Zeitschrift: Schweizerische mineralogische und petrographische Mitteilungen = Bulletin suisse de minéralogie et pétrographie

Band: 50 (1970)

Heft: 2

Artikel: Geological observations in the Bergell Area (SE-Alps). II, Contact minerals from Mt. Sissone-cima di Vazzeda (a mineralogical note)

Autor: Wenk, Hans-Rudolf / Maurizio, Remo

DOI: https://doi.org/10.5169/seals-39261

Geological Observations in the Bergell Area (SE-Alps)

II. Contact Minerals from Mt. Sissone–Cima di Vazzeda (A Mineralogical Note)

By *Hans-Rudolf Wenk* (Berkeley)*) and *Remo Maurizio* (Vicosoprano)

With 2 figures and 3 tables in the text

Abstract. Chemical data and unit cell dimensions are given for some newly found minerals occurring in the contact zone of carbonate and calc-silicate rocks and amphibolites with the Bergell granite in the Sissone-Vazzeda area. Diopsides show a linear relation between lattice constants and Mg/Fe ratio. Of special interest are a deep blue diopside and scheelite.

The northern contact zone of the granitic rocks of the Bergell with metamorphic rocks of the Margna nappe has been studied geologically by Gyr (1967). Discordant contacts of calc-silicates and amphibolites with granite and well preserved lenses of marble which are floating in the granite are the most conspicuous features. These rocks belong to the amphibolite metamorphic facies and show mineral assemblages labradorite-hornblende (E. Wenk and Keller, 1969), and anorthite-diopside-calcite with wollastonite and clinohumite (E. Wenk, 1962; E. Wenk, 1963; Trommsdorff, 1966; Schwander and E. Wenk, 1967; E. Wenk et al., 1967). The Bergell is known for its abundance of rare minerals, some of them unique for Switzerland. It is surprising that they have been treated only superficially. In addition to the papers mentioned above Staub (1920), Déverin (1937), Niggli et al. (1940), Weibel and Locher (1964) are the only references we were able to find in the literature on the mineralogy of the area. In recent years (1966–1969) some unusual finds have been made in the area Val Sissone–Cima di Vazzeda–Vadrec del Forno which warrant a description in a short note. Localities are listed in Table 1. Most of the specimens were found in moraines. The original samples are in the mineralogical collection of the museum in Stampa (Ciäsa Granda). The results reported in

*) University of California, Dept. of Geology and Geophysics, Berkeley, California 94720.

Table 1. *Localities* (coordinates of Swiss maps are used)
All specimens were found in blocks in local moraines

Diopside	1	Val Sissone, 2000 m	777.9/129.5
	2	Alpe Sissone, 2600 m	777.1/130.9
	3	Val Sissone, 2200 m	777.4/129.4
	4	Val Sissone, 2200 m	777.4/129.4
	5	Alpe Vazzeda, 2600 m	777.2/131.8
	6	moraine from Pizzo Vazzeda, Vadrec del Forno, 2600 m	774.7/132.4
Tremolite		same specimen as diopside 4	
Spinel		moraine from Pizzo Vazzeda, Vadrec del Forno, 2600 m	774.7/132.4
Scheelite		Val Sissone, 2500 m	777.0/130.0

this study include microprobe analyses (done by F. Brown at Berkeley: Table 2), and precise determination of lattice constants with a Jagodzinski-type Guinier camera (Fe $K\alpha_1$-radiation, Si as internal standard, least squares refinement: Table 3).

This short mineralogical note is meant as part of a series of contributions of data to the geology of the Bergell. No effort for completeness is made, nor do we try to propose ultimate interpretations. (See also Wenk, 1970a.)

Diopside

Trommsdorff (1966) shows a map of the distribution of diopside associated with calcite in the Lepontine Alps. Its occurrence coincides with the zone of highest regional metamorphism. The Bergell is located in the peripheral part of this metamorphic complex. We describe six finds of diopside of various chemical compositions in this area.

1. Dark green prismatic crystals, up to two inches long. Good cleavage. Inclusions in pegmatitic dykes cutting across amphibolites.

2. Tabular idiomorphic crystals in a cavity associated with quartz, feldspar and calcite. Light green color. Many crystals clear. $^1/_8$–$1^1/_2''$. These crystals were used by Leung (1969) to study deformation effects. Under nonhydrostatic stress submicroscopic twinning on (100) was produced (cf. Wenk, 1970b).

3. Aggregate of prismatic greyish-green milky crystals in a cavity. Individual crystals reach a size of $1^1/_2''$. They are chemically very heterogeneous. The diopside is associated with calcite.

