.273	19.054	3.000	Lochsitenkalk
chu99.9	-0.369	19.131	2.000	Lochsitenkalk
chu99.10	-0.282	19.009	7.000	Lochsitenkalk
chu99.11	-0.014	19.063	22.000	Lochsitenkalk

Sample	δ^{13} C (‰PDB)	δ^{18}O (‰SMOW)	Vertical distance to Ref. (cm)	Lithology
chu99.13b	0.493	18.648	20.000	Lochsitenkalk
chu99.13t	-0.774	18.817	27.000	Lochsitenkalk
chu99.14	-0.774	19.184	15.000	Verrucano
chu99.15	-1.780	19.371	50.000	Verrucano
chu99.16	-4.052	18.461	140.000	Verrucano
chu99.17	-5.307	17.783	270.000	Verrucano
chu99.18	-6.082	15.784	700.000	Verrucano
mean LK	-0.086	18.874		
Mutta Rodunda (735.700/192.010)			**Ref.: Lochsitenkalk-Verrucano Contact**	
mr99.1a	1.491	10.554	-2.000	Lochsitenkalk
mr99.1b	1.561	11.905	-5.500	Lochsitenkalk
mr99.1c	1.500	11.404	-9.500	Lochsitenkalk
mr99.1d	1.391	10.588	-11.500	Lochsitenkalk
mr99.2t	-0.677	11.104	6.000	Lochsitenkalk
mr99.2b	-0.195	10.754	1.000	Lochsitenkalk
mr99.3	0.755	11.624	-12.000	Lochsitenkalk
mr99.4b	1.360	11.827	-22.500	Lochsitenkalk
mr99.4c	1.394	11.989	-25.000	Lochsitenkalk
mr99.4d	1.415	12.097	-27.500	Lochsitenkalk
mr99.5	1.637	13.356	-50.000	Lochsitenkalk
mr99.6	1.792	14.750	-75.000	Lochsitenkalk
mr99.7a	1.953	14.269	-90.000	Mesozoic carbonates
mr99.7b	1.910	13.540	-93.000	Mesozoic carbonates
mr99.7c	1.963	13.509	-96.000	Mesozoic carbonates
mr99.7d	1.877	13.418	-99.000	Mesozoic carbonates
mr99.9	-2.465	13.968	60.000	Verrucano
mr99.10	-4.366	10.648	110.000	Verrucano
mr99.11	-5.121	9.036	400.000	Verrucano
mr99.14	2.019	16.718	-140.000	Mesozoic carbonates
mr99.15	2.026	16.901	-200.000	Mesozoic carbonates
mr99.16	2.078	19.616	-400.000	Mesozoic carbonates
mr99.17	2.100	25.239	-600.000	Mesozoic carbonates
mean LK	1.119	11.829		
Alp da Ruschein (731.375/189.600)			**Ref.: Lochsitenkalk-Verrucano Contact**	
AR 99.1	0.752	14.616	-5.000	Contact Veruca.
AR 99.2	0.928	15.517	-8.000	Lochsite
AR 99.3	1.093	16.718	-20.000	Mesozoic carbonates
AR 99.4	0.823	18.520	-40.000	Mesozoic carbonates
AR 99.5	1.023	21.724	-100.000	Mesozoic carbonates
AR 99.6	0.062	22.526	5.000	Mesozoic carbonates
AR 99.7	0.974	23.125	-180.000	Mesozoic carbonates
AR 99.8	-3.226	12.823	150.000	Verrucano
AR 99.9	-2.300	4.058	500.000	Verrucano
AR 99.10	-2.601	12.721	1500.000	Verrucano
AR 99.12	0.695	22.225	3000.000	Verrucano
Prachtvoller Wasserfall (717.250/196.400)			**Ref.: septum**	
PW 99.1	1.569	20.922	-26.000	Lochsitenkalk
PW 99.2	1.859	21.522	-8.000	Lochsitenkalk
PW 99.3	1.994	20.620	-2.000	Lochsitenkalk
PW 99.4	1.928	22.522	-14.000	Lochsitenkalk
PW 99.5	1.921	22.723	-2.000	Lochsitenkalk
PW 99.6	1.608	16.817	2.000	Lochsitenkalk
PW 99.7	1.918	19.820	-2.000	Lochsitenkalk
PW 99.8	1.969	21.321	2.000	Lochsitenkalk

Sample	δ^{13} C (‰PDB)	δ^{18}O (‰SMOW)	Vertical distance to Ref. (cm)	Lithology
PW 99.9	1.272	20.522	-2.000	Tertiary Flysch
PW 99.10	0.816	21.724	-50.000	Tertiary Flysch
PW 99.11	0.812	21.824	-90.000	Tertiary Flysch
PW 99.12	0.087	21.826	-200.000	Tertiary Flysch
PW 99.13	1.316	22.223	-300.000	Tertiary Flysch
PW 99.14	1.313	22.324	-500.000	Tertiary Flysch
PW 99.15	2.559	25.224	20.000	Lochsitenkalk
PW 99.16	2.279	24.324	10.000	Lochsitenkalk
PW 99.17	2.366	24.824	35.000	Lochsitenkalk
PW 99.18	2.538	25.825	70.000	Lochsitenkalk
PW 99.19	2.531	26.025	100.000	Lochsitenkalk
PW 99.20	2.631	26.125	120.000	Mesozoic carbonates
PW 99.21	2.417	26.326	220.000	Mesozoic carbonates
PW 99.22	2.610	26.726	500.000	Mesozoic carbonates
PW 99.23	2.517	26.425	1000.000	Mesozoic carbonates
PW sept	1.140	13.021	0.000	
mean LK	2.119	22.758		
Risetenpass (737.275/204.000)			**Ref.: septum**	
Ris 99.1	-1.205	20.227	2.000	Lochsitenkalk
Ris 99.2	-0.369	20.025	2.000	Lochsitenkalk
Ris 99.3	-0.565	19.725	3.000	Lochsitenkalk
RIS 99.4	0.260	19.823	18.000	Lochsitenkalk
RIS 99.5	0.709	18.821	45.000	Lochsitenkalk
RIS 99.6	0.077	19.123	60.000	Lochsitenkalk
RIS 99.8	-1.463	20.210	-90.000	Tertiary Flysch
RIS 99.9	-1.342	19.709	-140.000	Tertiary Flysch
RIS 99.10	-1.242	19.809	85.000	Verrucano
RIS 99.11	-2.105	20.812	150.000	Verrucano
mean LK	-0.182	19.624		
Steinstossfürgeli (724.150/199.800)				
SSF 99.1	2.091	22.304	-10.000	Lochsitenkalk
SSF 99.2t	2.087	22.404	-20.000	Lochsitenkalk
SSF 99.2b	1.638	23.406	-20.000	Lochsitenkalk
SSF 99.3	1.956	23.205	-40.000	Lochsitenkalk
SSF 99.4	2.056	23.305	-90.000	Lochsitenkalk
SSF 99.5	2.056	23.305	-90.000	Lochsitenkalk
SSF 99.6	2.084	22.504	0.000	Lochsitenkalk
SSF 99.7	2.080	22.604	20.000	Lochsitenkalk
SSF 99.8	2.070	22.905	60.000	Lochsitenkalk
SSF 99.9	2.091	22.304	90.000	Lochsitenkalk
SSF 99.10	2.084	22.504	200.000	Lochsitenkalk
SSF 99.11	2.066	23.005	400.000	Lochsitenkalk
SSF 99.12	1.904	21.704	600.000	Lochsitenkalk
SSF 99.13	2.266	23.204	800.000	Lochsitenkalk
SSF 99.14	0.971	23.225	1050.000	Mesozoic carbonates
SSF 99.15	1.802	26.127	1250.000	Mesozoic carbonates
mean LK	2.038	22.762		
Hausstock (724.250/192.625)			**Ref.: Lochsitenkalk-Verrucano Contact**	
HS 1	0.139	17.932	-5.000	Lochsitenkalk
HS 2	-0.146	17.069	-15.000	Lochsitenkalk
HS 3	-0.034	17.529	-30.000	Lochsitenkalk
HS 4	-0.637	17.989	-55.000	Lochsitenkalk
HS 5	-0.708	14.164	-75.000	Lochsitenkalk
HS 6	0.373	17.196	-85.000	Lochsitenkalk

Sample	δ^{13} C (‰PDB)	δ^{18}O (‰SMOW)	Vertical distance to Ref. (cm)	Lithology
HS 7	0.140	18.290	-95.000	Lochsitenkalk
HS 8	0.250	18.093	-121.000	Lochsitenkalk
HS 9t	-0.191	18.261	-130.000	Lochsitenkalk
HS 9b	-0.219	18.409	-145.000	Lochsitenkalk
HS 10	0.406	18.114	-160.000	Lochsitenkalk
HS 11	0.375	18.225	-170.000	Lochsitenkalk
HS 12	1.793	17.504	-200.000	Lochsitenkalk
HS 13	0.897	18.756	-230.000	Tertiary Flysch
HS 14	0.035	18.634	3.000	Verrucano
HS 15	-1.989	17.615	50.000	Verrucano
HS 16	-4.464	17.001	150.000	Verrucano
mean LK	0.118	17.598		

†. Table 2

Bulk silicate $\delta^{18}O$ and calcite $\delta^{18}O$ and $\delta^{13}C$ values determined for Verrucano samples taken 100 m above the thrust in five sampling sites along an approximate N-S profile. The exact localization of samples is given according to Swiss coordinate system. Note that in Kärpf, the sampling site is localized closed to a volcanic horizon. The analytical technique used for the determination of the $\delta^{18}O$ and $\delta^{13}C$ is explained at the beginning of chapter III.

Sample	Bulk silicate $\delta^{18}O$ (‰SMOW)	Calcite $\delta^{18}O$ (‰SMOW)	Calcite $\delta^{13}C$ (‰PDB)
Alp da Ruschein (731.700/189.600)			
ar99.13	10.72	13.741	-5.751
ar99.14	11.795	13.48	-5.387
ar99.15	11.5	13.784	-5.323
ar99.15	11.32		
ar99.16	10.745		
ar99.16	10.809	13.421	-5.661
ar99.17	11.872	13.35	-5.704
ar99.18	12.358	13.691	-5.443
Vorab Pign (732.180/192.740)			
vp99.1	11.128	13.883	-2.129
vp99.2	11.217	14.247	-2.19
vp99.3	10.944	14.105	-2.339
vp99.3	10.982		
vp99-4	10.791		
vp99.5	11.146	13.891	-2.209
vp99.7	12.967	13.388	-4.169
vp99.7	12.894		
vp99.8	13.707	13.129	-4.254
vp99.9	12.797		
Kärpf (726.500/197.225)			
kae99.1	14.58		
kae99.1	14.402	15.387	-4.965
kae99.2	14.896	15.964	-5.052
kae99.3	14.975		
kae99.4	14.828		
kae99.4	14.889	16.969	-4.086
kae99.5	14.536	15.395	-4.713
kae99.6	13.724	15.258	-4.827

Sample	Bulk silicate $\delta^{18}O$ (‰SMOW)	Calcite $\delta^{18}O$ (‰SMOW)	Calcite $\delta^{13}C$ (‰PDB)
Mettmen (726.100/202.400)			
met99.1	10.843	12.632	-5.871
met99.2	11.661	12.682	-5.785
met99.3	11.668	12.559	-5.934
met99.3	11.229		
met99.4	11.579		
met99.4	11.942		
met99.5	11.205		
met99.6	11.673		
Lochsite (726.400/206.750)			
lo99.8	13.27		
lo99.9	12.73	12.944	-6.247
lo99.9	11.894	12.464	-6.249
lo99.9	12.186		
lo99.10	11.975	12.625	-6.305
lo99.11	10.987	13.674	-5.601
lo99.12	12.348	12.518	-6.232
lo99.13	11.847	12.378	-6.252

†. Table 3

Calcite $^{87}Sr/^{86}Sr$ and $\delta^{18}O$ data of small drill spots from three slabs of Lochsitenkalk collected at the contact with the Verrucano hangingwall. The rock powder has been extracted with a diamond dentist drill, and the localization of each hole is indicated with a vertical and a horizontal distance with respect to an arbitrary reference, which is the upper Lochsitenkalk contact for the vertical distance. The analytical technique used for the determination of the $^{87}Sr/^{86}Sr$ and $\delta^{18}O$ is explained at the beginning of chapter III.

Sample	$^{87}Sr/^{86}Sr$	Calcite $\delta^{18}O$ (‰SMOW)	distance vert. (cm)	distance hor. (cm)
Vorab Pign (732.180/192.740)		**Ref: Lochsitenkalk-Verrucano contact**		
VP1/1	0.710587	13.39026956	-2	0.4
VP1/2	0.710952	13.72417724	-2.5	2.35
VP1/3	0.710344	13.66266856	-4.4	4.5
VP1/4	0.710059	13.32862174	-5.3	1.45
VP1/5	0.709767	12.87847415	-6.9	1.2
VP1/6	0.709642	13.06619999	-9.3	0.6
VP1/8	0.711065	13.92480592	-1.3	7.7
VP1/9	0.711054	13.88510315	-0.7	6.2
VP1/10	0.711039	13.70568084	-2.3	5
VP1/11	0.71088	13.71512242	-2	3.65
VP1/12	0.710991	13.45339285	-2	2.45
VP1/13	0.710867	13.59485754	-2.35	1.55
VP1/14	0.711037	13.71726148	-2.55	3.3
VP1/15	0.71107	13.57293946	-3	5.4
VP1/16	0.710806	13.57395093	-3.15	2.25
VP1/17	0.710273	13.30628165	-3.9	1.5
VP1/18	0.710047	13.11241081	-5.9	1.7
VP1/19	0.709811	13.25718321	-8.25	1
VP1/20	0.709382	13.56699255	-10.2	0.6
Piz Sardona (738.150/197.600)		**Ref: Lochsitenkalk-Verrucano contact**		
SAR5/2	0.710679	19.30796146	-2.5	4.1
SAR5/3	0.71043	19.5048265	-5.6	1.95
SAR5/4	0.710336	19.42779472	-8.15	3.95
SAR5/5	0.710342	19.48370985	-8.85	4.55
SAR5/6	0.710365	19.57578482	-9.6	2.8
SAR5/7	0.710414	19.27486407	-0.65	2.95
SAR5/8	0.710453	19.36406828	-4	1.4
SAR5/9	0.71043	19.37796643	-4.7	2.2
SAR5/10	0.710524	19.37662663	-5.5	0.95
SAR5/11	0.710444	19.53012823	-6.45	2.75
SAR5/12	0.710356	19.18174518	-7.25	3.65
SAR5/13	0.710391	19.51387687	-8.4	4.2
SAR5/14	0.710382	19.46173854	-9.05	3.8
SAR5/15	0.710392	19.47431213	-9.25	3

Sample	Sr87/Sr86	Calcite δ^{18}O (‰SMOW)	tance vert. to ref. (cm	distance hor. to ref. (cm)
SAR5/16	0.710334	19.56420688	-10.1	2.8
SAR5/17	0.71035	19.50599254	-10.9	2
SAR5/18	0.710376	19.16460918	-12.6	1.8
Fuorcla Sura (732.900/190.700)		**Ref: Lochsitenkalk-Verrucano contact**		
FS1/1	0.712388	13.59157458	-0.4	2.45
FS1/2	0.71256	13.39884212	-0.9	3.3
FS1/3	0.711642	13.66958213	-1.7	0.85
FS1/4	0.711869	13.78545169	-2.2	1.1
FS1/9	0.712432	13.44195155	-1.2	2.5
FS1/10	0.712525	13.53873252	-1.45	1.95
FS1/11	0.712485	13.48312002	-1.75	1.2
FS1/14	0.710669	15.91017825	-4.2	4.2

†. Table 4

Calcite $\delta^{18}O$ and $\delta^{13}C$ values determined from Verrucano, Flysch or footwall carbonates veins, matrix or bulk rock. Distance to the Verrucano-Lochsitenkalk contact is given in cm, together with the host lithology. The analytical technique used for the determination of the $\delta^{18}O$ and $\delta^{13}C$ is explained at the beginning of chapter III. Bulk rock, vein or matrix powder extraction has been performed with a carbide-tungsten drill

Sample	δ^{13}C (‰PDB)	δ^{18}O (‰SMOW)	Distance to upper contact (cm)	Veine, matrix, bulk rock	Lithology
Lo2	1.700	20.158	-60.000	Bulk rock	Tertiary Flysch
Lo2	1.929	21.822	-60.000	Matrix	Tertiary Flysch
Lo5	1.831	19.630	-166.000	Bulk rock	Tertiary Flysch
Lo5	1.808	19.709	-166.000	Matrix	Tertiary Flysch
Lo21	-6.803	16.549	710.000	Bulk rock	Verrucano
Lo21	-6.170	17.890	710.000	Matrix	Verrucano
Lo22	-7.229	16.431	2010.000	Bulk rock	Verrucano
Lo22	-6.310	16.710	2010.000	Matrix	Verrucano
Ruf 3	0.981	20.580	-693.750	Bulk rock	Tertiary Flysch
Ruf 3	0.488	20.229	-693.750	Matrix	Tertiary Flysch
Ruf 4	-1.508	19.569	-931.250	Bulk rock	Tertiary Flysch
Ruf 4	-1.364	20.151	-931.250	Matrix	Tertiary Flysch
Ruf 5	-0.792	20.517	-1281.250	Bulk rock	Tertiary Flysch
Ruf 5	-1.015	20.090	-1281.250	Matrix	Tertiary Flysch
Ruf 16	1.323	21.259	18.750	Veine	Mesozoic carbonate
Ruf 16	1.574	21.423	18.750	Bulk rock	Mesozoic carbonate
RUF 99	1.106	22.324	-640.000	Veine	Tertiary Flysch
RUF 99	1.037	21.323	-640.000	Bulk rock	Tertiary Flysch
RUF 99	1.154	20.922	-790.000	Bulk rock	Tertiary Flysch
RUF 99	0.840	21.023	-790.000	Veine	Tertiary Flysch
TS-8	0.810	14.409	-15.000	Bulk rock	Mesozoic carbonate
TS-8	1.054	15.323	-15.000	Matrix	Mesozoic carbonate
BAE-1	1.476	22.027	-425.000	Bulk rock	Tertiary Flysch
BAE-1	1.520	22.304	-425.000	Matrix	Tertiary Flysch
BAE-2	1.376	21.879	-605.000	Bulk rock	Tertiary Flysch
BAE-2	1.447	22.514	-605.000	Matrix	Tertiary Flysch
BAE-3	1.463	21.272	-825.000	Bulk rock	Tertiary Flysch
BAE-3	1.334	22.043	-825.000	Matrix	Tertiary Flysch
BAE-4	-1.836	20.726	-1285.000	Bulk rock	Tertiary Flysch
BAE-4	-1.283	22.143	-1285.000	Matrix	Tertiary Flysch
BAE-5	0.804	21.659	-365.000	Bulk rock	Tertiary Flysch
BAE-5	0.620	21.848	-365.000	Matrix	Tertiary Flysch
VP-17	-2.017	12.902	1600.000	Veine	Verrucano
VP-17	-2.080	12.700	1600.000	Matrix	Verrucano
CW-17	1.465	20.309	-515.000	Bulk rock	Mesozoic carbonate
CW-17	1.397	20.605	-515.000	Matrix	Mesozoic carbonate
CW-19	1.111	20.376	-640.000	Bulk rock	Mesozoic carbonate
CW-19	1.062	21.046	-640.000	Matrix	Mesozoic carbonate
CW-21	-3.848	13.394	40.000	Bulk rock	Verrucano
CW-21	-3.782	13.592	40.000	Matrix	Verrucano
CW-22	-4.363	13.107	80.000	Bulk rock	Verrucano
CW-22	-4.210	13.414	80.000	Matrix	Verrucano

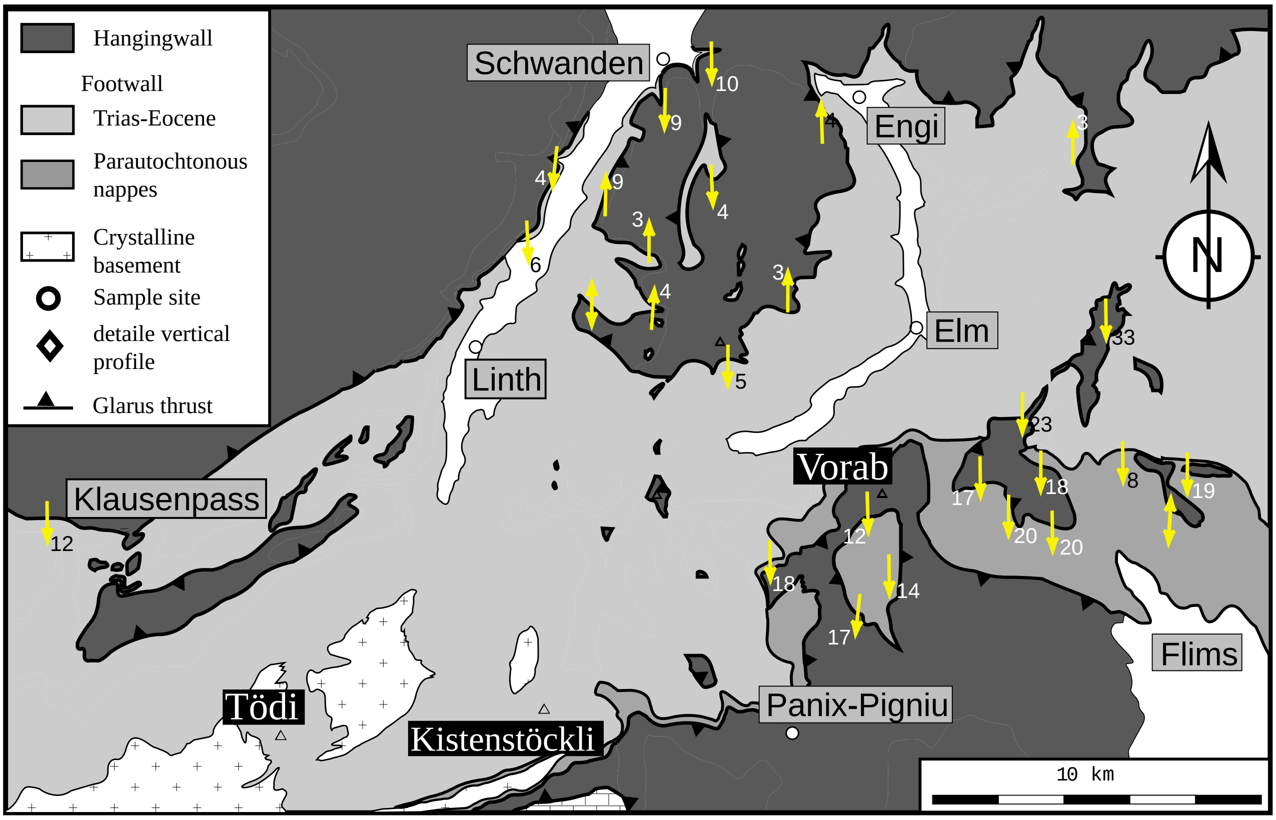
Appendix II is composed of 7 maps and two sets of stereoplots that constitute the complete structural data set collected during summers 1998 and 1999.

†. Map 2-8

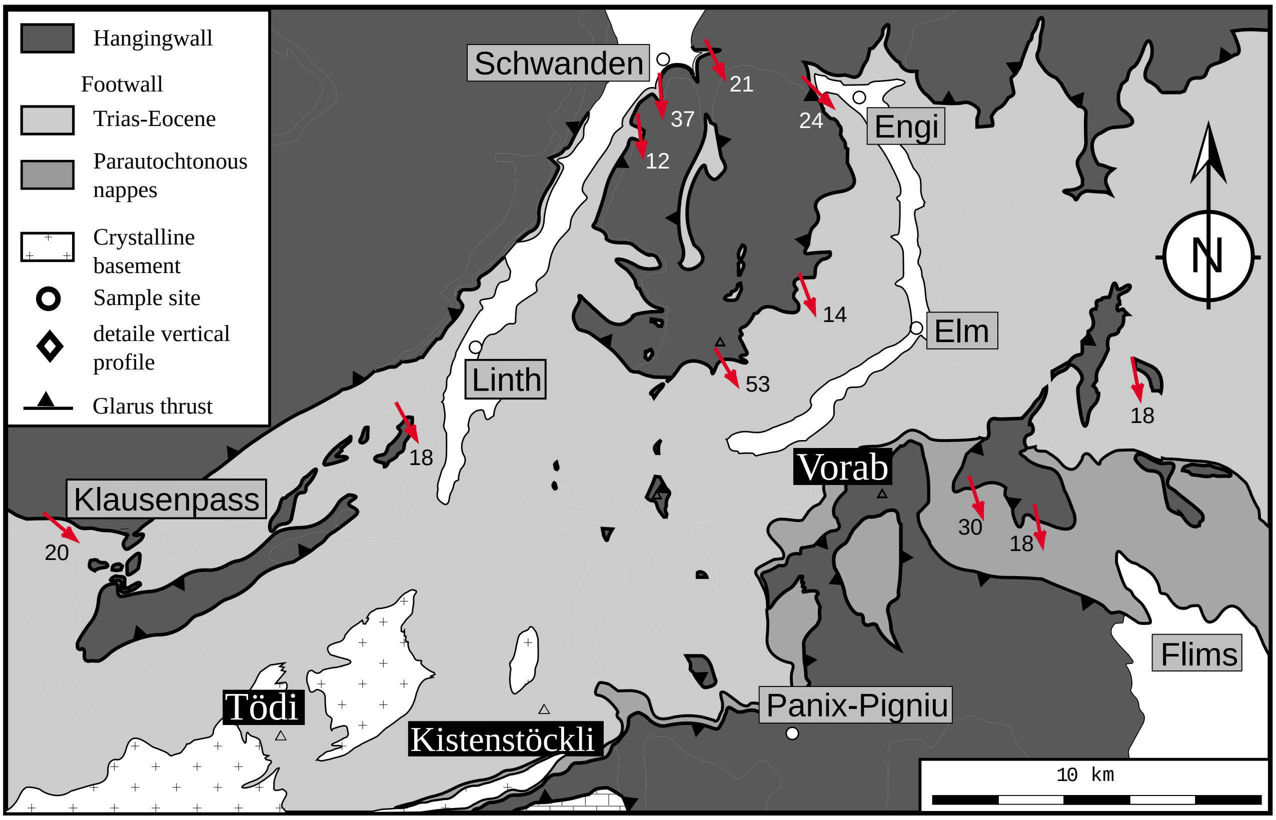
Simplified tectonic maps of the Glarus Alps (modified after Oberholzer, 19933) on which are reported the mean orientation of different structural features. The vertical distance from the measure point to the Glarus overthrust contact is not specified. As these structural observations are poorly discussed in the different papers, some additional comments are necessary:

- Map 2: the mineral stretching lineation has a very constant orientation in the hangingwall. This supports the idea that the foliation and lineation in the hangingwall are syn-overthrust features
- Map 3: the stretching lineation in the footwall is not very constant because it is a Calanda structure that is passively reoriented toward a N-S orientation in the last meter below the thrust
- Map 4-5: the direction of the crenulation axis in both the footwall and hangingwall of the thrust range from E-W to N-S, because this axis is reoriented parallel to the transport direction close to the thrust (e. g. stereoplots)
- Map 6: The stretching lineation in the Lochsitenkalk is N-S in the southern part of the study area, whereas in the north, it is oriented NW-SE. In the south, this stretching lineation is measured on foliation planes and could indicate the transport direction during the main thrusting activity. In the north, the stretching lineation has been measured on the septum, which certainly represents one of the last fracturing event that has occurred. These together could document an anticlockwise rotation of the transport direction

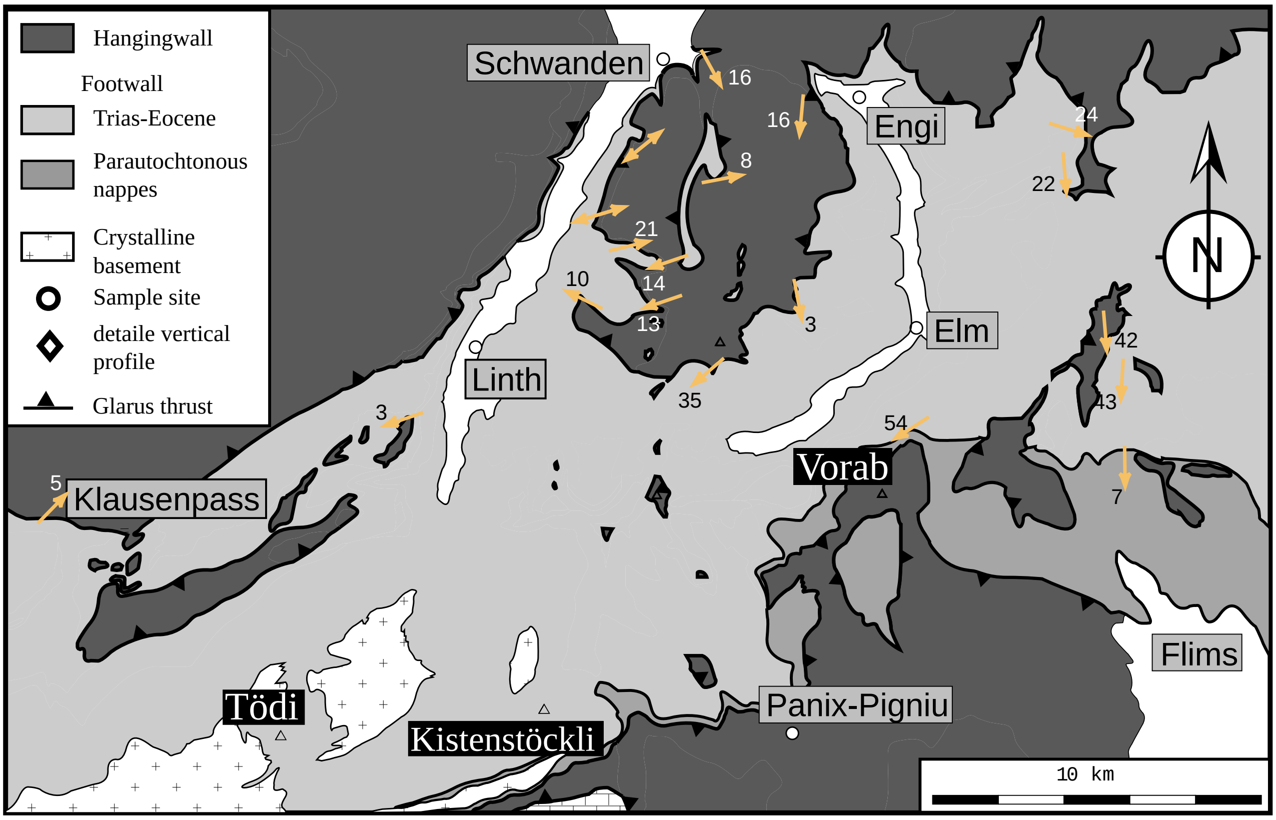
Map 2: Stretching lineations in the Hangingwall of the Glarus overthrust



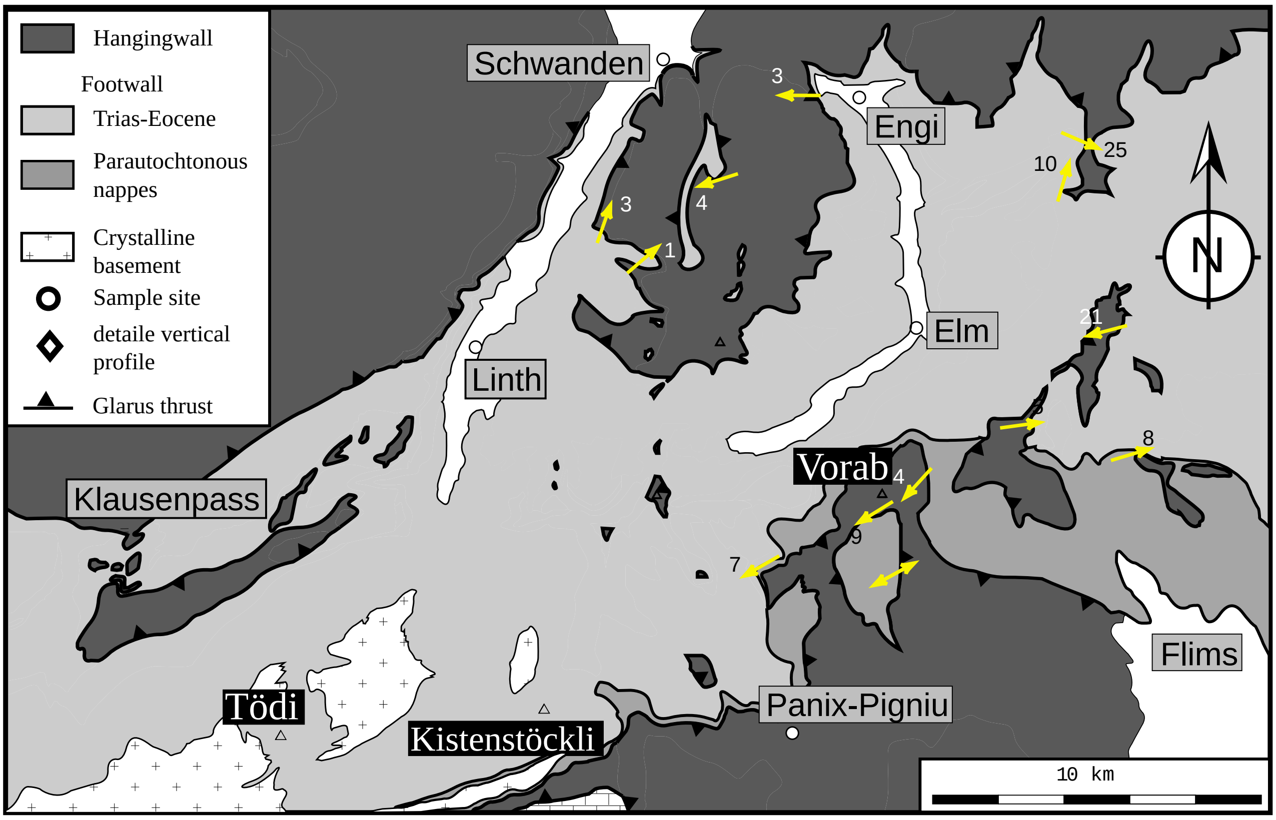
Map 3: Stretching lineations in the footwall of the Glarus overthrust



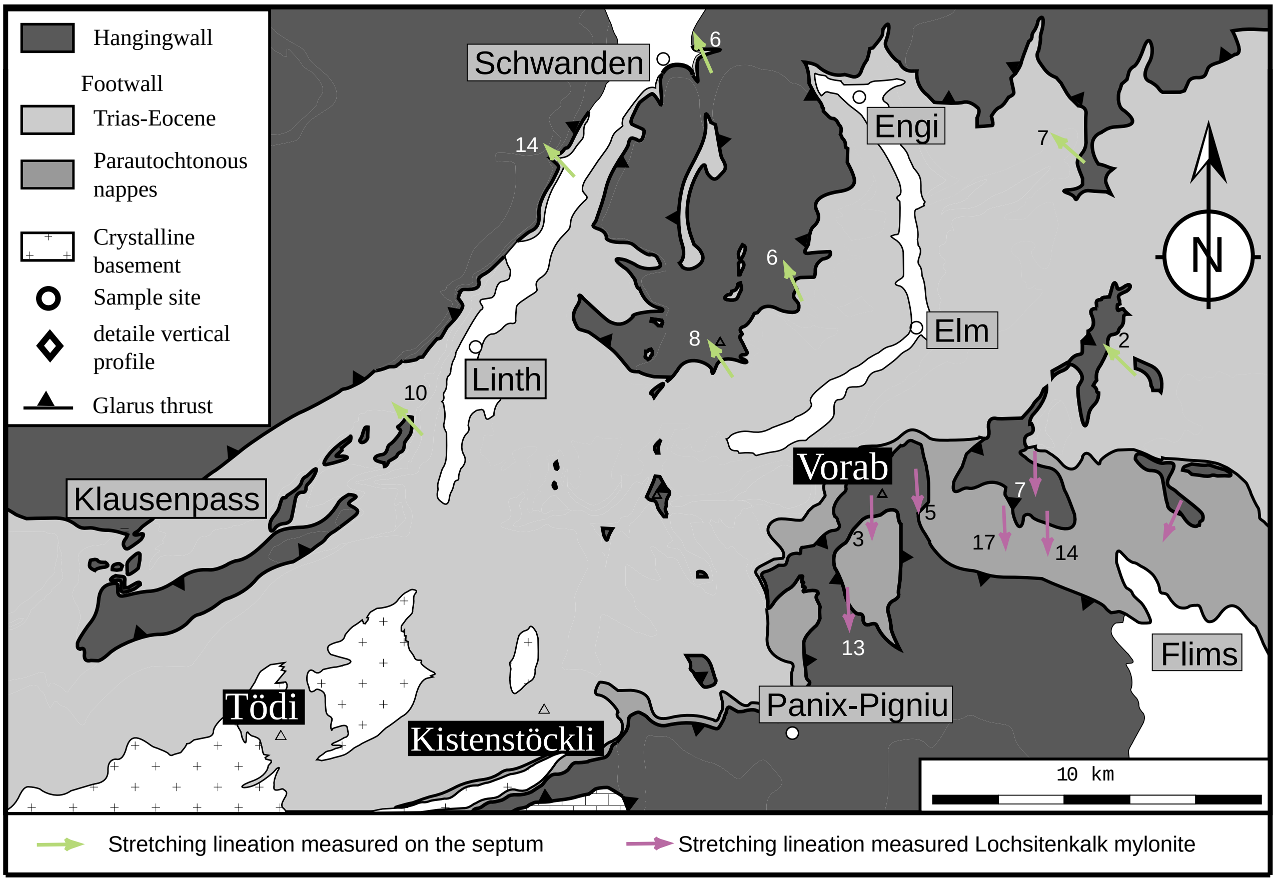
Map 4: Crenulation axis in the footwall of the Glarus overthrust



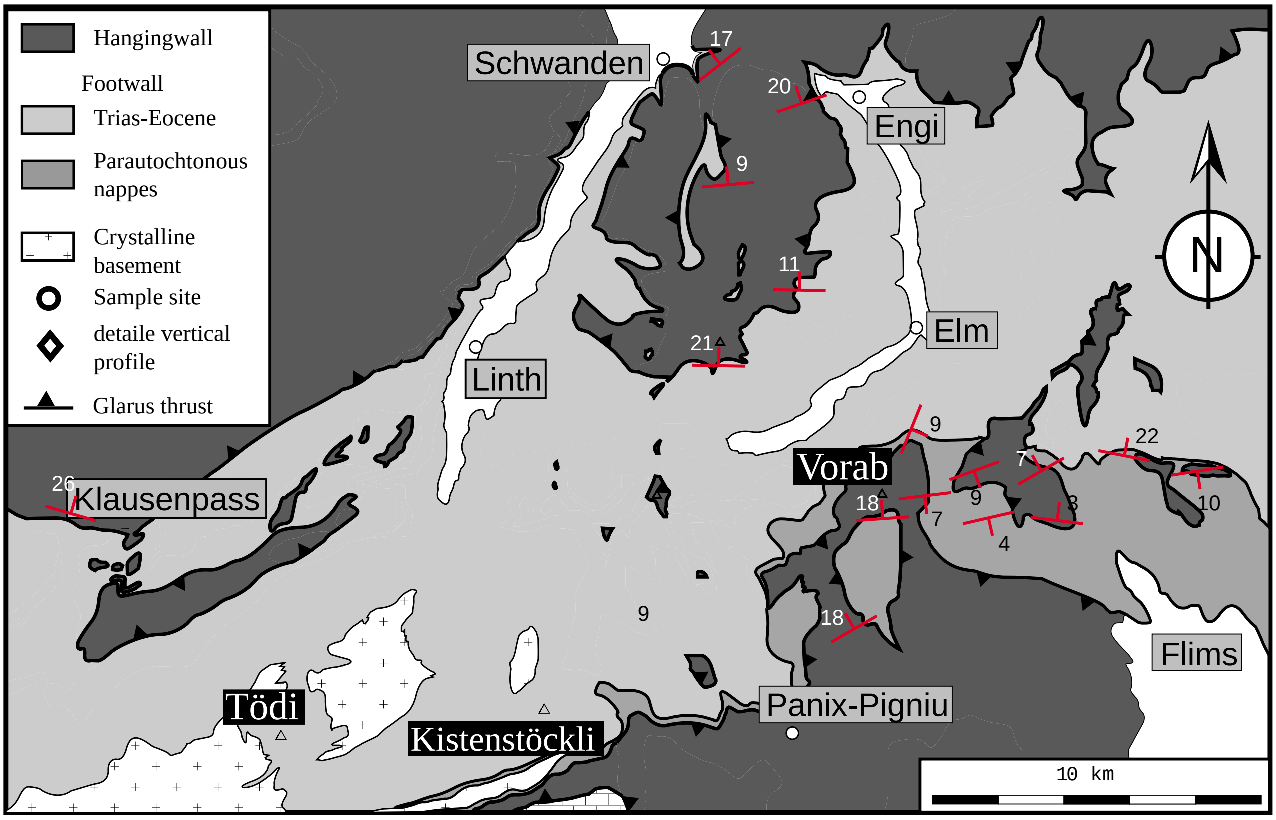
Map 5: Crenulation axis in the Verrucano hangingwall of the Glarus overthrust



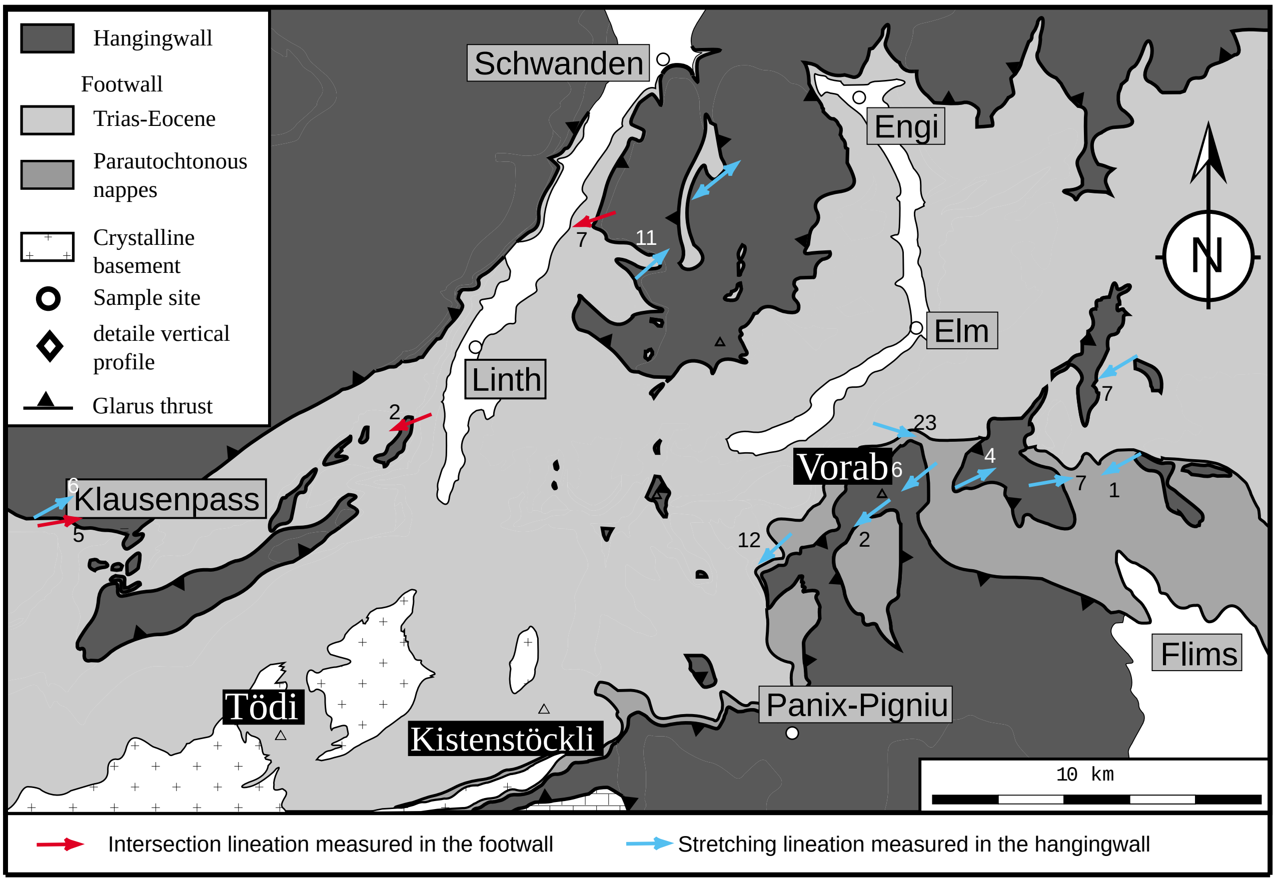
Map 6: Stretching lineations in Lochsitenkalk mylonite and on the septum



Map 7: C' plane in the Verrucano hangingwall of the Glarus overthrust



Map 8: Intersection lineations in the footwall and hangingwall of the Glarus overthrust

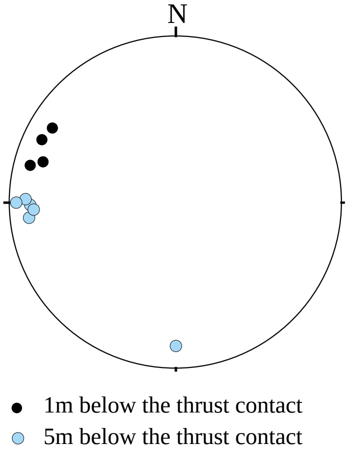


†. Stereoplot 1-2

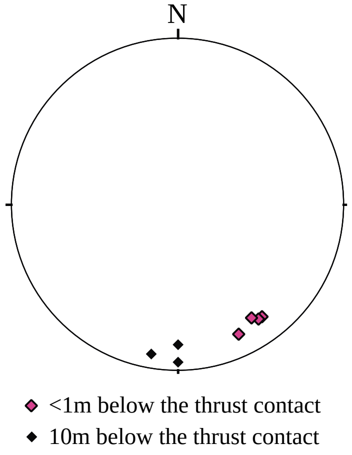
Stereographic projections (lower hemisphere) of structural features from the footwall or hangingwall. For each data, the distance between the thrust and the measure station is specified. Such stereographic projections have been constructed in order to illustrate the re-orientation of some structures when approaching the contact. When looking at these stereoplots it becomes clear that the crenulation axis in the hangingwall Verrucano become parallel to the stretching lineation (N-S) close to the thrust as deformation increases. The stretching lineation in the footwall flysch is passively re-oriented from a SE direction more than 10 m below the thrust toward a N-S direction close to the thrust.

Stereoplots 1: structural data from sites situated in the northern parth of the Glarus overthrust

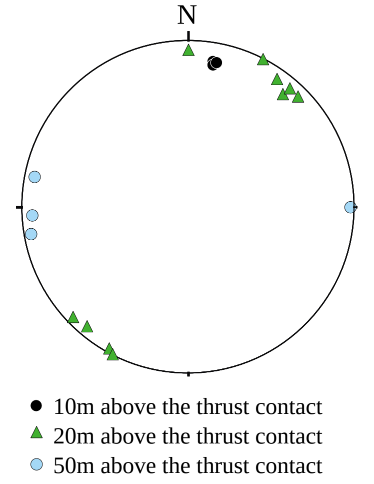
Bächibach (721.050/203.150)
Crenulation axis in the footwall



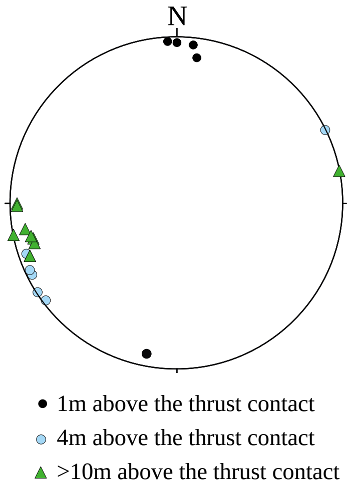
Bächibach (721.050/203.150)
Stretching lineation in the footwall



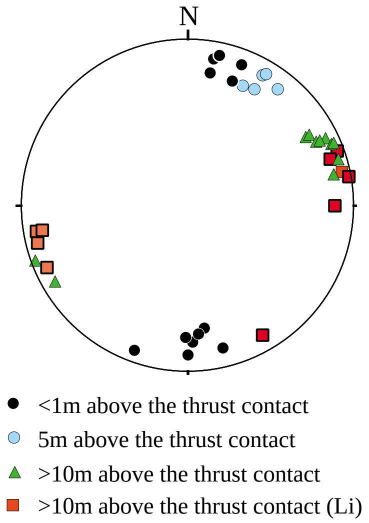
Bächibach (721.050/203.150)
Crenulation axis in the hangingwall



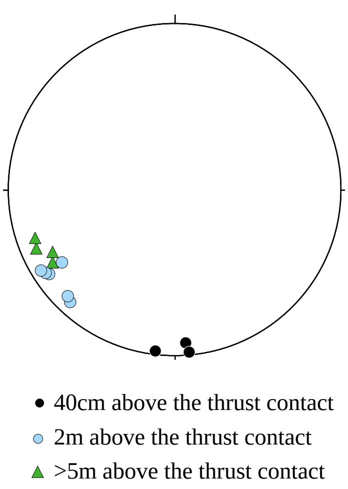
Chuebodensee (729.100/199.860)
Crenulation axis in the hangingwall



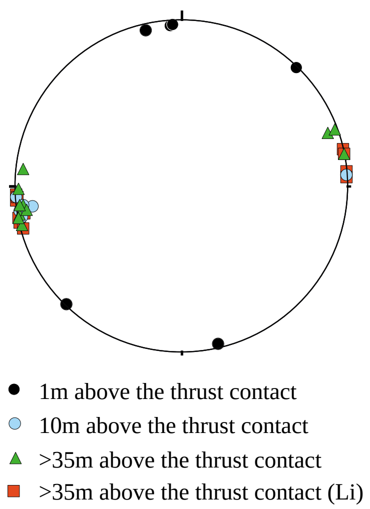
Kärpf (726.250/197.000)
Crenulation axis and intersection lineation (Li) in the hangingwall



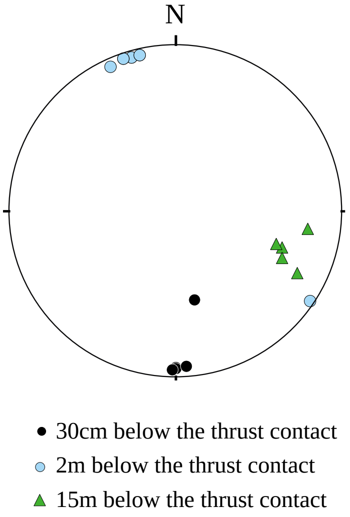
Piz Dolf North (738.900/196.435)
Crenulation axis in the hangingwall



Risetenpass (737.275/204.000)
Crenulation axis and intersection lineation (Li) in the hangingwall

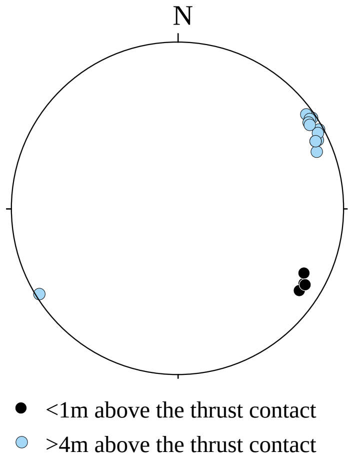


Risetenpass (737.275/204.000)
Crenulation axis in the footwall

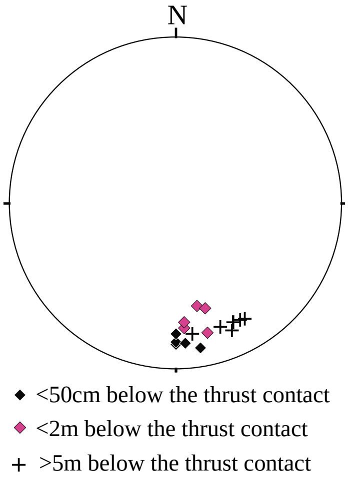


Stereoplots 1: structural data from sites situated in the southern parth of the Glarus overthrust

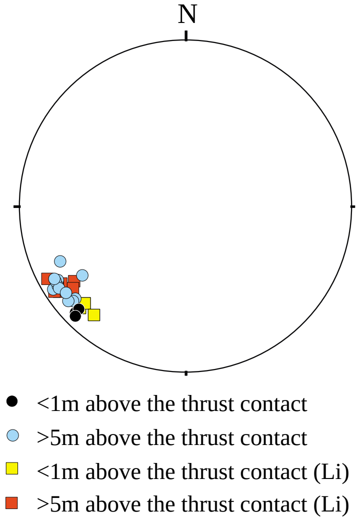
Eastern Vorab (739.100/193.350)
Crenulation axis in the hangingwall



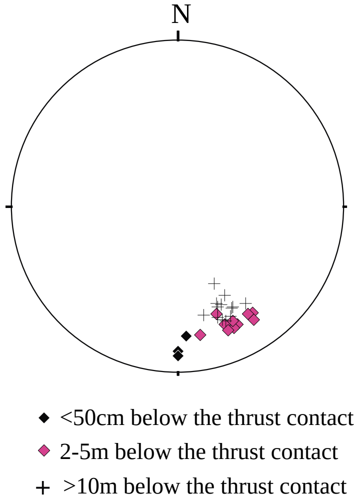
Crap da Flem (739.100/193.350)
Stretching lineation in the footwall



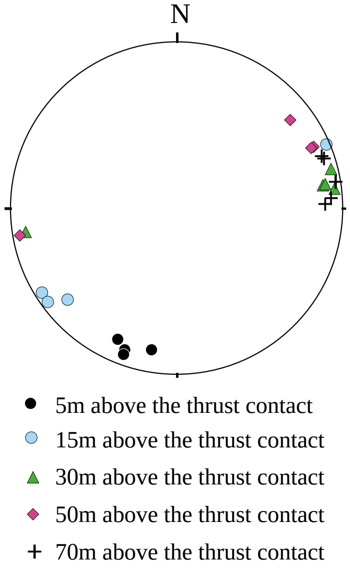
Crap da Flem (739.100/193.350)
Crenulation axis and intersection lineation (Li) in the hangingwall



Grau Berg (736.250/193.000)
Stretching lineation in the footwall



Grau Berg (736.250/193.000)
Crenulation axis in the hangingwall



Appendix III is composed of 3 tables of raw data and some calculations of the mineralogical composition of the Verrucano and Lochsitenkalk that constitute the whole XRD and XRF data set. The techniques used for XRD and XRF data acquisition are described at the beginning of chapter III.

†. Table 5

XRF data of major and minor elements of Verrucano samples collected 100 m above the Glarus thrust along a N-S profile. The exact localization of these sampling sites is given in brackets according to the Swiss coordinate system. No additional comments are needed, as these are raw data.