4. Fine-grained turquoise blue diopside intermixed with coarser-grained colorless diopside occurs as the central part of a concentrically zoned lens 2′ long and 3″ wide (Fig. 1). The blue diopside is surrounded by 1″ of white pure tremolite (cf. Wenk, 1970c) and 1–2″ dark green diopside, rich in Fe. The zoned lens is included in white calcite marble. Due to its conspicuous color the diopside has first been mistaken for lazulite which occurs in the lower metamorphic rocks of the Suretta nappe along the north side of the Bergell Valley.

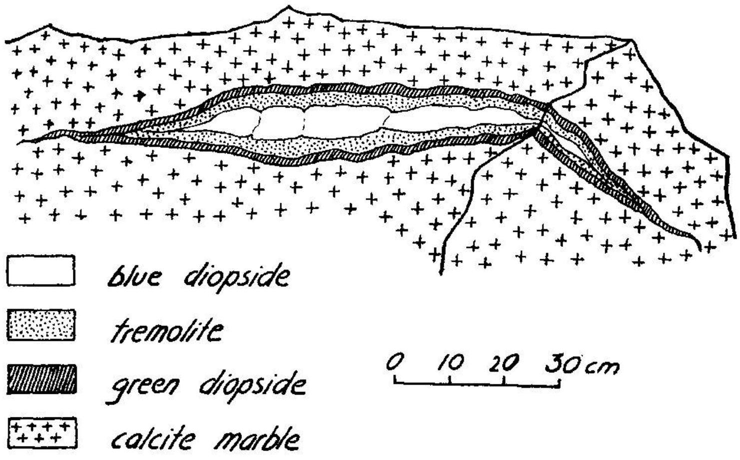

Fig. 1. Schematic sketch of the lens of blue diopside in Val Sissone.

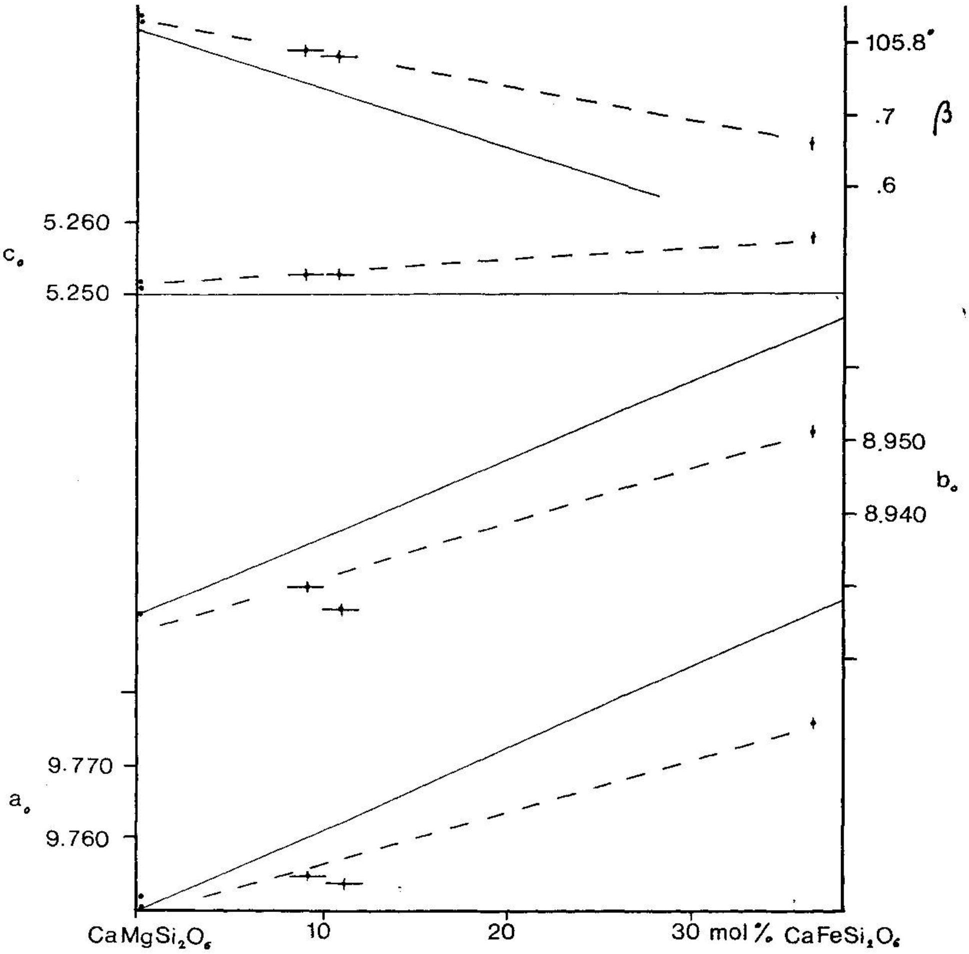

Fig. 2. Relation between lattice constants and Fe/Mg ratio. The fine lines are the ones given by Rutstein and Yund (1969); the dashed lines indicate the dependence found in this study.