		ALP DA RUSCHEIN (731.375/189.600)						VORAB PIGN (732.250/192.520)								KARPF	
Channel	Unit	13	14	15	16	17	18	1	2	3	4	5	7	8	9	1	2
SiO2	%	48.57	58.30	58.47	52.15	54.69	57.48	53.17	46.44	48.05	58.44	53.53	68.16	74.10	68.07	66.41	61.17
Al2O3	%	11.88	14.73	14.69	15.64	15.24	14.15	18.13	11.69	15.01	21.87	17.35	15.01	11.70	15.20	15.20	13.38
Fe2O3	%	5.63	7.14	7.23	9.30	8.26	8.22	10.07	9.92	8.99	6.94	9.74	3.58	2.20	3.80	6.52	5.74
MgO	%	4.24	4.98	5.18	6.14	5.58	5.82	5.67	3.31	5.22	0.86	5.13	1.07	0.80	1.16	1.83	1.63
Na2O	%	3.17	3.97	3.98	4.03	4.09	3.48	4.21	1.15	3.68	3.71	4.43	4.66	3.17	4.81	0.52	0.65
L O I	%	9.86	2.68	2.53	4.90	4.41	4.25	4.19	12.39	9.12	2.84	4.76	2.33	2.80	2.20	3.60	7.08
TiO2	%	0.70	0.91	0.92	0.99	0.95	0.88	1.54	0.89	1.22	1.10	1.45	0.52	0.29	0.56	0.66	0.58
CaO	%	13.16	4.54	4.34	4.73	4.66	3.67	0.98	12.11	7.51	0.43	2.05	1.45	2.29	1.38	1.23	6.15
K2O	%	1.68	1.85	1.98	1.31	1.50	1.32	0.86	0.89	0.45	3.14	0.80	2.36	2.10	2.31	3.27	2.82
P2O5	%	0.18	0.21	0.21	0.23	0.22	0.21	0.31	0.20	0.25	0.22	0.30	0.10	0.08	0.10	0.17	0.18
MnO	%	0.51	0.14	0.16	0.23	0.22	0.19	0.08	0.25	0.14	0.01	0.08	0.03	0.05	0.04	0.05	0.08
TOTAL	**%**	**99.58**	**99.45**	**99.69**	**99.65**	**99.82**	**99.67**	**99.21**	**99.24**	**99.64**	**99.56**	**99.62**	**99.27**	**99.58**	**99.63**	**99.46**	**99.46**
Ba	ppm	601	735	804	498	565	476	238	344	147	1004	339	466	379	454	471	275
Cr	ppm	282	348	342	389	408	356	445	255	365	57	413	27	16	36	68	62
Cu	ppm	6	7	11	8	<5	6	11	16	10	16	20	6	11	17	8	6
Nb	ppm	<5	7	5	7	6	7	8	<5	5	16	7	10	10	12	10	7
Ni	ppm	31	20	28	23	20	21	66	61	61	39	67	39	32	37	55	52
Pb	ppm	23	11	20	15	28	24	19	21	20	27	17	34	27	27	18	25
Rb	ppm	29	30	34	18	26	19	22	21	9	110	17	127	114	124	151	126
Sr	ppm	306	296	376	294	290	214	78	300	187	201	77	63	63	62	28	122
V	ppm	129	160	156	170	166	153	208	132	166	109	190	31	33	31	51	57
Y	ppm	29	21	20	24	24	20	28	29	25	23	25	25	26	27	29	31
Zn	ppm	24	25	29	34	34	32	38	46	34	10	48	10	<5	34	43	34
Zr	ppm	137	109	119	144	133	144	152	105	138	75	150	96	108	89	141	127

		KARPF (726.250/197.000)				METTMEN KIES (726.125/202.650)						LOCHISTE (725.860/206.400)				
Channel	Unit	3	4	5	6	1	2	3	4	5	6	9	10	11	12	13
SiO2	%	65.90	76.29	76.24	77.67	67.57	69.00	69.10	73.16	69.25	71.35	72.39	73.04	72.20	73.30	73.36
Al2O3	%	17.55	13.08	13.26	11.22	14.94	13.86	13.75	12.94	14.63	13.82	13.63	13.54	13.35	13.37	12.22
Fe2O3	%	5.47	1.51	1.71	1.19	3.97	3.34	3.67	3.54	4.10	3.29	1.99	2.25	3.64	1.83	2.55
MgO	%	1.49	0.64	0.45	0.51	2.16	1.79	1.60	1.37	1.76	1.43	1.42	1.43	1.59	1.08	1.17
Na2O	%	0.88	3.82	2.61	3.70	2.35	2.75	3.01	3.98	3.37	3.42	3.06	2.77	3.10	3.78	3.65
L O I	%	2.94	1.57	2.02	2.27	2.59	2.96	2.93	1.59	1.90	1.87	2.40	1.98	1.98	2.25	2.62
TiO2	%	0.73	0.11	0.11	0.10	0.65	0.51	0.48	0.42	0.60	0.39	0.38	0.38	0.44	0.44	0.34
CaO	%	0.20	0.42	0.70	1.66	0.84	1.52	1.63	0.17	0.40	0.43	1.06	0.41	0.37	1.31	1.67
K2O	%	4.01	1.98	2.76	1.50	4.05	3.49	3.26	2.35	3.40	3.15	3.26	3.41	3.04	2.50	2.26
P2O5	%	0.16	0.02	0.02	0.02	0.13	0.12	0.11	0.08	0.13	0.09	0.10	0.09	0.11	0.07	0.08
MnO	%	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.04	0.05	0.04	0.04	0.03	0.04	0.04	0.06
SUM %	%	99.36	99.47	99.91	99.88	99.29	99.39	99.59	99.64	99.59	99.28	99.73	99.33	99.86	99.97	99.98
Ba	ppm	419	263	285	182	368	311	339	290	422	361	468	420	498	705	463
Cr	ppm	72	9	<5	9	75	48	43	25	41	26	38	41	42	22	28
Cu	ppm	<5	<5	<5	8	12	11	23	12	7	9	6	<5	11	6	<5
Nb	ppm	12	16	12	8	12	12	8	6	8	10	13	12	9	5	9
Ni	ppm	63	23	32	22	58	43	37	23	41	31	81	38	34	28	23
Pb	ppm	23	24	22	23	41	34	37	35	37	32	21	21	36	38	19
Rb	ppm	191	72	121	48	147	125	114	81	118	110	107	112	97	71	69
Sr	ppm	15	30	32	52	32	53	59	48	41	53	71	47	66	78	82
V	ppm	60	<5	<5	<5	54	42	37	42	100	41	58	37	34	37	32
Y	ppm	29	23	29	35	31	28	28	18	30	24	79	25	24	29	19
Zn	ppm	30	12	4	10	28	21	17	16	28	16	11	11	17	23	11
Zr	ppm	139	79	83	73	94	45	65	105	46	118	77	82	113	121	107

†. Table 6

Calculations of the normative mineralogical composition of Verrucano samples collected 100 m above the Glarus overthrust. These calculations are based on the elemental composition obtained by XRF (table 5), on the semi quantitative XRD determination of apatite, titanite, albite, calcite, dolomite, muscovite, Fe-Mg Chlorite and quartz mainly, and on thin-sections observations (table 7, verso). Three model of calculations have been established:

- In the first model: TiO_2 is ascribed to titanite, albite is pure
- In the second model, TiO_2 is ascribed to rutile and there is 6% of Ca in albite
- In the third model, TiO_2 is ascribed to rutile, and albite contains 10% of Ca

For each model, two type of chlorite are used. These different calculations mainly result in different quartz content. For other minerals, the weight percent variation is never more than 1%. For samples with very little CaO, all calculations are made with pure albite. Apart from quartz and muscovite increase toward the north at the expense of chlorite, no large-scale trend can be documented. Actinote is present in Alp da Ruschein in some basic volcanic horizons

Alp da Ruschein 13 Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	48.570	60.090	808.288	808.288	799.527	492.653	492.653	492.653	385.647	86.477	145.929
Al2O3	11.880	101.940	233.078	233.078	233.078	130.787	130.787	130.787	23.781	0.000	0.000
Fe2O3	5.630	159.700	70.507	70.507	70.507	70.507	70.507	70.507	70.507	0.000	0.000
MgO	4.240	40.320	105.159	105.159	105.159	105.159	105.159	105.159	105.159	0.000	0.000
Na2O	3.170	61.980	102.291	102.291	102.291	0.000	0.000	0.000	0.000	0.000	0.000
L O I	9.860	44.010	224.040	224.040	224.040	224.040	2.363	2.363	-33.306	-332.476	-296.805
TiO2	0.700	79.900	8.761	8.761	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	13.160	56.080	234.665	230.438	221.677	221.677	0.000	0.000	0.000	0.000	0.000
K2O	1.680	94.200	35.669	35.669	35.669	35.669	35.669	35.669	0.000	0.000	0.000
P2O5	0.180	141.950	2.536	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.510	70.940	7.189	7.189	7.189	7.189	7.189	7.189	7.189	7.189	7.189

Mn Oxyde	MnO2	7.189	Mn	7.189	with M. W	86.937	this gives	625.004
Apatite	Ca5(PO4)3(F,OH,Cl)	2.536	P	0.845	with M. W	502.314	this gives	424.640
Titanite	CaTi SiO5	8.761	Ti	8.761	with M. W	196.063	this gives	1717.698
Albite	NaAlSi3O8	102.291	Na	102.291	with M. W	262.225	this gives	26823.224
Calcite	CaCO3	221.677	Ca	221.677	with M. W	100.089	this gives	22187.471
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	35.669	K	35.669	with M. W	398.309	this gives	14207.208
Chlorite I		299.170	Si	74.793	with M. W	623.067	this gives	46600.772
Quartz		86.477	Si	86.477	with M. W	60.090	this gives	5196.396
Chlorite II		263.499	Al+Si	65.875	with M. W	629.814	this gives	41488.799
Quartz		145.929	Si	145.929	with M. W	60.090	this gives	8768.875

Chlorite type Ripidolite

Sum with chlorite I 117782.413
Sum with chlorite II 116242.919

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.119	Al
			0.354	Fe
			0.527	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.401	Fe
			0.599	Mg
M. W : molelcular weight		with Si in second bracket	0.910	Si
			0.090	Al

Mineralogy with Chlorite I		Mineralogy with Chlorite II	
Apatite	0.361	Apatite	0.365
Titanite	1.458	Titanite	1.478
Albite	22.774	Albite	23.075
Calcite	18.838	Calcite	19.087
Muscovite	12.062	Muscovite	12.222
Chlorite	39.565	Chlorite	35.691
Quartz	4.412	Quartz	7.544
MnO2	0.531	MnO2	0.538
	100.000		100.000

Alp da Ruschein 13 Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	48.570	60.090	808.288	808.288	808.288	488.356	488.356	488.356	381.350	101.767	128.573
Al2O3	11.880	101.940	233.078	233.078	233.078	117.729	117.729	117.729	10.722	0.000	0.000
Fe2O3	5.630	159.700	70.507	70.507	70.507	70.507	70.507	70.507	70.507	0.000	0.000
MgO	4.240	40.320	105.159	105.159	105.159	105.159	105.159	105.159	105.159	0.000	0.000
Na2O	3.170	61.980	102.291	102.291	102.291	0.000	0.000	0.000	0.000	0.000	0.000
L O I	9.860	44.010	224.040	224.040	224.040	224.040	0.131	0.131	-35.538	-315.120	-299.036
TiO2	0.700	79.900	8.761	8.761	8.761	8.761	8.761	8.761	8.761	8.761	8.761
CaO	13.160	56.080	234.665	230.438	230.438	223.909	0.000	0.000	0.000	0.000	0.000
K2O	1.680	94.200	35.669	35.669	35.669	35.669	35.669	35.669	0.000	0.000	0.000
P2O5	0.180	141.950	2.536	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.510	70.940	7.189	7.189	7.189	7.189	7.189	7.189	7.189	7.189	7.189

Rutile	TiO2	8.761	Ti	8.761	with M. W	79.899	this gives	699.989
Mn Oxyde	MnO2	7.189	Mn	7.189	with M. W	86.937	this gives	625.004
Apatite	Ca5(PO4)3(F,OH,Cl)	2.536	P	0.845	with M. W	502.314	this gives	424.640
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	102.291	Na	102.291	with M. W	262.225	this gives	26823.224
Calcite	CaCO3	223.909	Ca	223.909	with M. W	100.089	this gives	22410.843
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	35.669	K	35.669	with M. W	398.309	this gives	14207.208
Chlorite I		279.583	Si	69.896	with M. W	626.765	this gives	43808.132
Quartz		101.767	Si	101.767	with M. W	60.090	this gives	6115.183
Chlorite II		263.499	Al+Si	65.875	with M. W	630.033	this gives	41503.222
Quartz		128.573	Si	128.573	with M. W	60.090	this gives	7725.958

Chlorite type Ripidolite

Sum with chlorite I 115114.223
Sum with chlorite II 114420.088

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.058	Al
			0.378	Fe
			0.564	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.401	Fe
			0.599	Mg
M. W : molelcular weight		with Si in second bracket	0.959	Si
			0.041	Al

Mineralogy with Chlorite I		Mineralogy with Chlorite II	
Apatite	0.369	Apatite	0.371
Titanite	0.000	Titanite	0.000
Albite	23.301	Albite	23.443
Calcite	19.468	Calcite	19.586
Muscovite	12.342	Muscovite	12.417
Chlorite	38.056	Chlorite	36.273
Quartz	5.312	Quartz	6.752
MnO2	0.543	MnO2	0.546
TiO2	0.608	TiO2	0.612
	100.000		100.000

Alp da Ruschein 13 Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	48.570	60.090	808.288	808.288	808.288	478.683	478.683	478.683	371.677	106.604	109.227
Al2O3	11.880	101.940	233.078	233.078	233.078	108.056	108.056	108.056	1.050	0.000	0.000
Fe2O3	5.630	159.700	70.507	70.507	70.507	70.507	70.507	70.507	70.507	0.000	0.000
MgO	4.240	40.320	105.159	105.159	105.159	105.159	105.159	105.159	105.159	0.000	0.000
Na2O	3.170	61.980	102.291	102.291	102.291	0.000	0.000	0.000	0.000	0.000	0.000
L O I	9.860	44.010	224.040	224.040	224.040	224.040	4.968	4.968	-30.701	-295.774	-294.200
TiO2	0.700	79.900	8.761	8.761	8.761	8.761	8.761	8.761	8.761	8.761	8.761
CaO	13.160	56.080	234.665	230.438	230.438	219.072	0.000	0.000	0.000	0.000	0.000
K2O	1.680	94.200	35.669	35.669	35.669	35.669	35.669	35.669	0.000	0.000	0.000
P2O5	0.180	141.950	2.536	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.510	70.940	7.189	7.189	7.189	7.189	7.189	7.189	7.189	7.189	7.189

Rutile	TiO2	8.761	Ti	8.761	with M. W	79.899	this gives	699.989
Mn Oxyde	MnO2	7.189	Mn	7.189	with M. W	86.937	this gives	625.004
Apatite	Ca5(PO4)3(F,OH,Cl)	2.536	P	0.845	with M. W	502.314	this gives	424.640
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	102.291	Na	102.291	with M. W	262.225	this gives	26823.224
Calcite	CaCO3	219.072	Ca	219.072	with M. W	100.089	this gives	21926.766
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	35.669	K	35.669	with M. W	398.309	this gives	14207.208
Chlorite I		265.073	Si	66.268	with M. W	629.856	this gives	41739.509
Quartz		106.604	Si	106.604	with M. W	60.090	this gives	6405.805
Chlorite II		263.499	Al+Si	65.875	with M. W	630.195	this gives	41513.906
Quartz		109.227	Si	109.227	with M. W	60.090	this gives	6563.467

Chlorite type Ripidolite

Sum with chlorite I 112852.146
Sum with chlorite II 112784.204

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.006	Al
			0.399	Fe
			0.595	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.401	Fe
			0.599	Mg
M. W : molelcular weight		with Si in second bracket	0.996	Si
			0.004	Al

Mineralogy with Chlorite I		Mineralogy with Chlorite II	
Apatite	0.376	Apatite	0.377
Titanite	0.000	Titanite	0.000
Albite	23.768	Albite	23.783
Calcite	19.430	Calcite	19.441
Muscovite	12.589	Muscovite	12.597
Chlorite	36.986	Chlorite	36.808
Quartz	5.676	Quartz	5.819
MnO2	0.554	MnO2	0.554
TiO2	0.620	TiO2	0.621
	100.000		100.000

Alp da Ruschein 14 Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	58.300	60.090	970.211	970.211	958.822	574.505	574.505	574.505	456.670	72.696	180.329
Al2O3	14.730	101.940	288.994	288.994	288.994	160.888	160.888	160.888	43.053	0.000	0.000
Fe2O3	7.140	159.700	89.418	89.418	89.418	89.418	89.418	89.418	89.418	0.000	0.000
MgO	4.980	40.320	123.512	123.512	123.512	123.512	123.512	123.512	123.512	0.000	0.000
Na2O	3.970	61.980	128.106	128.106	128.106	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.680	44.010	60.895	60.895	60.895	60.895	-3.740	-3.740	-43.018	-426.992	-362.412
TiO2	0.910	79.900	11.389	11.389	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	4.540	56.080	80.956	76.024	64.635	64.635	0.000	0.000	0.000	0.000	0.000
K2O	1.850	94.200	39.278	39.278	39.278	39.278	39.278	39.278	0.000	0.000	0.000
P2O5	0.210	141.950	2.959	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.140	70.940	1.973	1.973	1.973	1.973	1.973	1.973	1.973	1.973	1.973

Mn Oxyde	MnO2	1.973	Mn	1.973	with M. W	86.937	this gives	171.570
Apatite	Ca5(PO4)3(F,OH,Cl)	2.959	P	0.986	with M. W	502.314	this gives	495.414
Titanite	CaTi SiO5	11.389	Ti	11.389	with M. W	196.063	this gives	2233.008
Albite	NaAlSi3O8	128.106	Na	128.106	with M. W	262.225	this gives	33592.491
Calcite	CaCO3	64.635	Ca	64.635	with M. W	100.089	this gives	6469.288
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	39.278	K	39.278	with M. W	398.309	this gives	15644.842
Chlorite I		383.974	Si	95.994	with M. W	623.056	this gives	59809.369
Quartz		72.696	Si	72.696	with M. W	60.090	this gives	4368.298
Chlorite II		319.394	Al+Si	79.849	with M. W	633.130	this gives	50554.559
Quartz		180.329	Si	180.329	with M. W	60.090	this gives	10835.978

Chlorite type Ripidolite

					sum with chlorite I		122784.279	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.168	Al	sum with chlorite II		119997.149	
			0.349	Fe				
			0.483	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.403	Apatite	0.413
					Titanite	1.819	Titanite	1.861
					Albite	27.359	Albite	27.994
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	5.269	Calcite	5.391
			0.420	Fe	Muscovite	12.742	Muscovite	13.038
			0.580	Mg	Chlorite	48.711	Chlorite	42.130
M. W : molelcular weight		with Si in second bracket	0.865	Si	Quartz	3.558	Quartz	9.030
			0.135	Al	MnO2	0.140	MnO2	0.143
						100.000		100.000

Alp da Ruschein 14 Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	58.300	60.090	970.211	970.211	970.211	569.540	569.540	569.540	451.705	92.262	159.011
Al2O3	14.730	101.940	288.994	288.994	288.994	144.534	144.534	144.534	26.699	0.000	0.000
Fe2O3	7.140	159.700	89.418	89.418	89.418	89.418	89.418	89.418	89.418	0.000	0.000
MgO	4.980	40.320	123.512	123.512	123.512	123.512	123.512	123.512	123.512	0.000	0.000
Na2O	3.970	61.980	128.106	128.106	128.106	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.680	44.010	60.895	60.895	60.895	60.895	-6.952	-6.952	-46.230	-405.674	-365.625
TiO2	0.910	79.900	11.389	11.389	11.389	11.389	11.389	11.389	11.389	11.389	11.389
CaO	4.540	56.080	80.956	76.024	76.024	67.847	0.000	0.000	0.000	0.000	0.000
K2O	1.850	94.200	39.278	39.278	39.278	39.278	39.278	39.278	0.000	0.000	0.000
P2O5	0.210	141.950	2.959	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.140	70.940	1.973	1.973	1.973	1.973	1.973	1.973	1.973	1.973	1.973

Rutile	TiO2	11.389	Ti	11.389	with M. W	79.899	this gives	909.986
Mn Oxyde	MnO2	1.973	Mn	1.973	with M. W	86.937	this gives	171.570
Apatite	Ca5(PO4)3(F,OH,Cl)	2.959	P	0.986	with M. W	502.314	this gives	495.414
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	128.106	Na	128.106	with M. W	262.225	this gives	33592.491
Calcite	CaCO3	67.847	Ca	67.847	with M. W	100.089	this gives	6790.802
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	39.278	K	39.278	with M. W	398.309	this gives	15644.842
Chlorite I		359.443	Si	89.861	with M. W	626.657	this gives	56311.961
Quartz		92.262	Si	92.262	with M. W	60.090	this gives	5544.031
Chlorite II		319.394	Al+Si	79.849	with M. W	633.357	this gives	50572.621
Quartz		159.011	Si	159.011	with M. W	60.090	this gives	9554.941

Chlorite type Ripidolite

					sum with chlorite I		119461.096	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.111	Al	sum with chlorite II		117732.667	
			0.373	Fe				
			0.515	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.415	Apatite	0.421
					Titanite	0.000	Titanite	0.000
					Albite	28.120	Albite	28.533
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	5.685	Calcite	5.768
			0.420	Fe	Muscovite	13.096	Muscovite	13.288
			0.580	Mg	Chlorite	47.138	Chlorite	42.955
M. W : molelcular weight		with Si in second bracket	0.916	Si	Quartz	4.641	Quartz	8.116
			0.084	Al	MnO2	0.144	MnO2	0.146
					TiO2	0.762	TiO2	0.773
						100.000		100.000

Alp da Ruschein 14 Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	58.300	60.090	970.211	970.211	970.211	557.426	557.426	557.426	439.591	98.319	134.782
Al2O3	14.730	101.940	288.994	288.994	288.994	132.420	132.420	132.420	14.585	0.000	0.000
Fe2O3	7.140	159.700	89.418	89.418	89.418	89.418	89.418	89.418	89.418	0.000	0.000
MgO	4.980	40.320	123.512	123.512	123.512	123.512	123.512	123.512	123.512	0.000	0.000
Na2O	3.970	61.980	128.106	128.106	128.106	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.680	44.010	60.895	60.895	60.895	60.895	-0.895	-0.895	-40.173	-381.446	-359.568
TiO2	0.910	79.900	11.389	11.389	11.389	11.389	11.389	11.389	11.389	11.389	11.389
CaO	4.540	56.080	80.956	76.024	76.024	61.790	0.000	0.000	0.000	0.000	0.000
K2O	1.850	94.200	39.278	39.278	39.278	39.278	39.278	39.278	0.000	0.000	0.000
P2O5	0.210	141.950	2.959	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.140	70.940	1.973	1.973	1.973	1.973	1.973	1.973	1.973	1.973	1.973

Rutile	TiO2	11.389	Ti	11.389	with M. W	79.899	this gives	909.986
Mn Oxyde	MnO2	1.973	Mn	1.973	with M. W	86.937	this gives	171.570
Apatite	Ca5(PO4)3(F,OH,Cl)	2.959	P	0.986	with M. W	502.314	this gives	495.414
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	128.106	Na	128.106	with M. W	262.225	this gives	33592.491
Calcite	CaCO3	61.790	Ca	61.790	with M. W	100.089	this gives	6184.560
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	39.278	K	39.278	with M. W	398.309	this gives	15644.842
Chlorite I		341.272	Si	85.318	with M. W	629.659	this gives	53721.288
Quartz		98.319	Si	98.319	with M. W	60.090	this gives	5907.997
Chlorite II		319.394	Al+Si	79.849	with M. W	633.524	this gives	50586.001
Quartz		134.782	Si	134.782	with M. W	60.090	this gives	8099.077

Chlorite type Ripidolite

					sum with chlorite I		116628.148	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.064	Al	sum with chlorite II		115683.942	
			0.393	Fe				
			0.543	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.425	Apatite	0.428
					Titanite	0.000	Titanite	0.000
					Albite	28.803	Albite	29.038
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	5.303	Calcite	5.346
			0.420	Fe	Muscovite	13.414	Muscovite	13.524
			0.580	Mg	Chlorite	46.062	Chlorite	43.728
M. W : molelcular weight		with Si in second bracket	0.954	Si	Quartz	5.066	Quartz	7.001
			0.046	Al	MnO2	0.147	MnO2	0.148
					TiO2	0.780	TiO2	0.787
						100.000		100.000

Alp da Ruschein 15 Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	58.470	60.090	973.040	973.040	961.526	576.240	576.240	576.240	450.126	71.102	155.266
Al2O3	14.690	101.940	288.209	288.209	288.209	159.780	159.780	159.780	33.666	0.000	0.000
Fe2O3	7.230	159.700	90.545	90.545	90.545	90.545	90.545	90.545	90.545	0.000	0.000
MgO	5.180	40.320	128.472	128.472	128.472	128.472	128.472	128.472	128.472	0.000	0.000
Na2O	3.980	61.980	128.429	128.429	128.429	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.530	44.010	57.487	57.487	57.487	57.487	-3.457	-3.457	-45.495	-424.519	-374.021
TiO2	0.920	79.900	11.514	11.514	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	4.340	56.080	77.389	72.458	60.944	60.944	0.000	0.000	0.000	0.000	0.000
K2O	1.980	94.200	42.038	42.038	42.038	42.038	42.038	42.038	0.000	0.000	0.000
P2O5	0.210	141.950	2.959	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.160	70.940	2.255	2.255	2.255	2.255	2.255	2.255	2.255	2.255	2.255

Mn Oxyde	MnO2	2.255	Mn	2.255	with M. W	86.937	this gives	196.080
Apatite	Ca5(PO4)3(F,OH,Cl)	2.959	P	0.986	with M. W	502.314	this gives	495.414
Titanite	CaTi SiO5	11.514	Ti	11.514	with M. W	196.063	this gives	2257.546
Albite	NaAlSi3O8	128.429	Na	128.429	with M. W	262.225	this gives	33677.107
Calcite	CaCO3	60.944	Ca	60.944	with M. W	100.089	this gives	6099.810
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	42.038	K	42.038	with M. W	398.309	this gives	16744.209
Chlorite I		379.024	Si	94.756	with M. W	624.203	this gives	59146.988
Quartz		71.102	Si	71.102	with M. W	60.090	this gives	4272.517
Chlorite II		328.525	Al+Si	82.131	with M. W	632.038	this gives	51910.178
Quartz		155.266	Si	155.266	with M. W	60.090	this gives	9329.928

Chlorite type Ripidolite

					sum with chlorite I		122889.672	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.133	Al	sum with chlorite II		120710.272	
			0.358	Fe				
			0.508	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.403	Apatite	0.410
					Titanite	1.837	Titanite	1.870
					Albite	27.404	Albite	27.899
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	4.964	Calcite	5.053
			0.413	Fe	Muscovite	13.625	Muscovite	13.871
			0.587	Mg	Chlorite	48.130	Chlorite	43.004
M. W : molelcular weight		with Si in second bracket	0.898	Si	Quartz	3.477	Quartz	7.729
			0.102	Al	MnO2	0.160	MnO2	0.162
						100.000		100.000

Alp da Ruschein 15 Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	58.470	60.090	973.040	973.040	973.040	571.360	571.360	571.360	445.245	90.814	133.990
Al2O3	14.690	101.940	288.209	288.209	288.209	143.385	143.385	143.385	17.270	0.000	0.000
Fe2O3	7.230	159.700	90.545	90.545	90.545	90.545	90.545	90.545	90.545	0.000	0.000
MgO	5.180	40.320	128.472	128.472	128.472	128.472	128.472	128.472	128.472	0.000	0.000
Na2O	3.980	61.980	128.429	128.429	128.429	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.530	44.010	57.487	57.487	57.487	57.487	-6.774	-6.774	-48.812	-403.243	-377.337
TiO2	0.920	79.900	11.514	11.514	11.514	11.514	11.514	11.514	11.514	11.514	11.514
CaO	4.340	56.080	77.389	72.458	72.458	64.261	0.000	0.000	0.000	0.000	0.000
K2O	1.980	94.200	42.038	42.038	42.038	42.038	42.038	42.038	0.000	0.000	0.000
P2O5	0.210	141.950	2.959	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.160	70.940	2.255	2.255	2.255	2.255	2.255	2.255	2.255	2.255	2.255

Rutile	TiO2	11.514	Ti	11.514	with M. W	79.899	this gives	919.986
Mn Oxyde	MnO2	2.255	Mn	2.255	with M. W	86.937	this gives	196.080
Apatite	Ca5(PO4)3(F,OH,Cl)	2.959	P	0.986	with M. W	502.314	this gives	495.414
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	128.429	Na	128.429	with M. W	262.225	this gives	33677.107
Calcite	CaCO3	64.261	Ca	64.261	with M. W	100.089	this gives	6431.788
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	42.038	K	42.038	with M. W	398.309	this gives	16744.209
Chlorite I		354.431	Si	88.608	with M. W	627.944	this gives	55640.771
Quartz		90.814	Si	90.814	with M. W	60.090	this gives	5457.009
Chlorite II		328.525	Al+Si	82.131	with M. W	632.259	this gives	51928.286
Quartz		133.990	Si	133.990	with M. W	60.090	this gives	8051.461

Chlorite type Ripidolite

					sum with chlorite I		119562.364	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.073	Al	sum with chlorite II		118444.332	
			0.383	Fe				
			0.544	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.414	Apatite	0.418
					Titanite	0.000	Titanite	0.000
					Albite	28.167	Albite	28.433
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	5.379	Calcite	5.430
			0.413	Fe	Muscovite	14.005	Muscovite	14.137
			0.587	Mg	Chlorite	46.537	Chlorite	43.842
M. W : molelcular weight		with Si in second bracket	0.947	Si	Quartz	4.564	Quartz	6.798
			0.053	Al	MnO2	0.164	MnO2	0.166
					TiO2	0.769	TiO2	0.777
						100.000		100.000

Alp da Ruschein 15 Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	58.470	60.090	973.040	973.040	973.040	559.215	559.215	559.215	433.101	96.886	109.701
Al2O3	14.690	101.940	288.209	288.209	288.209	131.241	131.241	131.241	5.126	0.000	0.000
Fe2O3	7.230	159.700	90.545	90.545	90.545	90.545	90.545	90.545	90.545	0.000	0.000
MgO	5.180	40.320	128.472	128.472	128.472	128.472	128.472	128.472	128.472	0.000	0.000
Na2O	3.980	61.980	128.429	128.429	128.429	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.530	44.010	57.487	57.487	57.487	57.487	-0.701	-0.701	-42.740	-378.954	-371.265
TiO2	0.920	79.900	11.514	11.514	11.514	11.514	11.514	11.514	11.514	11.514	11.514
CaO	4.340	56.080	77.389	72.458	72.458	58.188	0.000	0.000	0.000	0.000	0.000
K2O	1.980	94.200	42.038	42.038	42.038	42.038	42.038	42.038	0.000	0.000	0.000
P2O5	0.210	141.950	2.959	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.160	70.940	2.255	2.255	2.255	2.255	2.255	2.255	2.255	2.255	2.255

Rutile	TiO2	11.514	Ti	11.514	with M. W	79.899	this gives	919.986
Mn Oxyde	MnO2	2.255	Mn	2.255	with M. W	86.937	this gives	196.080
Apatite	Ca5(PO4)3(F,OH,Cl)	2.959	P	0.986	with M. W	502.314	this gives	495.414
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	128.429	Na	128.429	with M. W	262.225	this gives	33677.107
Calcite	CaCO3	58.188	Ca	58.188	with M. W	100.089	this gives	5824.020
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	42.038	K	42.038	with M. W	398.309	this gives	16744.209
Chlorite I		336.214	Si	84.054	with M. W	631.069	this gives	53043.573
Quartz		96.886	Si	96.886	with M. W	60.090	this gives	5821.892
Chlorite II		328.525	Al+Si	82.131	with M. W	632.422	this gives	51941.700
Quartz		109.701	Si	109.701	with M. W	60.090	this gives	6591.930

Chlorite type Ripidolite

					sum with chlorite I		116722.280	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.023	Al	sum with chlorite II		116390.446	
			0.404	Fe				
			0.573	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.424	Apatite	0.426
					Titanite	0.000	Titanite	0.000
					Albite	28.852	Albite	28.935
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	4.990	Calcite	5.004
			0.413	Fe	Muscovite	14.345	Muscovite	14.386
			0.587	Mg	Chlorite	45.444	Chlorite	44.627
M. W : molelcular weight		with Si in second bracket	0.984	Si	Quartz	4.988	Quartz	5.664
			0.016	Al	MnO2	0.168	MnO2	0.168
					TiO2	0.788	TiO2	0.790
						100.000		100.000

Alp da Ruschein 16 Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	52.150	60.090	867.865	867.865	855.474	465.349	465.349	465.349	381.909	-161.265	72.150
Al2O3	15.640	101.940	306.847	306.847	306.847	176.805	176.805	176.805	93.366	0.000	0.000
Fe2O3	9.300	159.700	116.468	116.468	116.468	116.468	116.468	116.468	116.468	0.000	0.000
MgO	6.140	40.320	152.282	152.282	152.282	152.282	152.282	152.282	152.282	0.000	0.000
Na2O	4.030	61.980	130.042	130.042	130.042	0.000	0.000	0.000	0.000	0.000	0.000
L O I	4.900	44.010	111.338	111.338	111.338	111.338	44.786	44.786	16.973	-526.201	-386.152
TiO2	0.990	79.900	12.390	12.390	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	4.730	56.080	84.344	78.943	66.552	66.552	0.000	0.000	0.000	0.000	0.000
K2O	1.310	94.200	27.813	27.813	27.813	27.813	27.813	27.813	0.000	0.000	0.000
P2O5	0.230	141.950	3.241	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.230	70.940	3.242	3.242	3.242	3.242	3.242	3.242	3.242	3.242	3.242

Mn Oxyde	MnO2	3.242	Mn	3.242	with M. W	86.937	this gives	281.864
Apatite	Ca5(PO4)3(F,OH,Cl)	3.241	P	1.080	with M. W	502.314	this gives	542.596
Titanite	CaTi SiO5	12.390	Ti	12.390	with M. W	196.063	this gives	2429.316
Albite	NaAlSi3O8	130.042	Na	130.042	with M. W	262.225	this gives	34100.186
Calcite	CaCO3	66.552	Ca	66.552	with M. W	100.089	this gives	6661.171
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	27.813	K	27.813	with M. W	398.309	this gives	11078.239
Chlorite I		543.174	Si	135.793	with M. W	619.255	this gives	84090.749
Quartz		-161.265	Si	-161.265	with M. W	60.090	this gives	-9690.398
Chlorite II		403.125	Al+Si	100.781	with M. W	635.244	this gives	64020.690
Quartz		72.150	Si	72.150	with M. W	60.090	this gives	4335.468

Chlorite type Ripidolite

					sum with chlorite I		129493.724	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.258	Al	sum with chlorite II		123449.532	
			0.322	Fe				
			0.421	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.419	Apatite	0.440
					Titanite	1.876	Titanite	1.968
					Albite	26.333	Albite	27.623
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	5.144	Calcite	5.396
			0.433	Fe	Muscovite	8.555	Muscovite	8.974
			0.567	Mg	Chlorite	64.938	Chlorite	51.860
M. W : molelcular weight		with Si in second bracket	0.768	Si	Quartz	-7.483	Quartz	3.512
			0.232	Al	MnO2	0.218	MnO2	0.228
						100.000		100.000

Alp da Ruschein 16 Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	52.150	60.090	867.865	867.865	867.865	461.138	461.138	461.138	377.698	-140.574	51.338
Al2O3	15.640	101.940	306.847	306.847	306.847	160.204	160.204	160.204	76.765	0.000	0.000
Fe2O3	9.300	159.700	116.468	116.468	116.468	116.468	116.468	116.468	116.468	0.000	0.000
MgO	6.140	40.320	152.282	152.282	152.282	152.282	152.282	152.282	152.282	0.000	0.000
Na2O	4.030	61.980	130.042	130.042	130.042	0.000	0.000	0.000	0.000	0.000	0.000
L O I	4.900	44.010	111.338	111.338	111.338	111.338	40.696	40.696	12.883	-505.389	-390.242
TiO2	0.990	79.900	12.390	12.390	12.390	12.390	12.390	12.390	12.390	12.390	12.390
CaO	4.730	56.080	84.344	78.943	78.943	70.642	0.000	0.000	0.000	0.000	0.000
K2O	1.310	94.200	27.813	27.813	27.813	27.813	27.813	27.813	0.000	0.000	0.000
P2O5	0.230	141.950	3.241	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.230	70.940	3.242	3.242	3.242	3.242	3.242	3.242	3.242	3.242	3.242

Rutile	TiO2	12.390	Ti	12.390	with M. W	79.899	this gives	989.985
Mn Oxyde	MnO2	3.242	Mn	3.242	with M. W	86.937	this gives	281.864
Apatite	Ca5(PO4)3(F,OH,Cl)	3.241	P	1.080	with M. W	502.314	this gives	542.596
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	130.042	Na	130.042	with M. W	262.225	this gives	34100.186
Calcite	CaCO3	70.642	Ca	70.642	with M. W	100.089	this gives	7070.529
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	27.813	K	27.813	with M. W	398.309	this gives	11078.239
Chlorite I		518.272	Si	129.568	with M. W	621.608	this gives	80540.483
Quartz		-140.574	Si	-140.574	with M. W	60.090	this gives	-8447.073
Chlorite II		403.125	Al+Si	100.781	with M. W	635.426	this gives	64039.026
Quartz		51.338	Si	51.338	with M. W	60.090	this gives	3084.893

Chlorite type Ripidolite

					sum with chlorite I		126156.811	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.222	Al	sum with chlorite II		121187.320	
			0.337	Fe				
			0.441	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.430	Apatite	0.448
					Titanite	0.000	Titanite	0.000
					Albite	27.030	Albite	28.138
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	5.605	Calcite	5.834
			0.433	Fe	Muscovite	8.781	Muscovite	9.141
			0.567	Mg	Chlorite	63.842	Chlorite	52.843
M. W : molelcular weight		with Si in second bracket	0.810	Si	Quartz	-6.696	Quartz	2.546
			0.190	Al	MnO2	0.223	MnO2	0.233
					TiO2	0.785	TiO2	0.817
						100.000		100.000

Alp da Ruschein 16 Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	52.150	60.090	867.865	867.865	867.865	448.841	448.841	448.841	365.401	-134.425	26.744
Al2O3	15.640	101.940	306.847	306.847	306.847	147.907	147.907	147.907	64.468	0.000	0.000
Fe2O3	9.300	159.700	116.468	116.468	116.468	116.468	116.468	116.468	116.468	0.000	0.000
MgO	6.140	40.320	152.282	152.282	152.282	152.282	152.282	152.282	152.282	0.000	0.000
Na2O	4.030	61.980	130.042	130.042	130.042	0.000	0.000	0.000	0.000	0.000	0.000
L O I	4.900	44.010	111.338	111.338	111.338	111.338	46.845	46.845	19.031	-480.795	-384.094
TiO2	0.990	79.900	12.390	12.390	12.390	12.390	12.390	12.390	12.390	12.390	12.390
CaO	4.730	56.080	84.344	78.943	78.943	64.494	0.000	0.000	0.000	0.000	0.000
K2O	1.310	94.200	27.813	27.813	27.813	27.813	27.813	27.813	0.000	0.000	0.000
P2O5	0.230	141.950	3.241	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.230	70.940	3.242	3.242	3.242	3.242	3.242	3.242	3.242	3.242	3.242

Rutile	TiO2	12.390	Ti	12.390	with M. W	79.899	this gives	989.985
Mn Oxyde	MnO2	3.242	Mn	3.242	with M. W	86.937	this gives	281.864
Apatite	Ca5(PO4)3(F,OH,Cl)	3.241	P	1.080	with M. W	502.314	this gives	542.596
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	130.042	Na	130.042	with M. W	262.225	this gives	34100.186
Calcite	CaCO3	64.494	Ca	64.494	with M. W	100.089	this gives	6455.125
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	27.813	K	27.813	with M. W	398.309	this gives	11078.239
Chlorite I		499.826	Si	124.957	with M. W	623.502	this gives	77910.657
Quartz		-134.425	Si	-134.425	with M. W	60.090	this gives	-8077.607
Chlorite II		403.125	Al+Si	100.781	with M. W	635.560	this gives	64052.608
Quartz		26.744	Si	26.744	with M. W	60.090	this gives	1607.026

Chlorite type Ripidolite

					sum with chlorite I		123281.047	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.193	Al	sum with chlorite II		119107.631	
			0.350	Fe				
			0.457	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.440	Apatite	0.456
					Titanite	0.000	Titanite	0.000
					Albite	27.661	Albite	28.630
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	5.236	Calcite	5.420
			0.433	Fe	Muscovite	8.986	Muscovite	9.301
			0.567	Mg	Chlorite	63.198	Chlorite	53.777
M. W : molelcular weight		with Si in second bracket	0.840	Si	Quartz	-6.552	Quartz	1.349
			0.160	Al	MnO2	0.229	MnO2	0.237
					TiO2	0.803	TiO2	0.831
						100.000		100.000

Table 6

Alp da Ruschein 17

Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	54.690	60.090	910.135	910.135	898.245	502.311	502.311	502.311	406.769	-63.206	115.494
Al2O3	15.240	101.940	298.999	298.999	298.999	167.021	167.021	167.021	71.480	0.000	0.000
Fe2O3	8.260	159.700	103.444	103.444	103.444	103.444	103.444	103.444	103.444	0.000	0.000
MgO	5.580	40.320	138.393	138.393	138.393	138.393	138.393	138.393	138.393	0.000	0.000
Na2O	4.090	61.980	131.978	131.978	131.978	0.000	0.000	0.000	0.000	0.000	0.000
L O I	4.410	44.010	100.204	100.204	100.204	100.204	34.165	34.165	2.318	-467.657	-360.437
TiO2	0.950	79.900	11.890	11.890	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	4.660	56.080	83.096	77.929	66.040	66.040	0.000	0.000	0.000	0.000	0.000
K2O	1.500	94.200	31.847	31.847	31.847	31.847	31.847	31.847	0.000	0.000	0.000
P2O5	0.220	141.950	3.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.220	70.940	3.101	3.101	3.101	3.101	3.101	3.101	3.101	3.101	3.101

Mn Oxyde	MnO2	3.101	Mn	3.101	with M. W	86.937	this gives	269.609
Apatite	Ca5(PO4)3(F,OH,Cl)	3.100	P	1.033	with M. W	502.314	this gives	519.005
Titanite	CaTi SiO5	11.890	Ti	11.890	with M. W	196.063	this gives	2331.162
Albite	NaAlSi3O8	131.978	Na	131.978	with M. W	262.225	this gives	34607.881
Calcite	CaCO3	66.040	Ca	66.040	with M. W	100.089	this gives	6609.848
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	31.847	K	31.847	with M. W	398.309	this gives	12685.007
Chlorite I		469.975	Si	117.494	with M. W	620.392	this gives	72892.232
Quartz		-63.206	Si	-63.206	with M. W	60.090	this gives	-3798.036
Chlorite II		362.755	Al+Si	90.689	with M. W	634.332	this gives	57526.777
Quartz		115.494	Si	115.494	with M. W	60.090	this gives	6940.040

Chlorite type Ripidolite

						sum with chlorite I	126116.709	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.228	Al		sum with chlorite II	121489.330	
			0.330	Fe				
			0.442	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.412	Apatite	0.427
					Titanite	1.848	Titanite	1.919
					Albite	27.441	Albite	28.486
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	5.241	Calcite	5.441
			0.428	Fe	Muscovite	10.058	Muscovite	10.441
			0.572	Mg	Chlorite	57.797	Chlorite	47.351
M. W : molelcular weight		with Si in second bracket	0.803	Si	Quartz	-3.012	Quartz	5.712
			0.197	Al	MnO2	0.214	MnO2	0.222
						100.000		100.000

Alp da Ruschein 17

Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	54.690	60.090	910.135	910.135	910.135	497.352	497.352	497.352	401.811	-42.892	93.687
Al2O3	15.240	101.940	298.999	298.999	298.999	150.173	150.173	150.173	54.632	0.000	0.000
Fe2O3	8.260	159.700	103.444	103.444	103.444	103.444	103.444	103.444	103.444	0.000	0.000
MgO	5.580	40.320	138.393	138.393	138.393	138.393	138.393	138.393	138.393	0.000	0.000
Na2O	4.090	61.980	131.978	131.978	131.978	0.000	0.000	0.000	0.000	0.000	0.000
L O I	4.410	44.010	100.204	100.204	100.204	100.204	30.699	30.699	-1.148	-445.851	-363.903
TiO2	0.950	79.900	11.890	11.890	11.890	11.890	11.890	11.890	11.890	11.890	11.890
CaO	4.660	56.080	83.096	77.929	77.929	69.505	0.000	0.000	0.000	0.000	0.000
K2O	1.500	94.200	31.847	31.847	31.847	31.847	31.847	31.847	0.000	0.000	0.000
P2O5	0.220	141.950	3.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.220	70.940	3.101	3.101	3.101	3.101	3.101	3.101	3.101	3.101	3.101

Rutile	TiO2	11.890	Ti	11.890	with M. W	79.899	this gives	949.986
Mn Oxyde	MnO2	3.101	Mn	3.101	with M. W	86.937	this gives	269.609
Apatite	Ca5(PO4)3(F,OH,Cl)	3.100	P	1.033	with M. W	502.314	this gives	519.005
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	131.978	Na	131.978	with M. W	262.225	this gives	34607.881
Calcite	CaCO3	69.505	Ca	69.505	with M. W	100.089	this gives	6956.731
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	31.847	K	31.847	with M. W	398.309	this gives	12685.007
Chlorite I		444.703	Si	111.176	with M. W	623.240	this gives	69289.109
Quartz		-42.892	Si	-42.892	with M. W	60.090	this gives	-2577.368
Chlorite II		362.755	Al+Si	90.689	with M. W	634.537	this gives	57545.386
Quartz		93.687	Si	93.687	with M. W	60.090	this gives	5629.678

Chlorite type Ripidolite

						sum with chlorite I	122699.960	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.184	Al		sum with chlorite II	119163.283	
			0.349	Fe				
			0.467	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.423	Apatite	0.436
					Titanite	0.000	Titanite	0.000
					Albite	28.205	Albite	29.042
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	5.670	Calcite	5.838
			0.428	Fe	Muscovite	10.338	Muscovite	10.645
			0.572	Mg	Chlorite	56.470	Chlorite	48.291
M. W : molelcular weight		with Si in second bracket	0.849	Si	Quartz	-2.101	Quartz	4.724
			0.151	Al	MnO2	0.220	MnO2	0.226
					TiO2	0.774	TiO2	0.797
						100.000		100.000

Alp da Ruschein 17

Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	54.690	60.090	910.135	910.135	910.135	484.872	484.872	484.872	389.331	-36.652	68.727
Al2O3	15.240	101.940	298.999	298.999	298.999	137.693	137.693	137.693	42.151	0.000	0.000
Fe2O3	8.260	159.700	103.444	103.444	103.444	103.444	103.444	103.444	103.444	0.000	0.000
MgO	5.580	40.320	138.393	138.393	138.393	138.393	138.393	138.393	138.393	0.000	0.000
Na2O	4.090	61.980	131.978	131.978	131.978	0.000	0.000	0.000	0.000	0.000	0.000
L O I	4.410	44.010	100.204	100.204	100.204	100.204	36.939	36.939	5.092	-420.890	-357.663
TiO2	0.950	79.900	11.890	11.890	11.890	11.890	11.890	11.890	11.890	11.890	11.890
CaO	4.660	56.080	83.096	77.929	77.929	63.265	0.000	0.000	0.000	0.000	0.000
K2O	1.500	94.200	31.847	31.847	31.847	31.847	31.847	31.847	0.000	0.000	0.000
P2O5	0.220	141.950	3.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.220	70.940	3.101	3.101	3.101	3.101	3.101	3.101	3.101	3.101	3.101

Rutile	TiO2	11.890	Ti	11.890	with M. W	79.899	this gives	949.986
Mn Oxyde	MnO2	3.101	Mn	3.101	with M. W	86.937	this gives	269.609
Apatite	Ca5(PO4)3(F,OH,Cl)	3.100	P	1.033	with M. W	502.314	this gives	519.005
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	131.978	Na	131.978	with M. W	262.225	this gives	34607.881
Calcite	CaCO3	63.265	Ca	63.265	with M. W	100.089	this gives	6332.164
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	31.847	K	31.847	with M. W	398.309	this gives	12685.007
Chlorite I		425.982	Si	106.496	with M. W	625.567	this gives	66620.129
Quartz		-36.652	Si	-36.652	with M. W	60.090	this gives	-2202.401
Chlorite II		362.755	Al+Si	90.689	with M. W	634.689	this gives	57559.170
Quartz		68.727	Si	68.727	with M. W	60.090	this gives	4129.808

Chlorite type Ripidolite

						sum with chlorite I	119781.381	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.148	Al		sum with chlorite II	117052.631	
			0.364	Fe				
			0.487	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.433	Apatite	0.443
					Titanite	0.000	Titanite	0.000
					Albite	28.893	Albite	29.566
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	5.286	Calcite	5.410
			0.428	Fe	Muscovite	10.590	Muscovite	10.837
			0.572	Mg	Chlorite	55.618	Chlorite	49.174
M. W : molelcular weight		with Si in second bracket	0.884	Si	Quartz	-1.839	Quartz	3.528
			0.116	Al	MnO2	0.225	MnO2	0.230
					TiO2	0.793	TiO2	0.812
						100.000		100.000

Alp da Ruschein 18 Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	57.480	60.090	956.565	956.565	945.551	608.669	608.669	608.669	524.592	31.794	234.903
Al2O3	14.150	101.940	277.614	277.614	277.614	165.320	165.320	165.320	81.244	0.000	0.000
Fe2O3	8.220	159.700	102.943	102.943	102.943	102.943	102.943	102.943	102.943	0.000	0.000
MgO	5.820	40.320	144.345	144.345	144.345	144.345	144.345	144.345	144.345	0.000	0.000
Na2O	3.480	61.980	112.294	112.294	112.294	0.000	0.000	0.000	0.000	0.000	0.000
L O I	4.250	44.010	96.569	96.569	96.569	96.569	47.072	47.072	19.046	-473.751	-351.886
TiO2	0.880	79.900	11.014	11.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	3.670	56.080	65.442	60.511	49.497	49.497	0.000	0.000	0.000	0.000	0.000
K2O	1.320	94.200	28.025	28.025	28.025	28.025	28.025	28.025	0.000	0.000	0.000
P2O5	0.210	141.950	2.959	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.190	70.940	2.678	2.678	2.678	2.678	2.678	2.678	2.678	2.678	2.678

Mn Oxyde	MnO2	2.678	Mn	2.678	with M. W	86.937	this gives	232.845
Apatite	Ca5(PO4)3(F,OH,Cl)	2.959	P	0.986	with M. W	502.314	this gives	495.414
Titanite	CaTi SiO5	11.014	Ti	11.014	with M. W	196.063	this gives	2159.392
Albite	NaAlSi3O8	112.294	Na	112.294	with M. W	262.225	this gives	29446.315
Calcite	CaCO3	49.497	Ca	49.497	with M. W	100.089	this gives	4954.130
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	28.025	K	28.025	with M. W	398.309	this gives	11162.806
Chlorite I		492.798	Si	123.199	with M. W	617.517	this gives	76077.793
Quartz		31.794	Si	31.794	with M. W	60.090	this gives	1910.523
Chlorite II		370.932	Al+Si	92.733	with M. W	632.067	this gives	58613.536
Quartz		234.903	Si	234.903	with M. W	60.090	this gives	14115.337

Chlorite type Ripidolite

					sum with chlorite I		126439.217	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.247	Al	sum with chlorite II		121179.775	
			0.313	Fe				
			0.439	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.392	Apatite	0.409
					Titanite	1.708	Titanite	1.782
					Albite	23.289	Albite	24.300
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	3.918	Calcite	4.088
			0.416	Fe	Muscovite	8.829	Muscovite	9.212
			0.584	Mg	Chlorite	60.169	Chlorite	48.369
M. W : molelcular weight		with Si in second bracket	0.781	Si	Quartz	1.511	Quartz	11.648
			0.219	Al	MnO2	0.184	MnO2	0.192
						100.000		100.000

Alp da Ruschein 18 Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	57.480	60.090	956.565	956.565	956.565	605.347	605.347	605.347	521.270	49.976	217.246
Al2O3	14.150	101.940	277.614	277.614	277.614	150.985	150.985	150.985	66.908	0.000	0.000
Fe2O3	8.220	159.700	102.943	102.943	102.943	102.943	102.943	102.943	102.943	0.000	0.000
MgO	5.820	40.320	144.345	144.345	144.345	144.345	144.345	144.345	144.345	0.000	0.000
Na2O	3.480	61.980	112.294	112.294	112.294	0.000	0.000	0.000	0.000	0.000	0.000
L O I	4.250	44.010	96.569	96.569	96.569	96.569	43.226	43.226	15.200	-456.094	-355.732
TiO2	0.880	79.900	11.014	11.014	11.014	11.014	11.014	11.014	11.014	11.014	11.014
CaO	3.670	56.080	65.442	60.511	60.511	53.343	0.000	0.000	0.000	0.000	0.000
K2O	1.320	94.200	28.025	28.025	28.025	28.025	28.025	28.025	0.000	0.000	0.000
P2O5	0.210	141.950	2.959	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.190	70.940	2.678	2.678	2.678	2.678	2.678	2.678	2.678	2.678	2.678

Rutile	TiO2	11.014	Ti	11.014	with M. W	79.899	this gives	879.987
Mn Oxyde	MnO2	2.678	Mn	2.678	with M. W	86.937	this gives	232.845
Apatite	Ca5(PO4)3(F,OH,Cl)	2.959	P	0.986	with M. W	502.314	this gives	495.414
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	112.294	Na	112.294	with M. W	262.225	this gives	29446.315
Calcite	CaCO3	53.343	Ca	53.343	with M. W	100.089	this gives	5339.077
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	28.025	K	28.025	with M. W	398.309	this gives	11162.806
Chlorite I		471.295	Si	117.824	with M. W	619.672	this gives	73012.055
Quartz		49.976	Si	49.976	with M. W	60.090	this gives	3003.049
Chlorite II		370.932	Al+Si	92.733	with M. W	632.238	this gives	58629.370
Quartz		217.246	Si	217.246	with M. W	60.090	this gives	13054.321

Chlorite type Ripidolite

					sum with chlorite I		123571.548	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.213	Al	sum with chlorite II		119240.134	
			0.328	Fe				
			0.459	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.401	Apatite	0.415
					Titanite	0.000	Titanite	0.000
					Albite	23.829	Albite	24.695
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	4.321	Calcite	4.478
			0.416	Fe	Muscovite	9.033	Muscovite	9.362
			0.584	Mg	Chlorite	59.085	Chlorite	49.169
M. W : molelcular weight		with Si in second bracket	0.820	Si	Quartz	2.430	Quartz	10.948
			0.180	Al	MnO2	0.188	MnO2	0.195
					TiO2	0.712	TiO2	0.738
						100.000		100.000

Alp da Ruschein 18 Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	57.480	60.090	956.565	956.565	956.565	594.728	594.728	594.728	510.652	55.285	196.008
Al2O3	14.150	101.940	277.614	277.614	277.614	140.366	140.366	140.366	56.289	0.000	0.000
Fe2O3	8.220	159.700	102.943	102.943	102.943	102.943	102.943	102.943	102.943	0.000	0.000
MgO	5.820	40.320	144.345	144.345	144.345	144.345	144.345	144.345	144.345	0.000	0.000
Na2O	3.480	61.980	112.294	112.294	112.294	0.000	0.000	0.000	0.000	0.000	0.000
L O I	4.250	44.010	96.569	96.569	96.569	96.569	48.535	48.535	20.510	-434.857	-350.423
TiO2	0.880	79.900	11.014	11.014	11.014	11.014	11.014	11.014	11.014	11.014	11.014
CaO	3.670	56.080	65.442	60.511	60.511	48.034	0.000	0.000	0.000	0.000	0.000
K2O	1.320	94.200	28.025	28.025	28.025	28.025	28.025	28.025	0.000	0.000	0.000
P2O5	0.210	141.950	2.959	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.190	70.940	2.678	2.678	2.678	2.678	2.678	2.678	2.678	2.678	2.678

Rutile	TiO2	11.014	Ti	11.014	with M. W	79.899	this gives	879.987
Mn Oxyde	MnO2	2.678	Mn	2.678	with M. W	86.937	this gives	232.845
Apatite	Ca5(PO4)3(F,OH,Cl)	2.959	P	0.986	with M. W	502.314	this gives	495.414
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	112.294	Na	112.294	with M. W	262.225	this gives	29446.315
Calcite	CaCO3	48.034	Ca	48.034	with M. W	100.089	this gives	4807.661
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	28.025	K	28.025	with M. W	398.309	this gives	11162.806
Chlorite I		455.366	Si	113.842	with M. W	621.400	this gives	70741.139
Quartz		55.285	Si	55.285	with M. W	60.090	this gives	3322.092
Chlorite II		370.932	Al+Si	92.733	with M. W	632.364	this gives	58641.098
Quartz		196.008	Si	196.008	with M. W	60.090	this gives	11778.148

Chlorite type Ripidolite

					sum with chlorite I		121088.258	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.185	Al	sum with chlorite II		117444.274	
			0.339	Fe				
			0.475	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.409	Apatite	0.422
					Titanite	0.000	Titanite	0.000
					Albite	24.318	Albite	25.073
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	3.970	Calcite	4.094
			0.416	Fe	Muscovite	9.219	Muscovite	9.505
			0.584	Mg	Chlorite	58.421	Chlorite	49.931
M. W : molelcular weight		with Si in second bracket	0.848	Si	Quartz	2.744	Quartz	10.029
			0.152	Al	MnO2	0.192	MnO2	0.198
					TiO2	0.727	TiO2	0.749
						100.000		100.000

Vorab Pign 1 — Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	53.170	60.090	884.839	884.839	874.644	467.093	467.093	467.093	412.316	-235.397	177.283
Al2O3	18.130	101.940	355.699	355.699	355.699	219.849	219.849	219.849	165.072	0.000	0.000
Fe2O3	10.070	159.700	126.111	126.111	126.111	126.111	126.111	126.111	126.111	0.000	0.000
MgO	5.670	40.320	140.625	140.625	140.625	140.625	140.625	140.625	140.625	0.000	0.000
Na2O	4.210	61.980	135.850	135.850	135.850	0.000	0.000	0.000	0.000	0.000	0.000
L O I	4.190	44.010	95.206	95.206	95.206	95.206	95.206	95.206	76.947	-570.766	-323.158
TiO2	1.540	79.900	19.274	19.274	9.079	9.079	9.079	9.079	9.079	9.079	9.079
CaO	0.980	56.080	17.475	10.195	0.000	0.000	0.000	0.000	0.000	0.000	0.000
K2O	0.860	94.200	18.259	18.259	18.259	18.259	18.259	18.259	0.000	0.000	0.000
P2O5	0.310	141.950	4.368	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.080	70.940	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128

Rutile	TiO2	9.079	Ti	9.079	with M. W	79.899	this gives	725.370
Mn Oxyde	MnO2	1.128	Mn	1.128	with M. W	86.937	this gives	98.040
Apatite	Ca5(PO4)3(F,OH,Cl)	4.368	P	1.456	with M. W	502.314	this gives	731.325
Titanite	CaTi SiO5	10.195	Ti	10.195	with M. W	196.063	this gives	1998.956
Albite	NaAlSi3O8	135.850	Na	135.850	with M. W	262.225	this gives	35623.272
Calcite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	18.259	K	18.259	with M. W	398.309	this gives	7272.737
Chlorite I		647.713	Si	161.928	with M. W	615.652	this gives	99691.343
Quartz		-235.397	Si	-235.397	with M. W	60.090	this gives	-14144.993
Chlorite II		400.105	Al+Si	100.026	with M. W	641.904	this gives	64207.161
Quartz		177.283	Si	177.283	with M. W	60.090	this gives	10652.962

Chlorite type Ripidolite

					sum with chlorite I		131996.051	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.382	Al	sum with chlorite II		121309.823	
			0.292	Fe				
			0.326	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.554	Apatite	0.603
					Titanite	1.514	Titanite	1.648
					Albite	26.988	Albite	29.366
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.000	Calcite	0.000
			0.473	Fe	Muscovite	5.510	Muscovite	5.995
			0.527	Mg	Chlorite	75.526	Chlorite	52.928
M. W : molelcular weight		with Si in second bracket	0.587	Si	Quartz	-10.716	Quartz	8.782
			0.413	Al	MnO2	0.074	MnO2	0.081
					TiO2	0.550	TiO2	0.598
						100.000		100.000

Vorab Pign 1 — Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	53.170	60.090	884.839	884.839	884.839	459.946	459.946	459.946	405.169	-216.530	152.794
Al2O3	18.130	101.940	355.699	355.699	355.699	202.507	202.507	202.507	147.729	0.000	0.000
Fe2O3	10.070	159.700	126.111	126.111	126.111	126.111	126.111	126.111	126.111	0.000	0.000
MgO	5.670	40.320	140.625	140.625	140.625	140.625	140.625	140.625	140.625	0.000	0.000
Na2O	4.210	61.980	135.850	135.850	135.850	0.000	0.000	0.000	0.000	0.000	0.000
L O I	4.190	44.010	95.206	95.206	95.206	95.206	93.681	93.681	75.422	-546.277	-324.682
TiO2	1.540	79.900	19.274	19.274	19.274	19.274	19.274	19.274	19.274	19.274	19.274
CaO	0.980	56.080	17.475	10.195	10.195	1.524	0.000	0.000	0.000	0.000	0.000
K2O	0.860	94.200	18.259	18.259	18.259	18.259	18.259	18.259	0.000	0.000	0.000
P2O5	0.310	141.950	4.368	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.080	70.940	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128

Rutile	TiO2	19.274	Ti	19.274	with M. W	79.899	this gives	1539.977
Mn Oxyde	MnO2	1.128	Mn	1.128	with M. W	86.937	this gives	98.040
Apatite	Ca5(PO4)3(F,OH,Cl)	4.368	P	1.456	with M. W	502.314	this gives	731.325
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	135.850	Na	135.850	with M. W	262.225	this gives	35623.272
Calcite	CaCO3	1.524	Ca	1.524	with M. W	100.089	this gives	152.554
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	18.259	K	18.259	with M. W	398.309	this gives	7272.737
Chlorite I		621.699	Si	155.425	with M. W	617.550	this gives	95982.505
Quartz		-216.530	Si	-216.530	with M. W	60.090	this gives	-13011.288
Chlorite II		400.105	Al+Si	100.026	with M. W	642.095	this gives	64226.316
Quartz		152.794	Si	152.794	with M. W	60.090	this gives	9181.376

Chlorite type Ripidolite

					sum with chlorite I		128389.122	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.356	Al	sum with chlorite II		118825.597	
			0.304	Fe				
			0.339	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.570	Apatite	0.615
					Titanite	0.000	Titanite	0.000
					Albite	27.746	Albite	29.979
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.119	Calcite	0.128
			0.473	Fe	Muscovite	5.665	Muscovite	6.121
			0.527	Mg	Chlorite	74.759	Chlorite	54.051
M. W : molelcular weight		with Si in second bracket	0.631	Si	Quartz	-10.134	Quartz	7.727
			0.369	Al	MnO2	0.076	MnO2	0.083
					TiO2	1.199	TiO2	1.296
						100.000		100.000

Vorab Pign 1 — Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	53.170	60.090	884.839	884.839	884.839	447.100	447.100	447.100	392.323	-210.107	127.101
Al2O3	18.130	101.940	355.699	355.699	355.699	189.660	189.660	189.660	134.883	0.000	0.000
Fe2O3	10.070	159.700	126.111	126.111	126.111	126.111	126.111	126.111	126.111	0.000	0.000
MgO	5.670	40.320	140.625	140.625	140.625	140.625	140.625	140.625	140.625	0.000	0.000
Na2O	4.210	61.980	135.850	135.850	135.850	0.000	0.000	0.000	0.000	0.000	0.000
L O I	4.190	44.010	95.206	95.206	95.206	95.206	100.105	100.105	81.846	-520.584	-318.259
TiO2	1.540	79.900	19.274	19.274	19.274	19.274	19.274	19.274	19.274	19.274	19.274
CaO	0.980	56.080	17.475	10.195	10.195	-4.899	0.000	0.000	0.000	0.000	0.000
K2O	0.860	94.200	18.259	18.259	18.259	18.259	18.259	18.259	0.000	0.000	0.000
P2O5	0.310	141.950	4.368	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.080	70.940	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128

Rutile	TiO2	19.274	Ti	19.274	with M. W	79.899	this gives	1539.977
Mn Oxyde	MnO2	1.128	Mn	1.128	with M. W	86.937	this gives	98.040
Apatite	Ca5(PO4)3(F,OH,Cl)	4.368	P	1.456	with M. W	502.314	this gives	731.325
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	135.850	Na	135.850	with M. W	262.225	this gives	35623.272
Calcite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	18.259	K	18.259	with M. W	398.309	this gives	7272.737
Chlorite I		602.429	Si	150.607	with M. W	619.062	this gives	93235.218
Quartz		-210.107	Si	-210.107	with M. W	60.090	this gives	-12625.319
Chlorite II		400.105	Al+Si	100.026	with M. W	642.237	this gives	64240.505
Quartz		127.101	Si	127.101	with M. W	60.090	this gives	7637.500

Chlorite type Ripidolite

					sum with chlorite I		125875.249	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.336	Al	sum with chlorite II		117143.356	
			0.314	Fe				
			0.350	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.581	Apatite	0.624
					Titanite	0.000	Titanite	0.000
					Albite	28.300	Albite	30.410
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.000	Calcite	0.000
			0.473	Fe	Muscovite	5.778	Muscovite	6.208
			0.527	Mg	Chlorite	74.070	Chlorite	54.839
M. W : molelcular weight		with Si in second bracket	0.663	Si	Quartz	-10.030	Quartz	6.520
			0.337	Al	MnO2	0.078	MnO2	0.084
					TiO2	1.223	TiO2	1.315
						100.000		100.000

Vorab Pign 2 Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	46.440	60.090	772.841	772.841	761.702	650.376	650.376	650.376	593.688	80.867	419.752
Al2O3	11.690	101.940	229.351	229.351	229.351	192.242	192.242	192.242	135.554	0.000	0.000
Fe2O3	9.920	159.700	124.233	124.233	124.233	124.233	124.233	124.233	124.233	0.000	0.000
MgO	3.310	40.320	82.093	82.093	82.093	82.093	82.093	82.093	82.093	0.000	0.000
Na2O	1.150	61.980	37.109	37.109	37.109	0.000	0.000	0.000	0.000	0.000	0.000
L O I	12.390	44.010	281.527	281.527	281.527	281.527	81.421	81.421	62.525	-450.295	-246.964
TiO2	0.890	79.900	11.139	11.139	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	12.110	56.080	215.942	211.245	200.106	200.106	0.000	0.000	0.000	0.000	0.000
K2O	0.890	94.200	18.896	18.896	18.896	18.896	18.896	18.896	0.000	0.000	0.000
P2O5	0.200	141.950	2.818	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.250	70.940	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524

Mn Oxyde	MnO2	3.524	Mn	3.524	with M. W	86.937	this gives	306.374
Apatite	Ca5(PO4)3(F,OH,Cl)	2.818	P	0.939	with M. W	502.314	this gives	471.823
Titanite	CaTi SiO5	11.139	Ti	11.139	with M. W	196.063	this gives	2183.931
Albite	NaAlSi3O8	37.109	Na	37.109	with M. W	262.225	this gives	9730.822
Calcite	CaCO3	200.106	Ca	200.106	with M. W	100.089	this gives	20028.459
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	18.896	K	18.896	with M. W	398.309	this gives	7526.437
Chlorite I		512.820	Si	128.205	with M. W	629.375	this gives	80689.063
Quartz		80.867	Si	80.867	with M. W	60.090	this gives	4859.326
Chlorite II		309.489	Al+Si	77.372	with M. W	666.261	this gives	51550.150
Quartz		419.752	Si	419.752	with M. W	60.090	this gives	25222.919

Chlorite type Ripidolite

						sum with chlorite I	125796.236	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.396	Al		sum with chlorite II	117020.916	
			0.363	Fe				
			0.240	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.375	Apatite	0.403
					Titanite	1.736	Titanite	1.866
					Albite	7.735	Albite	8.315
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	15.921	Calcite	17.115
			0.602	Fe	Muscovite	5.983	Muscovite	6.432
			0.398	Mg	Chlorite	64.143	Chlorite	44.052
M. W : molelcular weight		with Si in second bracket	0.562	Si	Quartz	3.863	Quartz	21.554
			0.438	Al	MnO2	0.244	MnO2	0.262
						100.000		100.000

Vorab Pign 2 Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	46.440	60.090	772.841	772.841	772.841	656.777	656.777	656.777	600.089	94.375	421.417
Al2O3	11.690	101.940	229.351	229.351	229.351	187.505	187.505	187.505	130.817	0.000	0.000
Fe2O3	9.920	159.700	124.233	124.233	124.233	124.233	124.233	124.233	124.233	0.000	0.000
MgO	3.310	40.320	82.093	82.093	82.093	82.093	82.093	82.093	82.093	0.000	0.000
Na2O	1.150	61.980	37.109	37.109	37.109	0.000	0.000	0.000	0.000	0.000	0.000
L O I	12.390	44.010	281.527	281.527	281.527	281.527	72.651	72.651	53.755	-451.960	-255.735
TiO2	0.890	79.900	11.139	11.139	11.139	11.139	11.139	11.139	11.139	11.139	11.139
CaO	12.110	56.080	215.942	211.245	211.245	208.876	0.000	0.000	0.000	0.000	0.000
K2O	0.890	94.200	18.896	18.896	18.896	18.896	18.896	18.896	0.000	0.000	0.000
P2O5	0.200	141.950	2.818	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.250	70.940	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524

Rutile	TiO2	11.139	Ti	11.139	with M. W	79.899	this gives	889.987
Mn Oxyde	MnO2	3.524	Mn	3.524	with M. W	86.937	this gives	306.374
Apatite	Ca5(PO4)3(F,OH,Cl)	2.818	P	0.939	with M. W	502.314	this gives	471.823
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	37.109	Na	37.109	with M. W	262.225	this gives	9730.822
Calcite	CaCO3	208.876	Ca	208.876	with M. W	100.089	this gives	20906.270
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	18.896	K	18.896	with M. W	398.309	this gives	7526.437
Chlorite I		505.714	Si	126.429	with M. W	630.205	this gives	79675.960
Quartz		94.375	Si	94.375	with M. W	60.090	this gives	5670.996
Chlorite II		309.489	Al+Si	77.372	with M. W	666.328	this gives	51555.382
Quartz		421.417	Si	421.417	with M. W	60.090	this gives	25322.930

Chlorite type Ripidolite

						sum with chlorite I	125178.669	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.388	Al		sum with chlorite II	116710.025	
			0.368	Fe				
			0.243	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.377	Apatite	0.404
					Titanite	0.000	Titanite	0.000
					Albite	7.774	Albite	8.338
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	16.701	Calcite	17.913
			0.602	Fe	Muscovite	6.013	Muscovite	6.449
			0.398	Mg	Chlorite	63.650	Chlorite	44.174
M. W : molelcular weight		with Si in second bracket	0.577	Si	Quartz	4.530	Quartz	21.697
			0.423	Al	MnO2	0.245	MnO2	0.263
					TiO2	0.711	TiO2	0.763
						100.000		100.000

Vorab Pign 2 Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	46.440	60.090	772.841	772.841	772.841	653.268	653.268	653.268	596.580	96.130	414.399
Al2O3	11.690	101.940	229.351	229.351	229.351	183.995	183.995	183.995	127.308	0.000	0.000
Fe2O3	9.920	159.700	124.233	124.233	124.233	124.233	124.233	124.233	124.233	0.000	0.000
MgO	3.310	40.320	82.093	82.093	82.093	82.093	82.093	82.093	82.093	0.000	0.000
Na2O	1.150	61.980	37.109	37.109	37.109	0.000	0.000	0.000	0.000	0.000	0.000
L O I	12.390	44.010	281.527	281.527	281.527	281.527	74.405	74.405	55.509	-444.942	-253.980
TiO2	0.890	79.900	11.139	11.139	11.139	11.139	11.139	11.139	11.139	11.139	11.139
CaO	12.110	56.080	215.942	211.245	211.245	207.122	0.000	0.000	0.000	0.000	0.000
K2O	0.890	94.200	18.896	18.896	18.896	18.896	18.896	18.896	0.000	0.000	0.000
P2O5	0.200	141.950	2.818	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.250	70.940	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524	3.524

Rutile	TiO2	11.139	Ti	11.139	with M. W	79.899	this gives	889.987
Mn Oxyde	MnO2	3.524	Mn	3.524	with M. W	86.937	this gives	306.374
Apatite	Ca5(PO4)3(F,OH,Cl)	2.818	P	0.939	with M. W	502.314	this gives	471.823
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	37.109	Na	37.109	with M. W	262.225	this gives	9730.822
Calcite	CaCO3	207.122	Ca	207.122	with M. W	100.089	this gives	20730.658
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	18.896	K	18.896	with M. W	398.309	this gives	7526.437
Chlorite I		500.451	Si	125.113	with M. W	630.836	this gives	78925.513
Quartz		96.130	Si	96.130	with M. W	60.090	this gives	5776.427
Chlorite II		309.489	Al+Si	77.372	with M. W	666.379	this gives	51559.258
Quartz		414.399	Si	414.399	with M. W	60.090	this gives	24901.206

Chlorite type Ripidolite

						sum with chlorite I	124358.042	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.382	Al		sum with chlorite II	116116.565	
			0.372	Fe				
			0.246	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.379	Apatite	0.406
					Titanite	0.000	Titanite	0.000
					Albite	7.825	Albite	8.380
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	16.670	Calcite	17.853
			0.602	Fe	Muscovite	6.052	Muscovite	6.482
			0.398	Mg	Chlorite	63.466	Chlorite	44.403
M. W : molelcular weight		with Si in second bracket	0.589	Si	Quartz	4.645	Quartz	21.445
			0.411	Al	MnO2	0.246	MnO2	0.264
					TiO2	0.716	TiO2	0.766
						100.000		100.000

Vorab Pign 3 Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	48.050	60.090	799.634	799.634	784.365	428.121	428.121	428.121	399.458	-184.232	183.459
Al2O3	15.010	101.940	294.487	294.487	294.487	175.739	175.739	175.739	147.077	0.000	0.000
Fe2O3	8.990	159.700	112.586	112.586	112.586	112.586	112.586	112.586	112.586	0.000	0.000
MgO	5.220	40.320	129.464	129.464	129.464	129.464	129.464	129.464	129.464	0.000	0.000
Na2O	3.680	61.980	118.748	118.748	118.748	0.000	0.000	0.000	0.000	0.000	0.000
L O I	9.120	44.010	207.226	207.226	207.226	207.226	94.449	94.449	84.895	-498.795	-278.180
TiO2	1.220	79.900	15.269	15.269	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	7.510	56.080	133.916	128.045	112.776	112.776	0.000	0.000	0.000	0.000	0.000
K2O	0.450	94.200	9.554	9.554	9.554	9.554	9.554	9.554	0.000	0.000	0.000
P2O5	0.250	141.950	3.522	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.140	70.940	1.973	1.973	1.973	1.973	1.973	1.973	1.973	1.973	1.973

Mn Oxyde	MnO2	1.973	Mn	1.973	with M. W	86.937	this gives	171.570
Apatite	Ca5(PO4)3(F,OH,Cl)	3.522	P	1.174	with M. W	502.314	this gives	589.778
Titanite	CaTi SiO5	15.269	Ti	15.269	with M. W	196.063	this gives	2993.703
Albite	NaAlSi3O8	118.748	Na	118.748	with M. W	262.225	this gives	31138.632
Calcite	CaCO3	112.776	Ca	112.776	with M. W	100.089	this gives	11287.673
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	9.554	K	9.554	with M. W	398.309	this gives	3805.502
Chlorite I		583.690	Si	145.923	with M. W	615.067	this gives	89752.171
Quartz		-184.232	Si	-184.232	with M. W	60.090	this gives	-11070.499
Chlorite II		363.076	Al+Si	90.769	with M. W	640.487	this gives	58136.340
Quartz		183.459	Si	183.459	with M. W	60.090	this gives	11024.075

Chlorite type Ripidolite

sum with chlorite I	128668.529
sum with chlorite II	119147.274

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.378	Al
			0.289	Fe
			0.333	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.465	Fe
			0.535	Mg
M. W : molelcular weight		with Si in second bracket	0.595	Si
			0.405	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.458	Apatite	0.495
Titanite	2.327	Titanite	2.513
Albite	24.201	Albite	26.135
Calcite	8.773	Calcite	9.474
Muscovite	2.958	Muscovite	3.194
Chlorite	69.755	Chlorite	48.794
Quartz	-8.604	Quartz	9.252
MnO2	0.133	MnO2	0.144
	100.000		100.000

Vorab Pign 3 Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	48.050	60.090	799.634	799.634	799.634	428.231	428.231	428.231	399.568	-161.383	168.410
Al2O3	15.010	101.940	294.487	294.487	294.487	160.580	160.580	160.580	131.917	0.000	0.000
Fe2O3	8.990	159.700	112.586	112.586	112.586	112.586	112.586	112.586	112.586	0.000	0.000
MgO	5.220	40.320	129.464	129.464	129.464	129.464	129.464	129.464	129.464	0.000	0.000
Na2O	3.680	61.980	118.748	118.748	118.748	0.000	0.000	0.000	0.000	0.000	0.000
L O I	9.120	44.010	207.226	207.226	207.226	207.226	86.760	86.760	77.206	-483.745	-285.870
TiO2	1.220	79.900	15.269	15.269	15.269	15.269	15.269	15.269	15.269	15.269	15.269
CaO	7.510	56.080	133.916	128.045	128.045	120.466	0.000	0.000	0.000	0.000	0.000
K2O	0.450	94.200	9.554	9.554	9.554	9.554	9.554	9.554	0.000	0.000	0.000
P2O5	0.250	141.950	3.522	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.140	70.940	1.973	1.973	1.973	1.973	1.973	1.973	1.973	1.973	1.973

Rutile	TiO2	15.269	Ti	15.269	with M. W	79.899	this gives	1219.982
Mn Oxyde	MnO2	1.973	Mn	1.973	with M. W	86.937	this gives	171.570
Apatite	Ca5(PO4)3(F,OH,Cl)	3.522	P	1.174	with M. W	502.314	this gives	589.778
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	118.748	Na	118.748	with M. W	262.225	this gives	31138.632
Calcite	CaCO3	120.466	Ca	120.466	with M. W	100.089	this gives	12057.302
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	9.554	K	9.554	with M. W	398.309	this gives	3805.502
Chlorite I		560.951	Si	140.238	with M. W	616.882	this gives	86510.241
Quartz		-161.383	Si	-161.383	with M. W	60.090	this gives	-9697.518
Chlorite II		363.076	Al+Si	90.769	with M. W	640.672	this gives	58153.084
Quartz		168.410	Si	168.410	with M. W	60.090	this gives	10119.748

Chlorite type Ripidolite

sum with chlorite I	125795.488
sum with chlorite II	117255.597

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.353	Al
			0.301	Fe
			0.346	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.465	Fe
			0.535	Mg
M. W : molelcular weight		with Si in second bracket	0.637	Si
			0.363	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.469	Apatite	0.503
Titanite	0.000	Titanite	0.000
Albite	24.753	Albite	26.556
Calcite	9.585	Calcite	10.283
Muscovite	3.025	Muscovite	3.245
Chlorite	68.771	Chlorite	49.595
Quartz	-7.709	Quartz	8.631
MnO2	0.136	MnO2	0.146
TiO2	0.970	TiO2	1.040
	100.000		100.000

Vorab Pign 3 Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	48.050	60.090	799.634	799.634	799.634	417.001	417.001	417.001	388.339	-155.769	145.952
Al2O3	15.010	101.940	294.487	294.487	294.487	149.351	149.351	149.351	120.688	0.000	0.000
Fe2O3	8.990	159.700	112.586	112.586	112.586	112.586	112.586	112.586	112.586	0.000	0.000
MgO	5.220	40.320	129.464	129.464	129.464	129.464	129.464	129.464	129.464	0.000	0.000
Na2O	3.680	61.980	118.748	118.748	118.748	0.000	0.000	0.000	0.000	0.000	0.000
L O I	9.120	44.010	207.226	207.226	207.226	207.226	92.375	92.375	82.820	-461.287	-280.255
TiO2	1.220	79.900	15.269	15.269	15.269	15.269	15.269	15.269	15.269	15.269	15.269
CaO	7.510	56.080	133.916	128.045	128.045	114.851	0.000	0.000	0.000	0.000	0.000
K2O	0.450	94.200	9.554	9.554	9.554	9.554	9.554	9.554	0.000	0.000	0.000
P2O5	0.250	141.950	3.522	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.140	70.940	1.973	1.973	1.973	1.973	1.973	1.973	1.973	1.973	1.973

Rutile	TiO2	15.269	Ti	15.269	with M. W	79.899	this gives	1219.982
Mn Oxyde	MnO2	1.973	Mn	1.973	with M. W	86.937	this gives	171.570
Apatite	Ca5(PO4)3(F,OH,Cl)	3.522	P	1.174	with M. W	502.314	this gives	589.778
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	118.748	Na	118.748	with M. W	262.225	this gives	31138.632
Calcite	CaCO3	114.851	Ca	114.851	with M. W	100.089	this gives	11495.345
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	9.554	K	9.554	with M. W	398.309	this gives	3805.502
Chlorite I		544.108	Si	136.027	with M. W	618.325	this gives	84108.812
Quartz		-155.769	Si	-155.769	with M. W	60.090	this gives	-9360.139
Chlorite II		363.076	Al+Si	90.769	with M. W	640.809	this gives	58165.487
Quartz		145.952	Si	145.952	with M. W	60.090	this gives	8770.232

Chlorite type Ripidolite

sum with chlorite I	123169.481
sum with chlorite II	115356.527

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.333	Al
			0.310	Fe
			0.357	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.465	Fe
			0.535	Mg
M. W : molelcular weight		with Si in second bracket	0.668	Si
			0.332	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.479	Apatite	0.511
Titanite	0.000	Titanite	0.000
Albite	25.281	Albite	26.993
Calcite	9.333	Calcite	9.965
Muscovite	3.090	Muscovite	3.299
Chlorite	68.287	Chlorite	50.422
Quartz	-7.599	Quartz	7.603
MnO2	0.139	MnO2	0.149
TiO2	0.990	TiO2	1.058
	100.000		100.000

Vorab Pign 4

Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	58.440	60.090	972.541	972.541	970.040	610.892	610.892	610.892	410.892	84.488	357.888
Al2O3	21.870	101.940	429.076	429.076	429.076	309.360	309.360	309.360	109.360	0.000	0.000
Fe2O3	6.940	159.700	86.913	86.913	86.913	86.913	86.913	86.913	86.913	0.000	0.000
MgO	0.860	40.320	21.329	21.329	21.329	21.329	21.329	21.329	21.329	0.000	0.000
Na2O	3.710	61.980	119.716	119.716	119.716	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.840	44.010	64.531	64.531	64.531	64.531	64.531	64.531	-2.136	-328.539	-164.499
TiO2	1.100	79.900	13.767	13.767	11.266	11.266	11.266	11.266	11.266	11.266	11.266
CaO	0.430	56.080	7.668	2.501	0.000	0.000	0.000	0.000	0.000	0.000	0.000
K2O	3.140	94.200	66.667	66.667	66.667	66.667	66.667	66.667	0.000	0.000	0.000
P2O5	0.220	141.950	3.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.010	70.940	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141

Mn Oxyde	TiO2	11.266	Ti	11.266	with M. W	79.899	this gives	900.118
Apatite	MnO2	0.141	Mn	0.141	with M. W	86.937	this gives	12.255
Titanite	Ca5(PO4)3(F,OH,Cl)	3.100	P	1.033	with M. W	502.314	this gives	519.005
Albite	CaTi SiO5	2.501	Ti	2.501	with M. W	196.063	this gives	490.448
Calcite	NaAlSi3O8	119.716	Na	119.716	with M. W	262.225	this gives	31392.479
Dolomite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Muscovite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Chlorite I	KAl2(AlSi3)O10(OH)2	66.667	K	66.667	with M. W	398.309	this gives	26553.948
Quartz		326.403	Si	81.601	with M. W	637.891	this gives	52052.465
Chlorite II		84.488	Si	84.488	with M. W	60.090	this gives	5076.900
Quartz		162.363	Al+Si	40.591	with M. W	703.219	this gives	28544.273
quartz restant		357.888	Si	357.888	with M. W	60.090	this gives	21505.490

Chlorite type Ripidolite

					sum with chlorite I		116997.618	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.503	Al	sum with chlorite II		109918.016	
			0.399	Fe				
			0.098	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.444	Apatite	0.472
					Titanite	0.419	Titanite	0.446
					Albite	26.832	Albite	28.560
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.000	Calcite	0.000
			0.803	Fe	Muscovite	22.696	Muscovite	24.158
			0.197	Mg	Chlorite	44.490	Chlorite	25.969
M. W : molelcular weight		with Si in second bracket	0.326	Si	Quartz	4.339	Quartz	19.565
			0.674	Al	MnO2	0.010	MnO2	0.011
					TiO2	0.769	TiO2	0.819
						100.000		100.000

Vorab Pign 4

Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	58.440	60.090	972.541	972.541	972.541	598.110	598.110	598.110	398.110	94.631	329.824
Al2O3	21.870	101.940	429.076	429.076	429.076	294.077	294.077	294.077	94.077	0.000	0.000
Fe2O3	6.940	159.700	86.913	86.913	86.913	86.913	86.913	86.913	86.913	0.000	0.000
MgO	0.860	40.320	21.329	21.329	21.329	21.329	21.329	21.329	21.329	0.000	0.000
Na2O	3.710	61.980	119.716	119.716	119.716	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.840	44.010	64.531	64.531	64.531	64.531	69.671	69.671	3.004	-300.475	-159.359
TiO2	1.100	79.900	13.767	13.767	13.767	13.767	13.767	13.767	13.767	13.767	13.767
CaO	0.430	56.080	7.668	2.501	2.501	-5.140	0.000	0.000	0.000	0.000	0.000
K2O	3.140	94.200	66.667	66.667	66.667	66.667	66.667	66.667	0.000	0.000	0.000
P2O5	0.220	141.950	3.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.010	70.940	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141

Rutile	TiO2	13.767	Ti	13.767	with M. W	79.899	this gives	1099.983
Mn Oxyde	MnO2	0.141	Mn	0.141	with M. W	86.937	this gives	12.255
Apatite	Ca5(PO4)3(F,OH,Cl)	3.100	P	1.033	with M. W	502.314	this gives	519.005
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	119.716	Na	119.716	with M. W	262.225	this gives	31392.479
Calcite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	66.667	K	66.667	with M. W	398.309	this gives	26553.948
Chlorite I		303.479	Si	75.870	with M. W	642.998	this gives	48784.107
Quartz		94.631	Si	94.631	with M. W	60.090	this gives	5686.389
Chlorite II		162.363	Al+Si	40.591	with M. W	703.635	this gives	28561.153
Quartz		329.824	Si	329.824	with M. W	60.090	this gives	19819.105

Chlorite type Ripidolite

					sum with chlorite I		114048.166	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.465	Al	sum with chlorite II		107957.929	
			0.430	Fe				
			0.105	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.455	Apatite	0.481
					Titanite	0.000	Titanite	0.000
					Albite	27.526	Albite	29.078
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.000	Calcite	0.000
			0.803	Fe	Muscovite	23.283	Muscovite	24.597
			0.197	Mg	Chlorite	42.775	Chlorite	26.456
M. W : molelcular weight		with Si in second bracket	0.421	Si	Quartz	4.986	Quartz	18.358
			0.579	Al	MnO2	0.011	MnO2	0.011
					TiO2	0.964	TiO2	1.019
						100.000		100.000

Vorab Pign 4

Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	58.440	60.090	972.541	972.541	972.541	586.790	586.790	586.790	386.790	100.292	307.182
Al2O3	21.870	101.940	429.076	429.076	429.076	282.756	282.756	282.756	82.756	0.000	0.000
Fe2O3	6.940	159.700	86.913	86.913	86.913	86.913	86.913	86.913	86.913	0.000	0.000
MgO	0.860	40.320	21.329	21.329	21.329	21.329	21.329	21.329	21.329	0.000	0.000
Na2O	3.710	61.980	119.716	119.716	119.716	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.840	44.010	64.531	64.531	64.531	64.531	75.331	75.331	8.664	-277.834	-153.699
TiO2	1.100	79.900	13.767	13.767	13.767	13.767	13.767	13.767	13.767	13.767	13.767
CaO	0.430	56.080	7.668	2.501	2.501	-10.800	0.000	0.000	0.000	0.000	0.000
K2O	3.140	94.200	66.667	66.667	66.667	66.667	66.667	66.667	0.000	0.000	0.000
P2O5	0.220	141.950	3.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.010	70.940	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141

Rutile	TiO2	13.767	Ti	13.767	with M. W	79.899	this gives	1099.983
Mn Oxyde	MnO2	0.141	Mn	0.141	with M. W	86.937	this gives	12.255
Apatite	Ca5(PO4)3(F,OH,Cl)	3.100	P	1.033	with M. W	502.314	this gives	519.005
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	119.716	Na	119.716	with M. W	262.225	this gives	31392.479
Calcite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	66.667	K	66.667	with M. W	398.309	this gives	26553.948
Chlorite I		286.498	Si	71.624	with M. W	647.308	this gives	46363.100
Quartz		100.292	Si	100.292	with M. W	60.090	this gives	6026.518
Chlorite II		162.363	Al+Si	40.591	with M. W	703.943	this gives	28573.657
Quartz		307.182	Si	307.182	with M. W	60.090	this gives	18458.587

Chlorite type Ripidolite

					sum with chlorite I		111967.289	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.433	Al	sum with chlorite II		106609.915	
			0.455	Fe				
			0.112	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.464	Apatite	0.487
					Titanite	0.000	Titanite	0.000
					Albite	28.037	Albite	29.446
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.000	Calcite	0.000
			0.803	Fe	Muscovite	23.716	Muscovite	24.908
			0.197	Mg	Chlorite	41.408	Chlorite	26.802
M. W : molelcular weight		with Si in second bracket	0.490	Si	Quartz	5.382	Quartz	17.314
			0.510	Al	MnO2	0.011	MnO2	0.011
					TiO2	0.982	TiO2	1.032
						100.000		100.000

Vorab Pign 5

Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	53.530	60.090	890.830	890.830	872.683	443.835	443.835	443.835	392.879	-200.674	165.555
Al2O3	17.350	101.940	340.396	340.396	340.396	197.447	197.447	197.447	146.492	0.000	0.000
Fe2O3	9.740	159.700	121.979	121.979	121.979	121.979	121.979	121.979	121.979	0.000	0.000
MgO	5.130	40.320	127.232	127.232	127.232	127.232	127.232	127.232	127.232	0.000	0.000
Na2O	4.430	61.980	142.949	142.949	142.949	0.000	0.000	0.000	0.000	0.000	0.000
L O I	4.760	44.010	108.157	108.157	108.157	108.157	96.795	96.795	79.810	-513.744	-294.007
TiO2	1.450	79.900	18.148	18.148	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	2.050	56.080	36.555	29.510	11.363	11.363	0.000	0.000	0.000	0.000	0.000
K2O	0.800	94.200	16.985	16.985	16.985	16.985	16.985	16.985	0.000	0.000	0.000
P2O5	0.300	141.950	4.227	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.080	70.940	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128

Mn Oxyde	MnO2	1.128	Mn	1.128	with M. W	86.937	this gives	98.040
Apatite	Ca5(PO4)3(F,OH,Cl)	4.227	P	1.409	with M. W	502.314	this gives	707.734
Titanite	CaTi SiO5	18.148	Ti	18.148	with M. W	196.063	this gives	3558.089
Albite	NaAlSi3O8	142.949	Na	142.949	with M. W	262.225	this gives	37484.820
Calcite	CaCO3	11.363	Ca	11.363	with M. W	100.089	this gives	1137.264
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	16.985	K	16.985	with M. W	398.309	this gives	6765.337
Chlorite I		593.554	Si	148.388	with M. W	618.524	this gives	91781.817
Quartz		-200.674	Si	-200.674	with M. W	60.090	this gives	-12058.519
Chlorite II		373.816	Al+Si	93.454	with M. W	645.148	this gives	60291.737
Quartz		165.555	Si	165.555	with M. W	60.090	this gives	9948.175

Chlorite type Ripidolite

						sum with chlorite I	129474.582	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.370	Al		sum with chlorite II	119991.197	
			0.308	Fe				
			0.322	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.547	Apatite	0.590
					Titanite	2.748	Titanite	2.965
					Albite	28.951	Albite	31.240
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.878	Calcite	0.948
			0.489	Fe	Muscovite	5.225	Muscovite	5.638
			0.511	Mg	Chlorite	70.888	Chlorite	50.247
M. W : molelcular weight		with Si in second bracket	0.608	Si	Quartz	-9.313	Quartz	8.291
			0.392	Al	MnO2	0.076	MnO2	0.082
						100.000		100.000

Vorab Pign 5

Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	53.530	60.090	890.830	890.830	890.830	443.734	443.734	443.734	392.778	-173.402	147.205
Al2O3	17.350	101.940	340.396	340.396	340.396	179.198	179.198	179.198	128.243	0.000	0.000
Fe2O3	9.740	159.700	121.979	121.979	121.979	121.979	121.979	121.979	121.979	0.000	0.000
MgO	5.130	40.320	127.232	127.232	127.232	127.232	127.232	127.232	127.232	0.000	0.000
Na2O	4.430	61.980	142.949	142.949	142.949	0.000	0.000	0.000	0.000	0.000	0.000
L O I	4.760	44.010	108.157	108.157	108.157	108.157	87.771	87.771	70.786	-495.394	-303.030
TiO2	1.450	79.900	18.148	18.148	18.148	18.148	18.148	18.148	18.148	18.148	18.148
CaO	2.050	56.080	36.555	29.510	29.510	20.386	0.000	0.000	0.000	0.000	0.000
K2O	0.800	94.200	16.985	16.985	16.985	16.985	16.985	16.985	0.000	0.000	0.000
P2O5	0.300	141.950	4.227	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.080	70.940	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128

Rutile	TiO2	18.148	Ti	18.148	with M. W	79.899	this gives	1449.978
Mn Oxyde	MnO2	1.128	Mn	1.128	with M. W	86.937	this gives	98.040
Apatite	Ca5(PO4)3(F,OH,Cl)	4.227	P	1.409	with M. W	502.314	this gives	707.734
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	142.949	Na	142.949	with M. W	262.225	this gives	37484.820
Calcite	CaCO3	20.386	Ca	20.386	with M. W	100.089	this gives	2040.395
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	16.985	K	16.985	with M. W	398.309	this gives	6765.337
Chlorite I		566.180	Si	141.545	with M. W	620.856	this gives	87879.168
Quartz		-173.402	Si	-173.402	with M. W	60.090	this gives	-10419.738
Chlorite II		373.816	Al+Si	93.454	with M. W	645.364	this gives	60311.893
Quartz		147.205	Si	147.205	with M. W	60.090	this gives	8845.522

Chlorite type Ripidolite

						sum with chlorite I	126005.733	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.340	Al		sum with chlorite II	117703.719	
			0.323	Fe				
			0.337	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.562	Apatite	0.601
					Titanite	0.000	Titanite	0.000
					Albite	29.749	Albite	31.847
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	1.619	Calcite	1.734
			0.489	Fe	Muscovite	5.369	Muscovite	5.748
			0.511	Mg	Chlorite	69.742	Chlorite	51.240
M. W : molelcular weight		with Si in second bracket	0.657	Si	Quartz	-8.269	Quartz	7.515
			0.343	Al	MnO2	0.078	MnO2	0.083
					TiO2	1.151	TiO2	1.232
						100.000		100.000

Vorab Pign 5

Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	53.530	60.090	890.830	890.830	890.830	430.216	430.216	430.216	379.260	-166.643	120.169
Al2O3	17.350	101.940	340.396	340.396	340.396	165.680	165.680	165.680	114.725	0.000	0.000
Fe2O3	9.740	159.700	121.979	121.979	121.979	121.979	121.979	121.979	121.979	0.000	0.000
MgO	5.130	40.320	127.232	127.232	127.232	127.232	127.232	127.232	127.232	0.000	0.000
Na2O	4.430	61.980	142.949	142.949	142.949	0.000	0.000	0.000	0.000	0.000	0.000
L O I	4.760	44.010	108.157	108.157	108.157	108.157	94.530	94.530	77.545	-468.359	-296.271
TiO2	1.450	79.900	18.148	18.148	18.148	18.148	18.148	18.148	18.148	18.148	18.148
CaO	2.050	56.080	36.555	29.510	29.510	13.627	0.000	0.000	0.000	0.000	0.000
K2O	0.800	94.200	16.985	16.985	16.985	16.985	16.985	16.985	0.000	0.000	0.000
P2O5	0.300	141.950	4.227	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.080	70.940	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128

Rutile	TiO2	18.148	Ti	18.148	with M. W	79.899	this gives	1449.978
Mn Oxyde	MnO2	1.128	Mn	1.128	with M. W	86.937	this gives	98.040
Apatite	Ca5(PO4)3(F,OH,Cl)	4.227	P	1.409	with M. W	502.314	this gives	707.734
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	142.949	Na	142.949	with M. W	262.225	this gives	37484.820
Calcite	CaCO3	13.627	Ca	13.627	with M. W	100.089	this gives	1363.908
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	16.985	K	16.985	with M. W	398.309	this gives	6765.337
Chlorite I		545.904	Si	136.476	with M. W	622.735	this gives	84988.317
Quartz		-166.643	Si	-166.643	with M. W	60.090	this gives	-10013.600
Chlorite II		373.816	Al+Si	93.454	with M. W	645.524	this gives	60326.823
Quartz		120.169	Si	120.169	with M. W	60.090	this gives	7220.969

Chlorite type Ripidolite

						sum with chlorite I	122844.534	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.315	Al		sum with chlorite II	115417.610	
			0.335	Fe				
			0.350	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.576	Apatite	0.613
					Titanite	0.000	Titanite	0.000
					Albite	30.514	Albite	32.478
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	1.110	Calcite	1.182
			0.489	Fe	Muscovite	5.507	Muscovite	5.862
			0.511	Mg	Chlorite	69.184	Chlorite	52.268
M. W : molelcular weight		with Si in second bracket	0.693	Si	Quartz	-8.151	Quartz	6.256
			0.307	Al	MnO2	0.080	MnO2	0.085
					TiO2	1.180	TiO2	1.256
						100.000		100.000

Vorab Pign 7 Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	68.160	60.090	1134.299	1134.299	1127.790	676.677	676.677	676.677	526.359	419.301	419.301
Al2O3	15.010	101.940	294.487	294.487	294.487	144.116	144.116	144.116	-6.203	0.000	0.000
Fe2O3	3.580	159.700	44.834	44.834	44.834	44.834	44.834	44.834	44.834	0.000	0.000
MgO	1.070	40.320	26.538	26.538	26.538	26.538	26.538	26.538	26.538	0.000	0.000
Na2O	4.660	61.980	150.371	150.371	150.371	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.330	44.010	52.943	52.943	52.943	52.943	35.943	35.943	-14.163	-121.221	-115.018
TiO2	0.520	79.900	6.508	6.508	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	1.450	56.080	25.856	23.508	17.000	17.000	0.000	0.000	0.000	0.000	0.000
K2O	2.360	94.200	50.106	50.106	50.106	50.106	50.106	50.106	0.000	0.000	0.000
P2O5	0.100	141.950	1.409	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.030	70.940	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423

Mn Oxyde	MnO2	0.423	Mn	0.423	with M. W	86.937	this gives	36.765
Apatite	Ca5(PO4)3(F,OH,Cl)	1.409	P	0.470	with M. W	502.314	this gives	235.911
Titanite	CaTi SiO5	6.508	Ti	6.508	with M. W	196.063	this gives	1276.005
Albite	NaAlSi3O8	150.371	Na	150.371	with M. W	262.225	this gives	39430.985
Calcite	CaCO3	17.000	Ca	17.000	with M. W	100.089	this gives	1701.470
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	50.106	K	50.106	with M. W	398.309	this gives	19957.744
Chlorite I		107.058	Si	26.764	with M. W	673.126	this gives	18015.827
Quartz		419.301	Si	419.301	with M. W	60.090	this gives	25195.799
Chlorite II		107.058	Al+Si	26.764	with M. W	673.126	this gives	18015.827
Quartz		419.301	Si	419.301	with M. W	60.090	this gives	25195.799

Chlorite type Ripidolite

						sum with chlorite I	105850.507	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	105850.507	
			0.628	Fe				
			0.372	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.223	Apatite	0.223
					Titanite	1.205	Titanite	1.205
					Albite	37.252	Albite	37.252
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	1.607	Calcite	1.607
			0.628	Fe	Muscovite	18.855	Muscovite	18.855
			0.372	Mg	Chlorite	17.020	Chlorite	17.020
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	23.803	Quartz	23.803
			0.000	Al	MnO2	0.035	MnO2	0.035
						100.000		100.000

Vorab Pign 7 Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	68.160	60.090	1134.299	1134.299	1134.299	663.989	663.989	663.989	513.671	406.613	406.613
Al2O3	15.010	101.940	294.487	294.487	294.487	124.920	124.920	124.920	-25.399	0.000	0.000
Fe2O3	3.580	159.700	44.834	44.834	44.834	44.834	44.834	44.834	44.834	0.000	0.000
MgO	1.070	40.320	26.538	26.538	26.538	26.538	26.538	26.538	26.538	0.000	0.000
Na2O	4.660	61.980	150.371	150.371	150.371	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.330	44.010	52.943	52.943	52.943	52.943	39.033	39.033	-11.073	-118.131	-92.732
TiO2	0.520	79.900	6.508	6.508	6.508	6.508	6.508	6.508	6.508	6.508	6.508
CaO	1.450	56.080	25.856	23.508	23.508	13.910	0.000	0.000	0.000	0.000	0.000
K2O	2.360	94.200	50.106	50.106	50.106	50.106	50.106	50.106	0.000	0.000	0.000
P2O5	0.100	141.950	1.409	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.030	70.940	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423

Rutile	TiO2	6.508	Ti	6.508	with M. W	79.899	this gives	519.992
Mn Oxyde	MnO2	0.423	Mn	0.423	with M. W	86.937	this gives	36.765
Apatite	Ca5(PO4)3(F,OH,Cl)	1.409	P	0.470	with M. W	502.314	this gives	235.911
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	150.371	Na	150.371	with M. W	262.225	this gives	39430.985
Calcite	CaCO3	13.910	Ca	13.910	with M. W	100.089	this gives	1392.193
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	50.106	K	50.106	with M. W	398.309	this gives	19957.744
Chlorite I		107.058	Si	26.764	with M. W	673.126	this gives	18015.827
Quartz		406.613	Si	406.613	with M. W	60.090	this gives	24433.367
Chlorite II		107.058	Al+Si	26.764	with M. W	673.126	this gives	18015.827
Quartz		406.613	Si	406.613	with M. W	60.090	this gives	24433.367

Chlorite type Ripidolite

						sum with chlorite I	104022.785	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	104022.785	
			0.628	Fe				
			0.372	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.227	Apatite	0.227
					Titanite	0.000	Titanite	0.000
					Albite	37.906	Albite	37.906
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	1.338	Calcite	1.338
			0.628	Fe	Muscovite	19.186	Muscovite	19.186
			0.372	Mg	Chlorite	17.319	Chlorite	17.319
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	23.488	Quartz	23.488
			0.000	Al	MnO2	0.035	MnO2	0.035
					TiO2	0.500	TiO2	0.500
						100.000		100.000

Vorab Pign 7 Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	68.160	60.090	1134.299	1134.299	1134.299	649.769	649.769	649.769	499.451	392.393	392.393
Al2O3	15.010	101.940	294.487	294.487	294.487	110.700	110.700	110.700	-39.618	0.000	0.000
Fe2O3	3.580	159.700	44.834	44.834	44.834	44.834	44.834	44.834	44.834	0.000	0.000
MgO	1.070	40.320	26.538	26.538	26.538	26.538	26.538	26.538	26.538	0.000	0.000
Na2O	4.660	61.980	150.371	150.371	150.371	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.330	44.010	52.943	52.943	52.943	52.943	46.143	46.143	-3.963	-111.021	-71.403
TiO2	0.520	79.900	6.508	6.508	6.508	6.508	6.508	6.508	6.508	6.508	6.508
CaO	1.450	56.080	25.856	23.508	23.508	6.800	0.000	0.000	0.000	0.000	0.000
K2O	2.360	94.200	50.106	50.106	50.106	50.106	50.106	50.106	0.000	0.000	0.000
P2O5	0.100	141.950	1.409	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.030	70.940	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423

Rutile	TiO2	6.508	Ti	6.508	with M. W	79.899	this gives	519.992
Mn Oxyde	MnO2	0.423	Mn	0.423	with M. W	86.937	this gives	36.765
Apatite	Ca5(PO4)3(F,OH,Cl)	1.409	P	0.470	with M. W	502.314	this gives	235.911
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	150.371	Na	150.371	with M. W	262.225	this gives	39430.985
Calcite	CaCO3	6.800	Ca	6.800	with M. W	100.089	this gives	680.584
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	50.106	K	50.106	with M. W	398.309	this gives	19957.744
Chlorite I		107.058	Si	26.764	with M. W	673.126	this gives	18015.827
Quartz		392.393	Si	392.393	with M. W	60.090	this gives	23578.918
Chlorite II		107.058	Al+Si	26.764	with M. W	673.126	this gives	18015.827
Quartz		392.393	Si	392.393	with M. W	60.090	this gives	23578.918

Chlorite type Ripidolite

						sum with chlorite I	102456.727	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	102456.727	
			0.628	Fe				
			0.372	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.230	Apatite	0.230
					Titanite	0.000	Titanite	0.000
					Albite	38.486	Albite	38.486
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.664	Calcite	0.664
			0.628	Fe	Muscovite	19.479	Muscovite	19.479
			0.372	Mg	Chlorite	17.584	Chlorite	17.584
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	23.014	Quartz	23.014
			0.000	Al	MnO2	0.036	MnO2	0.036
					TiO2	0.508	TiO2	0.508
						100.000		100.000

Vorab Pign 8 — Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	74.100	60.090	1233.150	1233.150	1229.521	922.648	922.648	922.648	788.890	717.800	717.800
Al2O3	11.700	101.940	229.547	229.547	229.547	127.256	127.256	127.256	-6.502	0.000	0.000
Fe2O3	2.200	159.700	27.552	27.552	27.552	27.552	27.552	27.552	27.552	0.000	0.000
MgO	0.800	40.320	19.841	19.841	19.841	19.841	19.841	19.841	19.841	0.000	0.000
Na2O	3.170	61.980	102.291	102.291	102.291	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.800	44.010	63.622	63.622	63.622	63.622	28.296	28.296	-16.290	-87.380	-80.878
TiO2	0.290	79.900	3.630	3.630	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	2.290	56.080	40.835	38.956	35.326	35.326	0.000	0.000	0.000	0.000	0.000
K2O	2.100	94.200	44.586	44.586	44.586	44.586	44.586	44.586	0.000	0.000	0.000
P2O5	0.080	141.950	1.127	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.050	70.940	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705

Mn Oxyde	MnO2	0.705	Mn	0.705	with M. W	86.937	this gives	61.275
Apatite	Ca5(PO4)3(F,OH,Cl)	1.127	P	0.376	with M. W	502.314	this gives	188.729
Titanite	CaTi SiO5	3.630	Ti	3.630	with M. W	196.063	this gives	711.618
Albite	NaAlSi3O8	102.291	Na	102.291	with M. W	262.225	this gives	26823.224
Calcite	CaCO3	35.326	Ca	35.326	with M. W	100.089	this gives	3535.790
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	44.586	K	44.586	with M. W	398.309	this gives	17759.010
Chlorite I		71.089	Si	17.772	with M. W	664.265	this gives	11805.555
Quartz		717.800	Si	717.800	with M. W	60.090	this gives	43132.614
Chlorite II		71.089	Al+Si	17.772	with M. W	664.265	this gives	11805.555
Quartz		717.800	Si	717.800	with M. W	60.090	this gives	43132.614

Chlorite type Ripidolite								
						sum with chlorite I	104017.814	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	104017.814	
			0.581	Fe				
			0.419	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.181	Apatite	0.181
					Titanite	0.684	Titanite	0.684
					Albite	25.787	Albite	25.787
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	3.399	Calcite	3.399
			0.581	Fe	Muscovite	17.073	Muscovite	17.073
			0.419	Mg	Chlorite	11.350	Chlorite	11.350
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	41.467	Quartz	41.467
			0.000	Al	MnO2	0.059	MnO2	0.059
						100.000		100.000

Vorab Pign 8 — Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	74.100	60.090	1233.150	1233.150	1233.150	913.219	913.219	913.219	779.461	708.371	708.371
Al2O3	11.700	101.940	229.547	229.547	229.547	114.197	114.197	114.197	-19.561	0.000	0.000
Fe2O3	2.200	159.700	27.552	27.552	27.552	27.552	27.552	27.552	27.552	0.000	0.000
MgO	0.800	40.320	19.841	19.841	19.841	19.841	19.841	19.841	19.841	0.000	0.000
Na2O	3.170	61.980	102.291	102.291	102.291	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.800	44.010	63.622	63.622	63.622	63.622	31.195	31.195	-13.391	-84.480	-64.920
TiO2	0.290	79.900	3.630	3.630	3.630	3.630	3.630	3.630	3.630	3.630	3.630
CaO	2.290	56.080	40.835	38.956	38.956	32.427	0.000	0.000	0.000	0.000	0.000
K2O	2.100	94.200	44.586	44.586	44.586	44.586	44.586	44.586	0.000	0.000	0.000
P2O5	0.080	141.950	1.127	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.050	70.940	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705

Rutile	TiO2	3.630	Ti	3.630	with M. W	79.899	this gives	289.996
Mn Oxyde	MnO2	0.705	Mn	0.705	with M. W	86.937	this gives	61.275
Apatite	Ca5(PO4)3(F,OH,Cl)	1.127	P	0.376	with M. W	502.314	this gives	188.729
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	102.291	Na	102.291	with M. W	262.225	this gives	26823.224
Calcite	CaCO3	32.427	Ca	32.427	with M. W	100.089	this gives	3245.563
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	44.586	K	44.586	with M. W	398.309	this gives	17759.010
Chlorite I		71.089	Si	17.772	with M. W	664.265	this gives	11805.555
Quartz		708.371	Si	708.371	with M. W	60.090	this gives	42566.031
Chlorite II		71.089	Al+Si	17.772	with M. W	664.265	this gives	11805.555
Quartz		708.371	Si	708.371	with M. W	60.090	this gives	42566.031

Chlorite type Ripidolite								
						sum with chlorite I	102739.382	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	102739.382	
			0.581	Fe				
			0.419	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.184	Apatite	0.184
					Titanite	0.000	Titanite	0.000
					Albite	26.108	Albite	26.108
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	3.159	Calcite	3.159
			0.581	Fe	Muscovite	17.285	Muscovite	17.285
			0.419	Mg	Chlorite	11.491	Chlorite	11.491
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	41.431	Quartz	41.431
			0.000	Al	MnO2	0.060	MnO2	0.060
					TiO2	0.282	TiO2	0.282
						100.000		100.000

Vorab Pign 8

Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	68.070	60.090	1132.801	1132.801	1125.792	660.158	660.158	660.158	513.024	398.486	398.486
Al2O3	15.200	101.940	298.215	298.215	298.215	143.003	143.003	143.003	-4.130	0.000	0.000
Fe2O3	3.800	159.700	47.589	47.589	47.589	47.589	47.589	47.589	47.589	0.000	0.000
MgO	1.160	40.320	28.770	28.770	28.770	28.770	28.770	28.770	28.770	0.000	0.000
Na2O	4.810	61.980	155.211	155.211	155.211	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.200	44.010	49.989	49.989	49.989	49.989	34.738	34.738	-14.307	-128.845	-124.715
TiO2	0.560	79.900	7.009	7.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	1.380	56.080	24.608	22.259	15.251	15.251	0.000	0.000	0.000	0.000	0.000
K2O	2.310	94.200	49.045	49.045	49.045	49.045	49.045	49.045	0.000	0.000	0.000
P2O5	0.100	141.950	1.409	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	1.409	P	0.470	with M. W	502.314	this gives	235.911
Titanite	CaTi SiO5	7.009	Ti	7.009	with M. W	196.063	this gives	1374.159
Albite	NaAlSi3O8	155.211	Na	155.211	with M. W	262.225	this gives	40700.222
Calcite	CaCO3	15.251	Ca	15.251	with M. W	100.089	this gives	1526.430
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	49.045	K	49.045	with M. W	398.309	this gives	19534.911
Chlorite I		114.539	Si	28.635	with M. W	672.190	this gives	19247.933
Quartz		398.486	Si	398.486	with M. W	60.090	this gives	23945.000
Chlorite II		114.539	Al+Si	28.635	with M. W	672.190	this gives	19247.933
Quartz		398.486	Si	398.486	with M. W	60.090	this gives	23945.000

Chlorite type Ripidolite

sum with chlorite I 106613.586
sum with chlorite II 106613.586

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al
			0.623	Fe
			0.377	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.623	Fe
			0.377	Mg
M. W : molelcular weight		with Si in second bracket	1.000	Si
			0.000	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.221	Apatite	0.221
Titanite	1.289	Titanite	1.289
Albite	38.175	Albite	38.175
Calcite	1.432	Calcite	1.432
Muscovite	18.323	Muscovite	18.323
Chlorite	18.054	Chlorite	18.054
Quartz	22.460	Quartz	22.460
MnO2	0.046	MnO2	0.046
	100.000		100.000

Vorab Pign 9

Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	68.070	60.090	1132.801	1132.801	1132.801	647.353	647.353	647.353	500.219	385.680	385.680
Al2O3	15.200	101.940	298.215	298.215	298.215	123.189	123.189	123.189	-23.945	0.000	0.000
Fe2O3	3.800	159.700	47.589	47.589	47.589	47.589	47.589	47.589	47.589	0.000	0.000
MgO	1.160	40.320	28.770	28.770	28.770	28.770	28.770	28.770	28.770	0.000	0.000
Na2O	4.810	61.980	155.211	155.211	155.211	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.200	44.010	49.989	49.989	49.989	49.989	37.636	37.636	-11.408	-125.947	-102.002
TiO2	0.560	79.900	7.009	7.009	7.009	7.009	7.009	7.009	7.009	7.009	7.009
CaO	1.380	56.080	24.608	22.259	22.259	12.352	0.000	0.000	0.000	0.000	0.000
K2O	2.310	94.200	49.045	49.045	49.045	49.045	49.045	49.045	0.000	0.000	0.000
P2O5	0.100	141.950	1.409	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Rutile	TiO2	7.009	Ti	7.009	with M. W	79.899	this gives	559.992
Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	1.409	P	0.470	with M. W	502.314	this gives	235.911
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	155.211	Na	155.211	with M. W	262.225	this gives	40700.222
Calcite	CaCO3	12.352	Ca	12.352	with M. W	100.089	this gives	1236.337
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	49.045	K	49.045	with M. W	398.309	this gives	19534.911
Chlorite I		114.539	Si	28.635	with M. W	672.190	this gives	19247.933
Quartz		385.680	Si	385.680	with M. W	60.090	this gives	23175.520
Chlorite II		114.539	Al+Si	28.635	with M. W	672.190	this gives	19247.933
Quartz		385.680	Si	385.680	with M. W	60.090	this gives	23175.520

Chlorite type Ripidolite

sum with chlorite I 104739.846
sum with chlorite II 104739.846

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al
			0.623	Fe
			0.377	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.623	Fe
			0.377	Mg
M. W : molelcular weight		with Si in second bracket	1.000	Si
			0.000	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.225	Apatite	0.225
Titanite	0.000	Titanite	0.000
Albite	38.858	Albite	38.858
Calcite	1.180	Calcite	1.180
Muscovite	18.651	Muscovite	18.651
Chlorite	18.377	Chlorite	18.377
Quartz	22.127	Quartz	22.127
MnO2	0.047	MnO2	0.047
TiO2	0.535	TiO2	0.535
	100.000		100.000

Vorab Pign 9

Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	68.070	60.090	1132.801	1132.801	1132.801	632.675	632.675	632.675	485.542	371.003	371.003
Al2O3	15.200	101.940	298.215	298.215	298.215	108.512	108.512	108.512	-38.622	0.000	0.000
Fe2O3	3.800	159.700	47.589	47.589	47.589	47.589	47.589	47.589	47.589	0.000	0.000
MgO	1.160	40.320	28.770	28.770	28.770	28.770	28.770	28.770	28.770	0.000	0.000
Na2O	4.810	61.980	155.211	155.211	155.211	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.200	44.010	49.989	49.989	49.989	49.989	44.975	44.975	-4.070	-118.608	-79.986
TiO2	0.560	79.900	7.009	7.009	7.009	7.009	7.009	7.009	7.009	7.009	7.009
CaO	1.380	56.080	24.608	22.259	22.259	5.014	0.000	0.000	0.000	0.000	0.000
K2O	2.310	94.200	49.045	49.045	49.045	49.045	49.045	49.045	0.000	0.000	0.000
P2O5	0.100	141.950	1.409	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Rutile	TiO2	7.009	Ti	7.009	with M. W	79.899	this gives	559.992
Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	1.409	P	0.470	with M. W	502.314	this gives	235.911
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	155.211	Na	155.211	with M. W	262.225	this gives	40700.222
Calcite	CaCO3	5.014	Ca	5.014	with M. W	100.089	this gives	501.822
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	49.045	K	49.045	with M. W	398.309	this gives	19534.911
Chlorite I		114.539	Si	28.635	with M. W	672.190	this gives	19247.933
Quartz		371.003	Si	371.003	with M. W	60.090	this gives	22293.567
Chlorite II		114.539	Al+Si	28.635	with M. W	672.190	this gives	19247.933
Quartz		371.003	Si	371.003	with M. W	60.090	this gives	22293.567

Chlorite type Ripidolite

sum with chlorite I 103123.378
sum with chlorite II 103123.378

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al
			0.623	Fe
			0.377	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.623	Fe
			0.377	Mg
M. W : molelcular weight		with Si in second bracket	1.000	Si
			0.000	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.229	Apatite	0.229
Titanite	0.000	Titanite	0.000
Albite	39.468	Albite	39.468
Calcite	0.487	Calcite	0.487
Muscovite	18.943	Muscovite	18.943
Chlorite	18.665	Chlorite	18.665
Quartz	21.618	Quartz	21.618
MnO2	0.048	MnO2	0.048
TiO2	0.543	TiO2	0.543
	100.000		100.000

Kärpf 1 Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	66.410	60.090	1105.176	1105.176	1096.915	1046.576	1046.576	1046.576	838.296	538.004	720.891
Al2O3	15.200	101.940	298.215	298.215	298.215	281.435	281.435	281.435	73.155	0.000	0.000
Fe2O3	6.520	159.700	81.653	81.653	81.653	81.653	81.653	81.653	81.653	0.000	0.000
MgO	1.830	40.320	45.387	45.387	45.387	45.387	45.387	45.387	45.387	0.000	0.000
Na2O	0.520	61.980	16.780	16.780	16.780	0.000	0.000	0.000	0.000	0.000	0.000
L O I	3.600	44.010	81.800	81.800	81.800	81.800	72.119	72.119	2.692	-297.600	-187.868
TiO2	0.660	79.900	8.260	8.260	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	1.230	56.080	21.933	17.941	9.681	9.681	0.000	0.000	0.000	0.000	0.000
K2O	3.270	94.200	69.427	69.427	69.427	69.427	69.427	69.427	0.000	0.000	0.000
P2O5	0.170	141.950	2.395	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.050	70.940	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705