Microprobe analyses showed that the coexisting colorless and blue diopside are very similar in chemical composition, almost Fe and Al free. However, there is a significant difference in the vanadium content. The electron beam of the microprobe produces bright blue fluorescence in the blue diopside and a pale pink one in the colorless-type. It is not impossible that this minute chemical difference be due to metasomatic replacement of fossiliferous limestone, as trace elements are often enriched in organic material.

5. In the moraine east of Passo di Vazzeda which is rich in calc-silicate rocks, large white crystals up to 1′ long are common. The mineral which could be mistaken for wollastonite with which it is associated, has been identified by Gyr (1967) as diopside. It is chemically extremely pure.

6. Similar crystals as are found on the Italian part of P. Vazzeda are carried down to the Forno glacier: they are very common in the northeastern moraine near Cap. Forno which is characterized by colorful carbonate and calc-silicate rocks originating from P. Vazzeda.

The chemical composition of diopsides from the same region varies considerably. A plot of chemical composition (Mg/Fe ratio) versus lattice constants of these genetically related specimens shows a nearly linear correlation which resembles but nevertheless differs from the results of Rutstein and Yund (1969) for synthetic diopsides. It is uncertain whether these differences are caused by conditions during formation or by a more complicated chemistry in the natural crystals (e. g., Al). It indicates, however, that the curves should be used with caution. It is obviously unjustified to generalize results from these few observations, but it appears that:

- the diopsides from carbonate rocks are extremely pure and homogeneous;
- diopsides in cavities (Alpine-type fissures) have an average of 15% Mg (by weight) and show even in clear single crystals large variations in chemical composition;
- diopsides in amphibolites have a composition of close to 50% hedenbergite (see also Wenk, 1970b).

Spinel

In marbles and calc-silicate rocks of the Vazzeda region very pure Al-Mg-Zn spinels occur quite frequently. Octahedral crystals which are associated with anorthite, calcite and grossularite are black or dark green and approximately $^1/_8$″ in size. The marble is fairly coarse-grained.

Scheelite

Scheelite is rare in the Alps. Niggli et al. (1940) describe finds of scheelite in the Aarmassiv and in the Simplon railway tunnel. The mineral was so far unknown in the Bergell. In 1967 a specimen of yellow scheelite with idio-

Table 2. *Chemical data* (determined with an ARL microprobe by F. Brown). Values are in weight percent

	TiO_2	SiO_2	Al_2O_3	FeO	CaO	MgO	MnO	V_2O_3	ZnO
Diopside									
1 Sissone	0.02	52.6	0.8	11.4	24.2	10.8	0.5		
2 Vazzeda	0	55.0	±0.5	2.9	25.0	±16.3	0.4		
3 Sissone	0.1	54.4	0.73	3.46	25.4	15.9	0.2		
4a Sissone blue[1]	0.03	55.2	0.1	0.08	25.7	18.8	0	0.11	
4b Sissone colorless[2]	0	55.3	0.1	0.1	25.9	18.6	<0.01	0.03	
5 Vazzeda-Sissone	0.11	55.4	0.83	0.14	25.3	18.0	0.03		
	(0.03–0.12)		(0.49–1.3)	(2.9–4.0)	(25.2–25.5)	(15.2–16.2)	(0.19–0.27)		
Tremolite	0.01	56.8	0.1	0.24	13.8_5	25.5	0		
Spinel	0.02	0.00	69.3	2.97	0.01	24.7			[3]

[1]) bright blue fluorescence [2]) pale purple fluorescence [3]) corresponds to 3.29% Fe_2O_3

Table 3. *Lattice constants determined with a Jagodzinski-type Guinier camera* (error is ±0.01%)