Mn Oxyde	MnO2	0.705	Mn	0.705	with M. W	86.937	this gives	61.275
Apatite	Ca5(PO4)3(F,OH,Cl)	2.395	P	0.798	with M. W	502.314	this gives	401.049
Titanite	CaTi SiO5	8.260	Ti	8.260	with M. W	196.063	this gives	1619.544
Albite	NaAlSi3O8	16.780	Na	16.780	with M. W	262.225	this gives	4400.024
Calcite	CaCO3	9.681	Ca	9.681	with M. W	100.089	this gives	968.925
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	69.427	K	69.427	with M. W	398.309	this gives	27653.315
Chlorite I		300.292	Si	75.073	with M. W	637.295	this gives	47843.646
Quartz		538.004	Si	538.004	with M. W	60.090	this gives	32328.660
Chlorite II		190.560	Al+Si	47.640	with M. W	674.185	this gives	32118.168
Quartz		720.891	Si	720.891	with M. W	60.090	this gives	43318.337

Chlorite type Ripidolite

					sum with chlorite I		115276.438	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.365	Al	sum with chlorite II		110540.637	
			0.408	Fe				
			0.227	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.348	Apatite	0.363
					Titanite	1.405	Titanite	1.465
					Albite	3.817	Albite	3.980
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.841	Calcite	0.877
			0.643	Fe	Muscovite	23.989	Muscovite	25.016
			0.357	Mg	Chlorite	41.503	Chlorite	29.056
M. W : molelcular weight		with Si in second bracket	0.616	Si	Quartz	28.044	Quartz	39.188
			0.384	Al	MnO2	0.053	MnO2	0.055
						100.000		100.000

Kärpf 1 Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	66.410	60.090	1105.176	1105.176	1105.176	1052.695	1052.695	1052.695	844.414	547.335	724.867
Al2O3	15.200	101.940	298.215	298.215	298.215	279.293	279.293	279.293	71.013	0.000	0.000
Fe2O3	6.520	159.700	81.653	81.653	81.653	81.653	81.653	81.653	81.653	0.000	0.000
MgO	1.830	40.320	45.387	45.387	45.387	45.387	45.387	45.387	45.387	0.000	0.000
Na2O	0.520	61.980	16.780	16.780	16.780	0.000	0.000	0.000	0.000	0.000	0.000
L O I	3.600	44.010	81.800	81.800	81.800	81.800	64.930	64.930	-4.497	-301.576	-195.057
TiO2	0.660	79.900	8.260	8.260	8.260	8.260	8.260	8.260	8.260	8.260	8.260
CaO	1.230	56.080	21.933	17.941	17.941	16.870	0.000	0.000	0.000	0.000	0.000
K2O	3.270	94.200	69.427	69.427	69.427	69.427	69.427	69.427	0.000	0.000	0.000
P2O5	0.170	141.950	2.395	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.050	70.940	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705

Rutile	TiO2	8.260	Ti	8.260	with M. W	79.899	this gives	659.990
Mn Oxyde	MnO2	0.705	Mn	0.705	with M. W	86.937	this gives	61.275
Apatite	Ca5(PO4)3(F,OH,Cl)	2.395	P	0.798	with M. W	502.314	this gives	401.049
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	16.780	Na	16.780	with M. W	262.225	this gives	4400.024
Calcite	CaCO3	16.870	Ca	16.870	with M. W	100.089	this gives	1688.495
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	69.427	K	69.427	with M. W	398.309	this gives	27653.315
Chlorite I		297.079	Si	74.270	with M. W	638.019	this gives	47385.547
Quartz		547.335	Si	547.335	with M. W	60.090	this gives	32889.382
Chlorite II		190.560	Al+Si	47.640	with M. W	674.235	this gives	32120.534
Quartz		724.867	Si	724.867	with M. W	60.090	this gives	43557.265

Chlorite type Ripidolite

					sum with chlorite I		115139.077	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.359	Al	sum with chlorite II		110541.947	
			0.412	Fe				
			0.229	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.348	Apatite	0.363
					Titanite	0.000	Titanite	0.000
					Albite	3.821	Albite	3.980
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	1.466	Calcite	1.527
			0.643	Fe	Muscovite	24.017	Muscovite	25.016
			0.357	Mg	Chlorite	41.155	Chlorite	29.057
M. W : molelcular weight		with Si in second bracket	0.627	Si	Quartz	28.565	Quartz	39.403
			0.373	Al	MnO2	0.053	MnO2	0.055
					TiO2	0.573	TiO2	0.597
						100.000		100.000

Kärpf 1 Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	66.410	60.090	1105.176	1105.176	1105.176	1051.108	1051.108	1051.108	842.828	548.129	721.694
Al2O3	15.200	101.940	298.215	298.215	298.215	277.706	277.706	277.706	69.426	0.000	0.000
Fe2O3	6.520	159.700	81.653	81.653	81.653	81.653	81.653	81.653	81.653	0.000	0.000
MgO	1.830	40.320	45.387	45.387	45.387	45.387	45.387	45.387	45.387	0.000	0.000
Na2O	0.520	61.980	16.780	16.780	16.780	0.000	0.000	0.000	0.000	0.000	0.000
L O I	3.600	44.010	81.800	81.800	81.800	81.800	65.723	65.723	-3.704	-298.403	-194.264
TiO2	0.660	79.900	8.260	8.260	8.260	8.260	8.260	8.260	8.260	8.260	8.260
CaO	1.230	56.080	21.933	17.941	17.941	16.077	0.000	0.000	0.000	0.000	0.000
K2O	3.270	94.200	69.427	69.427	69.427	69.427	69.427	69.427	0.000	0.000	0.000
P2O5	0.170	141.950	2.395	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.050	70.940	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705

Rutile	TiO2	8.260	Ti	8.260	with M. W	79.899	this gives	659.990
Mn Oxyde	MnO2	0.705	Mn	0.705	with M. W	86.937	this gives	61.275
Apatite	Ca5(PO4)3(F,OH,Cl)	2.395	P	0.798	with M. W	502.314	this gives	401.049
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	16.780	Na	16.780	with M. W	262.225	this gives	4400.024
Calcite	CaCO3	16.077	Ca	16.077	with M. W	100.089	this gives	1609.088
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	69.427	K	69.427	with M. W	398.309	this gives	27653.315
Chlorite I		294.699	Si	73.675	with M. W	638.566	this gives	47046.215
Quartz		548.129	Si	548.129	with M. W	60.090	this gives	32937.055
Chlorite II		190.560	Al+Si	47.640	with M. W	674.271	this gives	32122.287
Quartz		721.694	Si	721.694	with M. W	60.090	this gives	43366.572

Chlorite type Ripidolite

					sum with chlorite I		114768.011	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.353	Al	sum with chlorite II		110273.600	
			0.416	Fe				
			0.231	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.349	Apatite	0.364
					Titanite	0.000	Titanite	0.000
					Albite	3.834	Albite	3.990
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	1.402	Calcite	1.459
			0.643	Fe	Muscovite	24.095	Muscovite	25.077
			0.357	Mg	Chlorite	40.992	Chlorite	29.130
M. W : molelcular weight		with Si in second bracket	0.636	Si	Quartz	28.699	Quartz	39.326
			0.364	Al	MnO2	0.053	MnO2	0.056
					TiO2	0.575	TiO2	0.599
						100.000		100.000

Table 6

Kärpf 2

Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	61.170	60.090	1017.973	1017.973	1010.714	947.790	947.790	947.790	768.173	506.833	661.621
Al2O3	13.380	101.940	262.507	262.507	262.507	241.533	241.533	241.533	61.915	0.000	0.000
Fe2O3	5.740	159.700	71.885	71.885	71.885	71.885	71.885	71.885	71.885	0.000	0.000
MgO	1.630	40.320	40.427	40.427	40.427	40.427	40.427	40.427	40.427	0.000	0.000
Na2O	0.650	61.980	20.975	20.975	20.975	0.000	0.000	0.000	0.000	0.000	0.000
L O I	7.080	44.010	160.873	160.873	160.873	160.873	62.694	62.694	2.821	-258.519	-165.646
TiO2	0.580	79.900	7.259	7.259	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	6.150	56.080	109.665	105.438	98.179	98.179	0.000	0.000	0.000	0.000	0.000
K2O	2.820	94.200	59.873	59.873	59.873	59.873	59.873	59.873	0.000	0.000	0.000
P2O5	0.180	141.950	2.536	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.080	70.940	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128

Mn Oxyde	MnO2	1.128	Mn	1.128	with M. W	86.937	this gives	98.040
Apatite	Ca5(PO4)3(F,OH,Cl)	2.536	P	0.845	with M. W	502.314	this gives	424.640
Titanite	CaTi SiO5	7.259	Ti	7.259	with M. W	196.063	this gives	1423.236
Albite	NaAlSi3O8	20.975	Na	20.975	with M. W	262.225	this gives	5500.030
Calcite	CaCO3	98.179	Ca	98.179	with M. W	100.089	this gives	9826.643
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	59.873	K	59.873	with M. W	398.309	this gives	23847.813
Chlorite I		261.340	Si	65.335	with M. W	638.028	this gives	41685.484
Quartz		506.833	Si	506.833	with M. W	60.090	this gives	30455.597
Chlorite II		168.467	Al+Si	42.117	with M. W	673.749	this gives	28376.125
Quartz		661.621	Si	661.621	with M. W	60.090	this gives	39756.780

Chlorite type Ripidolite

sum with chlorite I 113261.483
sum with chlorite II 109253.307

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.355	Al
			0.413	Fe
			0.232	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.640	Fe
			0.360	Mg
M. W : molelcular weight		with Si in second bracket	0.632	Si
			0.368	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.375	Apatite	0.389
Titanite	1.257	Titanite	1.303
Albite	4.856	Albite	5.034
Calcite	8.676	Calcite	8.994
Muscovite	21.056	Muscovite	21.828
Chlorite	36.805	Chlorite	25.973
Quartz	26.890	Quartz	36.390
MnO2	0.087	MnO2	0.090
	100.000		100.000

Kärpf 2

Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	61.170	60.090	1017.973	1017.973	1017.973	952.372	952.372	952.372	772.754	515.431	663.524
Al2O3	13.380	101.940	262.507	262.507	262.507	238.855	238.855	238.855	59.237	0.000	0.000
Fe2O3	5.740	159.700	71.885	71.885	71.885	71.885	71.885	71.885	71.885	0.000	0.000
MgO	1.630	40.320	40.427	40.427	40.427	40.427	40.427	40.427	40.427	0.000	0.000
Na2O	0.650	61.980	20.975	20.975	20.975	0.000	0.000	0.000	0.000	0.000	0.000
L O I	7.080	44.010	160.873	160.873	160.873	160.873	56.773	56.773	-3.099	-260.422	-171.566
TiO2	0.580	79.900	7.259	7.259	7.259	7.259	7.259	7.259	7.259	7.259	7.259
CaO	6.150	56.080	109.665	105.438	105.438	104.099	0.000	0.000	0.000	0.000	0.000
K2O	2.820	94.200	59.873	59.873	59.873	59.873	59.873	59.873	0.000	0.000	0.000
P2O5	0.180	141.950	2.536	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.080	70.940	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128

Rutile	TiO2	7.259	Ti	7.259	with M. W	79.899	this gives	579.991
Mn Oxyde	MnO2	1.128	Mn	1.128	with M. W	86.937	this gives	98.040
Apatite	Ca5(PO4)3(F,OH,Cl)	2.536	P	0.845	with M. W	502.314	this gives	424.640
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	20.975	Na	20.975	with M. W	262.225	this gives	5500.030
Calcite	CaCO3	104.099	Ca	104.099	with M. W	100.089	this gives	10419.198
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	59.873	K	59.873	with M. W	398.309	this gives	23847.813
Chlorite I		257.323	Si	64.331	with M. W	639.085	this gives	41112.861
Quartz		515.431	Si	515.431	with M. W	60.090	this gives	30972.243
Chlorite II		168.467	Al+Si	42.117	with M. W	673.819	this gives	28379.082
Quartz		663.524	Si	663.524	with M. W	60.090	this gives	39871.184

Chlorite type Ripidolite

sum with chlorite I 112954.816
sum with chlorite II 109119.979

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.345	Al
			0.419	Fe
			0.236	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.640	Fe
			0.360	Mg
M. W : molelcular weight		with Si in second bracket	0.648	Si
			0.352	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.376	Apatite	0.389
Titanite	0.000	Titanite	0.000
Albite	4.869	Albite	5.040
Calcite	9.224	Calcite	9.548
Muscovite	21.113	Muscovite	21.855
Chlorite	36.398	Chlorite	26.007
Quartz	27.420	Quartz	36.539
MnO2	0.087	MnO2	0.090
TiO2	0.513	TiO2	0.532
	100.000		100.000

Kärpf 2

Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	61.170	60.090	1017.973	1017.973	1017.973	950.389	950.389	950.389	770.771	516.423	659.558
Al2O3	13.380	101.940	262.507	262.507	262.507	236.872	236.872	236.872	57.254	0.000	0.000
Fe2O3	5.740	159.700	71.885	71.885	71.885	71.885	71.885	71.885	71.885	0.000	0.000
MgO	1.630	40.320	40.427	40.427	40.427	40.427	40.427	40.427	40.427	0.000	0.000
Na2O	0.650	61.980	20.975	20.975	20.975	0.000	0.000	0.000	0.000	0.000	0.000
L O I	7.080	44.010	160.873	160.873	160.873	160.873	57.765	57.765	-2.108	-256.456	-170.575
TiO2	0.580	79.900	7.259	7.259	7.259	7.259	7.259	7.259	7.259	7.259	7.259
CaO	6.150	56.080	109.665	105.438	105.438	103.107	0.000	0.000	0.000	0.000	0.000
K2O	2.820	94.200	59.873	59.873	59.873	59.873	59.873	59.873	0.000	0.000	0.000
P2O5	0.180	141.950	2.536	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.080	70.940	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128	1.128

Rutile	TiO2	7.259	Ti	7.259	with M. W	79.899	this gives	579.991
Mn Oxyde	MnO2	1.128	Mn	1.128	with M. W	86.937	this gives	98.040
Apatite	Ca5(PO4)3(F,OH,Cl)	2.536	P	0.845	with M. W	502.314	this gives	424.640
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	20.975	Na	20.975	with M. W	262.225	this gives	5500.030
Calcite	CaCO3	103.107	Ca	103.107	with M. W	100.089	this gives	10319.940
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	59.873	K	59.873	with M. W	398.309	this gives	23847.813
Chlorite I		254.348	Si	63.587	with M. W	639.890	this gives	40688.695
Quartz		516.423	Si	516.423	with M. W	60.090	this gives	31031.834
Chlorite II		168.467	Al+Si	42.117	with M. W	673.871	this gives	28381.273
Quartz		659.558	Si	659.558	with M. W	60.090	this gives	39632.818

Chlorite type Ripidolite

sum with chlorite I 112490.984
sum with chlorite II 108784.546

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.338	Al
			0.424	Fe
			0.238	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.640	Fe
			0.360	Mg
M. W : molelcular weight		with Si in second bracket	0.660	Si
			0.340	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.377	Apatite	0.390
Titanite	0.000	Titanite	0.000
Albite	4.889	Albite	5.056
Calcite	9.174	Calcite	9.487
Muscovite	21.200	Muscovite	21.922
Chlorite	36.171	Chlorite	26.089
Quartz	27.586	Quartz	36.432
MnO2	0.087	MnO2	0.090
TiO2	0.516	TiO2	0.533
	100.000		100.000

Kärpf 3

Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	65.900	60.090	1096.688	1096.688	1096.879	1011.690	1011.690	1011.690	756.276	507.325	658.600
Al2O3	17.550	101.940	344.320	344.320	344.320	315.924	315.924	315.924	60.510	0.000	0.000
Fe2O3	5.470	159.700	68.503	68.503	68.503	68.503	68.503	68.503	68.503	0.000	0.000
MgO	1.490	40.320	36.954	36.954	36.954	36.954	36.954	36.954	36.954	0.000	0.000
Na2O	0.880	61.980	28.396	28.396	28.396	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.940	44.010	66.803	66.803	66.803	66.803	66.994	66.994	-18.144	-267.096	-176.331
TiO2	0.730	79.900	9.136	9.136	9.136	9.136	9.136	9.136	9.136	9.136	9.136
CaO	0.200	56.080	3.566	-0.191	-0.191	-0.191	-0.191	-0.191	-0.191	-0.191	-0.191
K2O	4.010	94.200	85.138	85.138	85.138	85.138	85.138	85.138	0.000	0.000	0.000
P2O5	0.160	141.950	2.254	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.030	70.940	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423

Mn Oxyde	TiO2	9.136	Ti	9.136	with M. W	79.899	this gives	729.989
Apatite	MnO2	0.423	Mn	0.423	with M. W	86.937	this gives	36.765
Titanite	Ca5(PO4)3(F,OH,Cl)	2.254	P	0.751	with M. W	502.314	this gives	377.458
Albite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Calcite	NaAlSi3O8	28.396	Na	28.396	with M. W	262.225	this gives	7446.195
Dolomite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Muscovite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Chlorite I	KAl2(AlSi3)O10(OH)2	85.138	K	85.138	with M. W	398.309	this gives	33911.252
Quartz		248.952	Si	62.238	with M. W	638.205	this gives	39720.556
Chlorite II		507.325	Si	507.325	with M. W	60.090	this gives	30485.146
Quartz		158.187	Al+Si	39.547	with M. W	675.486	this gives	26713.239
quartz restant		658.600	Si	658.600	with M. W	60.090	this gives	39575.249

Chlorite type Ripidolite

						sum with chlorite I	112707.361	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.365	Al		sum with chlorite II	108790.147	
			0.413	Fe				
			0.223	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.335	Apatite	0.347
					Titanite	0.000	Titanite	0.000
					Albite	6.607	Albite	6.845
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.000	Calcite	0.000
			0.650	Fe	Muscovite	30.088	Muscovite	31.171
			0.350	Mg	Chlorite	35.242	Chlorite	24.555
M. W : molelcular weight		with Si in second bracket	0.617	Si	Quartz	27.048	Quartz	36.378
			0.383	Al	MnO2	0.033	MnO2	0.034
					TiO2	0.648	TiO2	0.671
						100.000		100.000

Kärpf 3

Model without Titanite but with pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	65.900	60.090	1096.688	1096.688	1096.688	1011.500	1011.500	1011.500	756.086	507.134	658.409
Al2O3	17.550	101.940	344.320	344.320	344.320	315.924	315.924	315.924	60.510	0.000	0.000
Fe2O3	5.470	159.700	68.503	68.503	68.503	68.503	68.503	68.503	68.503	0.000	0.000
MgO	1.490	40.320	36.954	36.954	36.954	36.954	36.954	36.954	36.954	0.000	0.000
Na2O	0.880	61.980	28.396	28.396	28.396	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.940	44.010	66.803	66.803	66.803	66.803	66.994	66.994	-18.144	-267.096	-176.331
TiO2	0.730	79.900	9.136	9.136	9.136	9.136	9.136	9.136	9.136	9.136	9.136
CaO	0.200	56.080	3.566	-0.191	-0.191	-0.191	-0.191	-0.191	-0.191	-0.191	-0.191
K2O	4.010	94.200	85.138	85.138	85.138	85.138	85.138	85.138	0.000	0.000	0.000
P2O5	0.160	141.950	2.254	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.030	70.940	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423

Rutile	TiO2	9.136	Ti	9.136	with M. W	79.899	this gives	729.989
Mn Oxyde	MnO2	0.423	Mn	0.423	with M. W	86.937	this gives	36.765
Apatite	Ca5(PO4)3(F,OH,Cl)	2.254	P	0.751	with M. W	502.314	this gives	377.458
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	28.396	Na	28.396	with M. W	262.225	this gives	7446.195
Calcite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	85.138	K	85.138	with M. W	398.309	this gives	33911.252
Chlorite I		248.952	Si	62.238	with M. W	638.205	this gives	39720.556
Quartz		507.134	Si	507.134	with M. W	60.090	this gives	30473.678
Chlorite II		158.187	Al+Si	39.547	with M. W	675.486	this gives	26713.239
Quartz		658.409	Si	658.409	with M. W	60.090	this gives	39563.780

Chlorite type Ripidolite

						sum with chlorite I	112695.893	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.365	Al		sum with chlorite II	108778.678	
			0.413	Fe				
			0.223	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.335	Apatite	0.347
					Titanite	0.000	Titanite	0.000
					Albite	6.607	Albite	6.845
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.000	Calcite	0.000
			0.650	Fe	Muscovite	30.091	Muscovite	31.175
			0.350	Mg	Chlorite	35.246	Chlorite	24.557
M. W : molelcular weight		with Si in second bracket	0.617	Si	Quartz	27.041	Quartz	36.371
			0.383	Al	MnO2	0.033	MnO2	0.034
					TiO2	0.648	TiO2	0.671
						100.000		100.000

Kärpf 4

Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	76.290	60.090	1269.596	1269.596	1268.219	898.422	898.422	898.422	772.308	709.270	727.374
Al2O3	13.080	101.940	256.622	256.622	256.622	133.356	133.356	133.356	7.241	0.000	0.000
Fe2O3	1.510	159.700	18.910	18.910	18.910	18.910	18.910	18.910	18.910	0.000	0.000
MgO	0.640	40.320	15.873	15.873	15.873	15.873	15.873	15.873	15.873	0.000	0.000
Na2O	3.820	61.980	123.266	123.266	123.266	0.000	0.000	0.000	0.000	0.000	0.000
L O I	1.570	44.010	35.674	35.674	35.674	35.674	30.031	30.031	-12.007	-75.045	-64.183
TiO2	0.110	79.900	1.377	1.377	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	0.420	56.080	7.489	7.020	5.643	5.643	0.000	0.000	0.000	0.000	0.000
K2O	1.980	94.200	42.038	42.038	42.038	42.038	42.038	42.038	0.000	0.000	0.000
P2O5	0.020	141.950	0.282	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.030	70.940	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423

Mn Oxyde	MnO2	0.423	Mn	0.423	with M. W	86.937	this gives	36.765
Apatite	Ca5(PO4)3(F,OH,Cl)	0.282	P	0.094	with M. W	502.314	this gives	47.182
Titanite	CaTi SiO5	1.377	Ti	1.377	with M. W	196.063	this gives	269.924
Albite	NaAlSi3O8	123.266	Na	123.266	with M. W	262.225	this gives	32323.254
Calcite	CaCO3	5.643	Ca	5.643	with M. W	100.089	this gives	564.796
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	42.038	K	42.038	with M. W	398.309	this gives	16744.209
Chlorite I		63.037	Si	15.759	with M. W	642.170	this gives	10120.152
Quartz		709.270	Si	709.270	with M. W	60.090	this gives	42620.054
Chlorite II		52.175	Al+Si	13.044	with M. W	656.522	this gives	8563.545
Quartz		727.374	Si	727.374	with M. W	60.090	this gives	43707.882

Chlorite type Ripidolite

						sum with chlorite I	102726.337	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.172	Al		sum with chlorite II	102257.557	
			0.450	Fe				
			0.378	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.046	Apatite	0.046
					Titanite	0.263	Titanite	0.264
					Albite	31.465	Albite	31.610
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.550	Calcite	0.552
			0.544	Fe	Muscovite	16.300	Muscovite	16.375
			0.456	Mg	Chlorite	9.852	Chlorite	8.374
M. W : molelcular weight		with Si in second bracket	0.861	Si	Quartz	41.489	Quartz	42.743
			0.139	Al	MnO2	0.036	MnO2	0.036
						100.000		100.000

Kärpf 4

Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	76.290	60.090	1269.596	1269.596	1269.596	884.063	884.063	884.063	757.948	705.773	705.773
Al2O3	13.080	101.940	256.622	256.622	256.622	117.620	117.620	117.620	-8.495	0.000	0.000
Fe2O3	1.510	159.700	18.910	18.910	18.910	18.910	18.910	18.910	18.910	0.000	0.000
MgO	0.640	40.320	15.873	15.873	15.873	15.873	15.873	15.873	15.873	0.000	0.000
Na2O	3.820	61.980	123.266	123.266	123.266	0.000	0.000	0.000	0.000	0.000	0.000
L O I	1.570	44.010	35.674	35.674	35.674	35.674	36.522	36.522	-5.516	-57.691	-49.197
TiO2	0.110	79.900	1.377	1.377	1.377	1.377	1.377	1.377	1.377	1.377	1.377
CaO	0.420	56.080	7.489	7.020	7.020	-0.848	0.000	0.000	0.000	0.000	0.000
K2O	1.980	94.200	42.038	42.038	42.038	42.038	42.038	42.038	0.000	0.000	0.000
P2O5	0.020	141.950	0.282	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.030	70.940	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423

Rutile	TiO2	1.377	Ti	1.377	with M. W	79.899	this gives	109.998
Mn Oxyde	MnO2	0.423	Mn	0.423	with M. W	86.937	this gives	36.765
Apatite	Ca5(PO4)3(F,OH,Cl)	0.282	P	0.094	with M. W	502.314	this gives	47.182
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	123.266	Na	123.266	with M. W	262.225	this gives	32323.254
Calcite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	42.038	K	42.038	with M. W	398.309	this gives	16744.209
Chlorite I		52.175	Si	13.044	with M. W	657.135	this gives	8571.543
Quartz		705.773	Si	705.773	with M. W	60.090	this gives	42409.900
Chlorite II		52.175	Al+Si	13.044	with M. W	657.135	this gives	8571.543
Quartz		705.773	Si	705.773	with M. W	60.090	this gives	42409.900

Chlorite type Ripidolite

						sum with chlorite I	100242.851	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	100242.851	
			0.544	Fe				
			0.456	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.047	Apatite	0.047
					Titanite	0.000	Titanite	0.000
					Albite	32.245	Albite	32.245
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.000	Calcite	0.000
			0.544	Fe	Muscovite	16.704	Muscovite	16.704
			0.456	Mg	Chlorite	8.551	Chlorite	8.551
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	42.307	Quartz	42.307
			0.000	Al	MnO2	0.037	MnO2	0.037
					TiO2	0.110	TiO2	0.110
						100.000		100.000

Kärpf 4

Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	76.290	60.090	1269.596	1269.596	1269.596	872.407	872.407	872.407	746.292	694.117	694.117
Al2O3	13.080	101.940	256.622	256.622	256.622	105.964	105.964	105.964	-20.151	0.000	0.000
Fe2O3	1.510	159.700	18.910	18.910	18.910	18.910	18.910	18.910	18.910	0.000	0.000
MgO	0.640	40.320	15.873	15.873	15.873	15.873	15.873	15.873	15.873	0.000	0.000
Na2O	3.820	61.980	123.266	123.266	123.266	0.000	0.000	0.000	0.000	0.000	0.000
L O I	1.570	44.010	35.674	35.674	35.674	35.674	42.350	42.350	0.312	-51.863	-31.712
TiO2	0.110	79.900	1.377	1.377	1.377	1.377	1.377	1.377	1.377	1.377	1.377
CaO	0.420	56.080	7.489	7.020	7.020	-6.677	0.000	0.000	0.000	0.000	0.000
K2O	1.980	94.200	42.038	42.038	42.038	42.038	42.038	42.038	0.000	0.000	0.000
P2O5	0.020	141.950	0.282	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.030	70.940	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423

Rutile	TiO2	1.377	Ti	1.377	with M. W	79.899	this gives	109.998
Mn Oxyde	MnO2	0.423	Mn	0.423	with M. W	86.937	this gives	36.765
Apatite	Ca5(PO4)3(F,OH,Cl)	0.282	P	0.094	with M. W	502.314	this gives	47.182
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	123.266	Na	123.266	with M. W	262.225	this gives	32323.254
Calcite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	42.038	K	42.038	with M. W	398.309	this gives	16744.209
Chlorite I		52.175	Si	13.044	with M. W	657.135	this gives	8571.543
Quartz		694.117	Si	694.117	with M. W	60.090	this gives	41709.472
Chlorite II		52.175	Al+Si	13.044	with M. W	657.135	this gives	8571.543
Quartz		694.117	Si	694.117	with M. W	60.090	this gives	41709.472

Chlorite type Ripidolite

						sum with chlorite I	99542.423	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	99542.423	
			0.544	Fe				
			0.456	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.047	Apatite	0.047
					Titanite	0.000	Titanite	0.000
					Albite	32.472	Albite	32.472
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.000	Calcite	0.000
			0.544	Fe	Muscovite	16.821	Muscovite	16.821
			0.456	Mg	Chlorite	8.611	Chlorite	8.611
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	41.901	Quartz	41.901
			0.000	Al	MnO2	0.037	MnO2	0.037
					TiO2	0.111	TiO2	0.111
						100.000		100.000

Kärpf 5 Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	76.240	60.090	1268.764	1268.764	1267.387	1014.725	1014.725	1014.725	838.928	789.860	790.201
Al2O3	13.260	101.940	260.153	260.153	260.153	175.932	175.932	175.932	0.136	0.000	0.000
Fe2O3	1.710	159.700	21.415	21.415	21.415	21.415	21.415	21.415	21.415	0.000	0.000
MgO	0.450	40.320	11.161	11.161	11.161	11.161	11.161	11.161	11.161	0.000	0.000
Na2O	2.610	61.980	84.221	84.221	84.221	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.020	44.010	45.899	45.899	45.899	45.899	35.263	35.263	-23.336	-72.404	-72.200
TiO2	0.110	79.900	1.377	1.377	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	0.700	56.080	12.482	12.013	10.636	10.636	0.000	0.000	0.000	0.000	0.000
K2O	2.760	94.200	58.599	58.599	58.599	58.599	58.599	58.599	0.000	0.000	0.000
P2O5	0.020	141.950	0.282	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.030	70.940	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423

Mn Oxyde	MnO2	0.423	Mn	0.423	with M. W	86.937	this gives	36.765
Apatite	Ca5(PO4)3(F,OH,Cl)	0.282	P	0.094	with M. W	502.314	this gives	47.182
Titanite	CaTi SiO5	1.377	Ti	1.377	with M. W	196.063	this gives	269.924
Albite	NaAlSi3O8	84.221	Na	84.221	with M. W	262.225	this gives	22084.736
Calcite	CaCO3	10.636	Ca	10.636	with M. W	100.089	this gives	1064.529
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	58.599	K	58.599	with M. W	398.309	this gives	23340.413
Chlorite I		49.068	Si	12.267	with M. W	678.203	this gives	8319.521
Quartz		789.860	Si	789.860	with M. W	60.090	this gives	47462.715
Chlorite II		48.864	Al+Si	12.216	with M. W	678.642	this gives	8290.257
Quartz		790.201	Si	790.201	with M. W	60.090	this gives	47483.167

Chlorite type Ripidolite								
						sum with chlorite I	102625.786	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.004	Al		sum with chlorite II	102616.973	
			0.655	Fe				
			0.341	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.046	Apatite	0.046
					Titanite	0.263	Titanite	0.263
					Albite	21.520	Albite	21.522
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	1.037	Calcite	1.037
			0.657	Fe	Muscovite	22.743	Muscovite	22.745
			0.343	Mg	Chlorite	8.107	Chlorite	8.079
M. W : molelcular weight		with Si in second bracket	0.997	Si	Quartz	46.248	Quartz	46.272
			0.003	Al	MnO2	0.036	MnO2	0.036
						100.000		100.000

Kärpf 5 Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	76.240	60.090	1268.764	1268.764	1268.764	1005.350	1005.350	1005.350	829.554	780.690	780.690
Al2O3	13.260	101.940	260.153	260.153	260.153	165.181	165.181	165.181	-10.615	0.000	0.000
Fe2O3	1.710	159.700	21.415	21.415	21.415	21.415	21.415	21.415	21.415	0.000	0.000
MgO	0.450	40.320	11.161	11.161	11.161	11.161	11.161	11.161	11.161	0.000	0.000
Na2O	2.610	61.980	84.221	84.221	84.221	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.020	44.010	45.899	45.899	45.899	45.899	39.262	39.262	-19.337	-68.201	-57.585
TiO2	0.110	79.900	1.377	1.377	1.377	1.377	1.377	1.377	1.377	1.377	1.377
CaO	0.700	56.080	12.482	12.013	12.013	6.637	0.000	0.000	0.000	0.000	0.000
K2O	2.760	94.200	58.599	58.599	58.599	58.599	58.599	58.599	0.000	0.000	0.000
P2O5	0.020	141.950	0.282	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.030	70.940	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423

Rutile	TiO2	1.377	Ti	1.377	with M. W	79.899	this gives	109.998
Mn Oxyde	MnO2	0.423	Mn	0.423	with M. W	86.937	this gives	36.765
Apatite	Ca5(PO4)3(F,OH,Cl)	0.282	P	0.094	with M. W	502.314	this gives	47.182
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	84.221	Na	84.221	with M. W	262.225	this gives	22084.736
Calcite	CaCO3	6.637	Ca	6.637	with M. W	100.089	this gives	664.265
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	58.599	K	58.599	with M. W	398.309	this gives	23340.413
Chlorite I		48.864	Si	12.216	with M. W	678.654	this gives	8290.408
Quartz		780.690	Si	780.690	with M. W	60.090	this gives	46911.651
Chlorite II		48.864	Al+Si	12.216	with M. W	678.654	this gives	8290.408
Quartz		780.690	Si	780.690	with M. W	60.090	this gives	46911.651

Chlorite type Ripidolite								
						sum with chlorite I	101485.418	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	101485.418	
			0.657	Fe				
			0.343	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.046	Apatite	0.046
					Titanite	0.000	Titanite	0.000
					Albite	21.761	Albite	21.761
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.655	Calcite	0.655
			0.657	Fe	Muscovite	22.999	Muscovite	22.999
			0.343	Mg	Chlorite	8.169	Chlorite	8.169
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	46.225	Quartz	46.225
			0.000	Al	MnO2	0.036	MnO2	0.036
					TiO2	0.108	TiO2	0.108
						100.000		100.000

Kärpf 5 Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	76.240	60.090	1268.764	1268.764	1268.764	997.386	997.386	997.386	821.589	772.726	772.726
Al2O3	13.260	101.940	260.153	260.153	260.153	157.217	157.217	157.217	-18.580	0.000	0.000
Fe2O3	1.710	159.700	21.415	21.415	21.415	21.415	21.415	21.415	21.415	0.000	0.000
MgO	0.450	40.320	11.161	11.161	11.161	11.161	11.161	11.161	11.161	0.000	0.000
Na2O	2.610	61.980	84.221	84.221	84.221	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.020	44.010	45.899	45.899	45.899	45.899	43.244	43.244	-15.355	-64.219	-45.639
TiO2	0.110	79.900	1.377	1.377	1.377	1.377	1.377	1.377	1.377	1.377	1.377
CaO	0.700	56.080	12.482	12.013	12.013	2.655	0.000	0.000	0.000	0.000	0.000
K2O	2.760	94.200	58.599	58.599	58.599	58.599	58.599	58.599	0.000	0.000	0.000
P2O5	0.020	141.950	0.282	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.030	70.940	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423

Rutile	TiO2	1.377	Ti	1.377	with M. W	79.899	this gives	109.998
Mn Oxyde	MnO2	0.423	Mn	0.423	with M. W	86.937	this gives	36.765
Apatite	Ca5(PO4)3(F,OH,Cl)	0.282	P	0.094	with M. W	502.314	this gives	47.182
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	84.221	Na	84.221	with M. W	262.225	this gives	22084.736
Calcite	CaCO3	2.655	Ca	2.655	with M. W	100.089	this gives	265.703
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	58.599	K	58.599	with M. W	398.309	this gives	23340.413
Chlorite I		48.864	Si	12.216	with M. W	678.654	this gives	8290.408
Quartz		772.726	Si	772.726	with M. W	60.090	this gives	46433.086
Chlorite II		48.864	Al+Si	12.216	with M. W	678.654	this gives	8290.408
Quartz		772.726	Si	772.726	with M. W	60.090	this gives	46433.086

Chlorite type Ripidolite								
						sum with chlorite I	100608.291	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	100608.291	
			0.657	Fe				
			0.343	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.047	Apatite	0.047
					Titanite	0.000	Titanite	0.000
					Albite	21.951	Albite	21.951
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.264	Calcite	0.264
			0.657	Fe	Muscovite	23.199	Muscovite	23.199
			0.343	Mg	Chlorite	8.240	Chlorite	8.240
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	46.152	Quartz	46.152
			0.000	Al	MnO2	0.037	MnO2	0.037
					TiO2	0.109	TiO2	0.109
						100.000		100.000

Kärpf 6

Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	77.670	60.090	1292.561	1292.561	1291.310	933.130	933.130	933.130	837.588	788.468	801.455
Al2O3	11.220	101.940	220.129	220.129	220.129	100.736	100.736	100.736	5.195	0.000	0.000
Fe2O3	1.190	159.700	14.903	14.903	14.903	14.903	14.903	14.903	14.903	0.000	0.000
MgO	0.510	40.320	12.649	12.649	12.649	12.649	12.649	12.649	12.649	0.000	0.000
Na2O	3.700	61.980	119.393	119.393	119.393	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.270	44.010	51.579	51.579	51.579	51.579	23.700	23.700	-8.147	-57.267	-49.475
TiO2	0.100	79.900	1.252	1.252	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	1.660	56.080	29.601	29.131	27.879	27.879	0.000	0.000	0.000	0.000	0.000
K2O	1.500	94.200	31.847	31.847	31.847	31.847	31.847	31.847	0.000	0.000	0.000
P2O5	0.020	141.950	0.282	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	0.282	P	0.094	with M. W	502.314	this gives	47.182
Titanite	CaTi SiO5	1.252	Ti	1.252	with M. W	196.063	this gives	245.385
Albite	NaAlSi3O8	119.393	Na	119.393	with M. W	262.225	this gives	31307.863
Calcite	CaCO3	27.879	Ca	27.879	with M. W	100.089	this gives	2790.423
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	31.847	K	31.847	with M. W	398.309	this gives	12685.007
Chlorite I		49.120	Si	12.280	with M. W	642.919	this gives	7895.007
Quartz		788.468	Si	788.468	with M. W	60.090	this gives	47379.066
Chlorite II		41.328	Al+Si	10.332	with M. W	656.059	this gives	6778.338
Quartz		801.455	Si	801.455	with M. W	60.090	this gives	48159.445

Chlorite type Ripidolite

					sum with chlorite I		102398.954	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.159	Al	sum with chlorite II		102062.664	
			0.455	Fe				
			0.386	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.046	Apatite	0.046
					Titanite	0.240	Titanite	0.240
					Albite	30.574	Albite	30.675
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	2.725	Calcite	2.734
			0.541	Fe	Muscovite	12.388	Muscovite	12.429
			0.459	Mg	Chlorite	7.710	Chlorite	6.641
M. W : molelcular weight		with Si in second bracket	0.874	Si	Quartz	46.269	Quartz	47.186
			0.126	Al	MnO2	0.048	MnO2	0.048
						100.000		100.000

Kärpf 6

Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	77.670	60.090	1292.561	1292.561	1292.561	919.139	919.139	919.139	823.598	782.270	782.270
Al2O3	11.220	101.940	220.129	220.129	220.129	85.494	85.494	85.494	-10.047	0.000	0.000
Fe2O3	1.190	159.700	14.903	14.903	14.903	14.903	14.903	14.903	14.903	0.000	0.000
MgO	0.510	40.320	12.649	12.649	12.649	12.649	12.649	12.649	12.649	0.000	0.000
Na2O	3.700	61.980	119.393	119.393	119.393	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.270	44.010	51.579	51.579	51.579	51.579	30.069	30.069	-1.778	-43.106	-33.059
TiO2	0.100	79.900	1.252	1.252	1.252	1.252	1.252	1.252	1.252	1.252	1.252
CaO	1.660	56.080	29.601	29.131	29.131	21.510	0.000	0.000	0.000	0.000	0.000
K2O	1.500	94.200	31.847	31.847	31.847	31.847	31.847	31.847	0.000	0.000	0.000
P2O5	0.020	141.950	0.282	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Rutile	TiO2	1.252	Ti	1.252	with M. W	79.899	this gives	99.998
Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	0.282	P	0.094	with M. W	502.314	this gives	47.182
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	119.393	Na	119.393	with M. W	262.225	this gives	31307.863
Calcite	CaCO3	21.510	Ca	21.510	with M. W	100.089	this gives	2152.926
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	31.847	K	31.847	with M. W	398.309	this gives	12685.007
Chlorite I		41.328	Si	10.332	with M. W	656.614	this gives	6784.075
Quartz		782.270	Si	782.270	with M. W	60.090	this gives	47006.626
Chlorite II		41.328	Al+Si	10.332	with M. W	656.614	this gives	6784.075
Quartz		782.270	Si	782.270	with M. W	60.090	this gives	47006.626

Chlorite type Ripidolite

					sum with chlorite I		100132.698	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al	sum with chlorite II		100132.698	
			0.541	Fe				
			0.459	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.047	Apatite	0.047
					Titanite	0.000	Titanite	0.000
					Albite	31.266	Albite	31.266
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	2.150	Calcite	2.150
			0.541	Fe	Muscovite	12.668	Muscovite	12.668
			0.459	Mg	Chlorite	6.775	Chlorite	6.775
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	46.944	Quartz	46.944
			0.000	Al	MnO2	0.049	MnO2	0.049
					TiO2	0.100	TiO2	0.100
						100.000		100.000

Kärpf 6

Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	77.670	60.090	1292.561	1292.561	1292.561	907.849	907.849	907.849	812.308	770.980	770.980
Al2O3	11.220	101.940	220.129	220.129	220.129	74.204	74.204	74.204	-21.337	0.000	0.000
Fe2O3	1.190	159.700	14.903	14.903	14.903	14.903	14.903	14.903	14.903	0.000	0.000
MgO	0.510	40.320	12.649	12.649	12.649	12.649	12.649	12.649	12.649	0.000	0.000
Na2O	3.700	61.980	119.393	119.393	119.393	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.270	44.010	51.579	51.579	51.579	51.579	35.714	35.714	3.867	-37.461	-16.123
TiO2	0.100	79.900	1.252	1.252	1.252	1.252	1.252	1.252	1.252	1.252	1.252
CaO	1.660	56.080	29.601	29.131	29.131	15.865	0.000	0.000	0.000	0.000	0.000
K2O	1.500	94.200	31.847	31.847	31.847	31.847	31.847	31.847	0.000	0.000	0.000
P2O5	0.020	141.950	0.282	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Rutile	TiO2	1.252	Ti	1.252	with M. W	79.899	this gives	99.998
Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	0.282	P	0.094	with M. W	502.314	this gives	47.182
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	119.393	Na	119.393	with M. W	262.225	this gives	31307.863
Calcite	CaCO3	15.865	Ca	15.865	with M. W	100.089	this gives	1587.915
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	31.847	K	31.847	with M. W	398.309	this gives	12685.007
Chlorite I		41.328	Si	10.332	with M. W	656.614	this gives	6784.075
Quartz		770.980	Si	770.980	with M. W	60.090	this gives	46328.201
Chlorite II		41.328	Al+Si	10.332	with M. W	656.614	this gives	6784.075
Quartz		770.980	Si	770.980	with M. W	60.090	this gives	46328.201

Chlorite type Ripidolite

					sum with chlorite I		98889.262	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al	sum with chlorite II		98889.262	
			0.541	Fe				
			0.459	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.048	Apatite	0.048
					Titanite	0.000	Titanite	0.000
					Albite	31.660	Albite	31.660
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	1.606	Calcite	1.606
			0.541	Fe	Muscovite	12.827	Muscovite	12.827
			0.459	Mg	Chlorite	6.860	Chlorite	6.860
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	46.849	Quartz	46.849
			0.000	Al	MnO2	0.050	MnO2	0.050
					TiO2	0.101	TiO2	0.101
						100.000		100.000

Mettmen 1

Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	67.570	60.090	1124.480	1124.480	1116.345	888.852	888.852	888.852	630.890	475.956	475.956
Al2O3	14.940	101.940	293.114	293.114	293.114	217.283	217.283	217.283	-40.679	0.000	0.000
Fe2O3	3.970	159.700	49.718	49.718	49.718	49.718	49.718	49.718	49.718	0.000	0.000
MgO	2.160	40.320	53.571	53.571	53.571	53.571	53.571	53.571	53.571	0.000	0.000
Na2O	2.350	61.980	75.831	75.831	75.831	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.590	44.010	58.850	58.850	58.850	58.850	55.060	55.060	-30.928	-185.862	-145.183
TiO2	0.650	79.900	8.135	8.135	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	0.840	56.080	14.979	11.926	3.791	3.791	0.000	0.000	0.000	0.000	0.000
K2O	4.050	94.200	85.987	85.987	85.987	85.987	85.987	85.987	0.000	0.000	0.000
P2O5	0.130	141.950	1.832	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	1.832	P	0.611	with M. W	502.314	this gives	306.685
Titanite	CaTi SiO5	8.135	Ti	8.135	with M. W	196.063	this gives	1595.006
Albite	NaAlSi3O8	75.831	Na	75.831	with M. W	262.225	this gives	19884.724
Calcite	CaCO3	3.791	Ca	3.791	with M. W	100.089	this gives	379.410
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	85.987	K	85.987	with M. W	398.309	this gives	34249.519
Chlorite I		154.934	Si	38.734	with M. W	645.345	this gives	24996.537
Quartz		475.956	Si	475.956	with M. W	60.090	this gives	28600.183
Chlorite II		154.934	Al+Si	38.734	with M. W	645.345	this gives	24996.537
Quartz		475.956	Si	475.956	with M. W	60.090	this gives	28600.183

Chlorite type Ripidolite

sum with chlorite I	110061.083		
sum with chlorite II	110061.083		

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al
			0.481	Fe
			0.519	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.481	Fe
			0.519	Mg
M. W : molelcular weight		with Si in second bracket	1.000	Si
			0.000	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.279	Apatite	0.279
Titanite	1.449	Titanite	1.449
Albite	18.067	Albite	18.067
Calcite	0.345	Calcite	0.345
Muscovite	31.119	Muscovite	31.119
Chlorite	22.712	Chlorite	22.712
Quartz	25.986	Quartz	25.986
MnO2	0.045	MnO2	0.045
	100.000		100.000

Mettmen 1

Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	67.570	60.090	1124.480	1124.480	1124.480	887.307	887.307	887.307	629.345	474.410	474.410
Al2O3	14.940	101.940	293.114	293.114	293.114	207.602	207.602	207.602	-50.360	0.000	0.000
Fe2O3	3.970	159.700	49.718	49.718	49.718	49.718	49.718	49.718	49.718	0.000	0.000
MgO	2.160	40.320	53.571	53.571	53.571	53.571	53.571	53.571	53.571	0.000	0.000
Na2O	2.350	61.980	75.831	75.831	75.831	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.590	44.010	58.850	58.850	58.850	58.850	51.765	51.765	-34.223	-189.157	-138.797
TiO2	0.650	79.900	8.135	8.135	8.135	8.135	8.135	8.135	8.135	8.135	8.135
CaO	0.840	56.080	14.979	11.926	11.926	7.086	0.000	0.000	0.000	0.000	0.000
K2O	4.050	94.200	85.987	85.987	85.987	85.987	85.987	85.987	0.000	0.000	0.000
P2O5	0.130	141.950	1.832	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Rutile	TiO2	8.135	Ti	8.135	with M. W	79.899	this gives	649.990
Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	1.832	P	0.611	with M. W	502.314	this gives	306.685
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	75.831	Na	75.831	with M. W	262.225	this gives	19884.724
Calcite	CaCO3	7.086	Ca	7.086	with M. W	100.089	this gives	709.193
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	85.987	K	85.987	with M. W	398.309	this gives	34249.519
Chlorite I		154.934	Si	38.734	with M. W	645.345	this gives	24996.537
Quartz		474.410	Si	474.410	with M. W	60.090	this gives	28507.321
Chlorite II		154.934	Al+Si	38.734	with M. W	645.345	this gives	24996.537
Quartz		474.410	Si	474.410	with M. W	60.090	this gives	28507.321

Chlorite type Ripidolite

sum with chlorite I	109352.989		
sum with chlorite II	109352.989		

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al
			0.481	Fe
			0.519	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.481	Fe
			0.519	Mg
M. W : molelcular weight		with Si in second bracket	1.000	Si
			0.000	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.280	Apatite	0.280
Titanite	0.000	Titanite	0.000
Albite	18.184	Albite	18.184
Calcite	0.649	Calcite	0.649
Muscovite	31.320	Muscovite	31.320
Chlorite	22.859	Chlorite	22.859
Quartz	26.069	Quartz	26.069
MnO2	0.045	MnO2	0.045
TiO2	0.594	TiO2	0.594
	100.000		100.000

Mettmen 1

Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	67.570	60.090	1124.480	1124.480	1124.480	880.136	880.136	880.136	622.174	467.240	467.240
Al2O3	14.940	101.940	293.114	293.114	293.114	200.431	200.431	200.431	-57.530	0.000	0.000
Fe2O3	3.970	159.700	49.718	49.718	49.718	49.718	49.718	49.718	49.718	0.000	0.000
MgO	2.160	40.320	53.571	53.571	53.571	53.571	53.571	53.571	53.571	0.000	0.000
Na2O	2.350	61.980	75.831	75.831	75.831	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.590	44.010	58.850	58.850	58.850	58.850	55.350	55.350	-30.637	-185.572	-128.041
TiO2	0.650	79.900	8.135	8.135	8.135	8.135	8.135	8.135	8.135	8.135	8.135
CaO	0.840	56.080	14.979	11.926	11.926	3.500	0.000	0.000	0.000	0.000	0.000
K2O	4.050	94.200	85.987	85.987	85.987	85.987	85.987	85.987	0.000	0.000	0.000
P2O5	0.130	141.950	1.832	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Rutile	TiO2	8.135	Ti	8.135	with M. W	79.899	this gives	649.990
Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	1.832	P	0.611	with M. W	502.314	this gives	306.685
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	75.831	Na	75.831	with M. W	262.225	this gives	19884.724
Calcite	CaCO3	3.500	Ca	3.500	with M. W	100.089	this gives	350.335
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	85.987	K	85.987	with M. W	398.309	this gives	34249.519
Chlorite I		154.934	Si	38.734	with M. W	645.345	this gives	24996.537
Quartz		467.240	Si	467.240	with M. W	60.090	this gives	28076.430
Chlorite II		154.934	Al+Si	38.734	with M. W	645.345	this gives	24996.537
Quartz		467.240	Si	467.240	with M. W	60.090	this gives	28076.430

Chlorite type Ripidolite

sum with chlorite I	108563.239		
sum with chlorite II	108563.239		

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al
			0.481	Fe
			0.519	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.481	Fe
			0.519	Mg
M. W : molelcular weight		with Si in second bracket	1.000	Si
			0.000	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.282	Apatite	0.282
Titanite	0.000	Titanite	0.000
Albite	18.316	Albite	18.316
Calcite	0.323	Calcite	0.323
Muscovite	31.548	Muscovite	31.548
Chlorite	23.025	Chlorite	23.025
Quartz	25.862	Quartz	25.862
MnO2	0.045	MnO2	0.045
TiO2	0.599	TiO2	0.599
	100.000		100.000

Table 6

Mettmen 2

Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	69.000	60.090	1148.278	1148.278	1141.895	875.680	875.680	875.680	653.387	524.052	524.052
Al2O3	13.860	101.940	271.925	271.925	271.925	183.186	183.186	183.186	-39.107	0.000	0.000
Fe2O3	3.340	159.700	41.828	41.828	41.828	41.828	41.828	41.828	41.828	0.000	0.000
MgO	1.790	40.320	44.395	44.395	44.395	44.395	44.395	44.395	44.395	0.000	0.000
Na2O	2.750	61.980	88.738	88.738	88.738	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.960	44.010	67.257	67.257	67.257	67.257	49.354	49.354	-24.743	-154.078	-114.972
TiO2	0.510	79.900	6.383	6.383	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	1.520	56.080	27.104	24.286	17.903	17.903	0.000	0.000	0.000	0.000	0.000
K2O	3.490	94.200	74.098	74.098	74.098	74.098	74.098	74.098	0.000	0.000	0.000
P2O5	0.120	141.950	1.691	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.050	70.940	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705

Mn Oxyde	MnO2	0.705	Mn	0.705	with M. W	86.937	this gives	61.275
Apatite	Ca5(PO4)3(F,OH,Cl)	1.691	P	0.564	with M. W	502.314	this gives	283.094
Titanite	CaTi SiO5	6.383	Ti	6.383	with M. W	196.063	this gives	1251.466
Albite	NaAlSi3O8	88.738	Na	88.738	with M. W	262.225	this gives	23269.358
Calcite	CaCO3	17.903	Ca	17.903	with M. W	100.089	this gives	1791.923
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	74.098	K	74.098	with M. W	398.309	this gives	29513.783
Chlorite I		129.335	Si	32.334	with M. W	646.058	this gives	20889.465
Quartz		524.052	Si	524.052	with M. W	60.090	this gives	31490.273
Chlorite II		129.335	Al+Si	32.334	with M. W	646.058	this gives	20889.465
Quartz		524.052	Si	524.052	with M. W	60.090	this gives	31490.273

Chlorite type Ripidolite								
					sum with chlorite I		108550.636	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al	sum with chlorite II		108550.636	
			0.485	Fe				
			0.515	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.261	Apatite	0.261
					Titanite	1.153	Titanite	1.153
					Albite	21.436	Albite	21.436
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	1.651	Calcite	1.651
			0.485	Fe	Muscovite	27.189	Muscovite	27.189
			0.515	Mg	Chlorite	19.244	Chlorite	19.244
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	29.010	Quartz	29.010
			0.000	Al	MnO2	0.056	MnO2	0.056
						100.000		100.000

Mettmen 2

Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	69.000	60.090	1148.278	1148.278	1148.278	870.734	870.734	870.734	648.441	519.106	519.106
Al2O3	13.860	101.940	271.925	271.925	271.925	171.858	171.858	171.858	-50.435	0.000	0.000
Fe2O3	3.340	159.700	41.828	41.828	41.828	41.828	41.828	41.828	41.828	0.000	0.000
MgO	1.790	40.320	44.395	44.395	44.395	44.395	44.395	44.395	44.395	0.000	0.000
Na2O	2.750	61.980	88.738	88.738	88.738	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.960	44.010	67.257	67.257	67.257	67.257	48.635	48.635	-25.462	-154.797	-104.362
TiO2	0.510	79.900	6.383	6.383	6.383	6.383	6.383	6.383	6.383	6.383	6.383
CaO	1.520	56.080	27.104	24.286	24.286	18.622	0.000	0.000	0.000	0.000	0.000
K2O	3.490	94.200	74.098	74.098	74.098	74.098	74.098	74.098	0.000	0.000	0.000
P2O5	0.120	141.950	1.691	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.050	70.940	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705

Rutile	TiO2	6.383	Ti	6.383	with M. W	79.899	this gives	509.992
Mn Oxyde	MnO2	0.705	Mn	0.705	with M. W	86.937	this gives	61.275
Apatite	Ca5(PO4)3(F,OH,Cl)	1.691	P	0.564	with M. W	502.314	this gives	283.094
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	88.738	Na	88.738	with M. W	262.225	this gives	23269.358
Calcite	CaCO3	18.622	Ca	18.622	with M. W	100.089	this gives	1863.871
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	74.098	K	74.098	with M. W	398.309	this gives	29513.783
Chlorite I		129.335	Si	32.334	with M. W	646.058	this gives	20889.465
Quartz		519.106	Si	519.106	with M. W	60.090	this gives	31193.109
Chlorite II		129.335	Al+Si	32.334	with M. W	646.058	this gives	20889.465
Quartz		519.106	Si	519.106	with M. W	60.090	this gives	31193.109

Chlorite type Ripidolite								
					sum with chlorite I		107583.946	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al	sum with chlorite II		107583.946	
			0.485	Fe				
			0.515	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.263	Apatite	0.263
					Titanite	0.000	Titanite	0.000
					Albite	21.629	Albite	21.629
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	1.732	Calcite	1.732
			0.485	Fe	Muscovite	27.433	Muscovite	27.433
			0.515	Mg	Chlorite	19.417	Chlorite	19.417
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	28.994	Quartz	28.994
			0.000	Al	MnO2	0.057	MnO2	0.057
					TiO2	0.474	TiO2	0.474
						100.000		100.000

Mettmen 2

Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	69.000	60.090	1148.278	1148.278	1148.278	862.343	862.343	862.343	640.050	510.715	510.715
Al2O3	13.860	101.940	271.925	271.925	271.925	163.467	163.467	163.467	-58.826	0.000	0.000
Fe2O3	3.340	159.700	41.828	41.828	41.828	41.828	41.828	41.828	41.828	0.000	0.000
MgO	1.790	40.320	44.395	44.395	44.395	44.395	44.395	44.395	44.395	0.000	0.000
Na2O	2.750	61.980	88.738	88.738	88.738	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.960	44.010	67.257	67.257	67.257	67.257	52.831	52.831	-21.267	-150.602	-91.775
TiO2	0.510	79.900	6.383	6.383	6.383	6.383	6.383	6.383	6.383	6.383	6.383
CaO	1.520	56.080	27.104	24.286	24.286	14.426	0.000	0.000	0.000	0.000	0.000
K2O	3.490	94.200	74.098	74.098	74.098	74.098	74.098	74.098	0.000	0.000	0.000
P2O5	0.120	141.950	1.691	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.050	70.940	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705

Rutile	TiO2	6.383	Ti	6.383	with M. W	79.899	this gives	509.992
Mn Oxyde	MnO2	0.705	Mn	0.705	with M. W	86.937	this gives	61.275
Apatite	Ca5(PO4)3(F,OH,Cl)	1.691	P	0.564	with M. W	502.314	this gives	283.094
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	88.738	Na	88.738	with M. W	262.225	this gives	23269.358
Calcite	CaCO3	14.426	Ca	14.426	with M. W	100.089	this gives	1443.930
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	74.098	K	74.098	with M. W	398.309	this gives	29513.783
Chlorite I		129.335	Si	32.334	with M. W	646.058	this gives	20889.465
Quartz		510.715	Si	510.715	with M. W	60.090	this gives	30688.874
Chlorite II		129.335	Al+Si	32.334	with M. W	646.058	this gives	20889.465
Quartz		510.715	Si	510.715	with M. W	60.090	this gives	30688.874

Chlorite type Ripidolite								
					sum with chlorite I		106659.770	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al	sum with chlorite II		106659.770	
			0.485	Fe				
			0.515	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.265	Apatite	0.265
					Titanite	0.000	Titanite	0.000
					Albite	21.816	Albite	21.816
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	1.354	Calcite	1.354
			0.485	Fe	Muscovite	27.671	Muscovite	27.671
			0.515	Mg	Chlorite	19.585	Chlorite	19.585
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	28.773	Quartz	28.773
			0.000	Al	MnO2	0.057	MnO2	0.057
					TiO2	0.478	TiO2	0.478
						100.000		100.000

Mettmen 3 — Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	69.100	60.090	1149.942	1149.942	1143.934	852.550	852.550	852.550	644.907	516.441	516.441
Al2O3	13.750	101.940	269.767	269.767	269.767	172.638	172.638	172.638	-35.005	0.000	0.000
Fe2O3	3.670	159.700	45.961	45.961	45.961	45.961	45.961	45.961	45.961	0.000	0.000
MgO	1.600	40.320	39.683	39.683	39.683	39.683	39.683	39.683	39.683	0.000	0.000
Na2O	3.010	61.980	97.128	97.128	97.128	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.930	44.010	66.576	66.576	66.576	66.576	46.101	46.101	-23.114	-151.579	-116.574
TiO2	0.480	79.900	6.008	6.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	1.630	56.080	29.066	26.483	20.475	20.475	0.000	0.000	0.000	0.000	0.000
K2O	3.260	94.200	69.214	69.214	69.214	69.214	69.214	69.214	0.000	0.000	0.000
P2O5	0.110	141.950	1.550	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.050	70.940	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705

Mn Oxyde	MnO2	0.705	Mn	0.705	with M. W	86.937	this gives	61.275
Apatite	Ca5(PO4)3(F,OH,Cl)	1.550	P	0.517	with M. W	502.314	this gives	259.502
Titanite	CaTi SiO5	6.008	Ti	6.008	with M. W	196.063	this gives	1177.850
Albite	NaAlSi3O8	97.128	Na	97.128	with M. W	262.225	this gives	25469.370
Calcite	CaCO3	20.475	Ca	20.475	with M. W	100.089	this gives	2049.331
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	69.214	K	69.214	with M. W	398.309	this gives	27568.749
Chlorite I		128.466	Si	32.116	with M. W	655.810	this gives	21062.238
Quartz		516.441	Si	516.441	with M. W	60.090	this gives	31032.942
Chlorite II		128.466	Al+Si	32.116	with M. W	655.810	this gives	21062.238
Quartz		516.441	Si	516.441	with M. W	60.090	this gives	31032.942

Chlorite type Ripidolite

					sum with chlorite I		108681.257	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al	sum with chlorite II		108681.257	
			0.537	Fe				
			0.463	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.239	Apatite	0.239
					Titanite	1.084	Titanite	1.084
					Albite	23.435	Albite	23.435
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	1.886	Calcite	1.886
			0.537	Fe	Muscovite	25.367	Muscovite	25.367
			0.463	Mg	Chlorite	19.380	Chlorite	19.380
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	28.554	Quartz	28.554
			0.000	Al	MnO2	0.056	MnO2	0.056
						100.000		100.000

Mettmen 3 — Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	69.100	60.090	1149.942	1149.942	1149.942	846.158	846.158	846.158	638.515	510.049	510.049
Al2O3	13.750	101.940	269.767	269.767	269.767	160.239	160.239	160.239	-47.404	0.000	0.000
Fe2O3	3.670	159.700	45.961	45.961	45.961	45.961	45.961	45.961	45.961	0.000	0.000
MgO	1.600	40.320	39.683	39.683	39.683	39.683	39.683	39.683	39.683	0.000	0.000
Na2O	3.010	61.980	97.128	97.128	97.128	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.930	44.010	66.576	66.576	66.576	66.576	46.293	46.293	-22.922	-151.387	-103.983
TiO2	0.480	79.900	6.008	6.008	6.008	6.008	6.008	6.008	6.008	6.008	6.008
CaO	1.630	56.080	29.066	26.483	26.483	20.283	0.000	0.000	0.000	0.000	0.000
K2O	3.260	94.200	69.214	69.214	69.214	69.214	69.214	69.214	0.000	0.000	0.000
P2O5	0.110	141.950	1.550	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.050	70.940	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705

Rutile	TiO2	6.008	Ti	6.008	with M. W	79.899	this gives	479.993
Mn Oxyde	MnO2	0.705	Mn	0.705	with M. W	86.937	this gives	61.275
Apatite	Ca5(PO4)3(F,OH,Cl)	1.550	P	0.517	with M. W	502.314	this gives	259.502
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	97.128	Na	97.128	with M. W	262.225	this gives	25469.370
Calcite	CaCO3	20.283	Ca	20.283	with M. W	100.089	this gives	2030.098
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	69.214	K	69.214	with M. W	398.309	this gives	27568.749
Chlorite I		128.466	Si	32.116	with M. W	655.810	this gives	21062.238
Quartz		510.049	Si	510.049	with M. W	60.090	this gives	30648.857
Chlorite II		128.466	Al+Si	32.116	with M. W	655.810	this gives	21062.238
Quartz		510.049	Si	510.049	with M. W	60.090	this gives	30648.857

Chlorite type Ripidolite

					sum with chlorite I		107580.082	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al	sum with chlorite II		107580.082	
			0.537	Fe				
			0.463	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.241	Apatite	0.241
					Titanite	0.000	Titanite	0.000
					Albite	23.675	Albite	23.675
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	1.887	Calcite	1.887
			0.537	Fe	Muscovite	25.626	Muscovite	25.626
			0.463	Mg	Chlorite	19.578	Chlorite	19.578
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	28.489	Quartz	28.489
			0.000	Al	MnO2	0.057	MnO2	0.057
					TiO2	0.446	TiO2	0.446
						100.000		100.000

Mettmen 3 — Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	69.100	60.090	1149.942	1149.942	1149.942	836.973	836.973	836.973	629.330	500.865	500.865
Al2O3	13.750	101.940	269.767	269.767	269.767	151.054	151.054	151.054	-56.589	0.000	0.000
Fe2O3	3.670	159.700	45.961	45.961	45.961	45.961	45.961	45.961	45.961	0.000	0.000
MgO	1.600	40.320	39.683	39.683	39.683	39.683	39.683	39.683	39.683	0.000	0.000
Na2O	3.010	61.980	97.128	97.128	97.128	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.930	44.010	66.576	66.576	66.576	66.576	50.885	50.885	-18.329	-146.795	-90.206
TiO2	0.480	79.900	6.008	6.008	6.008	6.008	6.008	6.008	6.008	6.008	6.008
CaO	1.630	56.080	29.066	26.483	26.483	15.691	0.000	0.000	0.000	0.000	0.000
K2O	3.260	94.200	69.214	69.214	69.214	69.214	69.214	69.214	0.000	0.000	0.000
P2O5	0.110	141.950	1.550	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.050	70.940	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705

Rutile	TiO2	6.008	Ti	6.008	with M. W	79.899	this gives	479.993
Mn Oxyde	MnO2	0.705	Mn	0.705	with M. W	86.937	this gives	61.275
Apatite	Ca5(PO4)3(F,OH,Cl)	1.550	P	0.517	with M. W	502.314	this gives	259.502
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	97.128	Na	97.128	with M. W	262.225	this gives	25469.370
Calcite	CaCO3	15.691	Ca	15.691	with M. W	100.089	this gives	1570.454
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	69.214	K	69.214	with M. W	398.309	this gives	27568.749
Chlorite I		128.466	Si	32.116	with M. W	655.810	this gives	21062.238
Quartz		500.865	Si	500.865	with M. W	60.090	this gives	30096.949
Chlorite II		128.466	Al+Si	32.116	with M. W	655.810	this gives	21062.238
Quartz		500.865	Si	500.865	with M. W	60.090	this gives	30096.949

Chlorite type Ripidolite

					sum with chlorite I		106568.530	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al	sum with chlorite II		106568.530	
			0.537	Fe				
			0.463	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.244	Apatite	0.244
					Titanite	0.000	Titanite	0.000
					Albite	23.900	Albite	23.900
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	1.474	Calcite	1.474
			0.537	Fe	Muscovite	25.870	Muscovite	25.870
			0.463	Mg	Chlorite	19.764	Chlorite	19.764
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	28.242	Quartz	28.242
			0.000	Al	MnO2	0.057	MnO2	0.057
					TiO2	0.450	TiO2	0.450
						100.000		100.000

Mettmen 4 Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	73.160	60.090	1217.507	1217.507	1212.251	826.965	826.965	826.965	677.283	559.816	559.816
Al2O3	12.940	101.940	253.875	253.875	253.875	125.446	125.446	125.446	-24.235	0.000	0.000
Fe2O3	3.540	159.700	44.333	44.333	44.333	44.333	44.333	44.333	44.333	0.000	0.000
MgO	1.370	40.320	33.978	33.978	33.978	33.978	33.978	33.978	33.978	0.000	0.000
Na2O	3.980	61.980	128.429	128.429	128.429	0.000	0.000	0.000	0.000	0.000	0.000
L O I	1.590	44.010	36.128	36.128	36.128	36.128	40.232	40.232	-9.662	-127.129	-102.894
TiO2	0.420	79.900	5.257	5.257	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	0.170	56.080	3.031	1.153	-4.104	-4.104	0.000	0.000	0.000	0.000	0.000
K2O	2.350	94.200	49.894	49.894	49.894	49.894	49.894	49.894	0.000	0.000	0.000
P2O5	0.080	141.950	1.127	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	1.127	P	0.376	with M. W	502.314	this gives	188.729
Titanite	CaTi SiO5	5.257	Ti	5.257	with M. W	196.063	this gives	1030.619
Albite	NaAlSi3O8	128.429	Na	128.429	with M. W	262.225	this gives	33677.107
Calcite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	49.894	K	49.894	with M. W	398.309	this gives	19873.178
Chlorite I		117.467	Si	29.367	with M. W	661.383	this gives	19422.672
Quartz		559.816	Si	559.816	with M. W	60.090	this gives	33639.370
Chlorite II		117.467	Al+Si	29.367	with M. W	661.383	this gives	19422.672
Quartz		559.816	Si	559.816	with M. W	60.090	this gives	33639.370

Chlorite type Ripidolite

sum with chlorite I 107880.695
sum with chlorite II 107880.695

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al
			0.566	Fe
			0.434	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.566	Fe
			0.434	Mg
M. W : molelcular weight		with Si in second bracket	1.000	Si
			0.000	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.175	Apatite	0.175
Titanite	0.955	Titanite	0.955
Albite	31.217	Albite	31.217
Calcite	0.000	Calcite	0.000
Muscovite	18.421	Muscovite	18.421
Chlorite	18.004	Chlorite	18.004
Quartz	31.182	Quartz	31.182
MnO2	0.045	MnO2	0.045
	100.000		100.000

Mettmen 4 Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	73.160	60.090	1217.507	1217.507	1217.507	815.826	815.826	815.826	666.145	548.678	548.678
Al2O3	12.940	101.940	253.875	253.875	253.875	109.051	109.051	109.051	-40.630	0.000	0.000
Fe2O3	3.540	159.700	44.333	44.333	44.333	44.333	44.333	44.333	44.333	0.000	0.000
MgO	1.370	40.320	33.978	33.978	33.978	33.978	33.978	33.978	33.978	0.000	0.000
Na2O	3.980	61.980	128.429	128.429	128.429	0.000	0.000	0.000	0.000	0.000	0.000
L O I	1.590	44.010	36.128	36.128	36.128	36.128	43.173	43.173	-6.721	-124.188	-83.558
TiO2	0.420	79.900	5.257	5.257	5.257	5.257	5.257	5.257	5.257	5.257	5.257
CaO	0.170	56.080	3.031	1.153	1.153	-7.045	0.000	0.000	0.000	0.000	0.000
K2O	2.350	94.200	49.894	49.894	49.894	49.894	49.894	49.894	0.000	0.000	0.000
P2O5	0.080	141.950	1.127	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Rutile	TiO2	5.257	Ti	5.257	with M. W	79.899	this gives	419.994
Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	1.127	P	0.376	with M. W	502.314	this gives	188.729
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	128.429	Na	128.429	with M. W	262.225	this gives	33677.107
Calcite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	49.894	K	49.894	with M. W	398.309	this gives	19873.178
Chlorite I		117.467	Si	29.367	with M. W	661.383	this gives	19422.672
Quartz		548.678	Si	548.678	with M. W	60.090	this gives	32970.054
Chlorite II		117.467	Al+Si	29.367	with M. W	661.383	this gives	19422.672
Quartz		548.678	Si	548.678	with M. W	60.090	this gives	32970.054

Chlorite type Ripidolite

sum with chlorite I 106600.754
sum with chlorite II 106600.754

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al
			0.566	Fe
			0.434	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.566	Fe
			0.434	Mg
M. W : molelcular weight		with Si in second bracket	1.000	Si
			0.000	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.177	Apatite	0.177
Titanite	0.000	Titanite	0.000
Albite	31.592	Albite	31.592
Calcite	0.000	Calcite	0.000
Muscovite	18.643	Muscovite	18.643
Chlorite	18.220	Chlorite	18.220
Quartz	30.929	Quartz	30.929
MnO2	0.046	MnO2	0.046
TiO2	0.394	TiO2	0.394
	100.000		100.000

Mettmen 4 Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	73.160	60.090	1217.507	1217.507	1217.507	803.682	803.682	803.682	654.000	536.533	536.533
Al2O3	12.940	101.940	253.875	253.875	253.875	96.907	96.907	96.907	-52.775	0.000	0.000
Fe2O3	3.540	159.700	44.333	44.333	44.333	44.333	44.333	44.333	44.333	0.000	0.000
MgO	1.370	40.320	33.978	33.978	33.978	33.978	33.978	33.978	33.978	0.000	0.000
Na2O	3.980	61.980	128.429	128.429	128.429	0.000	0.000	0.000	0.000	0.000	0.000
L O I	1.590	44.010	36.128	36.128	36.128	36.128	49.245	49.245	-0.649	-118.116	-65.341
TiO2	0.420	79.900	5.257	5.257	5.257	5.257	5.257	5.257	5.257	5.257	5.257
CaO	0.170	56.080	3.031	1.153	1.153	-13.117	0.000	0.000	0.000	0.000	0.000
K2O	2.350	94.200	49.894	49.894	49.894	49.894	49.894	49.894	0.000	0.000	0.000
P2O5	0.080	141.950	1.127	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Rutile	TiO2	5.257	Ti	5.257	with M. W	79.899	this gives	419.994
Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	1.127	P	0.376	with M. W	502.314	this gives	188.729
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	128.429	Na	128.429	with M. W	262.225	this gives	33677.107
Calcite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	49.894	K	49.894	with M. W	398.309	this gives	19873.178
Chlorite I		117.467	Si	29.367	with M. W	661.383	this gives	19422.672
Quartz		536.533	Si	536.533	with M. W	60.090	this gives	32240.289
Chlorite II		117.467	Al+Si	29.367	with M. W	661.383	this gives	19422.672
Quartz		536.533	Si	536.533	with M. W	60.090	this gives	32240.289

Chlorite type Ripidolite

sum with chlorite I 105870.989
sum with chlorite II 105870.989

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al
			0.566	Fe
			0.434	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.566	Fe
			0.434	Mg
M. W : molelcular weight		with Si in second bracket	1.000	Si
			0.000	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.178	Apatite	0.178
Titanite	0.000	Titanite	0.000
Albite	31.810	Albite	31.810
Calcite	0.000	Calcite	0.000
Muscovite	18.771	Muscovite	18.771
Chlorite	18.346	Chlorite	18.346
Quartz	30.452	Quartz	30.452
MnO2	0.046	MnO2	0.046
TiO2	0.397	TiO2	0.397
	100.000		100.000

Mettmen 5 Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	69.250	60.090	1152.438	1152.438	1148.358	822.124	822.124	822.124	605.563	463.068	463.068
Al2O3	14.630	101.940	287.032	287.032	287.032	178.287	178.287	178.287	-38.274	0.000	0.000
Fe2O3	4.100	159.700	51.346	51.346	51.346	51.346	51.346	51.346	51.346	0.000	0.000
MgO	1.760	40.320	43.651	43.651	43.651	43.651	43.651	43.651	43.651	0.000	0.000
Na2O	3.370	61.980	108.745	108.745	108.745	0.000	0.000	0.000	0.000	0.000	0.000
L O I	1.900	44.010	43.172	43.172	43.172	43.172	43.172	43.172	-29.015	-171.510	-133.237
TiO2	0.600	79.900	7.509	7.509	3.429	3.429	3.429	3.429	3.429	3.429	3.429
CaO	0.400	56.080	7.133	4.080	0.000	0.000	0.000	0.000	0.000	0.000	0.000
K2O	3.400	94.200	72.187	72.187	72.187	72.187	72.187	72.187	0.000	0.000	0.000
P2O5	0.130	141.950	1.832	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.050	70.940	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705

Rutile	TiO2	3.429	Ti	3.429	with M. W	79.899	this gives	274.008
Mn Oxyde	MnO2	0.705	Mn	0.705	with M. W	86.937	this gives	61.275
Apatite	Ca5(PO4)3(F,OH,Cl)	1.832	P	0.611	with M. W	502.314	this gives	306.685
Titanite	CaTi SiO5	4.080	Ti	4.080	with M. W	196.063	this gives	799.927
Albite	NaAlSi3O8	108.745	Na	108.745	with M. W	262.225	this gives	28515.540
Calcite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	72.187	K	72.187	with M. W	398.309	this gives	28752.683
Chlorite I		142.496	Si	35.624	with M. W	656.538	this gives	23388.433
Quartz		463.068	Si	463.068	with M. W	60.090	this gives	27825.737
Chlorite II		142.496	Al+Si	35.624	with M. W	656.538	this gives	23388.433
Quartz		463.068	Si	463.068	with M. W	60.090	this gives	27825.737

Chlorite type Ripidolite								
						sum with chlorite I	109924.288	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	109924.288	
			0.541	Fe				
			0.459	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.279	Apatite	0.279
					Titanite	0.728	Titanite	0.728
					Albite	25.941	Albite	25.941
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.000	Calcite	0.000
			0.541	Fe	Muscovite	26.157	Muscovite	26.157
			0.459	Mg	Chlorite	21.277	Chlorite	21.277
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	25.314	Quartz	25.314
			0.000	Al	MnO2	0.056	MnO2	0.056
					TiO2	0.249	TiO2	0.249
						100.000		100.000

Mettmen 5 Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	69.250	60.090	1152.438	1152.438	1152.438	812.321	812.321	812.321	595.761	453.265	453.265
Al2O3	14.630	101.940	287.032	287.032	287.032	164.405	164.405	164.405	-52.156	0.000	0.000
Fe2O3	4.100	159.700	51.346	51.346	51.346	51.346	51.346	51.346	51.346	0.000	0.000
MgO	1.760	40.320	43.651	43.651	43.651	43.651	43.651	43.651	43.651	0.000	0.000
Na2O	3.370	61.980	108.745	108.745	108.745	0.000	0.000	0.000	0.000	0.000	0.000
L O I	1.900	44.010	43.172	43.172	43.172	43.172	46.033	46.033	-26.154	-168.649	-116.493
TiO2	0.600	79.900	7.509	7.509	7.509	7.509	7.509	7.509	7.509	7.509	7.509
CaO	0.400	56.080	7.133	4.080	4.080	-2.861	0.000	0.000	0.000	0.000	0.000
K2O	3.400	94.200	72.187	72.187	72.187	72.187	72.187	72.187	0.000	0.000	0.000
P2O5	0.130	141.950	1.832	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.050	70.940	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705	0.705

Rutile	TiO2	7.509	Ti	7.509	with M. W	79.899	this gives	599.991
Mn Oxyde	MnO2	0.705	Mn	0.705	with M. W	86.937	this gives	61.275
Apatite	Ca5(PO4)3(F,OH,Cl)	1.832	P	0.611	with M. W	502.314	this gives	306.685
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	108.745	Na	108.745	with M. W	262.225	this gives	28515.540
Calcite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	72.187	K	72.187	with M. W	398.309	this gives	28752.683
Chlorite I		142.496	Si	35.624	with M. W	656.538	this gives	23388.433
Quartz		453.265	Si	453.265	with M. W	60.090	this gives	27236.713
Chlorite II		142.496	Al+Si	35.624	with M. W	656.538	this gives	23388.433
Quartz		453.265	Si	453.265	with M. W	60.090	this gives	27236.713

Chlorite type Ripidolite								
						sum with chlorite I	108861.320	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	108861.320	
			0.541	Fe				
			0.459	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.282	Apatite	0.282
					Titanite	0.000	Titanite	0.000
					Albite	26.194	Albite	26.194
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.000	Calcite	0.000
			0.541	Fe	Muscovite	26.412	Muscovite	26.412
			0.459	Mg	Chlorite	21.485	Chlorite	21.485
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	25.020	Quartz	25.020
			0.000	Al	MnO2	0.056	MnO2	0.056
					TiO2	0.551	TiO2	0.551
						100.000		100.000

Mettmen 6

Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	71.350	60.090	1187.386	1187.386	1182.504	851.430	851.430	851.430	650.793	535.790	535.790
Al2O3	13.820	101.940	271.140	271.140	271.140	160.782	160.782	160.782	-39.855	0.000	0.000
Fe2O3	3.290	159.700	41.202	41.202	41.202	41.202	41.202	41.202	41.202	0.000	0.000
MgO	1.430	40.320	35.466	35.466	35.466	35.466	35.466	35.466	35.466	0.000	0.000
Na2O	3.420	61.980	110.358	110.358	110.358	0.000	0.000	0.000	0.000	0.000	0.000
L O I	1.870	44.010	42.490	42.490	42.490	42.490	41.817	41.817	-25.062	-140.065	-100.209
TiO2	0.390	79.900	4.881	4.881	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	0.430	56.080	7.668	5.554	0.673	0.673	0.000	0.000	0.000	0.000	0.000
K2O	3.150	94.200	66.879	66.879	66.879	66.879	66.879	66.879	0.000	0.000	0.000
P2O5	0.090	141.950	1.268	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	1.268	P	0.423	with M. W	502.314	this gives	212.320
Titanite	CaTi SiO5	4.881	Ti	4.881	with M. W	196.063	this gives	957.003
Albite	NaAlSi3O8	110.358	Na	110.358	with M. W	262.225	this gives	28938.620
Calcite	CaCO3	0.673	Ca	0.673	with M. W	100.089	this gives	67.370
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	66.879	K	66.879	with M. W	398.309	this gives	26638.515
Chlorite I		115.003	Si	28.751	with M. W	655.952	this gives	18859.073
Quartz		535.790	Si	535.790	with M. W	60.090	this gives	32195.634
Chlorite II		115.003	Al+Si	28.751	with M. W	655.952	this gives	18859.073
Quartz		535.790	Si	535.790	with M. W	60.090	this gives	32195.634

Chlorite type Ripidolite

						sum with chlorite I	107917.555	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	107917.555	
			0.537	Fe				
			0.463	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.197	Apatite	0.197
					Titanite	0.887	Titanite	0.887
					Albite	26.815	Albite	26.815
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.062	Calcite	0.062
			0.537	Fe	Muscovite	24.684	Muscovite	24.684
			0.463	Mg	Chlorite	17.475	Chlorite	17.475
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	29.834	Quartz	29.834
			0.000	Al	MnO2	0.045	MnO2	0.045
						100.000		100.000

Mettmen 6

Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	71.350	60.090	1187.386	1187.386	1187.386	842.223	842.223	842.223	641.586	526.583	526.583
Al2O3	13.820	101.940	271.140	271.140	271.140	146.693	146.693	146.693	-53.944	0.000	0.000
Fe2O3	3.290	159.700	41.202	41.202	41.202	41.202	41.202	41.202	41.202	0.000	0.000
MgO	1.430	40.320	35.466	35.466	35.466	35.466	35.466	35.466	35.466	0.000	0.000
Na2O	3.420	61.980	110.358	110.358	110.358	0.000	0.000	0.000	0.000	0.000	0.000
L O I	1.870	44.010	42.490	42.490	42.490	42.490	43.980	43.980	-22.899	-137.901	-83.958
TiO2	0.390	79.900	4.881	4.881	4.881	4.881	4.881	4.881	4.881	4.881	4.881
CaO	0.430	56.080	7.668	5.554	5.554	-1.490	0.000	0.000	0.000	0.000	0.000
K2O	3.150	94.200	66.879	66.879	66.879	66.879	66.879	66.879	0.000	0.000	0.000
P2O5	0.090	141.950	1.268	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Rutile	TiO2	4.881	Ti	4.881	with M. W	79.899	this gives	389.994
Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	1.268	P	0.423	with M. W	502.314	this gives	212.320
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	110.358	Na	110.358	with M. W	262.225	this gives	28938.620
Calcite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	66.879	K	66.879	with M. W	398.309	this gives	26638.515
Chlorite I		115.003	Si	28.751	with M. W	655.952	this gives	18859.073
Quartz		526.583	Si	526.583	with M. W	60.090	this gives	31642.375
Chlorite II		115.003	Al+Si	28.751	with M. W	655.952	this gives	18859.073
Quartz		526.583	Si	526.583	with M. W	60.090	this gives	31642.375

Chlorite type Ripidolite

						sum with chlorite I	106729.917	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	106729.917	
			0.537	Fe				
			0.463	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.199	Apatite	0.199
					Titanite	0.000	Titanite	0.000
					Albite	27.114	Albite	27.114
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.000	Calcite	0.000
			0.537	Fe	Muscovite	24.959	Muscovite	24.959
			0.463	Mg	Chlorite	17.670	Chlorite	17.670
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	29.647	Quartz	29.647
			0.000	Al	MnO2	0.046	MnO2	0.046
					TiO2	0.365	TiO2	0.365
						100.000		100.000

Lochsite 9 Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	72.390	60.090	1204.693	1204.693	1199.937	903.712	903.712	903.712	696.069	605.859	605.859
Al2O3	13.630	101.940	267.412	267.412	267.412	168.671	168.671	168.671	-38.973	0.000	0.000
Fe2O3	1.990	159.700	24.922	24.922	24.922	24.922	24.922	24.922	24.922	0.000	0.000
MgO	1.420	40.320	35.218	35.218	35.218	35.218	35.218	35.218	35.218	0.000	0.000
Na2O	3.060	61.980	98.742	98.742	98.742	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.400	44.010	54.533	54.533	54.533	54.533	42.736	42.736	-26.479	-116.689	-77.716
TiO2	0.380	79.900	4.756	4.756	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	1.060	56.080	18.902	16.553	11.797	11.797	0.000	0.000	0.000	0.000	0.000
K2O	3.260	94.200	69.214	69.214	69.214	69.214	69.214	69.214	0.000	0.000	0.000
P2O5	0.100	141.950	1.409	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	1.409	P	0.470	with M. W	502.314	this gives	235.911
Titanite	CaTi SiO5	4.756	Ti	4.756	with M. W	196.063	this gives	932.465
Albite	NaAlSi3O8	98.742	Na	98.742	with M. W	262.225	this gives	25892.449
Calcite	CaCO3	11.797	Ca	11.797	with M. W	100.089	this gives	1180.790
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	69.214	K	69.214	with M. W	398.309	this gives	27568.749
Chlorite I		90.210	Si	22.552	with M. W	632.677	this gives	14268.437
Quartz		605.859	Si	605.859	with M. W	60.090	this gives	36406.076
Chlorite II		90.210	Al+Si	22.552	with M. W	632.677	this gives	14268.437
Quartz		605.859	Si	605.859	with M. W	60.090	this gives	36406.076

Chlorite type Ripidolite

						sum with chlorite I	106533.897	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	106533.897	
			0.414	Fe				
			0.586	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.221	Apatite	0.221
					Titanite	0.875	Titanite	0.875
					Albite	24.304	Albite	24.304
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	1.108	Calcite	1.108
			0.414	Fe	Muscovite	25.878	Muscovite	25.878
			0.586	Mg	Chlorite	13.393	Chlorite	13.393
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	34.173	Quartz	34.173
			0.000	Al	MnO2	0.046	MnO2	0.046
						100.000		100.000

Lochsite 9 Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	72.390	60.090	1204.693	1204.693	1204.693	895.863	895.863	895.863	688.220	598.010	598.010
Al2O3	13.630	101.940	267.412	267.412	267.412	156.065	156.065	156.065	-51.578	0.000	0.000
Fe2O3	1.990	159.700	24.922	24.922	24.922	24.922	24.922	24.922	24.922	0.000	0.000
MgO	1.420	40.320	35.218	35.218	35.218	35.218	35.218	35.218	35.218	0.000	0.000
Na2O	3.060	61.980	98.742	98.742	98.742	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.400	44.010	54.533	54.533	54.533	54.533	44.282	44.282	-24.932	-115.142	-63.564
TiO2	0.380	79.900	4.756	4.756	4.756	4.756	4.756	4.756	4.756	4.756	4.756
CaO	1.060	56.080	18.902	16.553	16.553	10.251	0.000	0.000	0.000	0.000	0.000
K2O	3.260	94.200	69.214	69.214	69.214	69.214	69.214	69.214	0.000	0.000	0.000
P2O5	0.100	141.950	1.409	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Rutile	TiO2	4.756	Ti	4.756	with M. W	79.899	this gives	379.994
Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	1.409	P	0.470	with M. W	502.314	this gives	235.911
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	98.742	Na	98.742	with M. W	262.225	this gives	25892.449
Calcite	CaCO3	10.251	Ca	10.251	with M. W	100.089	this gives	1025.982
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	69.214	K	69.214	with M. W	398.309	this gives	27568.749
Chlorite I		90.210	Si	22.552	with M. W	632.677	this gives	14268.437
Quartz		598.010	Si	598.010	with M. W	60.090	this gives	35934.408
Chlorite II		90.210	Al+Si	22.552	with M. W	632.677	this gives	14268.437
Quartz		598.010	Si	598.010	with M. W	60.090	this gives	35934.408

Chlorite type Ripidolite

						sum with chlorite I	105354.950	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	105354.950	
			0.414	Fe				
			0.586	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.224	Apatite	0.224
					Titanite	0.000	Titanite	0.000
					Albite	24.576	Albite	24.576
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.974	Calcite	0.974
			0.414	Fe	Muscovite	26.167	Muscovite	26.167
			0.586	Mg	Chlorite	13.543	Chlorite	13.543
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	34.108	Quartz	34.108
			0.000	Al	MnO2	0.047	MnO2	0.047
					TiO2	0.361	TiO2	0.361
						100.000		100.000

Lochsite 9 Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	72.390	60.090	1204.693	1204.693	1204.693	886.526	886.526	886.526	678.882	588.673	588.673
Al2O3	13.630	101.940	267.412	267.412	267.412	146.728	146.728	146.728	-60.915	0.000	0.000
Fe2O3	1.990	159.700	24.922	24.922	24.922	24.922	24.922	24.922	24.922	0.000	0.000
MgO	1.420	40.320	35.218	35.218	35.218	35.218	35.218	35.218	35.218	0.000	0.000
Na2O	3.060	61.980	98.742	98.742	98.742	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.400	44.010	54.533	54.533	54.533	54.533	48.951	48.951	-20.263	-110.473	-49.558
TiO2	0.380	79.900	4.756	4.756	4.756	4.756	4.756	4.756	4.756	4.756	4.756
CaO	1.060	56.080	18.902	16.553	16.553	5.582	0.000	0.000	0.000	0.000	0.000
K2O	3.260	94.200	69.214	69.214	69.214	69.214	69.214	69.214	0.000	0.000	0.000
P2O5	0.100	141.950	1.409	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Rutile	TiO2	4.756	Ti	4.756	with M. W	79.899	this gives	379.994
Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	1.409	P	0.470	with M. W	502.314	this gives	235.911
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	98.742	Na	98.742	with M. W	262.225	this gives	25892.449
Calcite	CaCO3	5.582	Ca	5.582	with M. W	100.089	this gives	558.702
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	69.214	K	69.214	with M. W	398.309	this gives	27568.749
Chlorite I		90.210	Si	22.552	with M. W	632.677	this gives	14268.437
Quartz		588.673	Si	588.673	with M. W	60.090	this gives	35373.332
Chlorite II		90.210	Al+Si	22.552	with M. W	632.677	this gives	14268.437
Quartz		588.673	Si	588.673	with M. W	60.090	this gives	35373.332

Chlorite type Ripidolite

						sum with chlorite I	104326.595	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	104326.595	
			0.414	Fe				
			0.586	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.226	Apatite	0.226
					Titanite	0.000	Titanite	0.000
					Albite	24.819	Albite	24.819
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.536	Calcite	0.536
			0.414	Fe	Muscovite	26.425	Muscovite	26.425
			0.586	Mg	Chlorite	13.677	Chlorite	13.677
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	33.906	Quartz	33.906
			0.000	Al	MnO2	0.047	MnO2	0.047
					TiO2	0.364	TiO2	0.364
						100.000		100.000

Lochsite 10 Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	73.040	60.090	1215.510	1215.510	1210.754	942.603	942.603	942.603	725.406	629.939	629.939
Al2O3	13.540	101.940	265.646	265.646	265.646	176.263	176.263	176.263	-40.935	0.000	0.000
Fe2O3	2.250	159.700	28.178	28.178	28.178	28.178	28.178	28.178	28.178	0.000	0.000
MgO	1.430	40.320	35.466	35.466	35.466	35.466	35.466	35.466	35.466	0.000	0.000
Na2O	2.770	61.980	89.384	89.384	89.384	0.000	0.000	0.000	0.000	0.000	0.000
L O I	1.980	44.010	44.990	44.990	44.990	44.990	44.548	44.548	-27.851	-123.317	-82.382
TiO2	0.380	79.900	4.756	4.756	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	0.410	56.080	7.311	5.198	0.442	0.442	0.000	0.000	0.000	0.000	0.000
K2O	3.410	94.200	72.399	72.399	72.399	72.399	72.399	72.399	0.000	0.000	0.000
P2O5	0.090	141.950	1.268	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.030	70.940	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423

Mn Oxyde	MnO2	0.423	Mn	0.423	with M. W	86.937	this gives	36.765
Apatite	Ca5(PO4)3(F,OH,Cl)	1.268	P	0.423	with M. W	502.314	this gives	212.320
Titanite	CaTi SiO5	4.756	Ti	4.756	with M. W	196.063	this gives	932.465
Albite	NaAlSi3O8	89.384	Na	89.384	with M. W	262.225	this gives	23438.590
Calcite	CaCO3	0.442	Ca	0.442	with M. W	100.089	this gives	44.201
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	72.399	K	72.399	with M. W	398.309	this gives	28837.249
Chlorite I		95.466	Si	23.867	with M. W	638.040	this gives	15227.805
Quartz		629.939	Si	629.939	with M. W	60.090	this gives	37853.065
Chlorite II		95.466	Al+Si	23.867	with M. W	638.040	this gives	15227.805
Quartz		629.939	Si	629.939	with M. W	60.090	this gives	37853.065

Chlorite type Ripidolite

					sum with chlorite I		106582.459	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al	sum with chlorite II		106582.459	
			0.443	Fe				
			0.557	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.199	Apatite	0.199
					Titanite	0.875	Titanite	0.875
					Albite	21.991	Albite	21.991
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.041	Calcite	0.041
			0.443	Fe	Muscovite	27.056	Muscovite	27.056
			0.557	Mg	Chlorite	14.287	Chlorite	14.287
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	35.515	Quartz	35.515
			0.000	Al	MnO2	0.034	MnO2	0.034
						100.000		100.000

Lochsite 10 Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	73.040	60.090	1215.510	1215.510	1215.510	935.948	935.948	935.948	718.751	623.285	623.285
Al2O3	13.540	101.940	265.646	265.646	265.646	164.852	164.852	164.852	-52.345	0.000	0.000
Fe2O3	2.250	159.700	28.178	28.178	28.178	28.178	28.178	28.178	28.178	0.000	0.000
MgO	1.430	40.320	35.466	35.466	35.466	35.466	35.466	35.466	35.466	0.000	0.000
Na2O	2.770	61.980	89.384	89.384	89.384	0.000	0.000	0.000	0.000	0.000	0.000
L O I	1.980	44.010	44.990	44.990	44.990	44.990	45.498	45.498	-26.902	-122.368	-70.022
TiO2	0.380	79.900	4.756	4.756	4.756	4.756	4.756	4.756	4.756	4.756	4.756
CaO	0.410	56.080	7.311	5.198	5.198	-0.508	0.000	0.000	0.000	0.000	0.000
K2O	3.410	94.200	72.399	72.399	72.399	72.399	72.399	72.399	0.000	0.000	0.000
P2O5	0.090	141.950	1.268	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.030	70.940	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423	0.423

Rutile	TiO2	4.756	Ti	4.756	with M. W	79.899	this gives	379.994
Mn Oxyde	MnO2	0.423	Mn	0.423	with M. W	86.937	this gives	36.765
Apatite	Ca5(PO4)3(F,OH,Cl)	1.268	P	0.423	with M. W	502.314	this gives	212.320
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	89.384	Na	89.384	with M. W	262.225	this gives	23438.590
Calcite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	72.399	K	72.399	with M. W	398.309	this gives	28837.249
Chlorite I		95.466	Si	23.867	with M. W	638.040	this gives	15227.805
Quartz		623.285	Si	623.285	with M. W	60.090	this gives	37453.181
Chlorite II		95.466	Al+Si	23.867	with M. W	638.040	this gives	15227.805
Quartz		623.285	Si	623.285	with M. W	60.090	this gives	37453.181

Chlorite type Ripidolite

					sum with chlorite I		105585.904	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al	sum with chlorite II		105585.904	
			0.443	Fe				
			0.557	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.201	Apatite	0.201
					Titanite	0.000	Titanite	0.000
					Albite	22.199	Albite	22.199
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.000	Calcite	0.000
			0.443	Fe	Muscovite	27.312	Muscovite	27.312
			0.557	Mg	Chlorite	14.422	Chlorite	14.422
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	35.472	Quartz	35.472
			0.000	Al	MnO2	0.035	MnO2	0.035
					TiO2	0.360	TiO2	0.360
						100.000		100.000

Lochsite 11 Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	72.200	60.090	1201.531	1201.531	1197.516	897.420	897.420	897.420	703.789	576.259	576.259
Al2O3	13.350	101.940	261.919	261.919	261.919	161.887	161.887	161.887	-31.744	0.000	0.000
Fe2O3	3.640	159.700	45.585	45.585	45.585	45.585	45.585	45.585	45.585	0.000	0.000
MgO	1.590	40.320	39.435	39.435	39.435	39.435	39.435	39.435	39.435	0.000	0.000
Na2O	3.100	61.980	100.032	100.032	100.032	0.000	0.000	0.000	0.000	0.000	0.000
L O I	1.980	44.010	44.990	44.990	44.990	44.990	44.990	44.990	-19.554	-147.084	-115.340
TiO2	0.440	79.900	5.507	5.507	1.492	1.492	1.492	1.492	1.492	1.492	1.492
CaO	0.370	56.080	6.598	4.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000
K2O	3.040	94.200	64.544	64.544	64.544	64.544	64.544	64.544	0.000	0.000	0.000
P2O5	0.110	141.950	1.550	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Rutile	TiO2	1.492	Ti	1.492	with M. W	79.899	this gives	119.228
Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	1.550	P	0.517	with M. W	502.314	this gives	259.502
Titanite	CaTi SiO5	4.015	Ti	4.015	with M. W	196.063	this gives	787.124
Albite	NaAlSi3O8	100.032	Na	100.032	with M. W	262.225	this gives	26230.913
Calcite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	64.544	K	64.544	with M. W	398.309	this gives	25708.281
Chlorite I		127.530	Si	31.882	with M. W	655.718	this gives	20905.940
Quartz		576.259	Si	576.259	with M. W	60.090	this gives	34627.404
Chlorite II		127.530	Al+Si	31.882	with M. W	655.718	this gives	20905.940
Quartz		576.259	Si	576.259	with M. W	60.090	this gives	34627.404

Chlorite type Ripidolite								
						sum with chlorite I	108687.411	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	108687.411	
			0.536	Fe				
			0.464	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.239	Apatite	0.239
					Titanite	0.724	Titanite	0.724
					Albite	24.134	Albite	24.134
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.000	Calcite	0.000
			0.536	Fe	Muscovite	23.653	Muscovite	23.653
			0.464	Mg	Chlorite	19.235	Chlorite	19.235
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	31.860	Quartz	31.860
			0.000	Al	MnO2	0.045	MnO2	0.045
					TiO2	0.110	TiO2	0.110
						100.000		100.000

Lochsite 11 Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	72.200	60.090	1201.531	1201.531	1201.531	888.664	888.664	888.664	695.034	567.504	567.504
Al2O3	13.350	101.940	261.919	261.919	261.919	149.116	149.116	149.116	-44.514	0.000	0.000
Fe2O3	3.640	159.700	45.585	45.585	45.585	45.585	45.585	45.585	45.585	0.000	0.000
MgO	1.590	40.320	39.435	39.435	39.435	39.435	39.435	39.435	39.435	0.000	0.000
Na2O	3.100	61.980	100.032	100.032	100.032	0.000	0.000	0.000	0.000	0.000	0.000
L O I	1.980	44.010	44.990	44.990	44.990	44.990	47.360	47.360	-17.183	-144.713	-100.199
TiO2	0.440	79.900	5.507	5.507	5.507	5.507	5.507	5.507	5.507	5.507	5.507
CaO	0.370	56.080	6.598	4.015	4.015	-2.370	0.000	0.000	0.000	0.000	0.000
K2O	3.040	94.200	64.544	64.544	64.544	64.544	64.544	64.544	0.000	0.000	0.000
P2O5	0.110	141.950	1.550	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Rutile	TiO2	5.507	Ti	5.507	with M. W	79.899	this gives	439.993
Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	1.550	P	0.517	with M. W	502.314	this gives	259.502
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	100.032	Na	100.032	with M. W	262.225	this gives	26230.913
Calcite	CaCO3	0.000	Ca	0.000	with M. W	100.089	this gives	0.000
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	64.544	K	64.544	with M. W	398.309	this gives	25708.281
Chlorite I		127.530	Si	31.882	with M. W	655.718	this gives	20905.940
Quartz		567.504	Si	567.504	with M. W	60.090	this gives	34101.291
Chlorite II		127.530	Al+Si	31.882	with M. W	655.718	this gives	20905.940
Quartz		567.504	Si	567.504	with M. W	60.090	this gives	34101.291

Chlorite type Ripidolite								
						sum with chlorite I	107694.939	
Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al		sum with chlorite II	107694.939	
			0.536	Fe				
			0.464	Mg	Mineralogy with chlorite I		Mineralogy with chlorite II	
		content Si in second bracket	1.000	Si				
					Apatite	0.241	Apatite	0.241
					Titanite	0.000	Titanite	0.000
					Albite	24.357	Albite	24.357
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al	Calcite	0.000	Calcite	0.000
			0.536	Fe	Muscovite	23.871	Muscovite	23.871
			0.464	Mg	Chlorite	19.412	Chlorite	19.412
M. W : molelcular weight		with Si in second bracket	1.000	Si	Quartz	31.665	Quartz	31.665
			0.000	Al	MnO2	0.046	MnO2	0.046
					TiO2	0.409	TiO2	0.409
						100.000		100.000

Lochsite 12

Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	73.300	60.090	1219.837	1219.837	1214.330	848.406	848.406	848.406	689.170	614.614	614.614
Al2O3	13.370	101.940	262.311	262.311	262.311	140.336	140.336	140.336	-18.899	0.000	0.000
Fe2O3	1.830	159.700	22.918	22.918	22.918	22.918	22.918	22.918	22.918	0.000	0.000
MgO	1.080	40.320	26.786	26.786	26.786	26.786	26.786	26.786	26.786	0.000	0.000
Na2O	3.780	61.980	121.975	121.975	121.975	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.250	44.010	51.125	51.125	51.125	51.125	34.916	34.916	-18.163	-92.718	-73.819
TiO2	0.440	79.900	5.507	5.507	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CaO	1.310	56.080	23.359	21.716	16.209	16.209	0.000	0.000	0.000	0.000	0.000
K2O	2.500	94.200	53.079	53.079	53.079	53.079	53.079	53.079	0.000	0.000	0.000
P2O5	0.070	141.950	0.986	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	0.986	P	0.329	with M. W	502.314	this gives	165.138
Titanite	CaTi SiO5	5.507	Ti	5.507	with M. W	196.063	this gives	1079.696
Albite	NaAlSi3O8	121.975	Na	121.975	with M. W	262.225	this gives	31984.790
Calcite	CaCO3	16.209	Ca	16.209	with M. W	100.089	this gives	1622.329
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	53.079	K	53.079	with M. W	398.309	this gives	21141.678
Chlorite I		74.556	Si	18.639	with M. W	641.512	this gives	11957.070
Quartz		614.614	Si	614.614	with M. W	60.090	this gives	36932.176
Chlorite II		74.556	Al+Si	18.639	with M. W	641.512	this gives	11957.070
Quartz		614.614	Si	614.614	with M. W	60.090	this gives	36932.176

Chlorite type Ripidolite

sum with chlorite I 104931.897
sum with chlorite II 104931.897

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al
			0.461	Fe
			0.539	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.461	Fe
			0.539	Mg
M. W : molelcular weight		with Si in second bracket	1.000	Si
			0.000	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.157	Apatite	0.157
Titanite	1.029	Titanite	1.029
Albite	30.481	Albite	30.481
Calcite	1.546	Calcite	1.546
Muscovite	20.148	Muscovite	20.148
Chlorite	11.395	Chlorite	11.395
Quartz	35.196	Quartz	35.196
MnO2	0.047	MnO2	0.047
	100.000		100.000

Lochsite 12

Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	73.300	60.090	1219.837	1219.837	1219.837	838.341	838.341	838.341	679.105	604.550	604.550
Al2O3	13.370	101.940	262.311	262.311	262.311	124.765	124.765	124.765	-34.471	0.000	0.000
Fe2O3	1.830	159.700	22.918	22.918	22.918	22.918	22.918	22.918	22.918	0.000	0.000
MgO	1.080	40.320	26.786	26.786	26.786	26.786	26.786	26.786	26.786	0.000	0.000
Na2O	3.780	61.980	121.975	121.975	121.975	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.250	44.010	51.125	51.125	51.125	51.125	37.195	37.195	-15.884	-90.439	-55.969
TiO2	0.440	79.900	5.507	5.507	5.507	5.507	5.507	5.507	5.507	5.507	5.507
CaO	1.310	56.080	23.359	21.716	21.716	13.930	0.000	0.000	0.000	0.000	0.000
K2O	2.500	94.200	53.079	53.079	53.079	53.079	53.079	53.079	0.000	0.000	0.000
P2O5	0.070	141.950	0.986	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Rutile	TiO2	5.507	Ti	5.507	with M. W	79.899	this gives	439.993
Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	0.986	P	0.329	with M. W	502.314	this gives	165.138
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	121.975	Na	121.975	with M. W	262.225	this gives	31984.790
Calcite	CaCO3	13.930	Ca	13.930	with M. W	100.089	this gives	1394.251
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	53.079	K	53.079	with M. W	398.309	this gives	21141.678
Chlorite I		74.556	Si	18.639	with M. W	641.512	this gives	11957.070
Quartz		604.550	Si	604.550	with M. W	60.090	this gives	36327.408
Chlorite II		74.556	Al+Si	18.639	with M. W	641.512	this gives	11957.070
Quartz		604.550	Si	604.550	with M. W	60.090	this gives	36327.408

Chlorite type Ripidolite

sum with chlorite I 103459.348
sum with chlorite II 103459.348

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al
			0.461	Fe
			0.539	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.461	Fe
			0.539	Mg
M. W : molelcular weight		with Si in second bracket	1.000	Si
			0.000	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.160	Apatite	0.160
Titanite	0.000	Titanite	0.000
Albite	30.915	Albite	30.915
Calcite	1.348	Calcite	1.348
Muscovite	20.435	Muscovite	20.435
Chlorite	11.557	Chlorite	11.557
Quartz	35.113	Quartz	35.113
MnO2	0.047	MnO2	0.047
TiO2	0.425	TiO2	0.425
	100.000		100.000

Lochsite 12

Model without Titanite and Albite with 10%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	73.300	60.090	1219.837	1219.837	1219.837	826.807	826.807	826.807	667.571	593.016	593.016
Al2O3	13.370	101.940	262.311	262.311	262.311	113.231	113.231	113.231	-46.005	0.000	0.000
Fe2O3	1.830	159.700	22.918	22.918	22.918	22.918	22.918	22.918	22.918	0.000	0.000
MgO	1.080	40.320	26.786	26.786	26.786	26.786	26.786	26.786	26.786	0.000	0.000
Na2O	3.780	61.980	121.975	121.975	121.975	0.000	0.000	0.000	0.000	0.000	0.000
L O I	2.250	44.010	51.125	51.125	51.125	51.125	42.962	42.962	-10.117	-84.672	-38.667
TiO2	0.440	79.900	5.507	5.507	5.507	5.507	5.507	5.507	5.507	5.507	5.507
CaO	1.310	56.080	23.359	21.716	21.716	8.163	0.000	0.000	0.000	0.000	0.000
K2O	2.500	94.200	53.079	53.079	53.079	53.079	53.079	53.079	0.000	0.000	0.000
P2O5	0.070	141.950	0.986	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MnO	0.040	70.940	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564	0.564

Rutile	TiO2	5.507	Ti	5.507	with M. W	79.899	this gives	439.993
Mn Oxyde	MnO2	0.564	Mn	0.564	with M. W	86.937	this gives	49.020
Apatite	Ca5(PO4)3(F,OH,Cl)	0.986	P	0.329	with M. W	502.314	this gives	165.138
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	121.975	Na	121.975	with M. W	262.225	this gives	31984.790
Calcite	CaCO3	8.163	Ca	8.163	with M. W	100.089	this gives	817.024
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	53.079	K	53.079	with M. W	398.309	this gives	21141.678
Chlorite I		74.556	Si	18.639	with M. W	641.512	this gives	11957.070
Quartz		593.016	Si	593.016	with M. W	60.090	this gives	35634.314
Chlorite II		74.556	Al+Si	18.639	with M. W	641.512	this gives	11957.070
Quartz		593.016	Si	593.016	with M. W	60.090	this gives	35634.314

Chlorite type Ripidolite

sum with chlorite I 102189.027
sum with chlorite II 102189.027

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al
			0.461	Fe
			0.539	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket	0.000	Al
			0.461	Fe
			0.539	Mg
M. W : molelcular weight		with Si in second bracket	1.000	Si
			0.000	Al

Mineralogy with chlorite I		Mineralogy with chlorite II	
Apatite	0.162	Apatite	0.162
Titanite	0.000	Titanite	0.000
Albite	31.300	Albite	31.300
Calcite	0.800	Calcite	0.800
Muscovite	20.689	Muscovite	20.689
Chlorite	11.701	Chlorite	11.701
Quartz	34.871	Quartz	34.871
MnO2	0.048	MnO2	0.048
TiO2	0.431	TiO2	0.431
	100.000		100.000

Lochsite 13

Model with Titanite and pure Albite

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	73.360	60.090	1220.835	1220.835	1216.580	863.240	863.240	863.240	719.291	627.862	
Al2O3	12.220	101.940	239.749	239.749	239.749	121.969	121.969	121.969	-21.980	0.000	
Fe2O3	2.550	159.700	31.935	31.935	31.935	31.935	31.935	31.935	31.935	0.000	
MgO	1.170	40.320	29.018	29.018	29.018	29.018	29.018	29.018	29.018	0.000	
Na2O	3.650	61.980	117.780	117.780	117.780	0.000	0.000	0.000	0.000	0.000	
L O I	2.620	44.010	59.532	59.532	59.532	59.532	35.887	35.887	-12.096	-103.525	
TiO2	0.340	79.900	4.255	4.255	0.000	0.000	0.000	0.000	0.000	0.000	
CaO	1.670	56.080	29.779	27.900	23.645	23.645	0.000	0.000	0.000	0.000	
K2O	2.260	94.200	47.983	47.983	47.983	47.983	47.983	47.983	0.000	0.000	
P2O5	0.080	141.950	1.127	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
MnO	0.060	70.940	0.846	0.846	0.846	0.846	0.846	0.846	0.846	0.846	

Mn Oxyde	MnO2	0.846	Mn	0.846	with M. W	86.937	this gives	73.530
Apatite	Ca5(PO4)3(F,OH,Cl)	1.127	P	0.376	with M. W	502.314	this gives	188.729
Titanite	CaTi SiO5	4.255	Ti	4.255	with M. W	196.063	this gives	834.311
Albite	NaAlSi3O8	117.780	Na	117.780	with M. W	262.225	this gives	30884.784
Calcite	CaCO3	23.645	Ca	23.645	with M. W	100.089	this gives	2366.606
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	47.983	K	47.983	with M. W	398.309	this gives	19112.077
Chlorite I		91.429	Si	22.857	with M. W	653.401	this gives	14934.978
Quartz		627.862	Si	627.862	with M. W	60.090	this gives	37728.237
Chlorite II								
Quartz								
						sum with chlorite I		106123.252

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al
			0.524	Fe
			0.476	Mg
		content Si in second bracket	1.000	Si
Chlorite II	(Fe,Mg)6(AlSi)4O10(OH)8	with Al in first bracket		
M. W : molelcular weight		with Si in second bracket		

Mineralogy with chlorite I

Apatite	0.178
Titanite	0.786
Albite	29.103
Calcite	2.230
Muscovite	18.009
Chlorite	14.073
Quartz	35.551
MnO2	0.069
	100.000

Lochsite 13

Model without Titanite and Albite with 6%Ca

Oxyde	% weight	Molecular mass	Cation equ.	Apatite	Titanite	Albite	Calcite	Dolomite	Muscovite	Chlorite I	Chlorite II
SiO2	73.360	60.090	1220.835	1220.835	1220.835	852.460	852.460	852.460	708.511	617.082	
Al2O3	12.220	101.940	239.749	239.749	239.749	106.933	106.933	106.933	-37.016	0.000	
Fe2O3	2.550	159.700	31.935	31.935	31.935	31.935	31.935	31.935	31.935	0.000	
MgO	1.170	40.320	29.018	29.018	29.018	29.018	29.018	29.018	29.018	0.000	
Na2O	3.650	61.980	117.780	117.780	117.780	0.000	0.000	0.000	0.000	0.000	
L O I	2.620	44.010	59.532	59.532	59.532	59.532	39.150	39.150	-8.834	-100.263	
TiO2	0.340	79.900	4.255	4.255	4.255	4.255	4.255	4.255	4.255	4.255	
CaO	1.670	56.080	29.779	27.900	27.900	20.382	0.000	0.000	0.000	0.000	
K2O	2.260	94.200	47.983	47.983	47.983	47.983	47.983	47.983	0.000	0.000	
P2O5	0.080	141.950	1.127	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
MnO	0.060	70.940	0.846	0.846	0.846	0.846	0.846	0.846	0.846	0.846	

Rutile	TiO2	4.255	Ti	4.255	with M. W	79.899	this gives	339.995
Mn Oxyde	MnO2	0.846	Mn	0.846	with M. W	86.937	this gives	73.530
Apatite	Ca5(PO4)3(F,OH,Cl)	1.127	P	0.376	with M. W	502.314	this gives	188.729
Titanite	CaTi SiO5	0.000	Ti	0.000	with M. W	196.063	this gives	0.000
Albite	NaAlSi3O8	117.780	Na	117.780	with M. W	262.225	this gives	30884.784
Calcite	CaCO3	20.382	Ca	20.382	with M. W	100.089	this gives	2040.060
Dolomite	CaMg(CO3)2	0.000	Ca	0.000	with M. W	184.411	this gives	0.000
Muscovite	KAl2(AlSi3)O10(OH)2	47.983	K	47.983	with M. W	398.309	this gives	19112.077
Chlorite I		91.429	Si	22.857	with M. W	653.401	this gives	14934.978
Quartz		617.082	Si	617.082	with M. W	60.090	this gives	37080.442
Chlorite II								
Quartz								

sum with chlorite I 104654.595

Chlorite I	(Fe,Mg,Al)6(Si)4O10(OH)8	dcontent in first bracket	0.000	Al
			0.524	Fe
			0.476	Mg
		content Si in second bracket	1.000	Si

Mineralogy with chlorite I

Apatite	0.180
Titanite	0.000
Albite	29.511
Calcite	1.949
Muscovite	18.262
Chlorite	14.271
Quartz	35.431
MnO2	0.070
TiO2	0.325
	100.000

†. Table 7

Lochsitenkalk XRD data and Lochsitenkalk and Verrucano calculated semi-quantitative mineralogical composition after XRD data. The technique of calculation is given at the beginning of chapter III. Verrucano samples come from about 100 m above the thrust. Their exact localization is given in Table 5. Lochsitenkalk samples can be localized according to their label and table 1. Note that the dolomite content in the Lochsitenkalk is never more than 8%, but the calculation is biased by the high percent of undosed minerals that can correspond to clays, oxydes…

Lochsitenkalk XRD analysis: value of each pic are given in pulse per minute

Sample	Phylosilicates19.9	Quartz 26.65	Calcite 29.45	Dolomite 30.9	K-Feldspar 27.5	Albite 27.9	Micas 001	Chlorite 002
CW1		75366	134036	26237		27434		
CW2		238695	110929	13579		47962		
CW3		69110	42349	7071		11824		
CW20	3600	330967	50420			7068	11083	5524
CW22	3360	259813	110037			4285	5813	5587
CW23	4560	142648	44955			44878	12443	20396
CW24	4140	71448	35843	8809	2630	25469	37681	26578
SAR1		386588	52951	15054				
SAR2		117593	120280	10989		10341		
SAR3		14938	194249			13370		
SAR4		348952	118843	9079		1800		
SAR5		19354	200312	12180		3251		3775

Lochsitenkalk mineralogical composition calculated trough MacDosage with XRD data, composition given in %

Sample	Phylosilicates	Quartz	Calcite	Dolomite	K-Felspar	Plagioclase	Undosed
CW1	0.000	11.987	36.956	8.035	0.000	11.429	31.592
CW2	0.000	34.404	27.717	3.769	0.000	18.107	16.003
CW3	0.000	9.608	10.206	1.893	0.000	4.306	73.987
CW20	15.054	43.577	11.508	0.000	0.000	2.438	27.423
CW22	15.832	38.547	28.300	0.000	0.000	1.665	15.655
CW23	19.199	18.910	10.331	0.000	0.000	15.583	35.976
CW24	17.887	9.719	8.452	2.307	1.211	9.075	51.347
SAR1	0.000	50.828	12.069	3.811	0.000	0.000	33.292
SAR2	0.000	18.300	32.449	3.293	0.000	4.215	41.742
SAR3	0.000	2.709	61.057	0.000	0.000	6.350	29.884
SAR4	0.000	51.655	30.496	2.588	0.000	0.698	14.563
SAR5	0.000	3.575	64.138	4.332	0.000	1.573	26.383

Verrucano mineralogical composition calculated trough MacDosage with XRD data, composition given in %

Sample	Undosed (mica, chl)	Quartz	Calcite	K-Felspar	Plagioclase
AR 99.13	59.800	9.620	15.040	0.000	15.540
AR 99.14	85.210	8.010	0.720	0.000	6.070
AR 99.15	72.190	11.440	0.000	0.000	16.370
AR 99.16	70.620	6.570	3.840	0.000	18.980
AR 99.17	68.970	10.050	3.480	1.520	15.980
AR 99.18	56.630	14.670	9.600	1.940	17.170
VP 99.1	69.240	11.570	0.000	0.000	19.190
VP 99.2	50.630	22.160	21.060	2.110	4.040
VP 99.3	47.320	12.200	22.960	1.470	16.040
VP 99.4	64.540	18.990	0.000	1.240	15.230
VP 99.5	65.540	12.780	0.870	0.000	20.810
VP 99.7	52.480	24.850	2.250	0.000	20.420
VP 99.9	72.230	14.020	1.400	0.000	12.360
Kä 99.1	61.160	32.180	3.290	0.000	3.380
Kä 99.2	48.820	37.360	10.010	0.000	3.820
Kä 99.3	67.860	28.590	0.000	0.000	3.550
Kä 99.4	45.550	30.330	0.000	0.000	24.120
Kä 99.5	26.980	39.070	0.000	0.000	33.950
Kä 99.6	43.370	36.640	2.380	0.000	17.610
Met 99.1	55.650	27.320	0.530	5.350	11.140
Met 99.2	67.170	19.670	1.350	0.000	11.810
Met 99.3	60.280	24.140	3.370	0.000	12.220
Met 99.4	36.690	28.140	2.220	0.000	32.950
Met 99.5	61.510	17.450	2.400	0.000	18.630
Lo 99.9	30.029	32.365	3.087	0.000	34.383
Lo 99.10	30.432	44.169	0.000	0.000	25.399
Lo 99.11	55.518	26.169	0.000	0.000	18.313
Lo 99.12	49.583	29.131	5.083	0.000	16.204
Lo 99.13	37.326	36.383	3.299	0.000	22.993

Appendix IV is composed of 10 sheets, each of which being composed of a SEM picture of Lochsitenkalk sample and four plots of the shape measurement data. Each sheet corresponds to investigations results on one sample that can be precisely localized according to table 1.

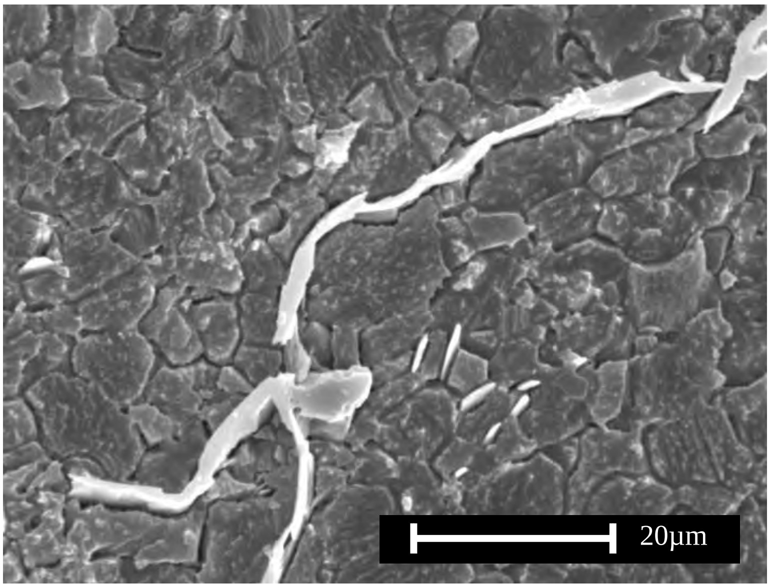
†. Description of the shape measurement data acquisition process

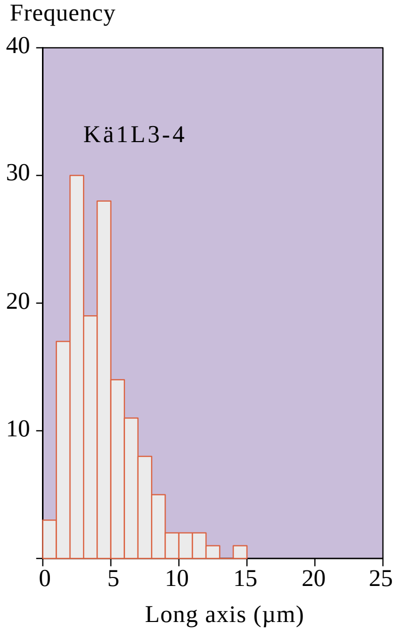
Small slabs of Lochsitenkalk have first been polished with down to 1mm diamond paste, before being etched with HCl 0.37% for 30 s then with CH_3COOH 0.1% for 1 minute. Finally these samples have been coated with gold for SEM observation. Pictures of Lochsitenkalk have been taken and the true axial ratio has been checked with a reference circle to avoid distortion due to sample tilting in the SEM chamber. The grain shape has been analyzed on these pictures with the software NIH 1.68. The following features have been measured on all grains: short axis, long axis, orientation of the long axis, area and perimeter. With these data, four kinds of plot have been constructed:

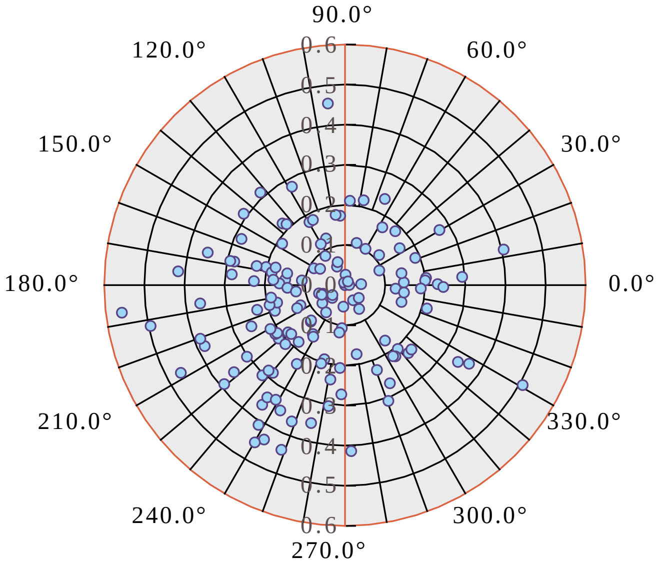
- Long axis vs. frequency to get an idea of the grain size fractions
- Orientation of the long axis (f) vs. axial ratio (polar graph). The axial ratio is the distance between the center and the point, the orientation is given as an angle with an arbitrary reference. Such a plot is aimed to document shape preferred orientation.
- Comparative roundness vs. frequency. The comparative roundness is a relative comparison between the measured perimeter of a grain and the perimeter of an imaginary grain that has the same axial ratio and area
- Area vs. comparative roundness

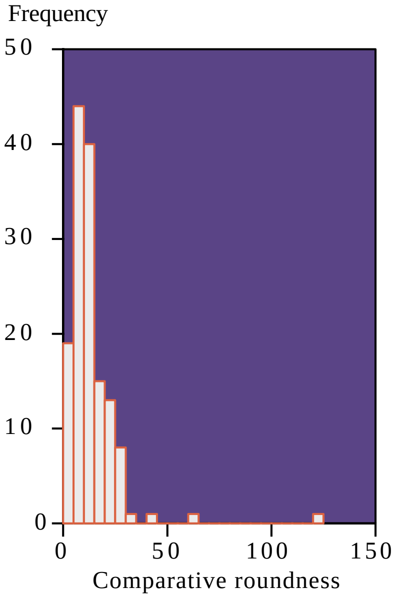
Some conclusions can be made from these measurements. The first plots clearly document that there are only few large grains that swim in the fine-grained matrix. There is no clear separation between small grains and large grains, but rather a smooth transition with intermediate grains. When looking at the second plot, it becomes obvious that shape preferred orientations are developed only in the south (samples from Vorab Pign). The plots Area vs. Comparative roundness clearly document that the small grains have much straighter boundaries than the large ones that can be extremely amoeboid. These two parameters are very well correlated, but sometimes, a separation between two different trends is documented, which could reflect a different stage of recrystallisation between two veins of different age.

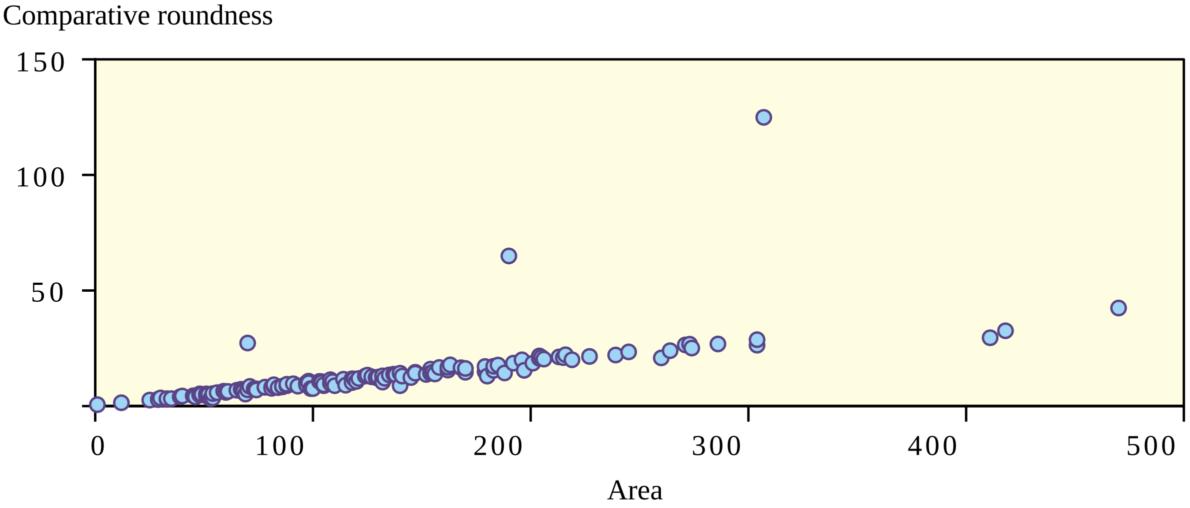
Kärpf 1L3-4


20µm

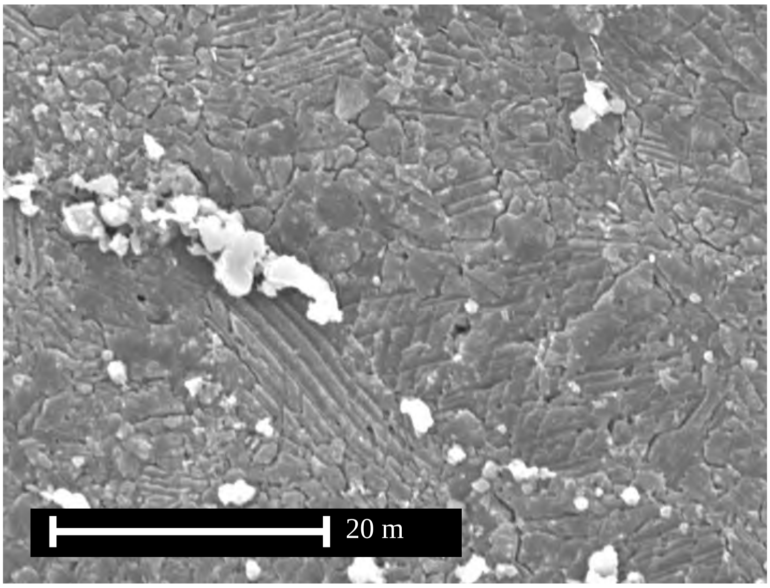

Frequency
40
30
20
10
Kä1L3-4
0
5
10
15
20
25
Long axis (µm)

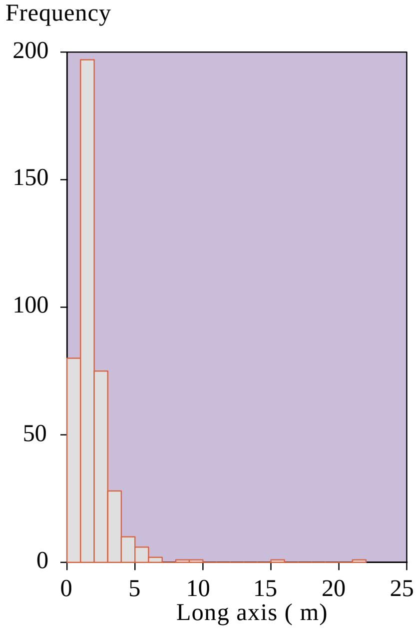

90.0°
60.0°
30.0°
0.0°
330.0°
300.0°
270.0°
240.0°
210.0°
180.0°
150.0°
120.0°
0.6
0.5
0.4
0.3
0.2
0.1
0.0

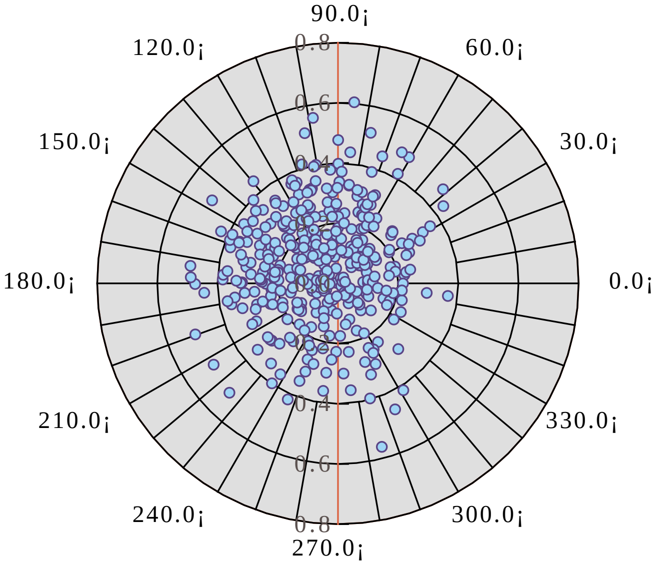

Frequency
50
40
30
20
10
0
0
50
100
150
Comparative roundness

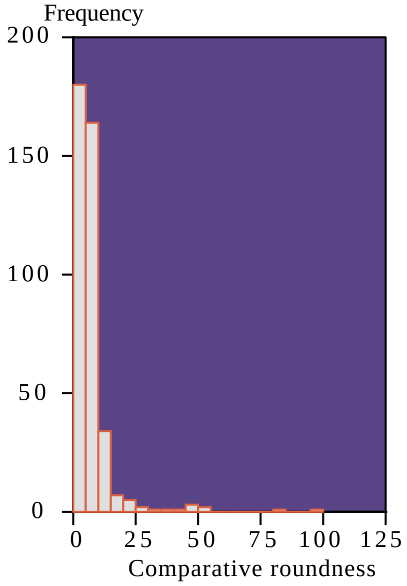

Comparative roundness
150
100
50
0
100
200
300
400
500
Area

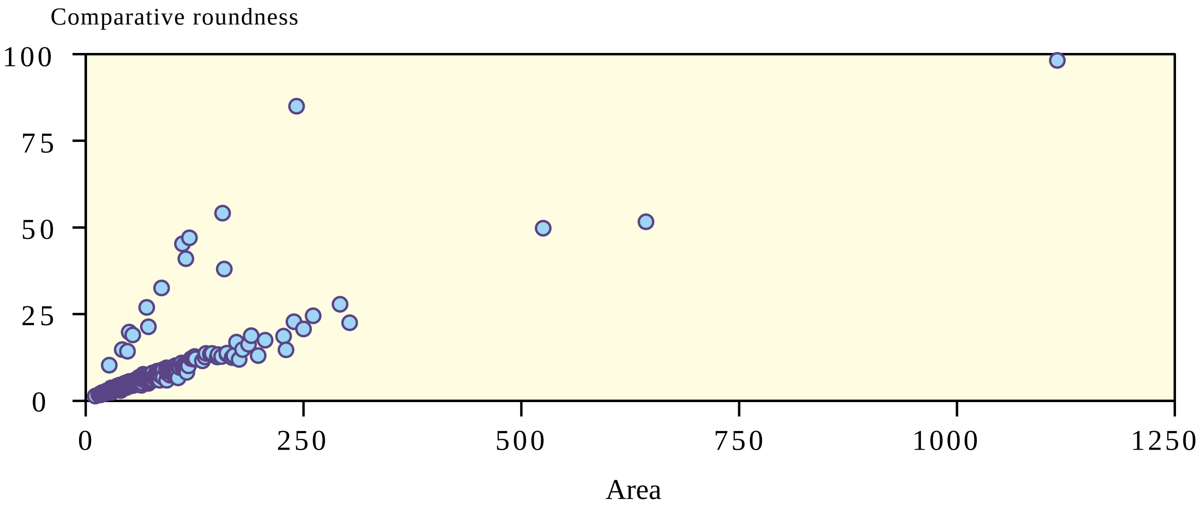
K rpf 2L2-2


20 m

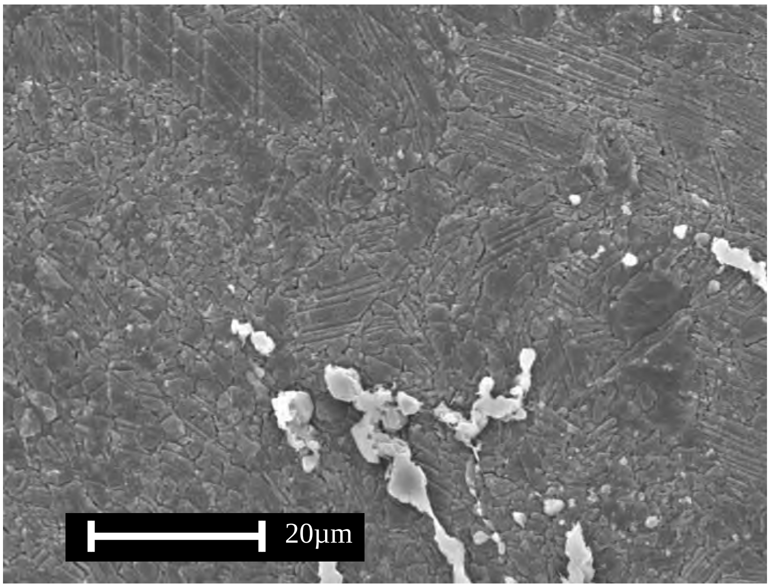

Frequency
200
150
100
50
0
0
5
10
15
20
25
Long axis (m)

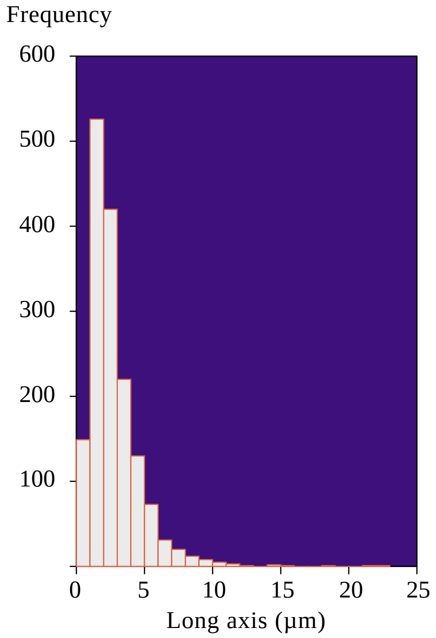

90.0¡
60.0¡
30.0¡
0.0¡
330.0¡
300.0¡
270.0¡
240.0¡
210.0¡
180.0¡
150.0¡
120.0¡
0.8
0.6
0.4
0.2
0.0
0.2
0.4
0.6
0.8

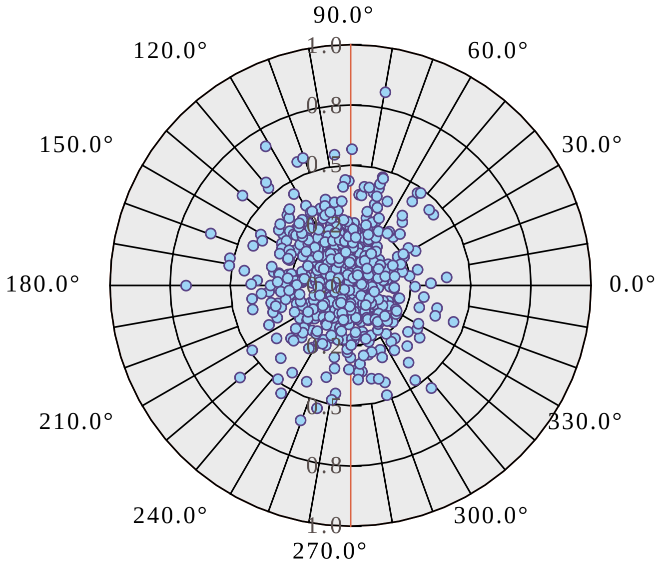

Frequency
200
150
100
50
0
0
25
50
75
100
125
Comparative roundness

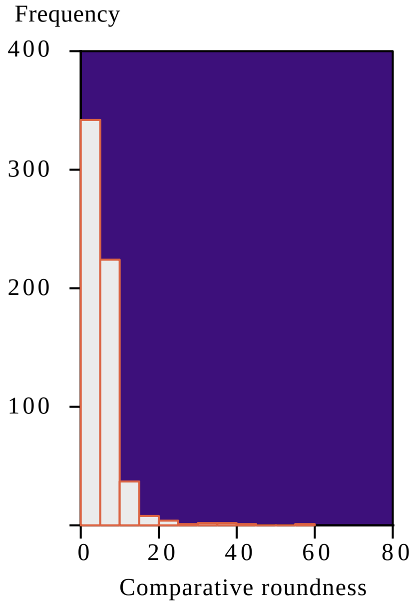

Comparative roundness
100
75
50
25
0
0
250
500
750
1000
1250
Area

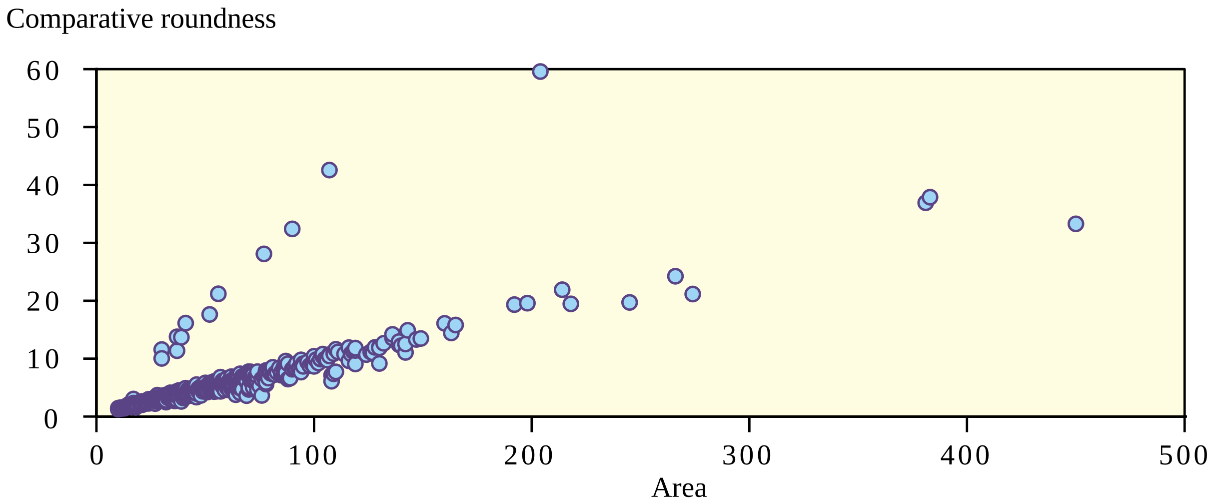
Kärpf 2L2-3


20µm

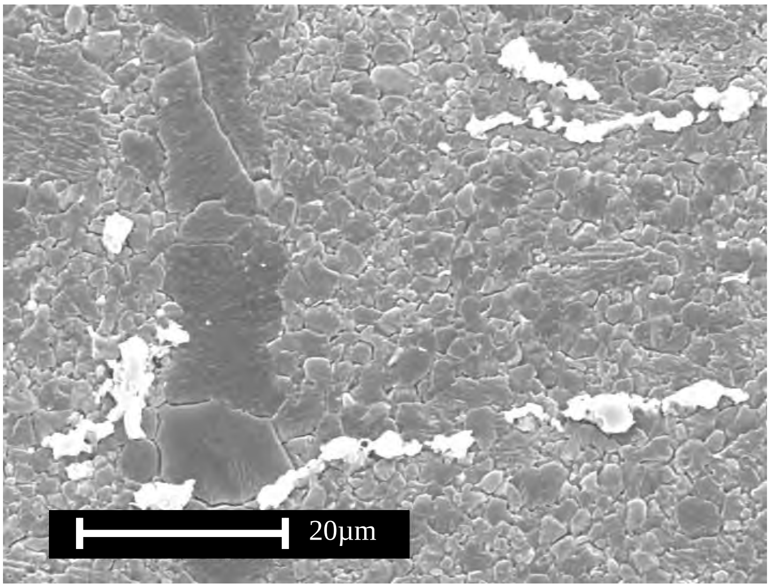

Frequency
600
500
400
300
200
100
0
5
10
15
20
25
Long axis (µm)

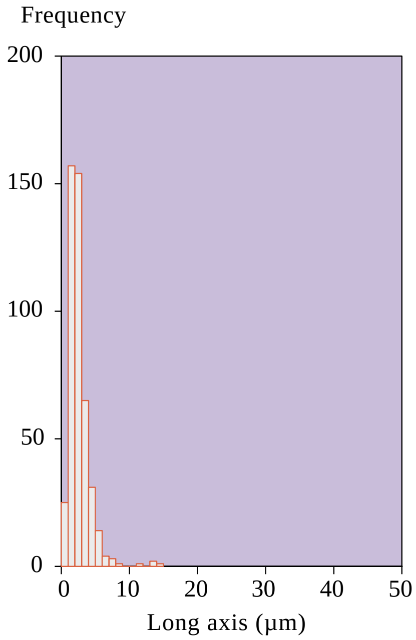

90.0°
120.0°
60.0°
150.0°
30.0°
180.0°
0.0°
210.0°
330.0°
240.0°
300.0°
270.0°
1.0
0.8
0.5
0.8
1.0

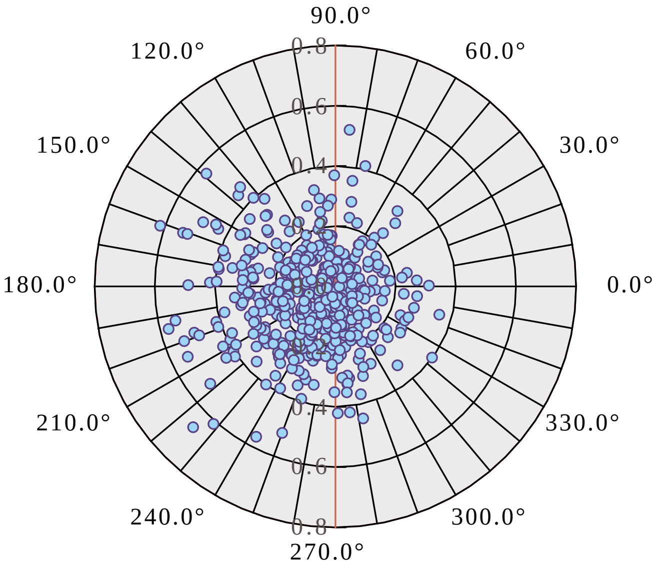

Frequency
400
300
200
100
0
20
40
60
80
Comparative roundness

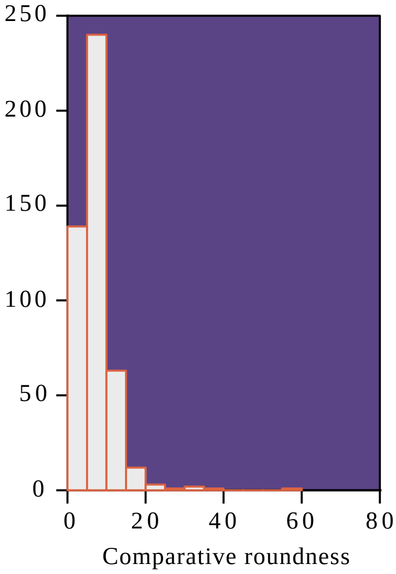

Comparative roundness
60
50
40
30
20
10
0
0
100
200
300
400
500
Area

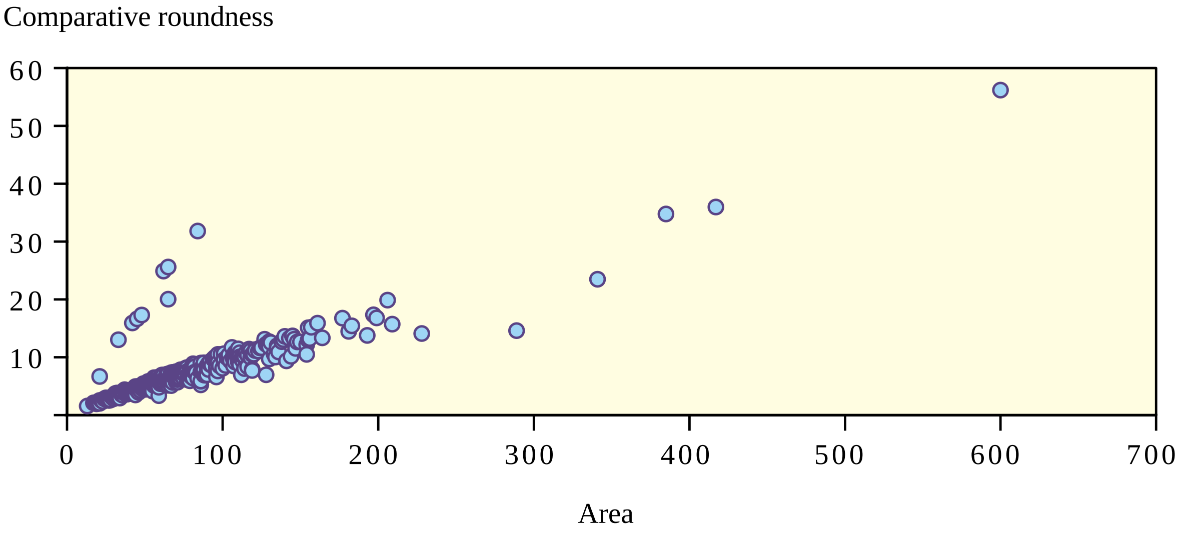
Kärpf 7-3


20μm

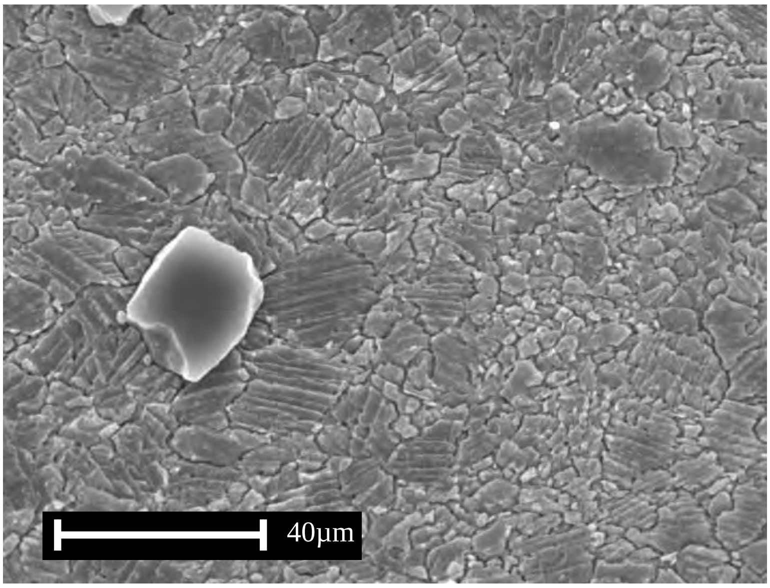

Frequency
200
150
100
50
0
0
10
20
30
40
50
Long axis (μm)

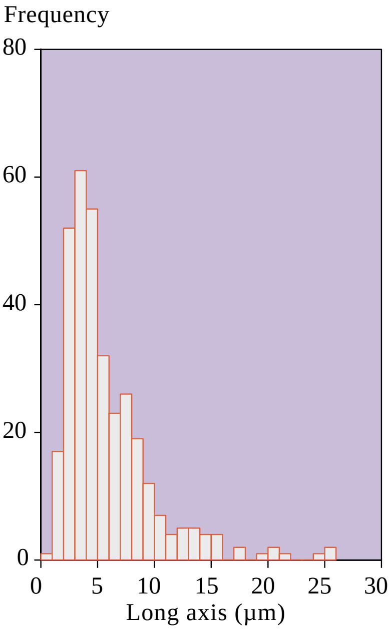

90.0°
120.0°
60.0°
150.0°
30.0°
180.0°
0.0°
210.0°
330.0°
240.0°
300.0°
270.0°
0.8
0.6
0.4
0.2
0.0
0.2
0.4
0.6
0.8

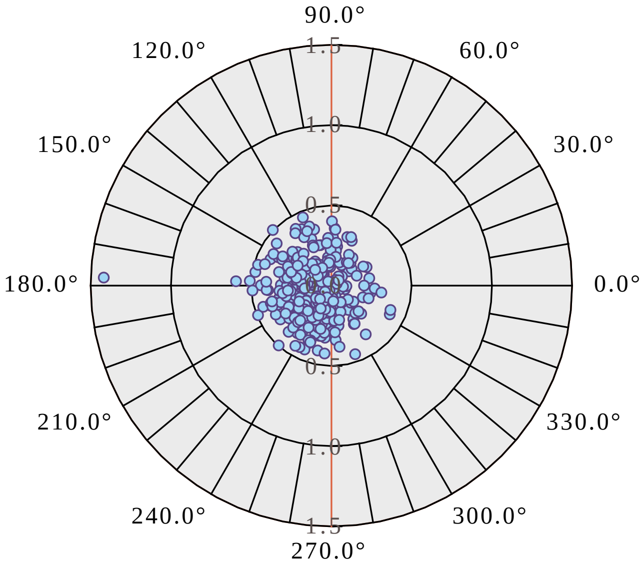

250
200
150
100
50
0
0
20
40
60
80
Comparative roundness

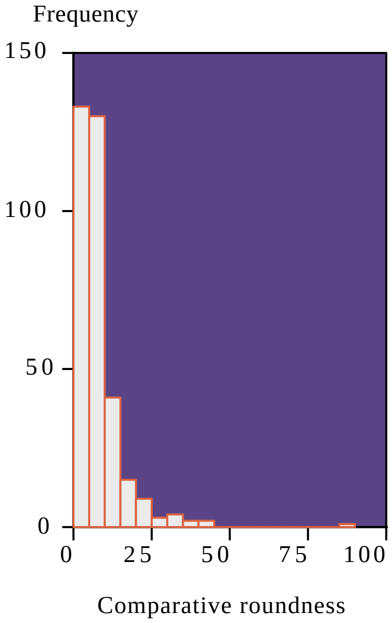

Comparative roundness
60
50
40
30
20
10
0
100
200
300
400
500
600
700
Area

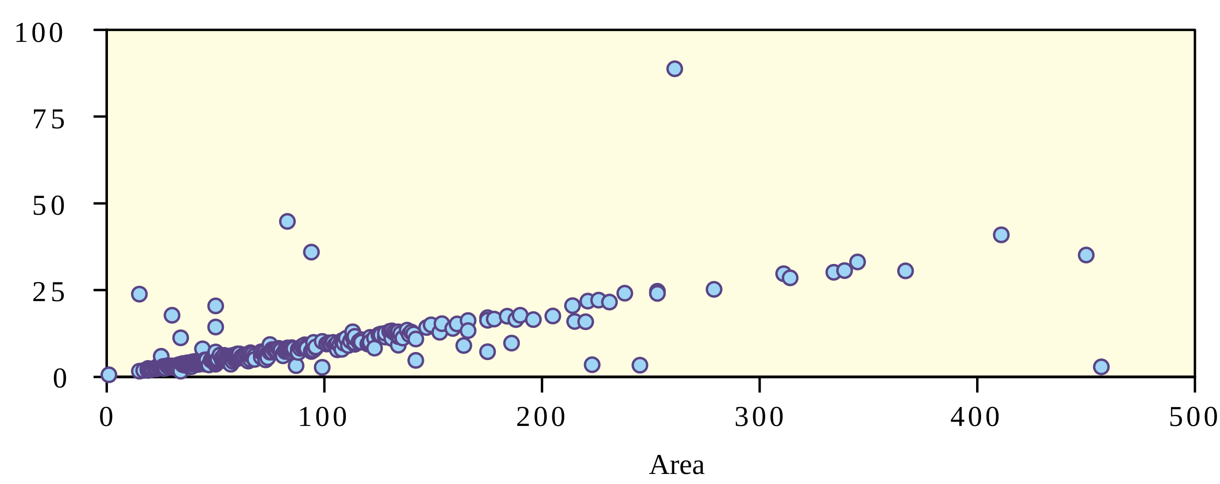
VORAB PIGN 1L1-1



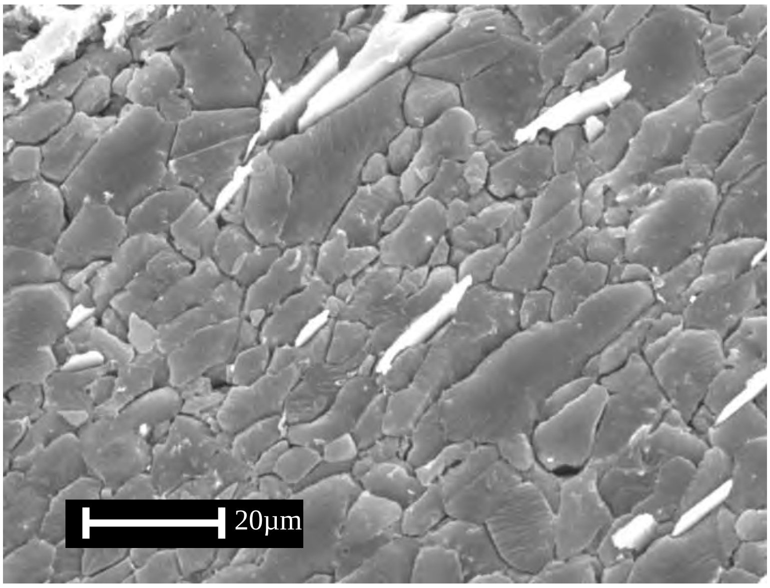


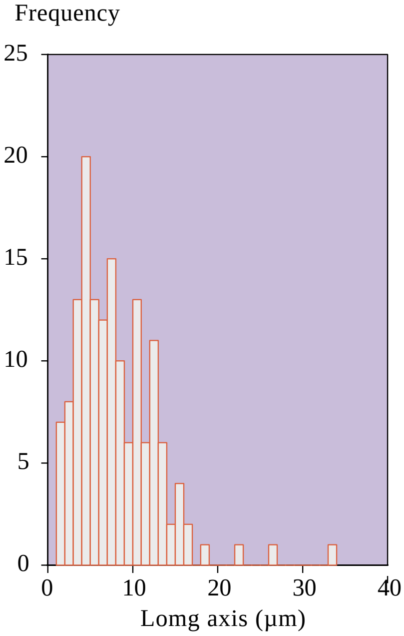


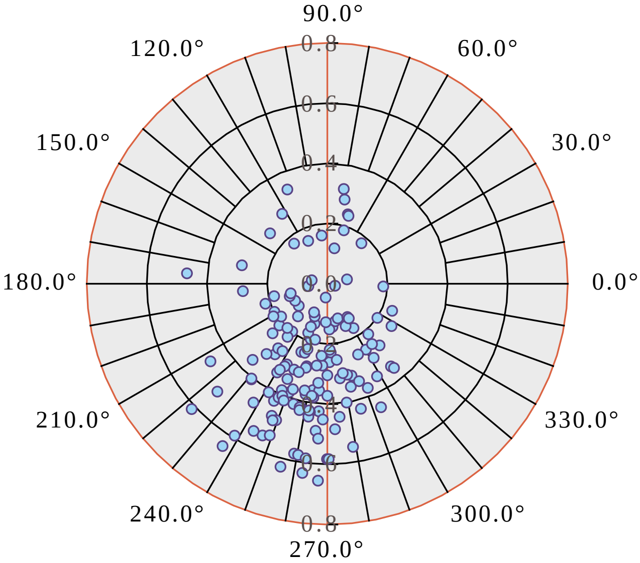


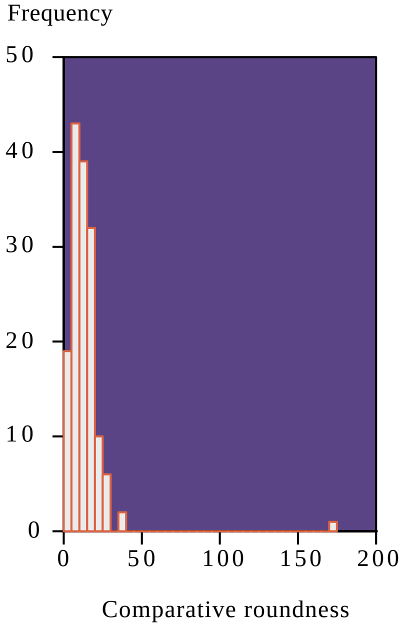


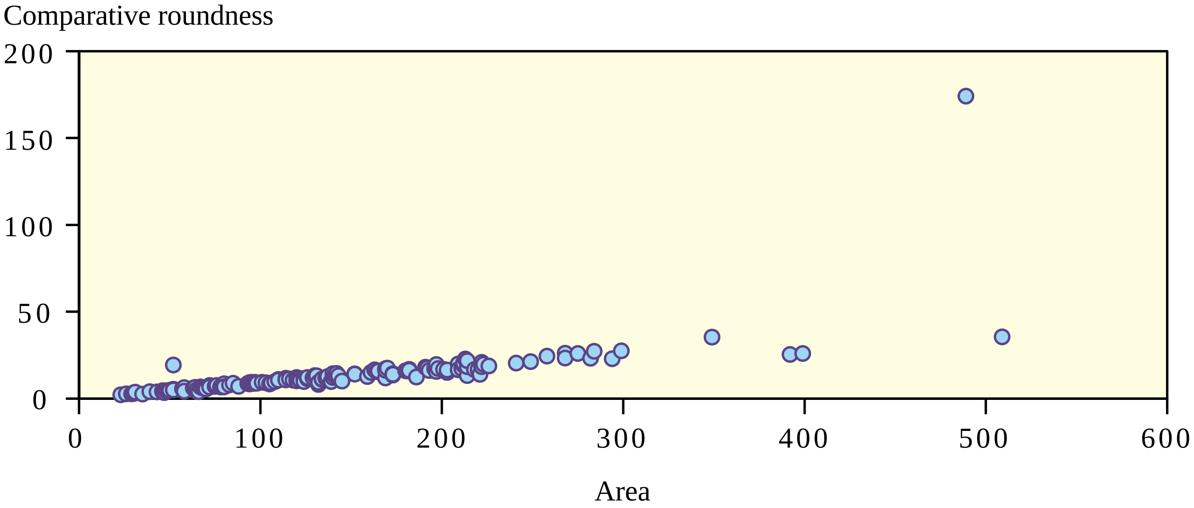
VORAB PIGN 1L3-2



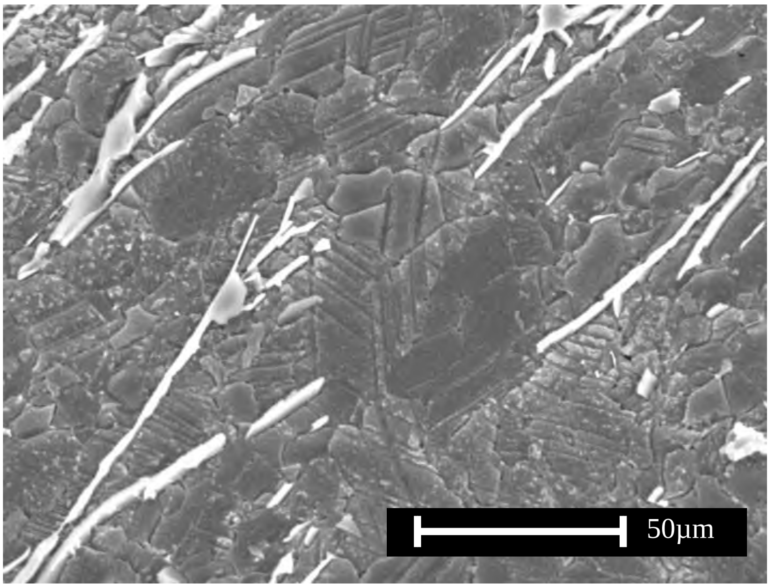


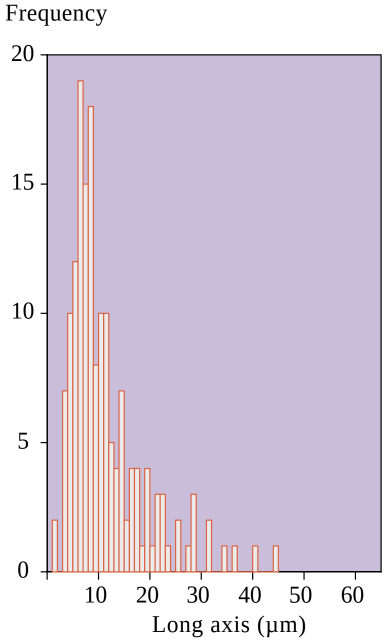


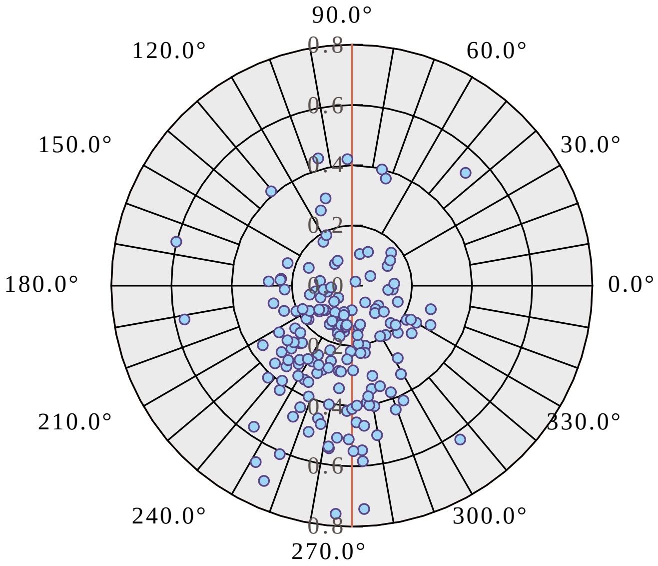


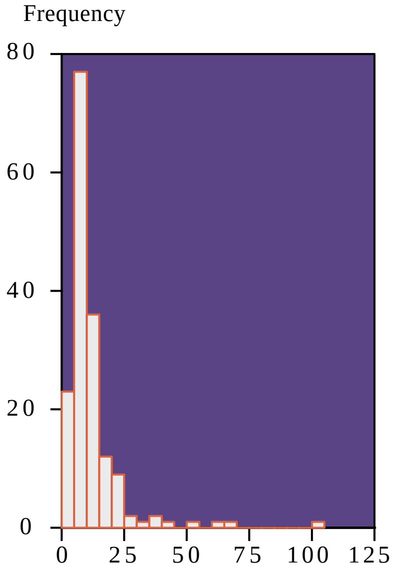


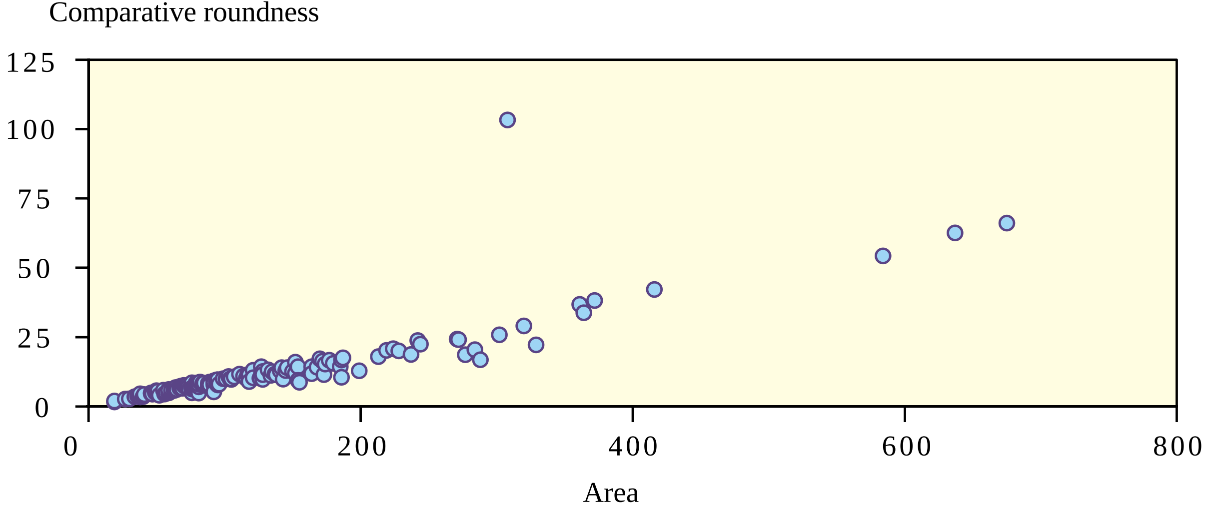
VORAB PIGN 1L3-4



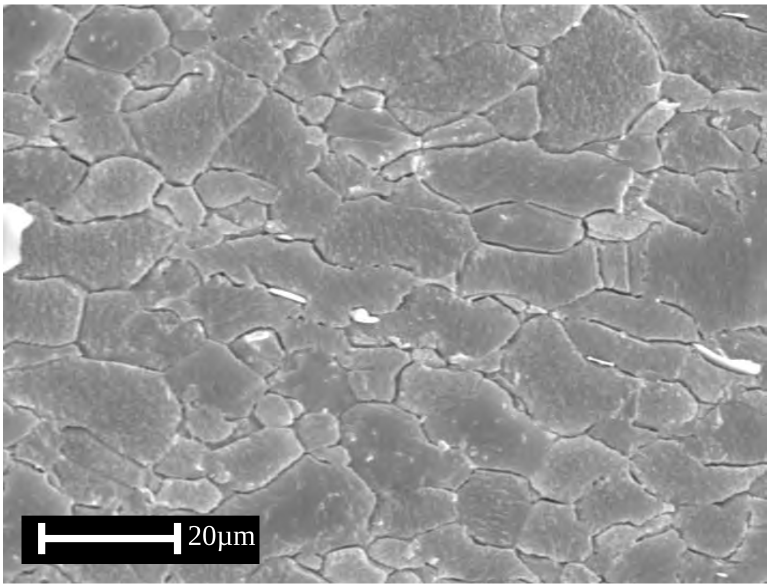


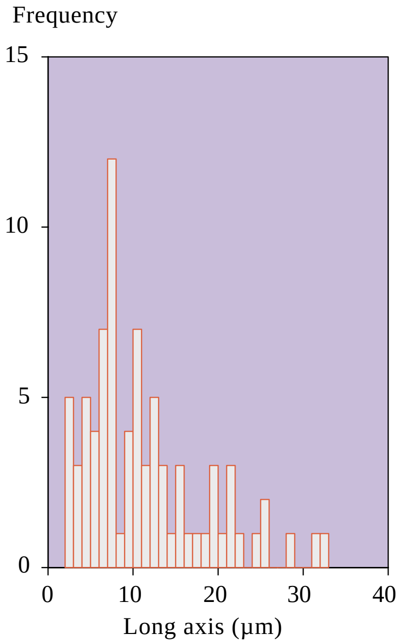


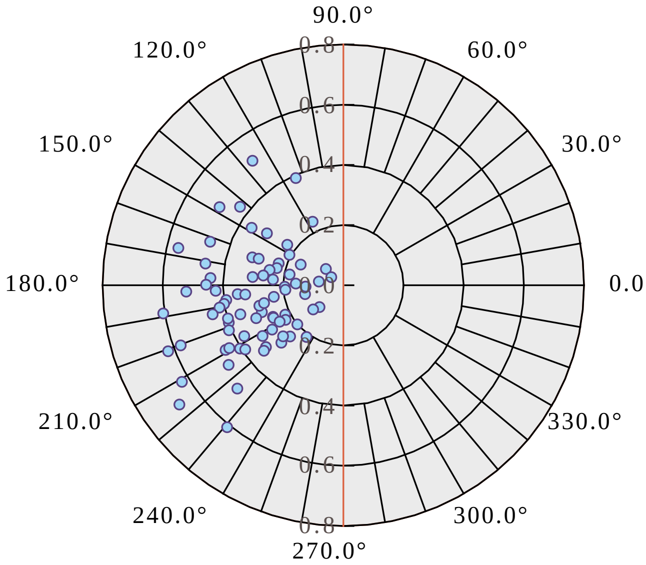


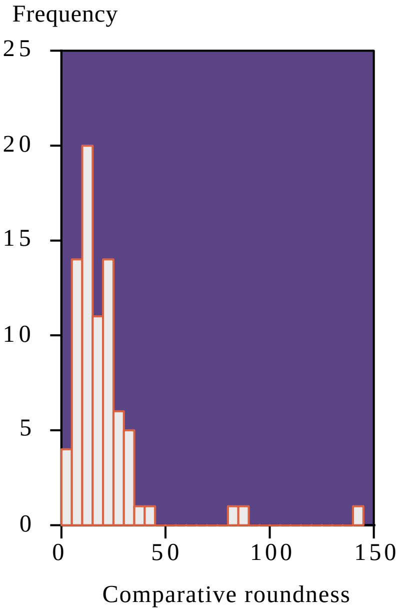


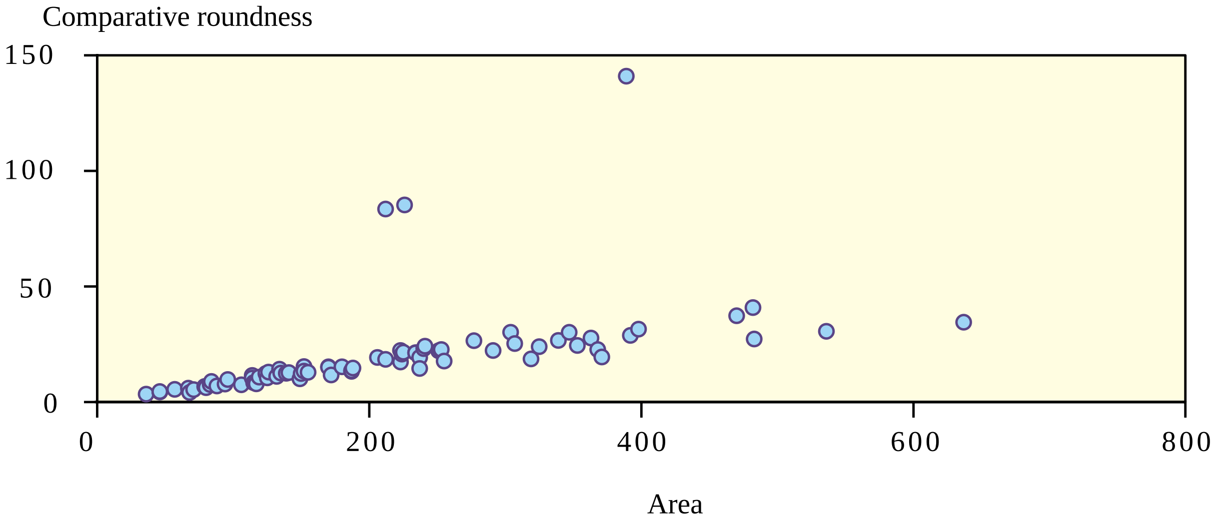
VORAB PIGN 2-1



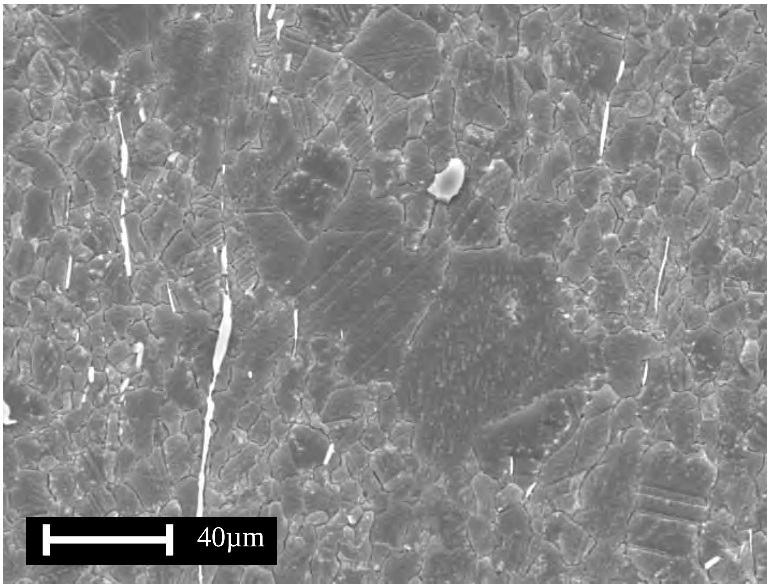


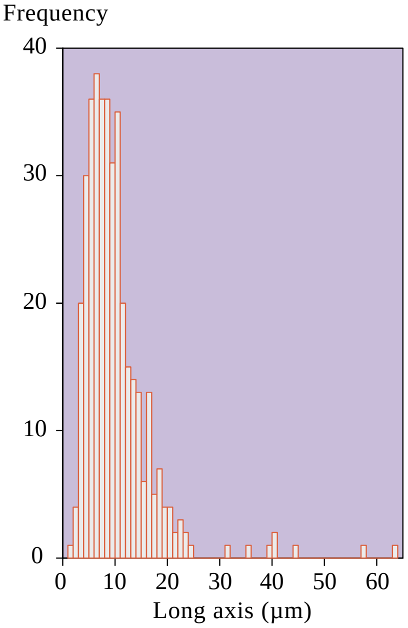


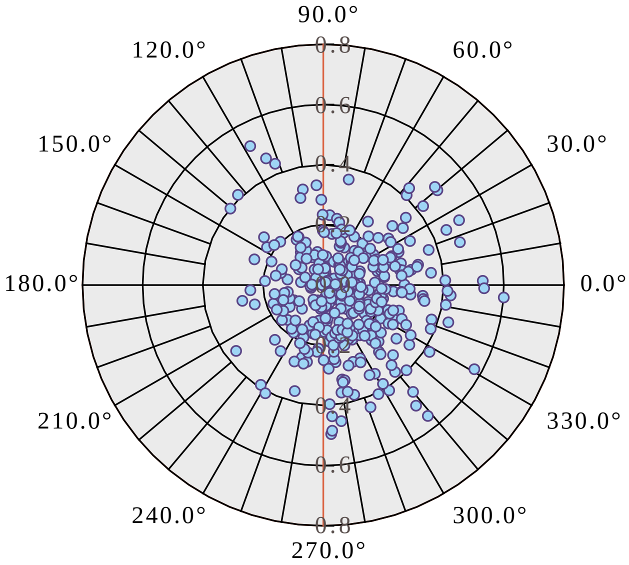


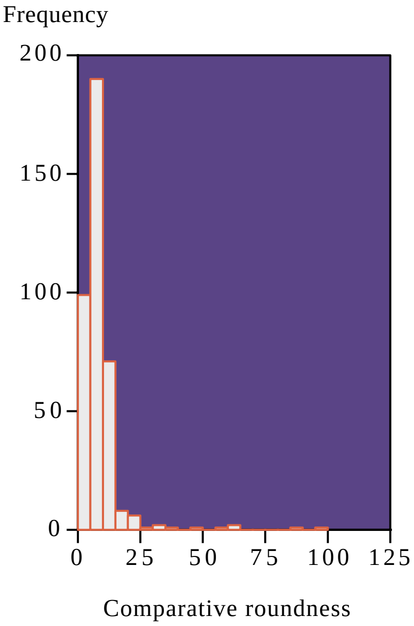


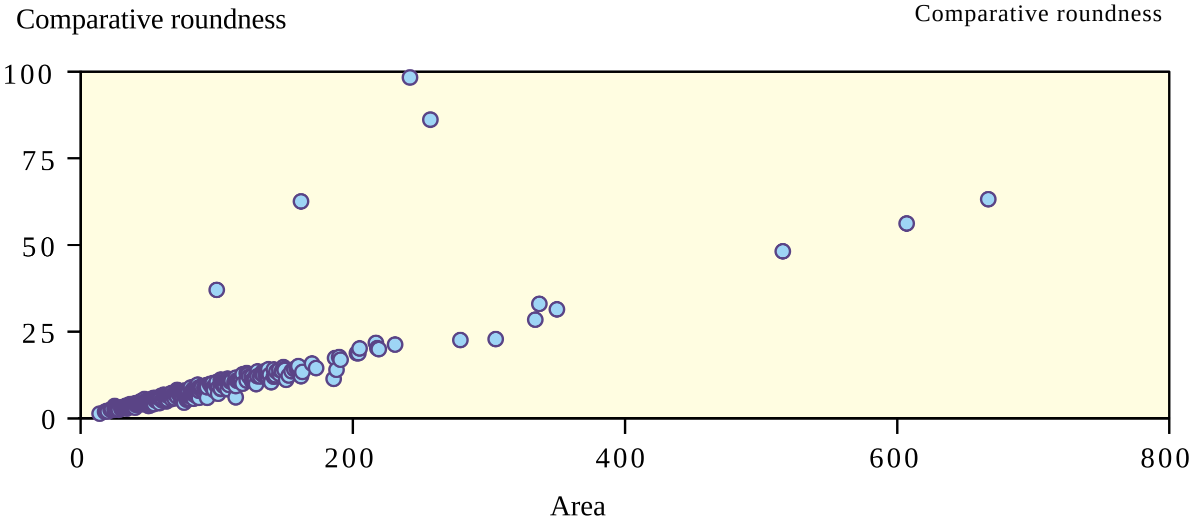
VORAB PIGN 2-3



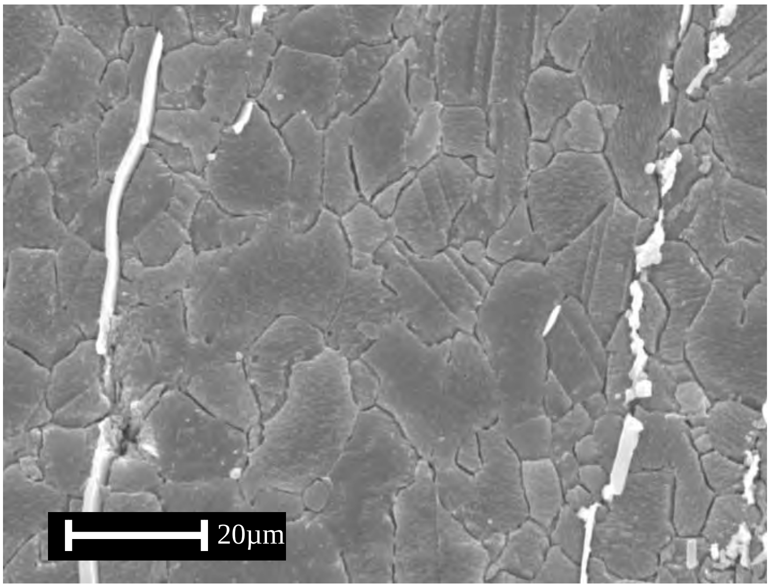


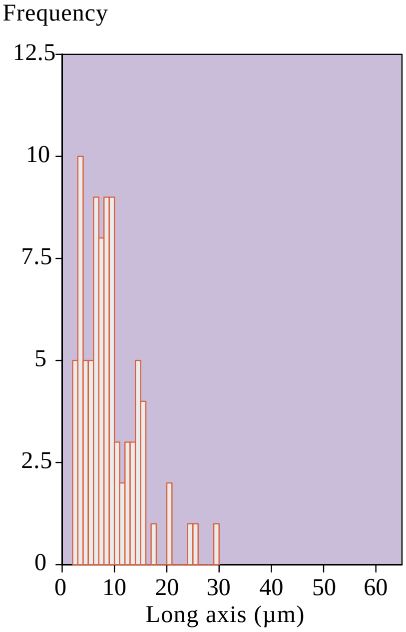


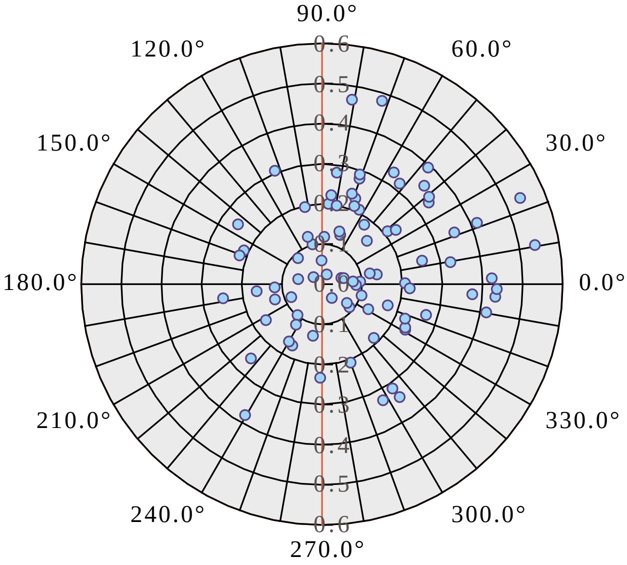


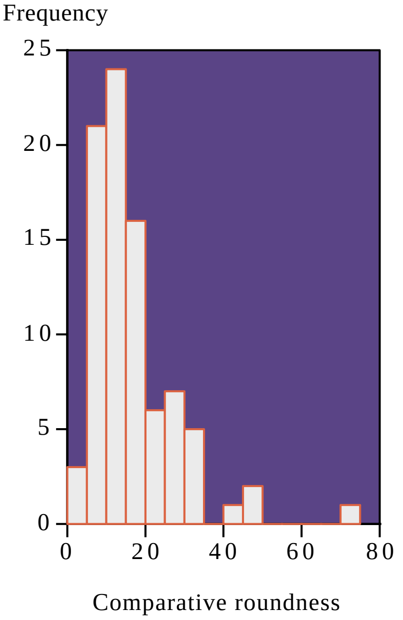


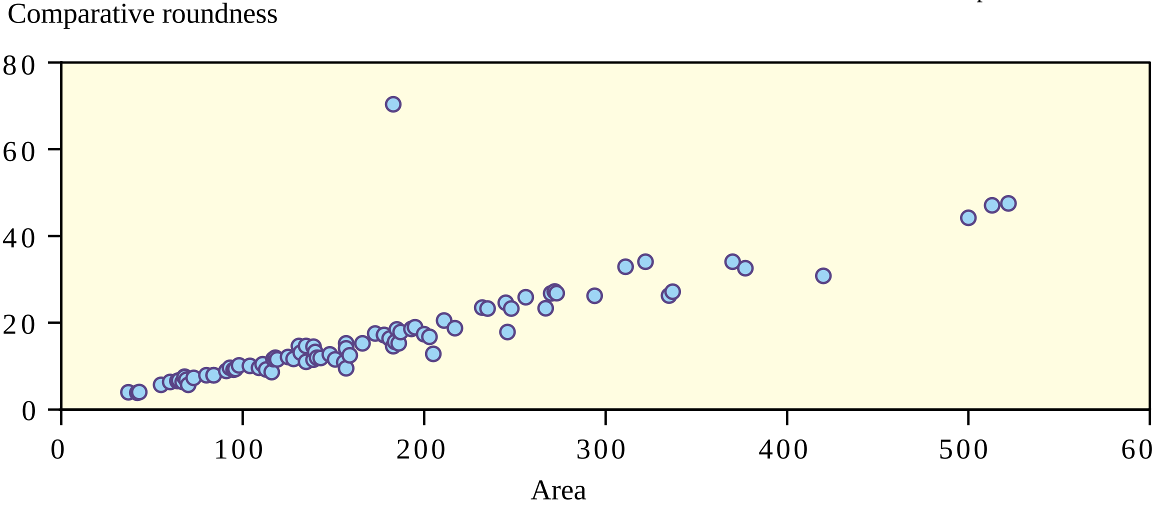
VORAB PIGN 2-4











Appendix V is composed of 16 SEM pictures of Lochsitenkalk samples that can be grouped in three different categories depending on the method of preparation for SEM observations.

†. Pictures of etched-polished surfaces of Lochsitenkalk slabs

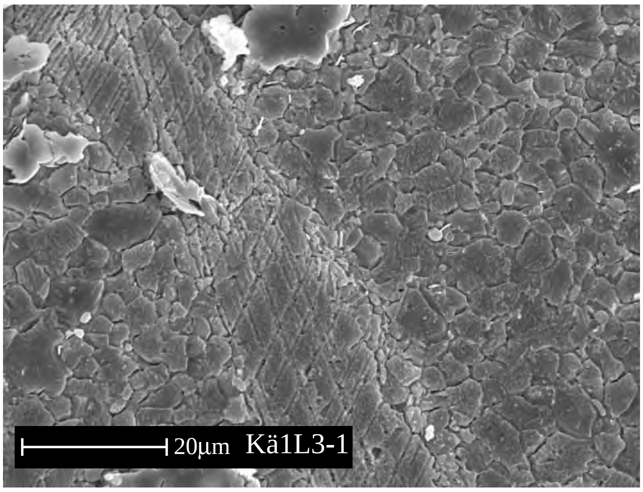
Small slabs of Lochsitenkalk have first been polished with down to 1mm diamond paste, before being etched with HCl 0.37% for 30 s then with CH_3COOH 0.1% for 1 minute. Finally these samples have been coated with gold for SEM observation. As quartz, albite, micas and dolomite are inert or much less reactive to HCl than calcite, these minerals form high relief. Apart from mica that can easily be recognized as flakes, the other minerals have not been determined (compare appendix VI). The aim of these pictures was to document nice textures in the Lochsitenkalk. The first five pictures document the omnipresence of large twinned grains that belong to veins inside an ultrafine-grained matrix. Depending on their state of ductile overprint, grains inside the veins can be fairly straight ((Kä3-5/Kä7) or can have sutured boundaries (Kä1L3-1). The sixth picture shows a nice co-existence of calcite and one of the above-mentioned minerals. It was chosen for its esthetical aspect. Pictures 7 (Lo6) and 8 (Lo6-1) display very late veins composed of large grains with straight boundaries, that crosscut an older partly recrystallised vein in one case (Lo6-1). On picture 9 (VP1L1-2), the typical occurrence of a euhedral pyrite is visible. The last two pictures underline the difference in texture between a sample with a shape-preferred orientation (VP1L3-2) from the south and a sample without SPO from the north.

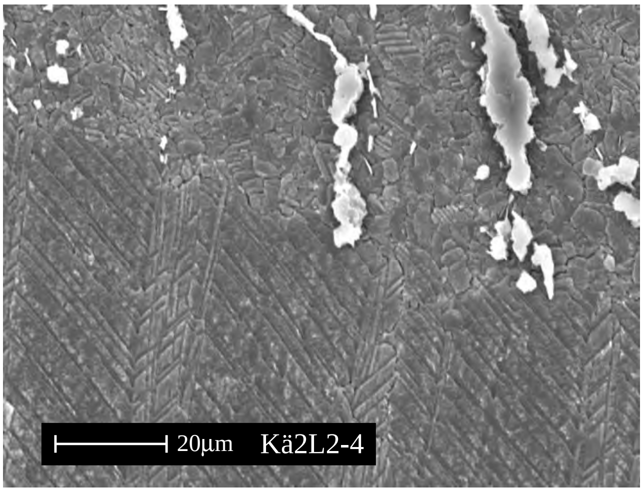
†. Pictures of septum fresh surface

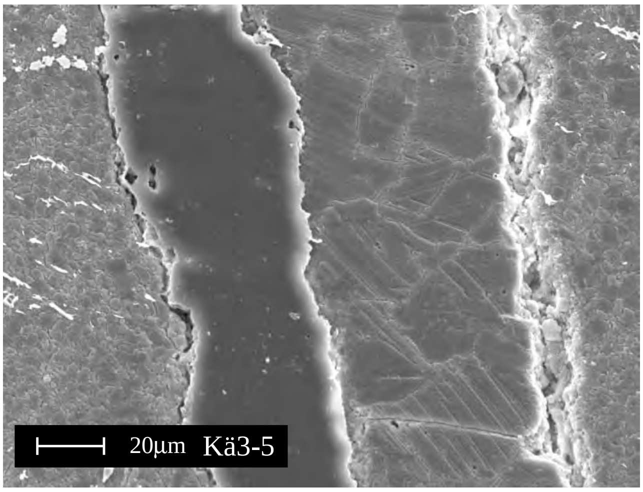
For these pictures, samples of the septum in the Lochsitenkalk that presented a glassy surface have been chosen. No other preparations but gold coating have been performed on these samples. The first two pictures document mechanical striation on these glassy surfaces associated with seismic slip. Cataclastic deformation and grain-size reduction can be documented along these striations. The next two pictures are presented because they constitute spectacular structures that remain unexplained.

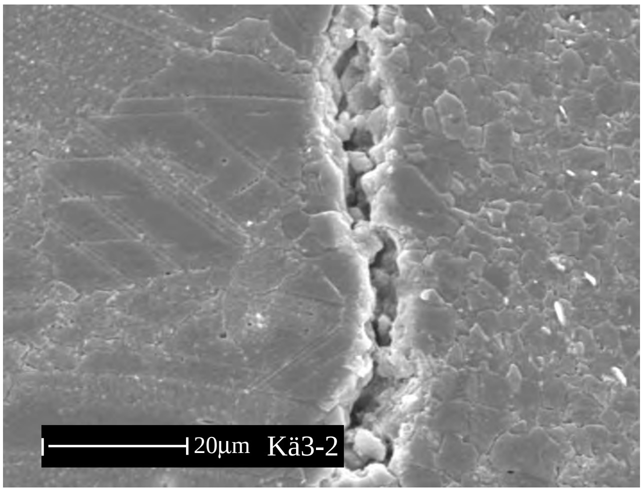
†. Pictures of etched samples and insoluble residues

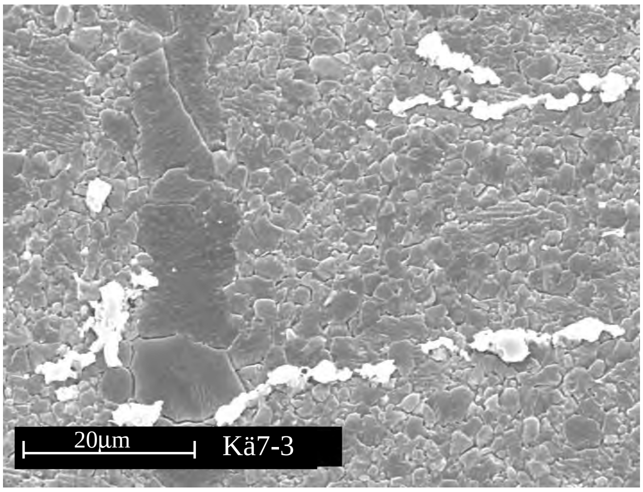
Small slabs of Lochsitenkalk have been etched with HCl 10% for about five minutes. The insoluble residues and the partly dissolved slabs have been washed under water. Finally these samples have been coated with gold for the SEM observation. Such a procedure of etching was performed in order to observe the 3D morphology of quartz and albite grains and to create high relief variations slab with calcite in the valleys. Apart from the fact that quartz never shows euhedral 3D (CE2/Lo12/PG1) morphology in contrary to albite (SAR5b), no other specific conclusion has been made from these analyses. Micas are often folded (SAR5a) and late calcite veins are over-visible (Lo12).

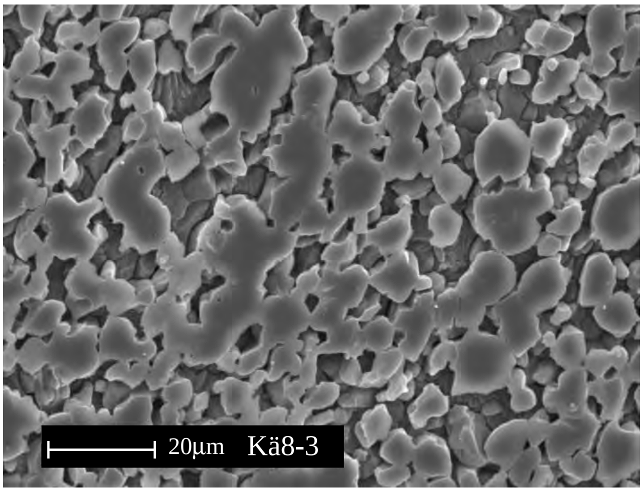

20µm
Kä1L3-1

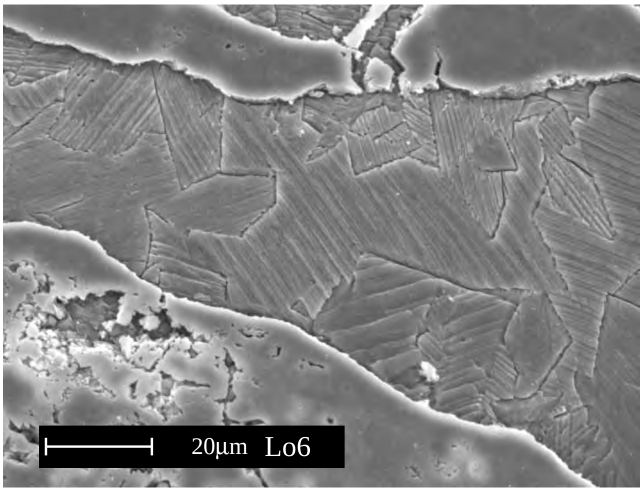

20µm
Kä2L2-4

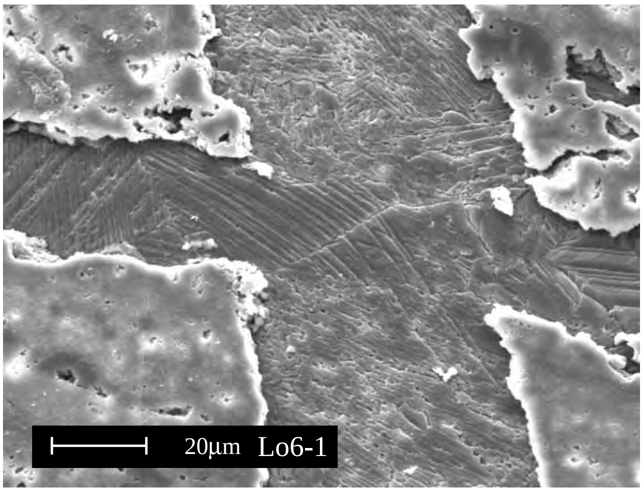

20µm
Kä3-5

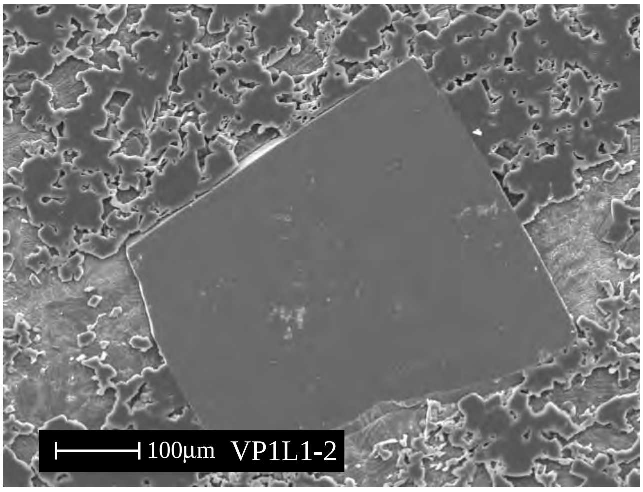

20µm
Kä3-2

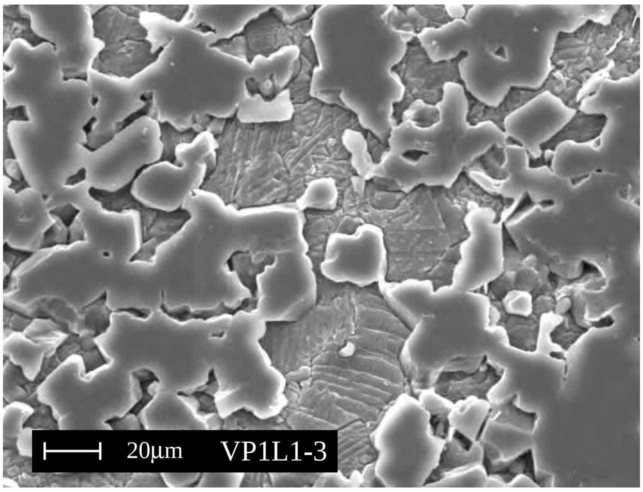

20µm
Kä7-3

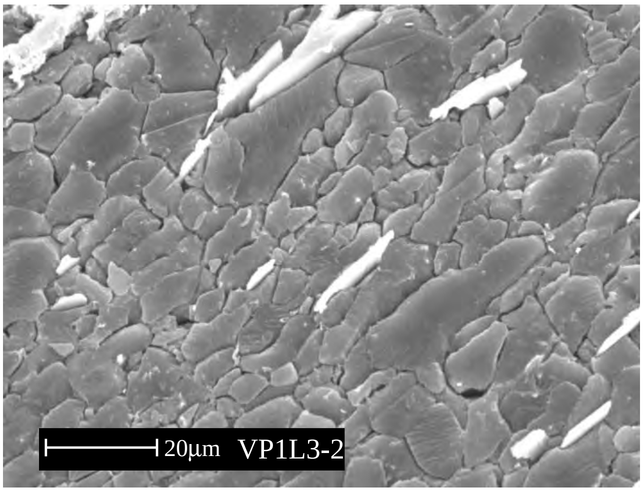

20µm
Kä8-3

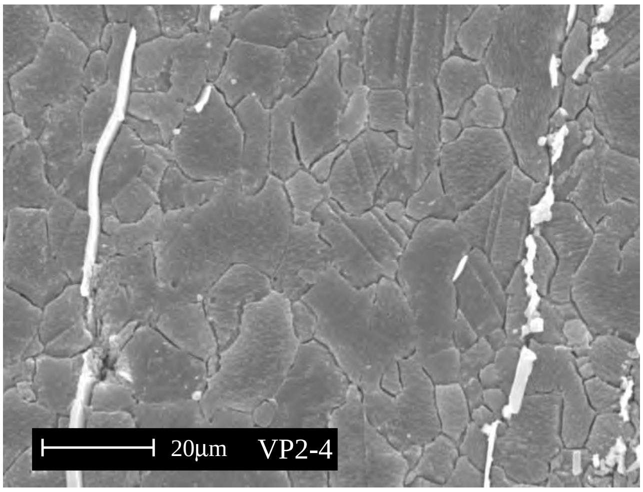

20µm Lo6

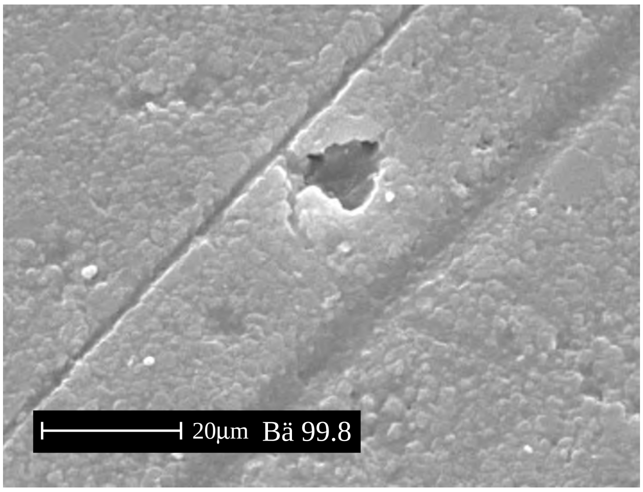

20µm Lo6-1

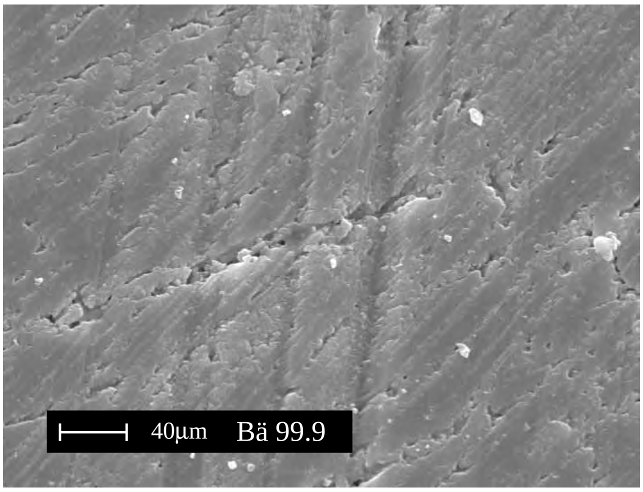

100µm VP1L1-2

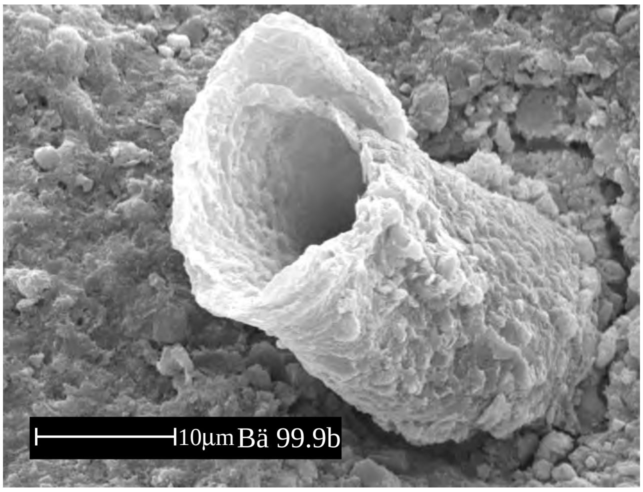

20µm VP1L1-3

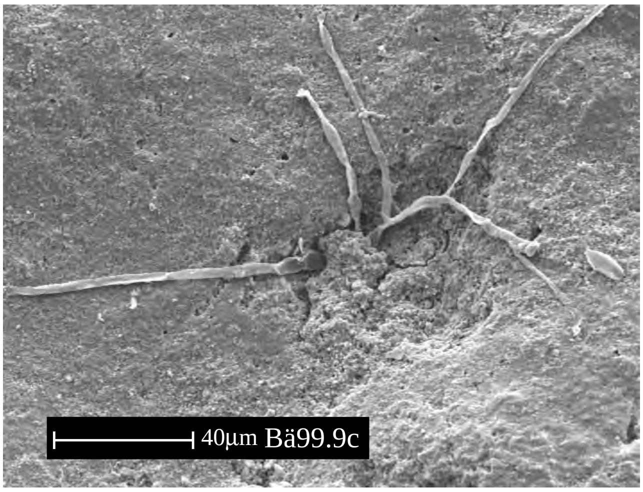

20µm VP1L3-2

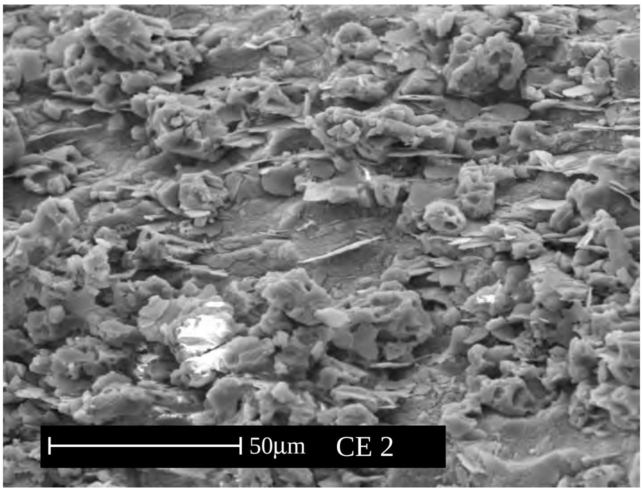

20µm VP2-4

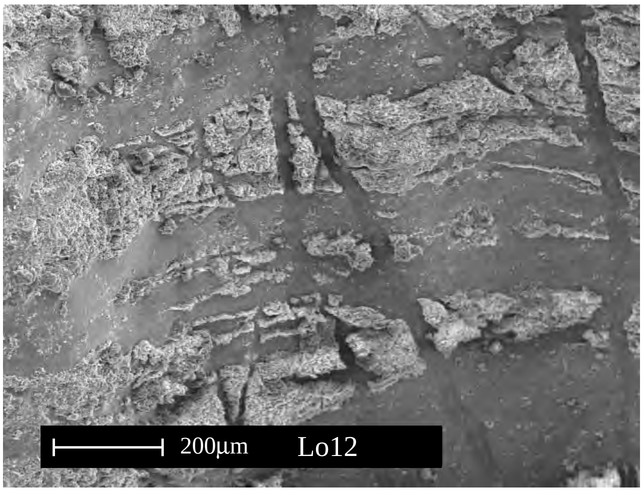

20µm Bä 99.8

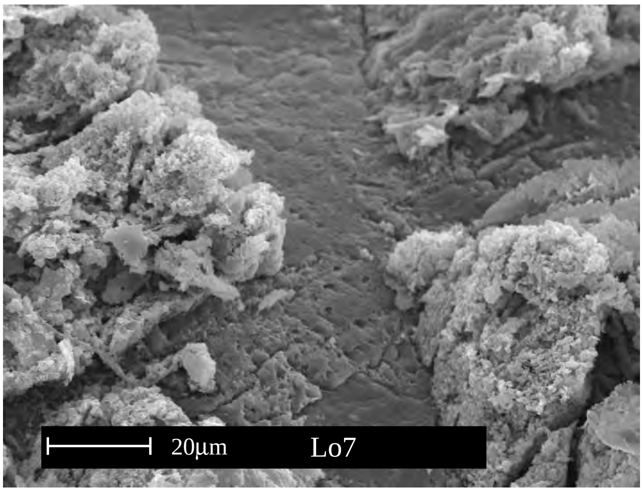

40µm Bä 99.9

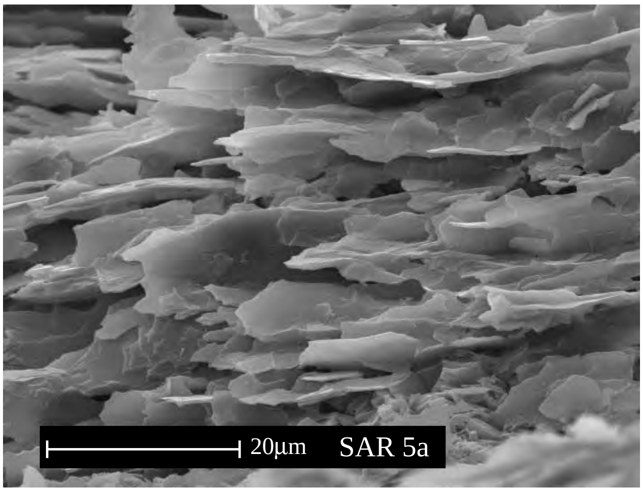

10µm Bä 99.9b

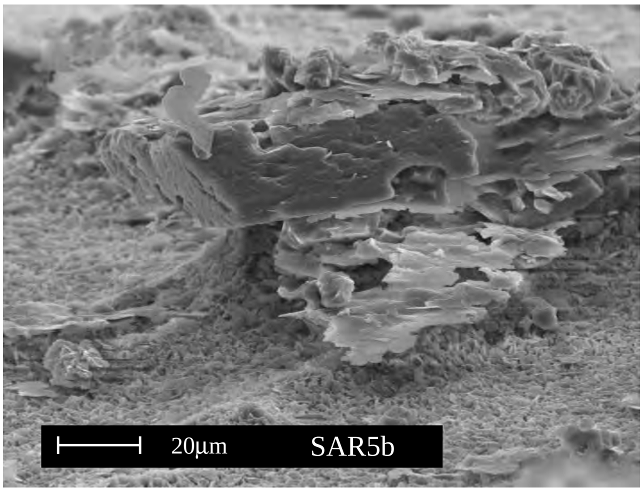

40µm Bä99.9c

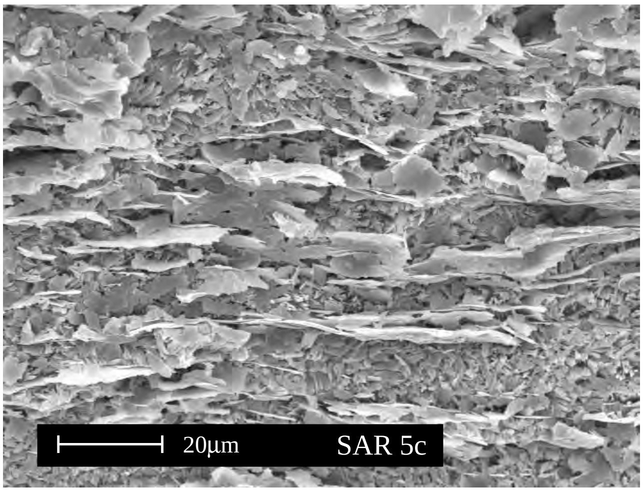

50µm
CE 2

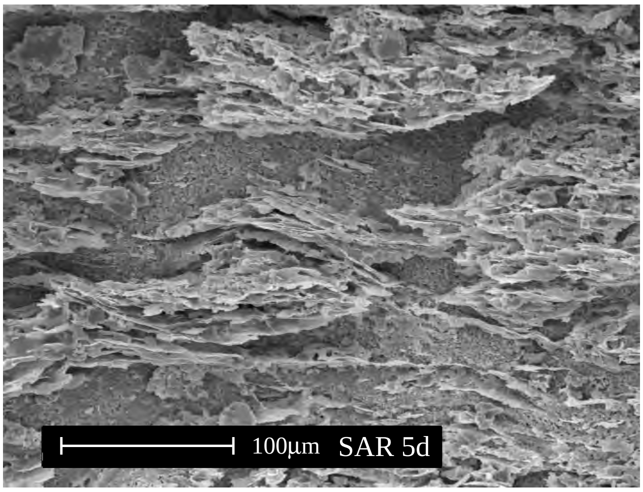

200µm
Lo12

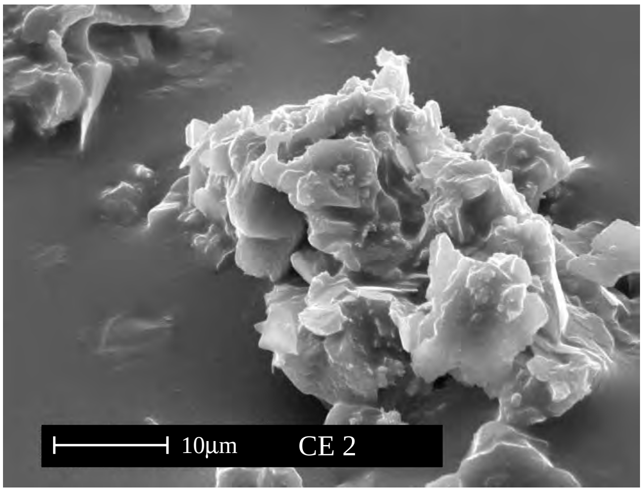

20µm
Lo7

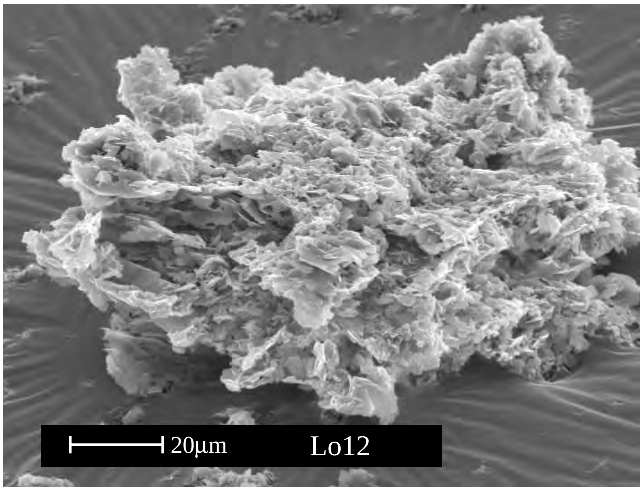

20µm
SAR 5a

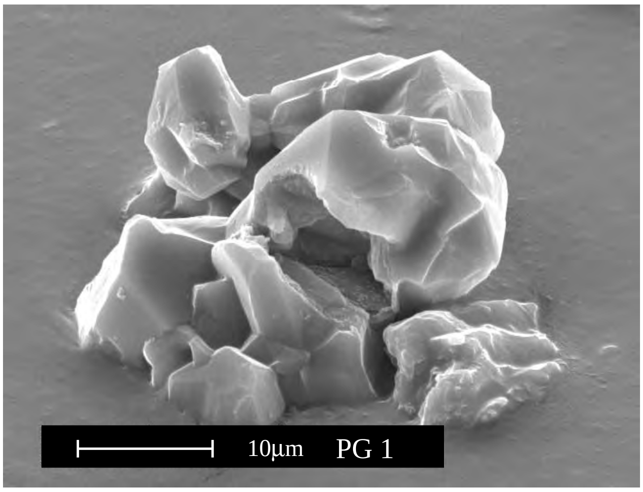

20µm
SAR5b


20µm
SAR 5c


100µm SAR 5d


10µm CE 2

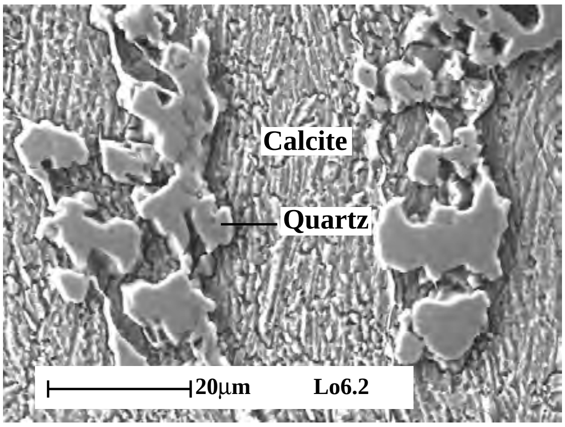

20µm Lo12

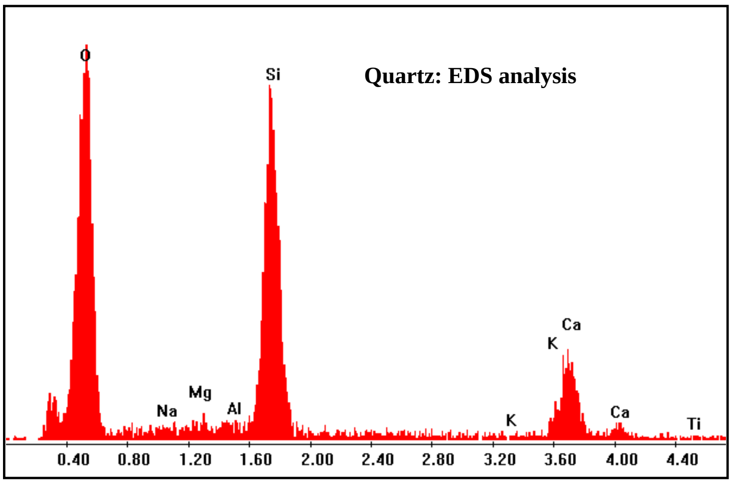

10µm PG 1

Appendix VI is composed of 5 ESEM pictures of Lochsitenkalk, each being linked to the EDS spectrum of quartz, albite, muscovite, dolomite and pyrite respectively. These pictures are representative for the general occurrence of these minerals.

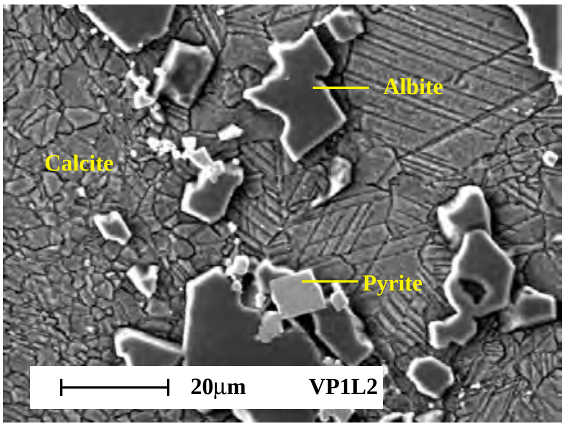
Small slabs of Lochsitenkalk have first been polished with down to 1mm diamond paste, before being etched with HCl 0.37% for 30 s then with CH_3COOH 0.1% for 1 minute. As quartz, albite, micas and dolomite are inert or much less reactive to HCl than calcite, these minerals form high relief on these pictures. Quartz is always present as amoeboid grains with a very complex 3D morphology (Lo6.2). In contrary, albite is mainly present as sub-euhedral and sometimes true euhedral crystals (VP1L2). No comments are necessary for muscovite. Dolomite occurs as large domains that have very sutured boundaries with calcite domains (Lo6). Pyrite is always euhedral (VP1L2).

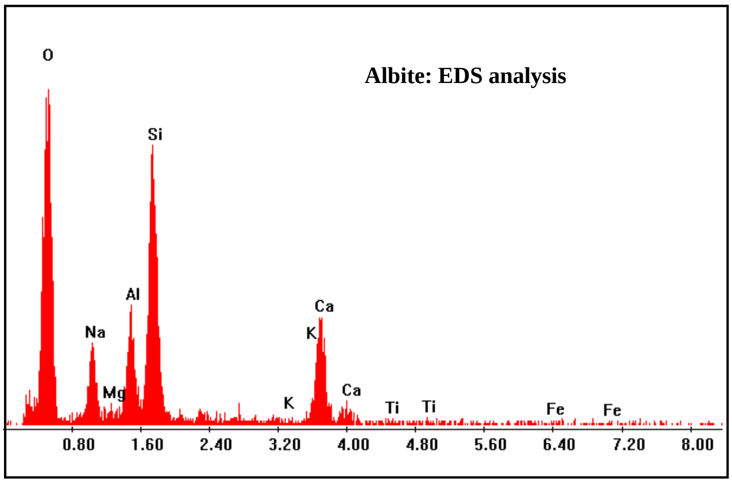
Lochsite



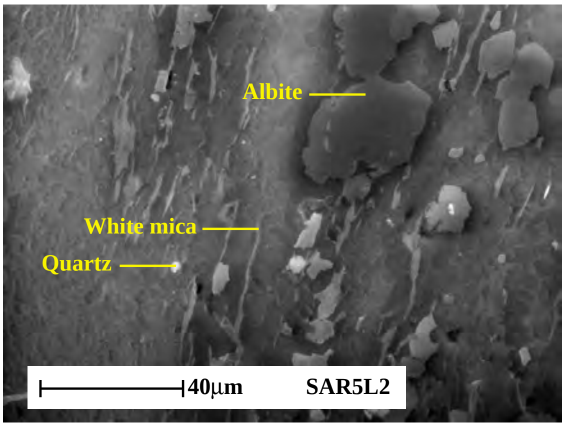


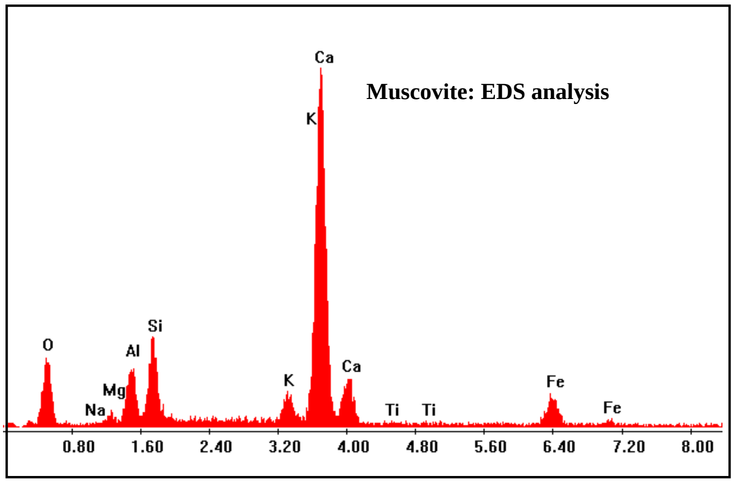
Vorab Pign



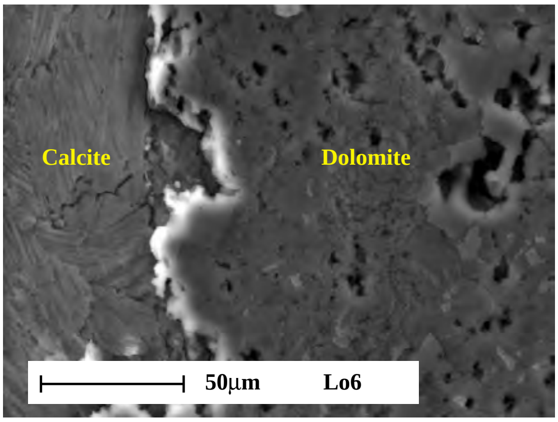


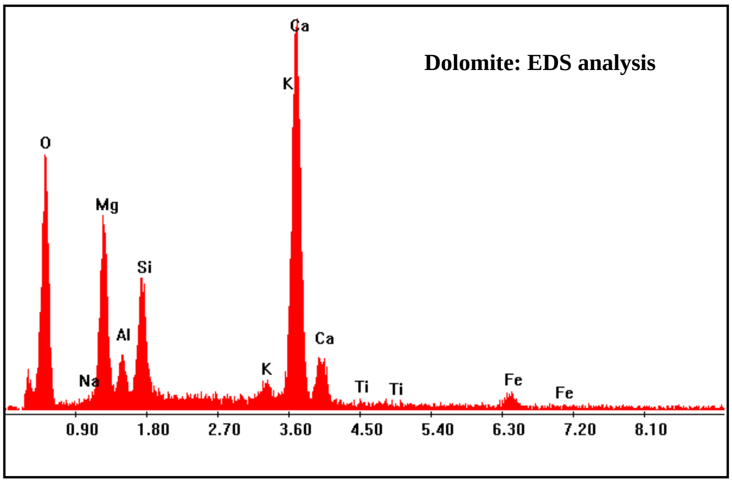
Piz Sardona



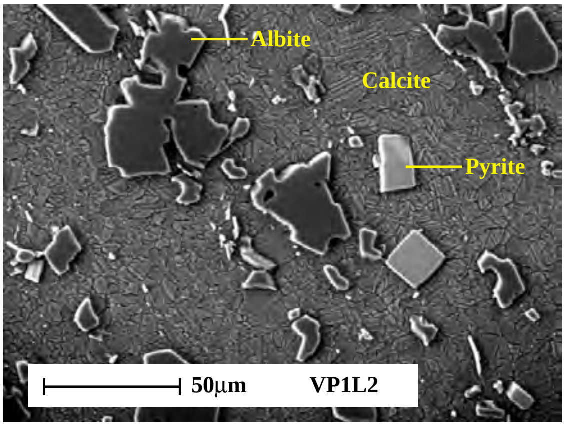


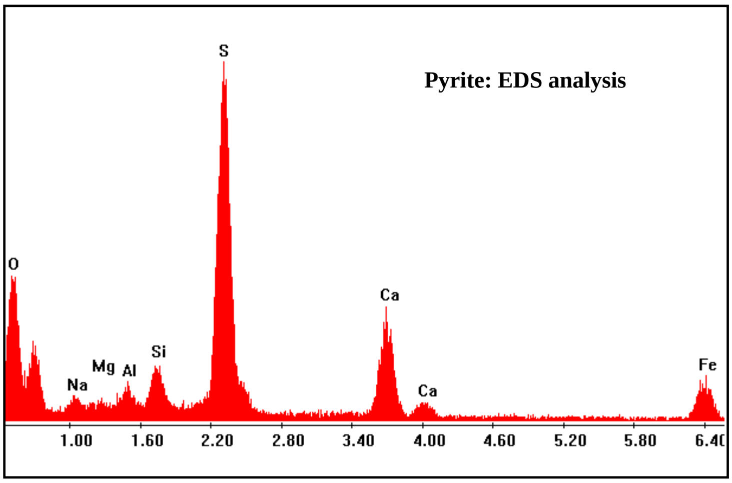
Lochsite





Vorab Pign



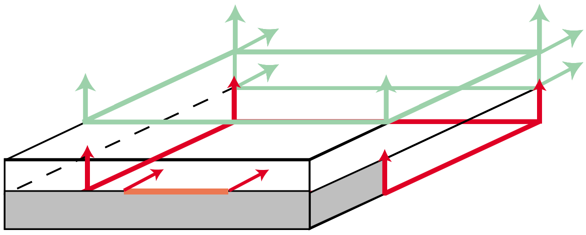


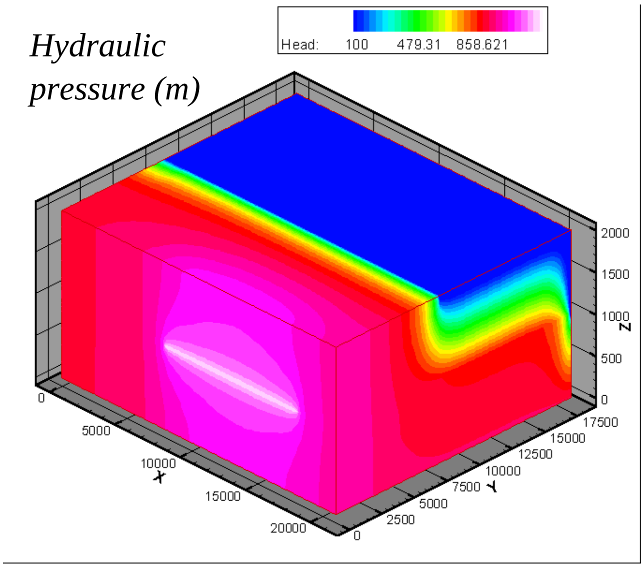
Appendix VII presents the results of 12 fluid flow 3D numerical simulations. These simulations have been performed with the finite element model FRAC3D. This model is precisely presented in chapter V. Each sheet presents the results of one simulation, for which the hydraulic parameters (table), the configurations of sources and drains (top-right), the hydraulic head (centre-left) and the resulting isotopic zonations after different duration are given. This appendix is a complement to chapter V. No more comments are necessary as these results can be analysed by comparison with the discussion presented in chapter V.

S81

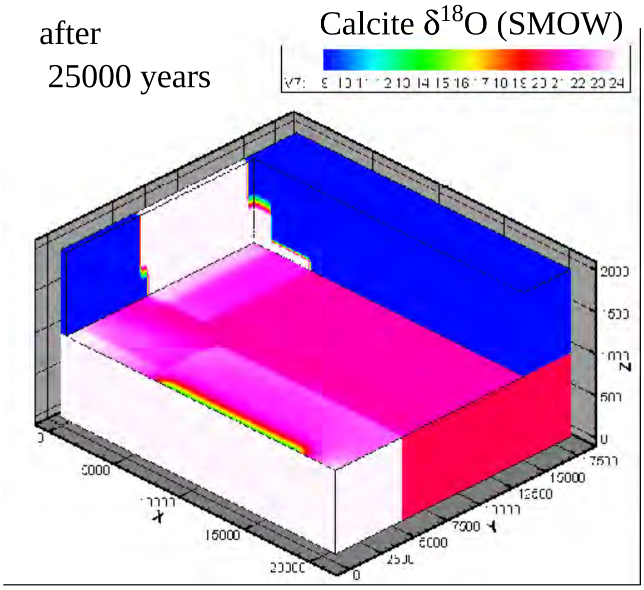
Basement head: 1200
Flysch head: 900

Lithology	Kxx	Kyy	Kzz	Ø	Xkk
Verrucano	0.0309	0.0309	0.01	0.03	1E-7
Flysch	0.15	0.15	0.15	0.06	1E-6
LK	6	0.5	0.5	0.05	1E-4
Foot. carb.	0.01	0.01	0..005	0.03	1E-7
Hang. carb.	0.03091	0.03091	0.0309	0.04	1E-6



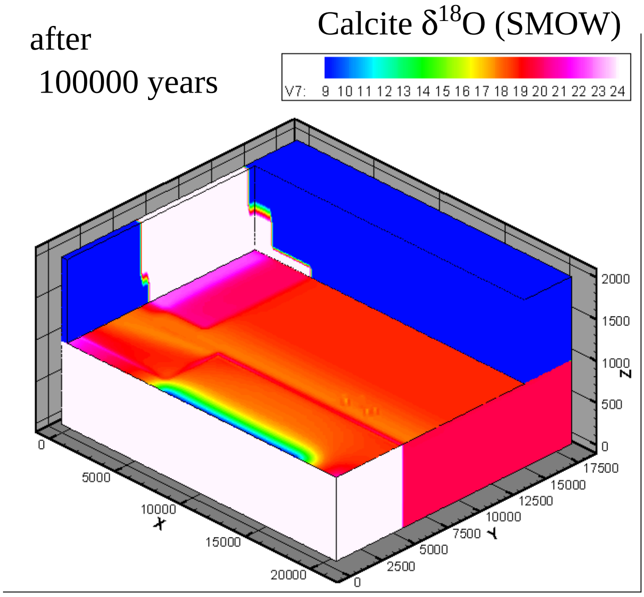


Hydraulic pressure (m)



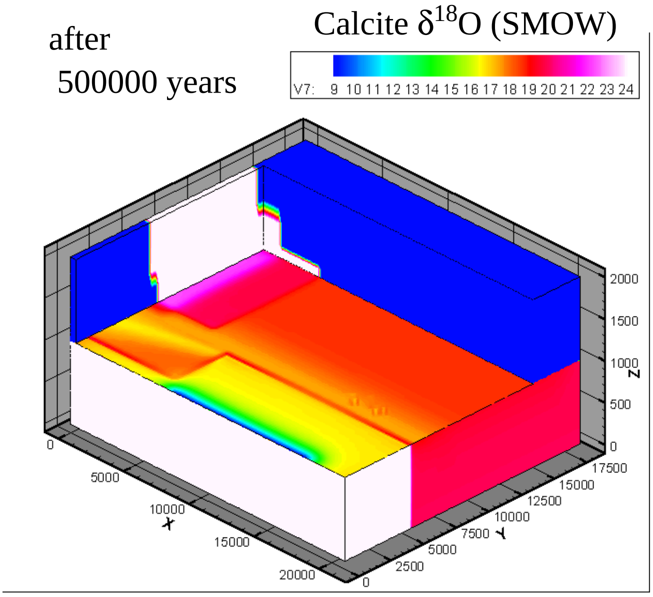
after
25000 years

Calcite $\delta^{18}O$ (SMOW)



after
100000 years

Calcite $\delta^{18}O$ (SMOW)



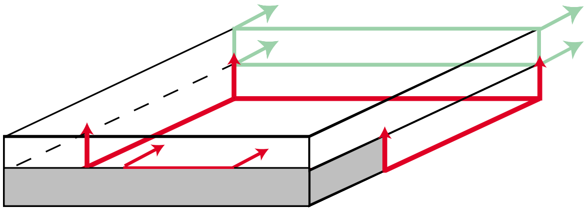
after
500000 years

Calcite $\delta^{18}O$ (SMOW)

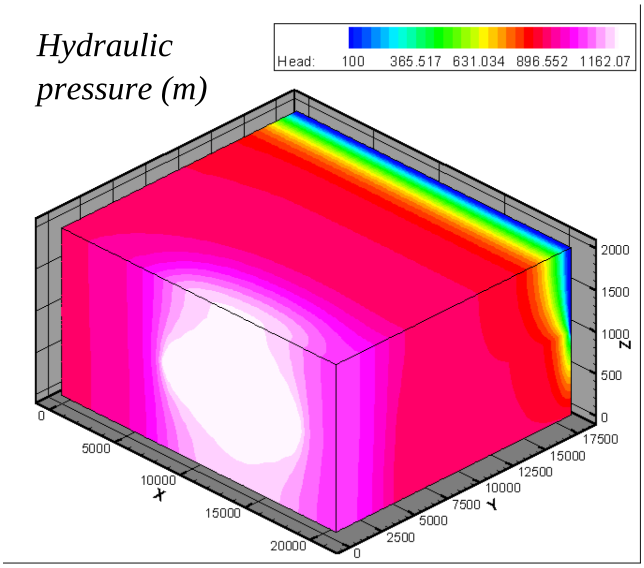
S76

Basement head: 1500
Flysch head: 900

Lithology	Kxx	Kyy	Kzz	Ø	Xkk
Verrucano	0.0309	0.0309	0.01	0.03	1E-7
Flysch	0.15	0.15	0.15	0.06	1E-6
LK	6	0.5	0.5	0.05	1E-4
Foot. carb.	0.01	0.01	0..005	0.03	1E-7
Hang. carb.	0.03091	0.03091	0.0309	0.04	1E-6

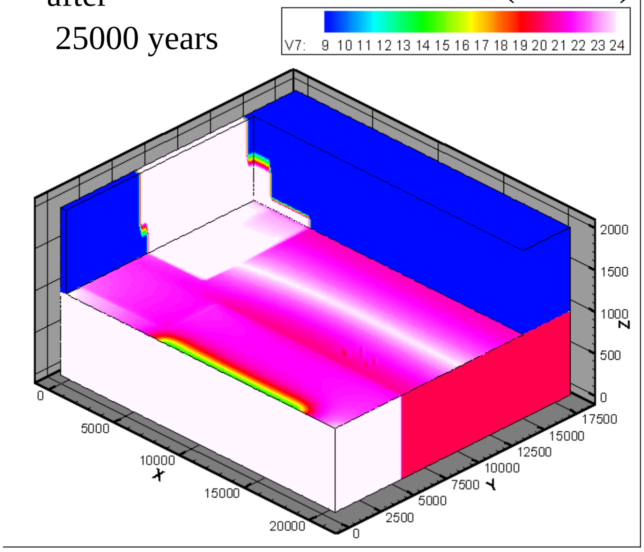


Hydraulic pressure (m)



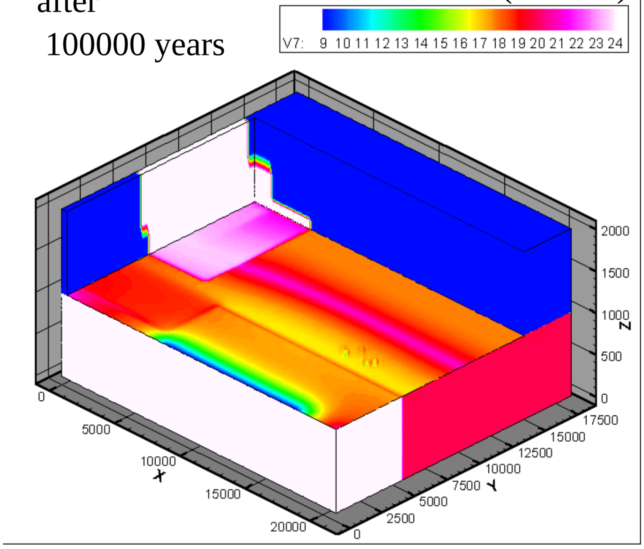
after
25000 years

Calcite δ^{18}O (SMOW)



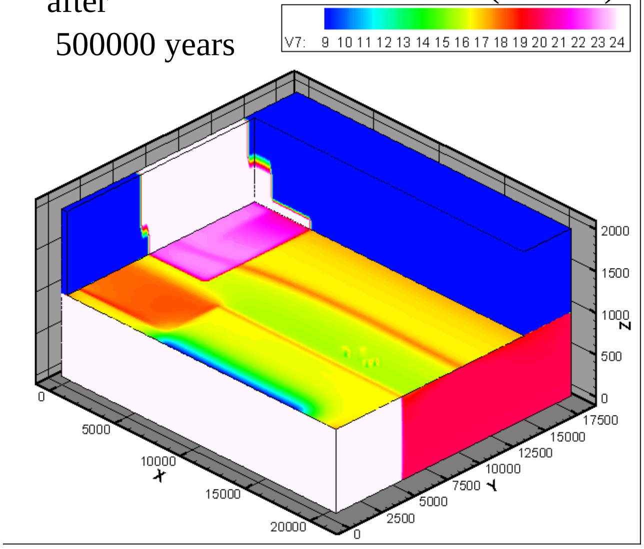
after
100000 years

Calcite δ^{18}O (SMOW)



after
500000 years

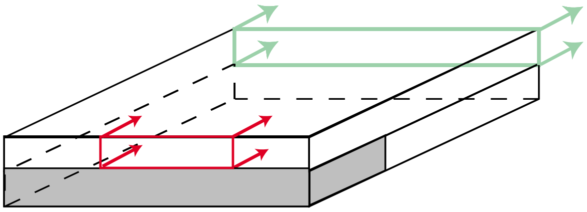
Calcite δ^{18}O (SMOW)

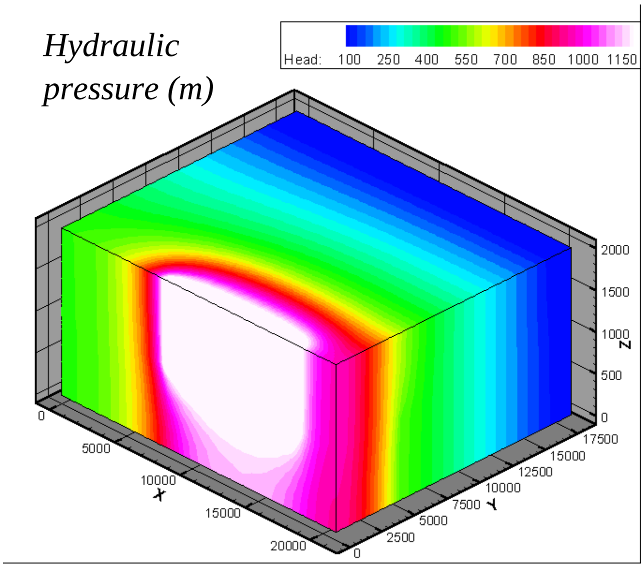


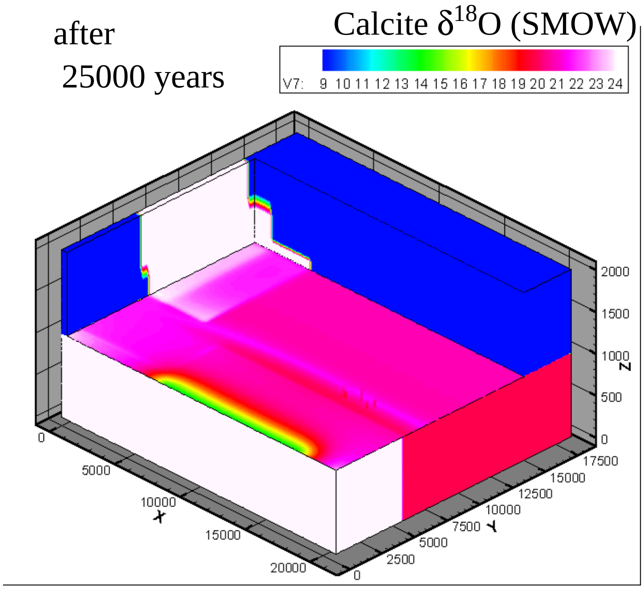
S78

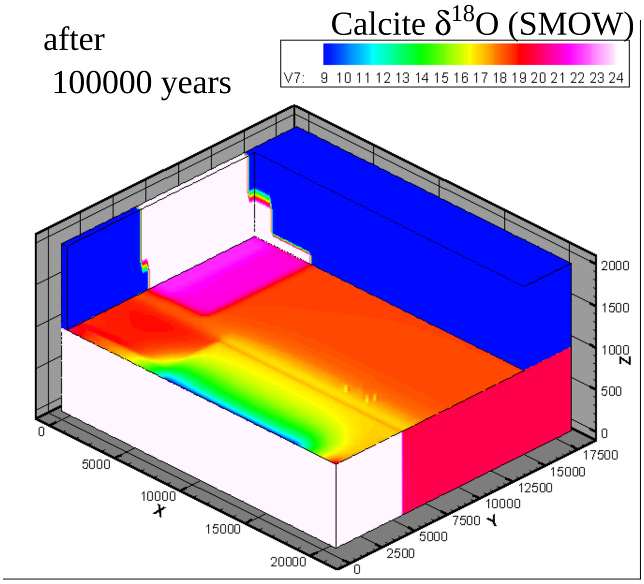
Basement head: 1500
Flysch head: 900

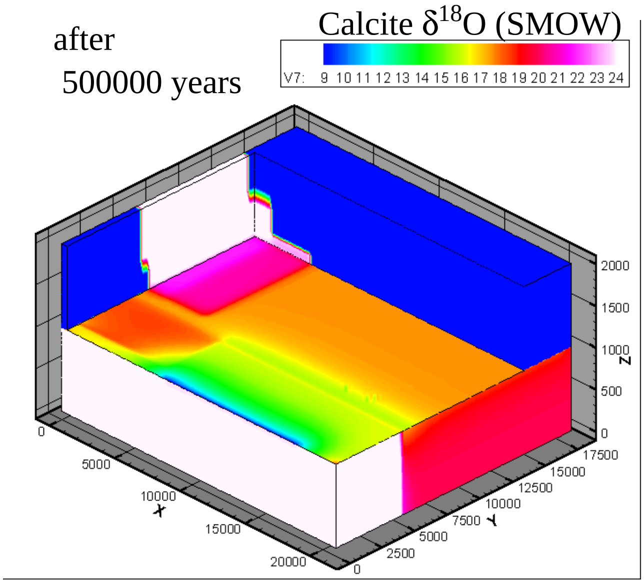
Lithology	Kxx	Kyy	Kzz	Ø	Xkk
Verrucano	0.0309	0.0309	0.01	0.03	1E-7
Flysch	0.15	0.15	0.15	0.06	1E-6
LK	6	0.5	0.5	0.05	1E-4
Foot. carb.	0.01	0.01	0..005	0.03	1E-7
Hang. carb.	0.03091	0.03091	0.0309	0.04	1E-6




Hydraulic pressure (m)


after
25000 years
Calcite δ^{18}O (SMOW)

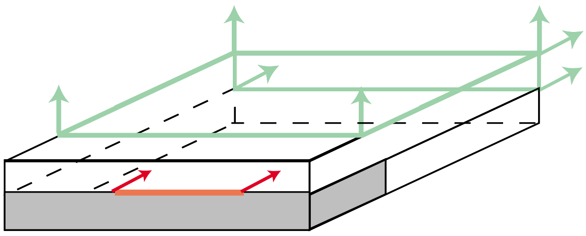

after
100000 years
Calcite δ^{18}O (SMOW)


after
500000 years
Calcite δ^{18}O (SMOW)

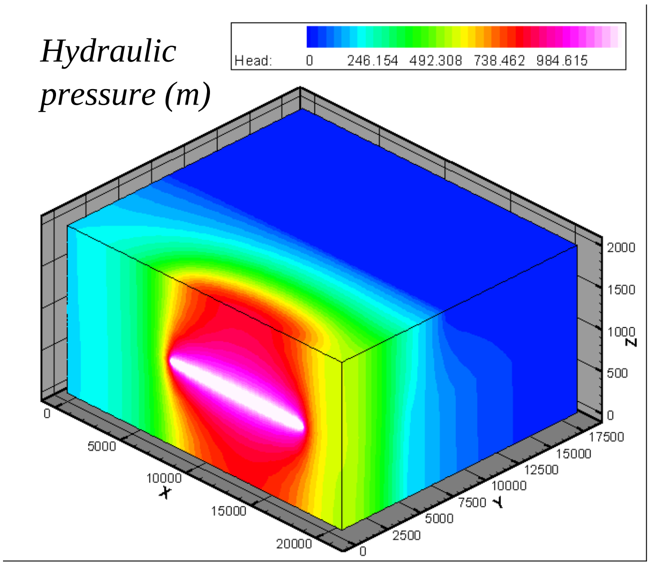
S23

Basement head: 1500

Lithology	Kxx	Kyy	Kzz	Ø	Xkk
Verrucano	0.0309	0.0309	0.01	0.03	1E-7
Flysch	0.15	0.15	0.15	0.06	1E-6
LK	6	0.5	0.5	0.05	1E-4
Foot. carb.	0.01	0.01	0..005	0.03	1E-7
Hang. carb.	0.03091	0.03091	0.0309	0.04	1E-6

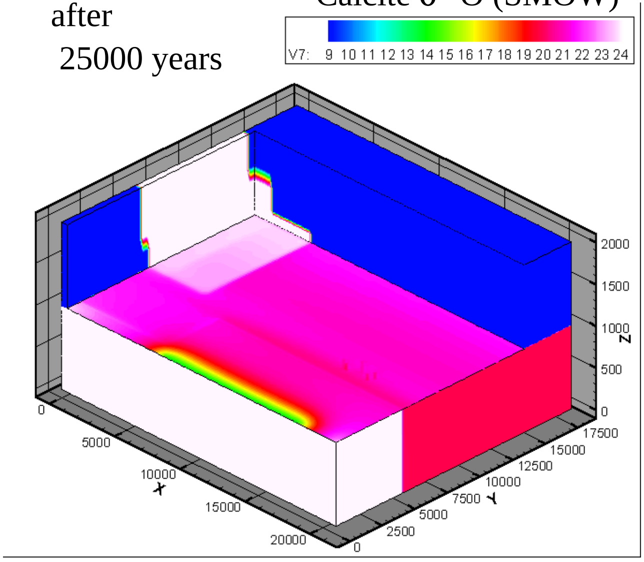


Hydraulic pressure (m)



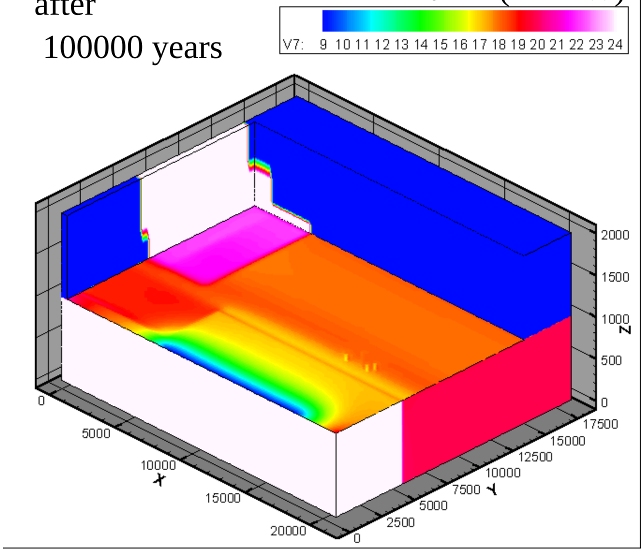
after
25000 years

Calcite $\delta^{18}O$ (SMOW)



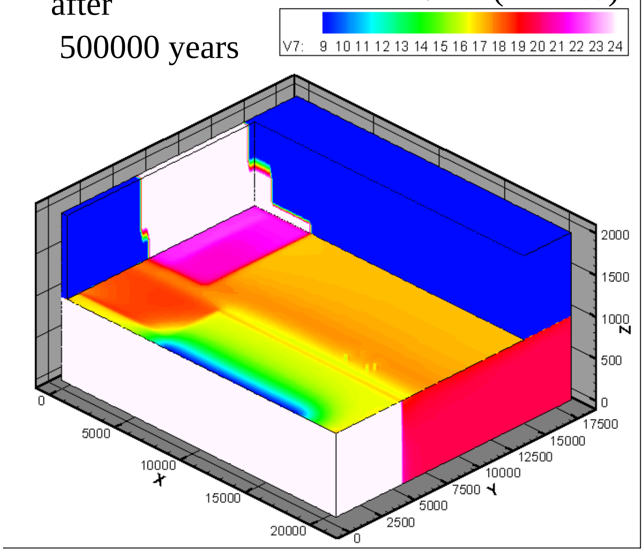
after
100000 years

Calcite $\delta^{18}O$ (SMOW)



after
500000 years

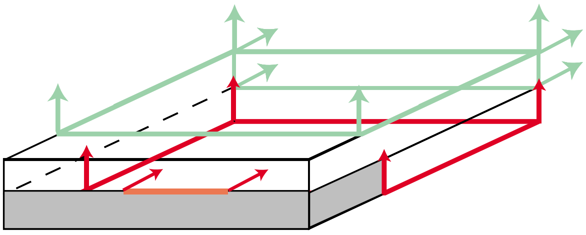
Calcite $\delta^{18}O$ (SMOW)



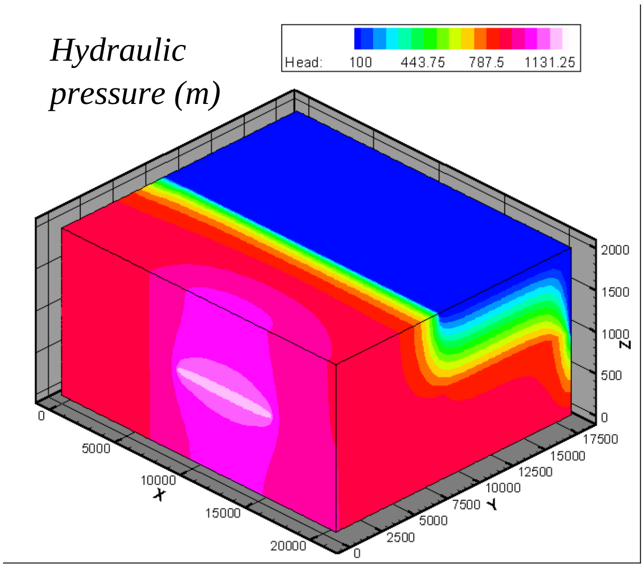
S24

Basement head: 1200
Flysch head: 900

Lithology	Kxx	Kyy	Kzz	Ø	Xkk
Verrucano	0.0309	0.0309	0.01	0.03	1E-7
Flysch	0.15	0.15	0.15	0.06	1E-6
LK	6	0.5	0.5	0.05	1E-4
Foot. carb.	0.01	0.01	0..005	0.03	1E-7
Hang. carb.	0.03091	0.03091	0.0309	0.04	1E-6

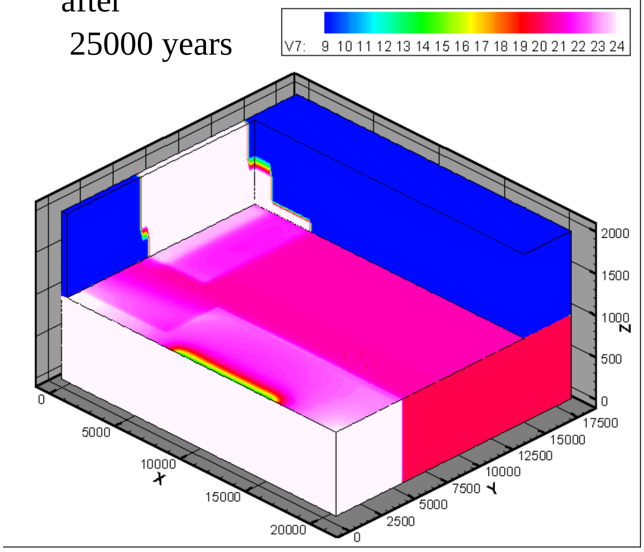


Hydraulic pressure (m)



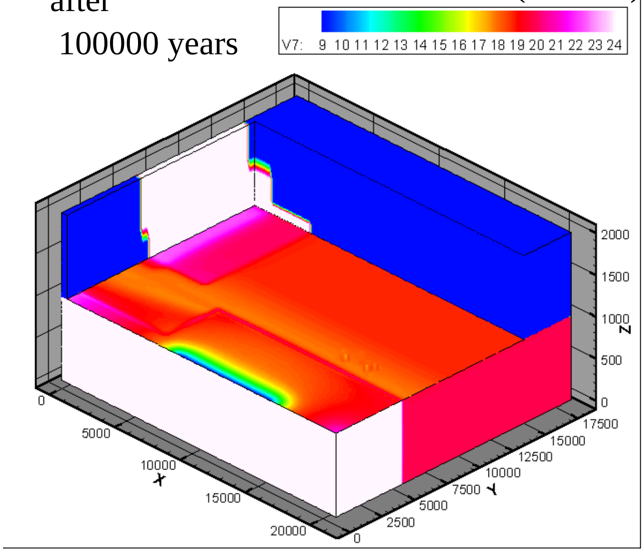
after 25000 years

Calcite δ^{18}O (SMOW)



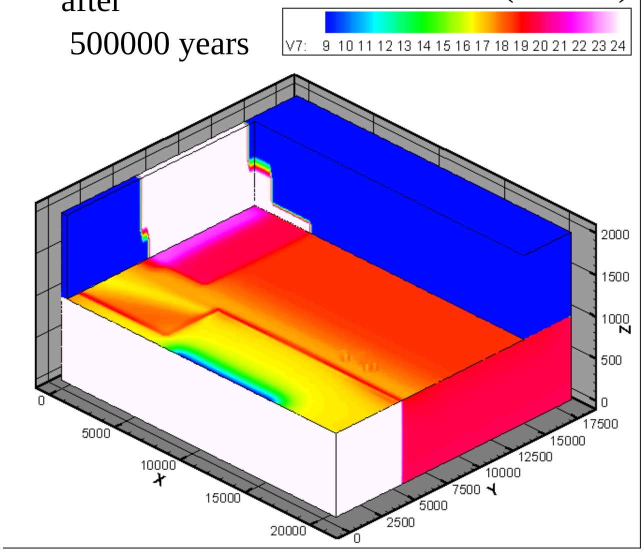
after 100000 years

Calcite δ^{18}O (SMOW)



after 500000 years

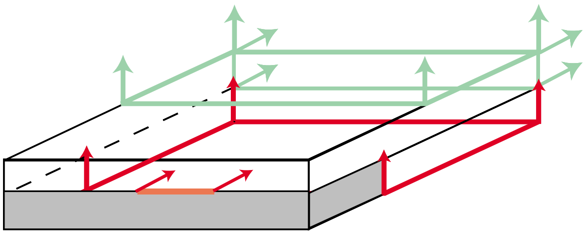
Calcite δ^{18}O (SMOW)



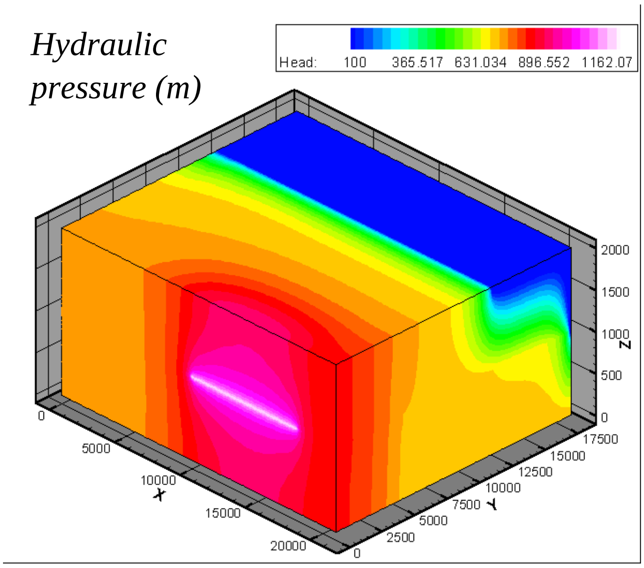
S38

Basement head: 1200
Flysch head: 700

Lithology	Kxx	Kyy	Kzz	Ø	Xkk
Verrucano	0.0309	0.0309	0.01	0.03	1E-7
Flysch	0.15	0.15	0.15	0.06	1E-6
LK	6	0.5	0.5	0.05	1E-4
Foot. carb.	0.01	0.01	0.005	0.03	1E-7
Hang. carb.	0.03091	0.03091	0.0309	0.04	1E-6

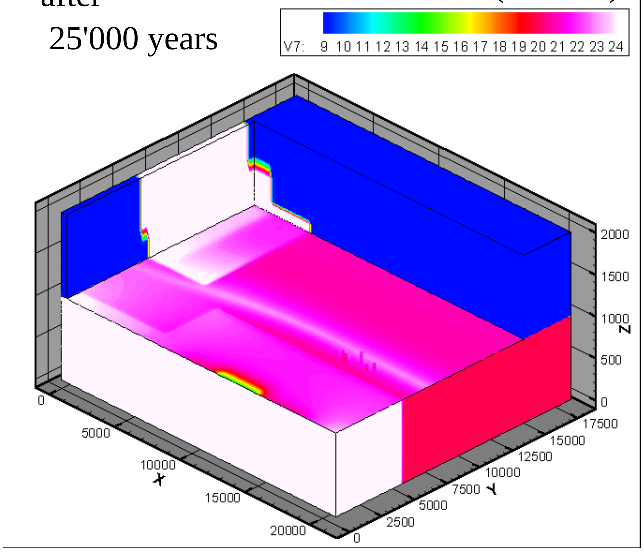


Hydraulic pressure (m)



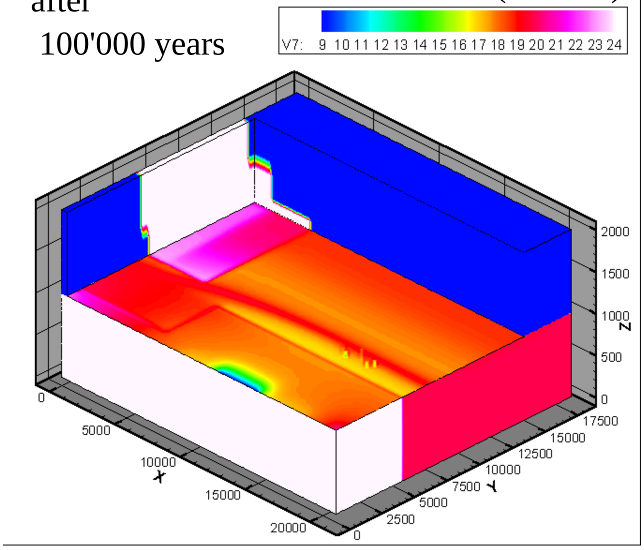
after
25'000 years

Calcite $\delta^{18}O$ (SMOW)



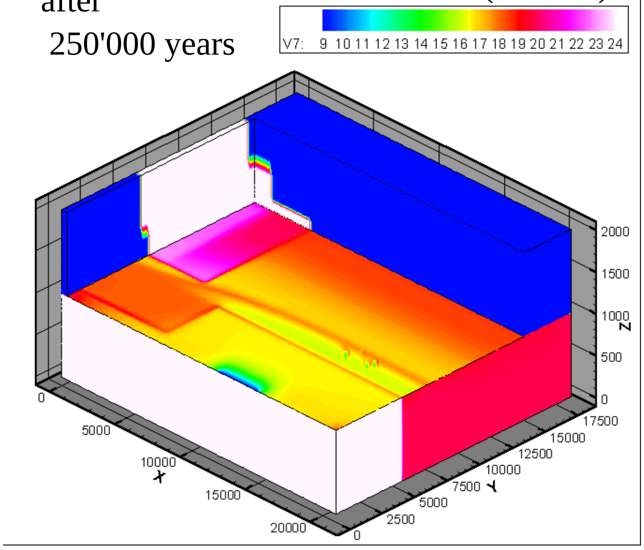
after
100'000 years

Calcite $\delta^{18}O$ (SMOW)



after
250'000 years

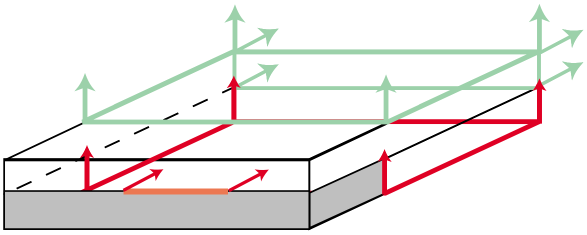
Calcite $\delta^{18}O$ (SMOW)

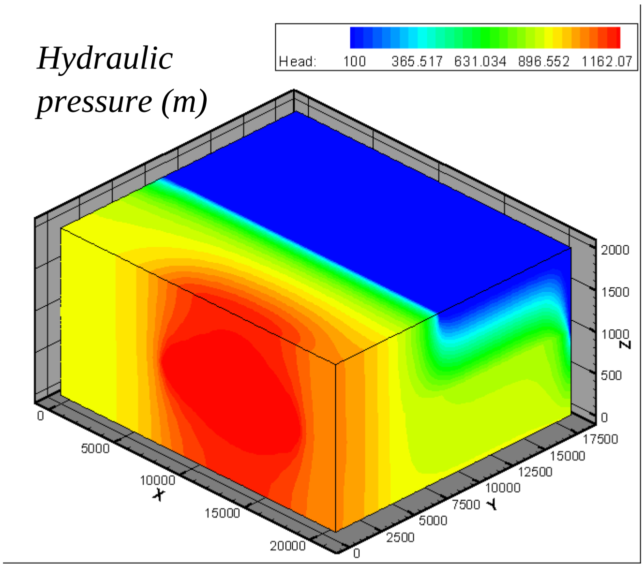


S25

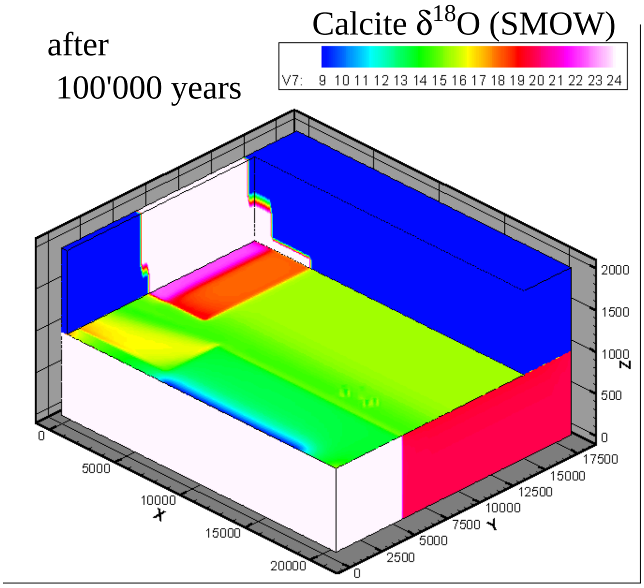
Basement head: 1500
Flysch head: 900

Lithology	Kxx	Kyy	Kzz	Ø	Xkk
Verrucano	0.0309	0.0309	0.01	0.03	1E-6
Flysch	0.15	0.15	0.15	0.06	1E-6
LK	6	0.5	0.5	0.05	1E-4
Foot. carb.	0.01	0.01	0..005	0.03	1E-7
Hang. carb.	0.03091	0.03091	0.0309	0.04	1E-6



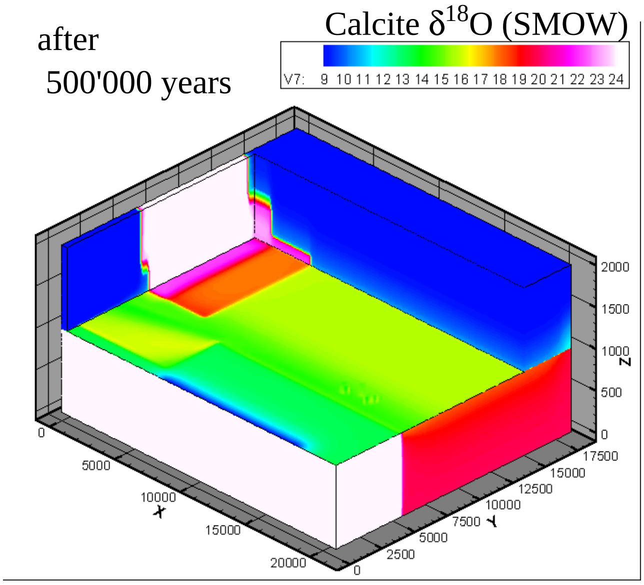


Hydraulic pressure (m)



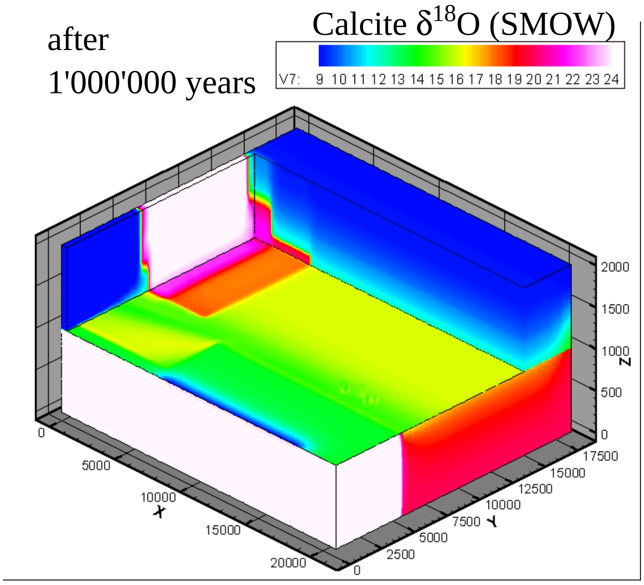
after
100'000 years

Calcite $\delta^{18}O$ (SMOW)



after
500'000 years

Calcite $\delta^{18}O$ (SMOW)



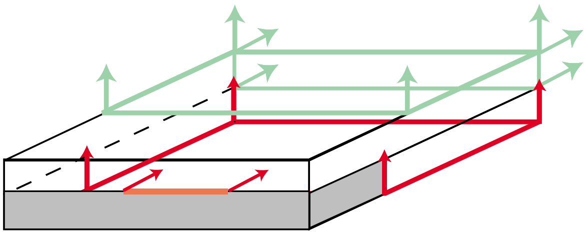
after
1'000'000 years

Calcite $\delta^{18}O$ (SMOW)

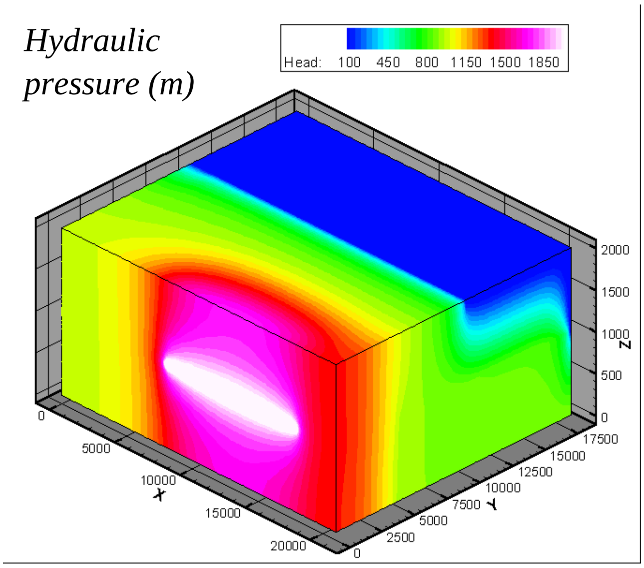
S72

Basement head: 2500
Flysch head: 900

Lithology	Kxx	Kyy	Kzz	Ø	Xkk
Verrucano	0.0309	0.0309	0.01	0.03	1E-7
Flysch	0.15	0.15	0.15	0.06	1E-6
LK	6	0.5	0.5	0.05	1E-4
Foot. carb.	0.01	0.01	0..005	0.03	1E-7
Hang. carb.	0.03091	0.03091	0.0309	0.04	1E-6

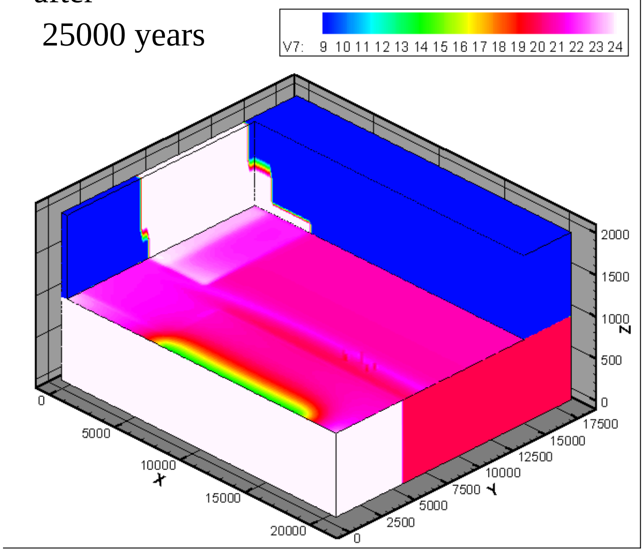


Hydraulic pressure (m)



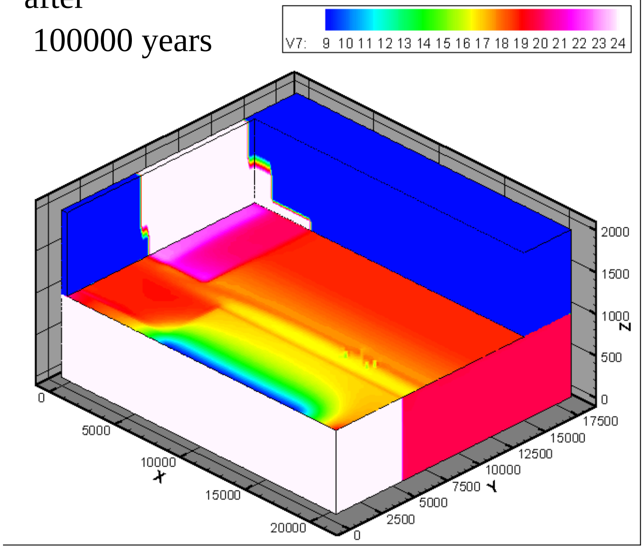
after
25000 years

Calcite $\delta^{18}O$ (SMOW)



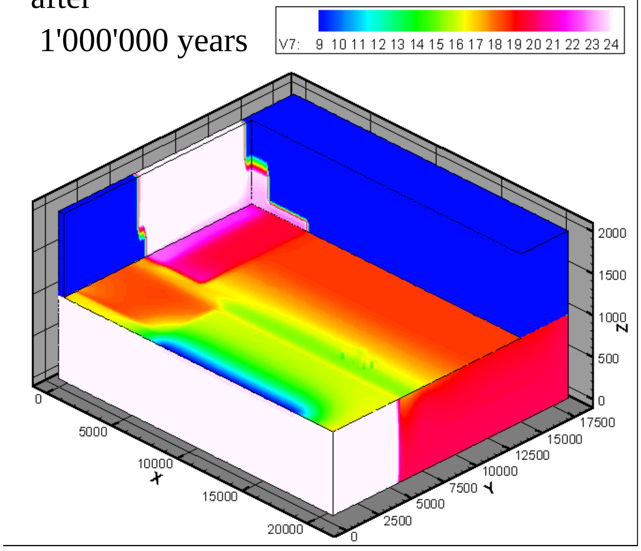
after
100000 years

Calcite $\delta^{18}O$ (SMOW)



after
1'000'000 years

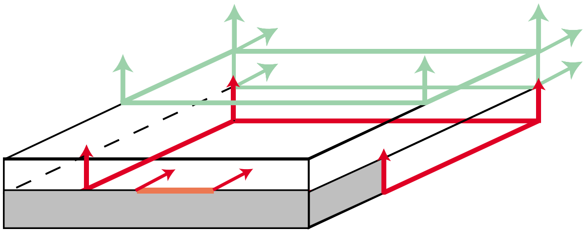
Calcite $\delta^{18}O$ (SMOW)

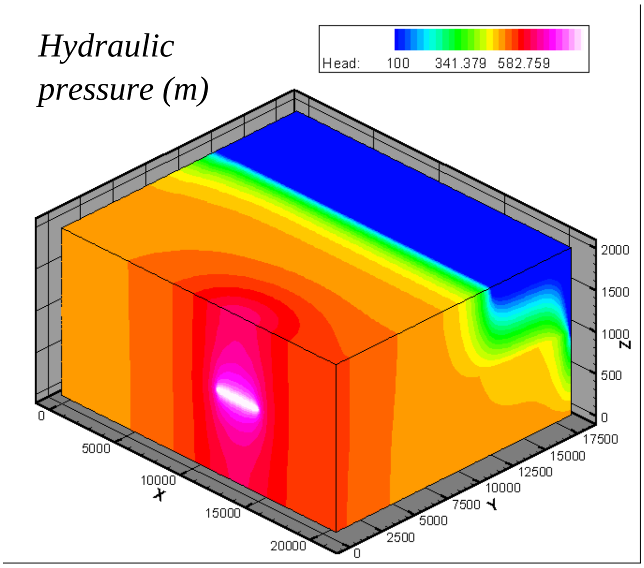


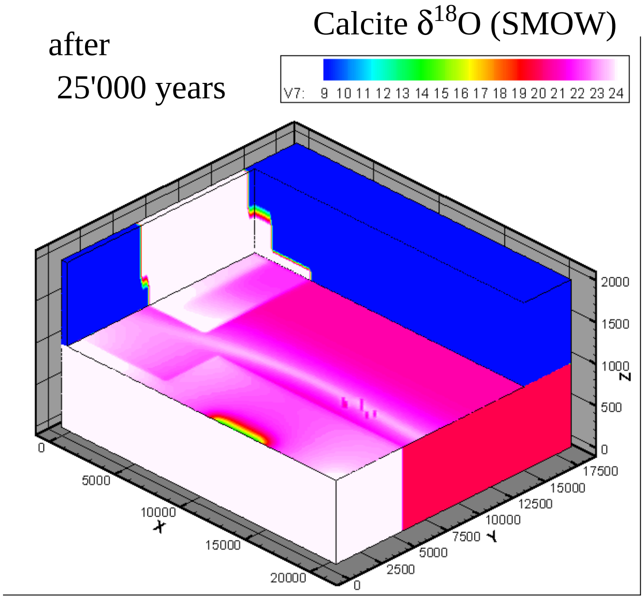
S34

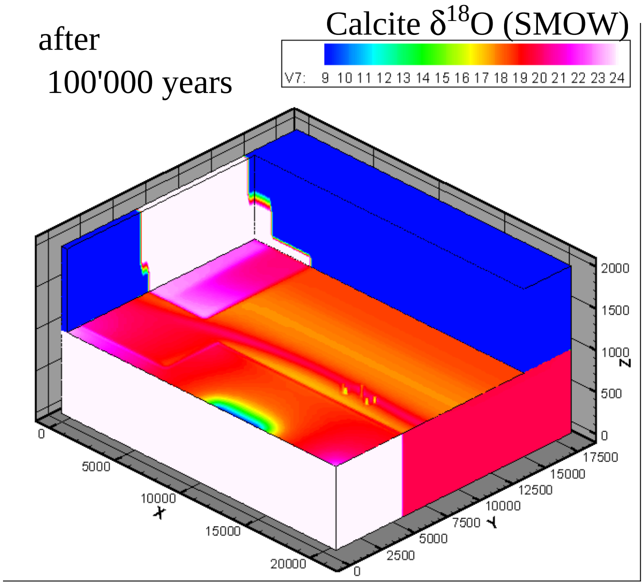
Basement head: 900
Flysch head: 500

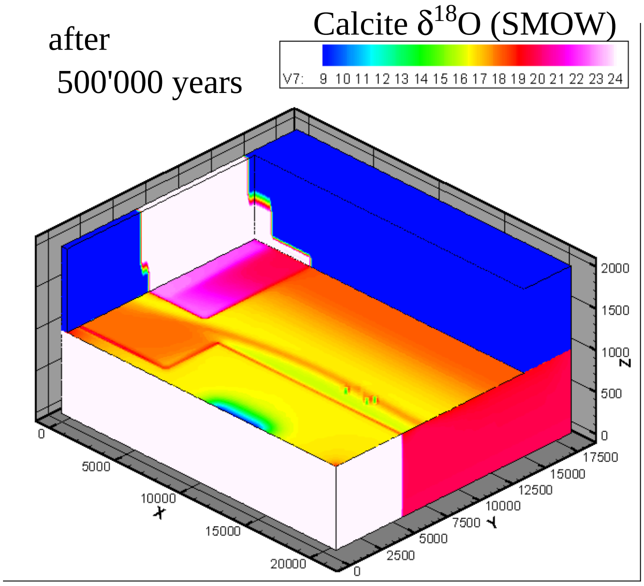
Lithology	Kxx	Kyy	Kzz	Ø	Xkk
Verrucano	0.0309	0.0309	0.01	0.03	1E-7
Flysch	0.15	0.15	0.15	0.06	1E-6
LK	4	0.5	0.5	0.08	1E-4
Foot. carb.	0.02	0.02	0.005	0.03	1E-7
Hang. carb.	0.03091	0.03091	0.0309	0.04	1E-6







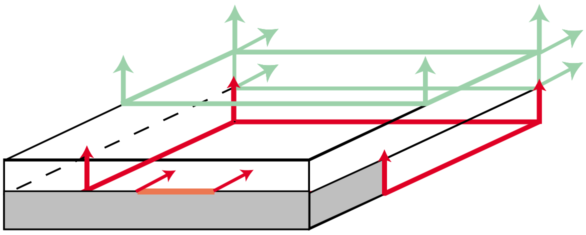




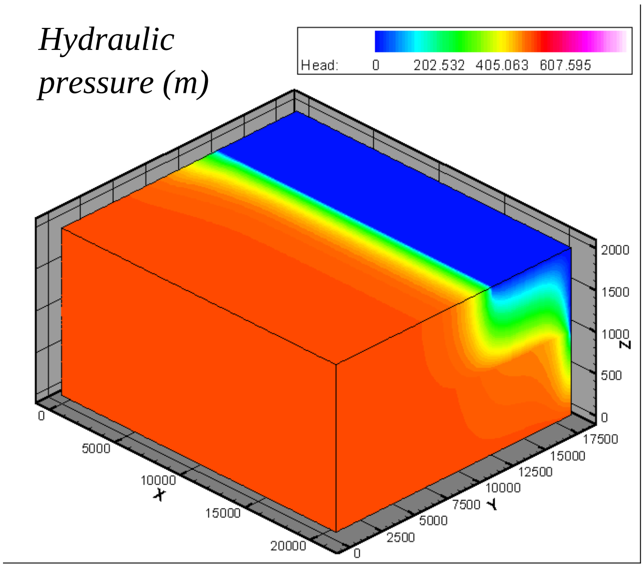
S32

Basement head: 500
Flysch head: 500

Lithology	Kxx	Kyy	Kzz	Ø	Xkk
Verrucano	0.0309	0.0309	0.01	0.03	1E-7
Flysch	0.15	0.15	0.15	0.06	1E-6
LK	5	2	0.5	0.05	1E-4
Foot. carb.	0.02	0.02	0.005	0.03	1E-7
Hang. carb.	0.03091	0.03091	0.0309	0.04	1E-6

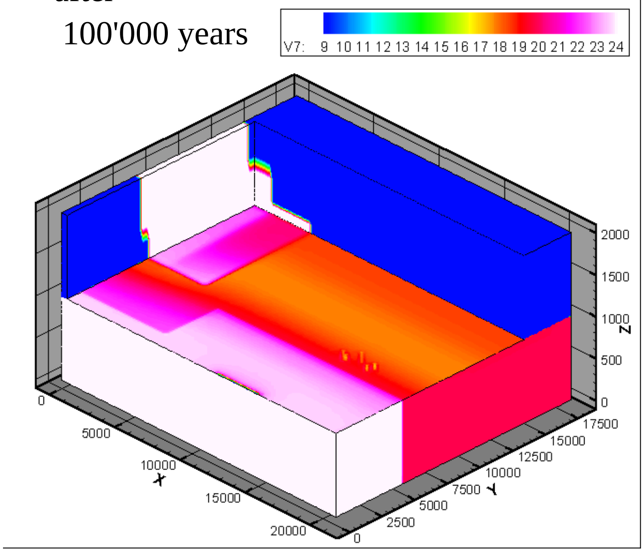


Hydraulic pressure (m)



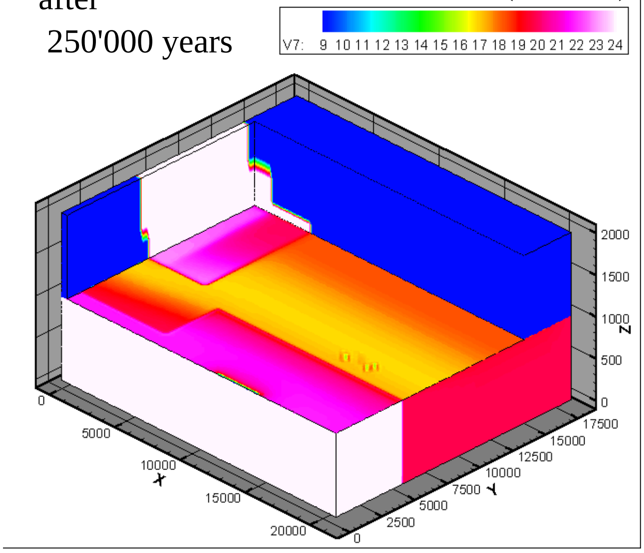
after
100'000 years

Calcite $\delta^{18}O$ (SMOW)



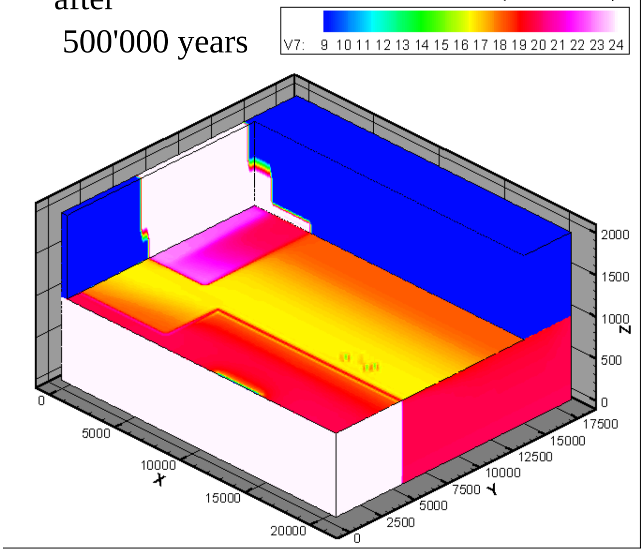
after
250'000 years

Calcite $\delta^{18}O$ (SMOW)



after
500'000 years

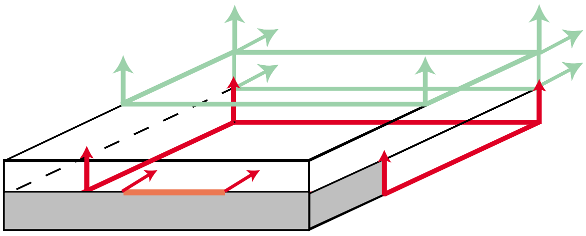
Calcite $\delta^{18}O$ (SMOW)



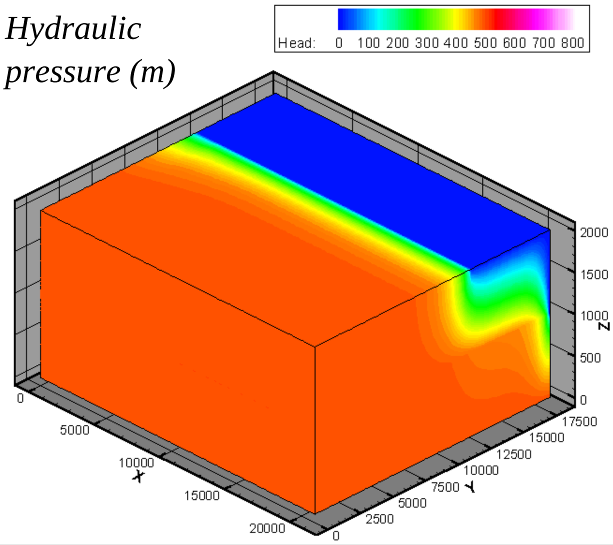
S66

Basement head: 500
Flysch head: 500

Lithology	Kxx	Kyy	Kzz	Ø	Xkk
Verrucano	0.0309	0.0309	0.01	0.03	1E-7
Flysch	0.15	0.15	0.15	0.06	1E-6
LK	2	2	2	0.05	1E-4
Foot. carb.	0.02	0.02	0.005	0.03	1E-7
Hang. carb.	0.03091	0.03091	0.0309	0.04	1E-6

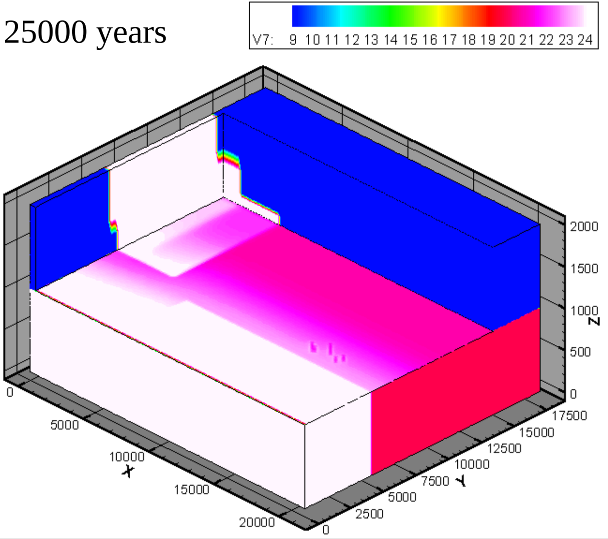


Hydraulic pressure (m)



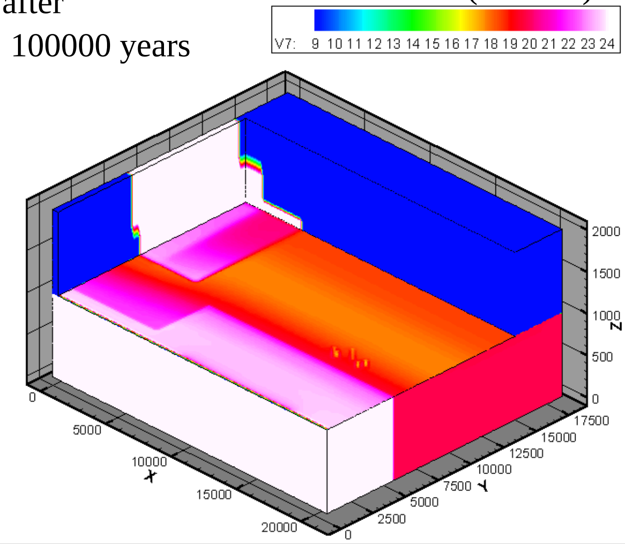
after
25000 years

Calcite δ^{18}O (SMOW)



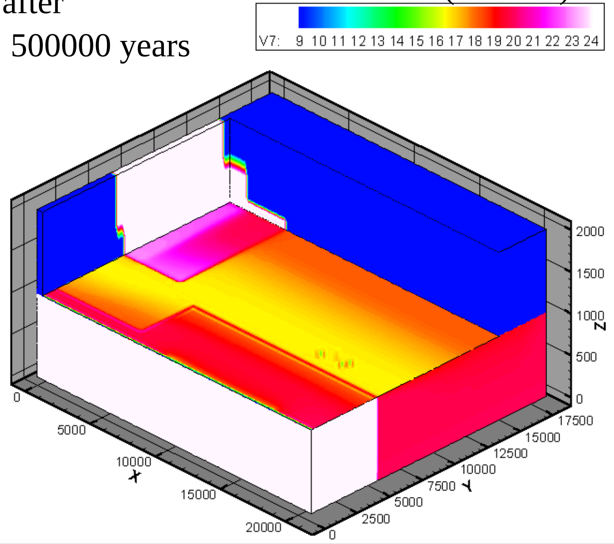
after
100000 years

Calcite δ^{18}O (SMOW)



after
500000 years

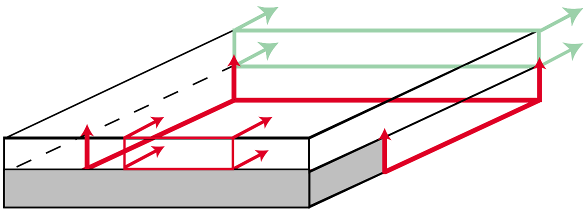
Calcite δ^{18}O (SMOW)



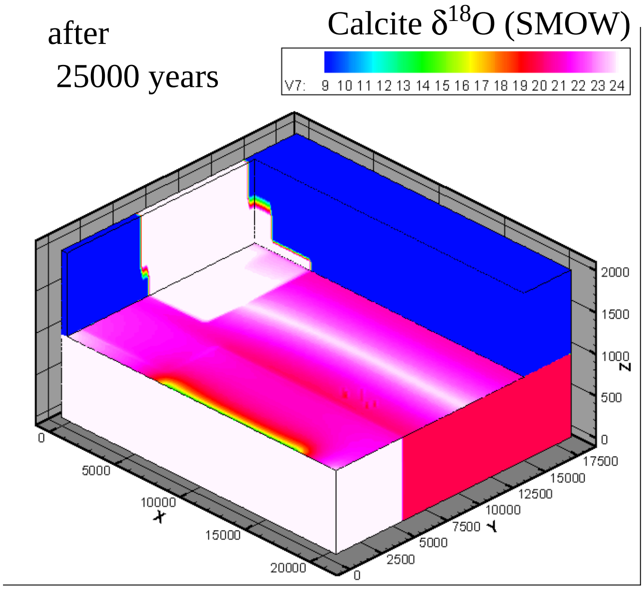
S77

Basement head: 1500
Flysch head: 900

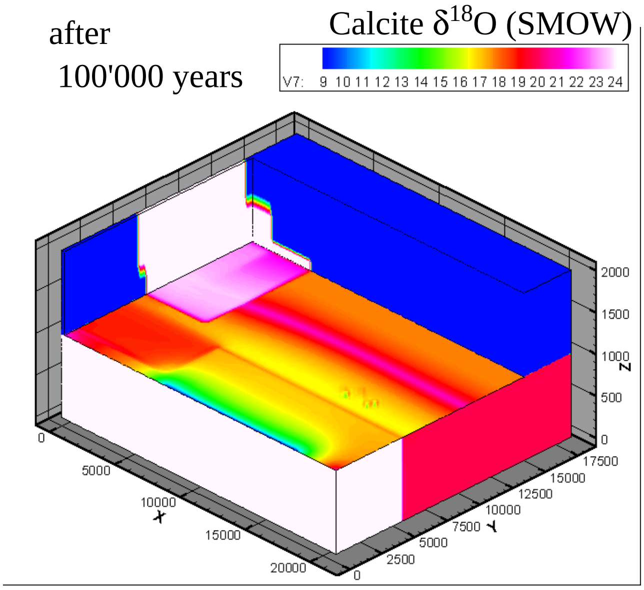
Lithology	Kxx	Kyy	Kzz	Ø	Xkk
Verrucano	0.0309	0.0309	0.01	0.03	1E-7
Flysch	0.15	0.15	0.15	0.06	1E-6
LK	6	0.5	0.5	0.05	1E-4
Foot. carb.	0.01	0.01	0..005	0.03	1E-7
Hang. carb.	0.03091	0.03091	0.0309	0.04	1E-6



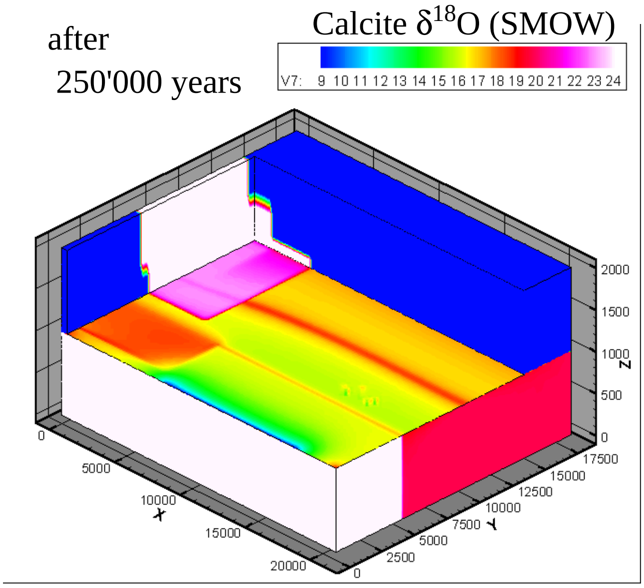
after
25000 years



after
100'000 years



after
250'000 years



after
500000 years