		X-ray Nr.	Number of observations	Direct lattice constants				Cell volume	Reciprocal lattice constants			
				a_0 (Å)	b_0 (Å)	c_0 (Å)	β	V (Å^3)	a* (A^{-1})	b* (A^{-1})	c* (A^{-1})	β*
Diopside	1a	369	20	9.775	8.951	5.257	105.66°	443.0	0.10624	0.11172	0.19754	74.34°
	1b	379	19	9.777	8.954	5.258	105.66°	443.2	0.10622	0.11169	0.19750	74.34°
	1a+b		39	9.776	8.952	5.258	105.66°	443.1	0.10623	0.11171	0.19752	74.34°
	2	378	16	9.755	8.930	5.253	105.79°	440.4	0.10653	0.11198	0.19785	74.21°
	3	474	18	9.754	8.931	5.253	105.78°	440.4	0.10653	0.11197	0.19782	74.22°
	4a	316	21	9.750	8.927	5.251	105.83°	439.7	0.10660	0.11202	0.19793	74.17°
	4b	375	20	9.751	8.925	5.252	105.84°	439.7	0.10661	0.11204	0.19793	74.16°
	4a+b		41	9.750_3	8.926_0	5.251_4	105 83_3°	439.7_0	0.10660_5	0.11203_2	0.19793	74.16_7°
	5	476	17	9.752	8.926	5.252	105.84°	439.8	0.10659	0.11203	0.19791	74.16°
	6	475	15	9.751	8.924	5.251	105.82°	439.7	0.10658	0.11205	0.19793	74.18°
Tremolite with diopside	4	325	21	9.844	18.053	5.279	104.75°	907.2	0.10505	0.05539	0.19489	75.25°
Scheelite		346	13	5.2450		11.376		312.95	0.19066		0.08791	
Spinel		322	20 (2 film)	8.089				529.3			0.12360	

morphic pyramidal forms, $^1/_2''$ in size was found in a quartz vein in Val Sissone. It seems to be a product of hydrothermal activity possibly related to the formation of molybdenite in the Forno granite. This hydrothermal activity produced a system of quartz, aplite and pegmatite dykes which penetrate the granite and caused alteration in metamorphic rocks in the vicinity (WENK, 1970a).

The authors wish to thank Frank Brown for the chemical analyses, and Ugo Ruinelli and Barbara Hiss for the contribution of specimens from their personal collections.

References

SMPM = Schweiz. Mineralog. u. Petrogr. Mitteilungen

DEER, W. A., R. A. HOWIE and J. ZUSSMANN (1963): Rock-forming Minerals, vol. 2. Longmans, London.

DÉVERIN, L. (1937): Kalksilikatmineralien, Bergell. SMPM 17, 531.

GYR, T. (1967): Geologische und petrographische Untersuchungen am Ostrande des Bergeller Massivs. Diss. ETH, Zürich.

LEUNG, S. (1969): Deformation Structures of Diopside. Ph. D. thesis, Berkeley.

NIGGLI, P., J. KOENIGSBERGER and R. L. PARKER (1940): Die Mineralien der Schweizer Alpen, Vol. 1. Wepf, Basel.

RUTSTEIN, M. S. and R. A. YUND (1969): Unit-cell parameters of synthetic diopside-hedenbergite solid solutions. Amer. Mineral. 54, 238–245.

SCHWANDER, H. and E. WENK (1967): Studie mit der Röntgen-Mikrosonde an basischen Plagioklasen alpiner Metamorphite. SMPM 47, 225–234.

STAUB, R. (1920): Gesteinsmetamorphose in Graubünden. Vjschr. natf. Ges. Zürich 65, 1–54.

TROMMSDORFF, V. (1966): Progressive Metamorphose kieseliger Karbonatgesteine in den Zentralalpen zwischen Bernina und Simplon. SMPM 46, 431–460.

WEIBEL, M. and T. LOCHER (1964): Die Kontaktgesteine im Albigna- und Fornostollen. (Nördl. Bergeller Massiv.) SMPM 44, 157–185.

WENK, E. (1962): Plagioklas als Index-Mineral in den Zentralalpen. SMPM 42, 139–152.

— (1963): Klinohumit und Chondrodit in Marmoren der Tessiner Alpen und der Disgrazia-Gruppe. SMPM 43, 287–294.

WENK, E. and F. KELLER (1969): Isograde in Amphibolitserien der Zentralalpen. SMPM 49, 157–177.

WENK, E., H. SCHWANDER and V. TROMMSDORFF (1967): Optische Orientierung zweier Anorthite aus metamorphen Gesteinen. SMPM 47, 219–224.

WENK, H.-R. (1970a): Geologische Beobachtungen im Bergell. I. Gedanken zur Genese des Bergeller Granits. Rückblick und Ausblick. SMPM 50, 321–348

— (1970b): Lattice parameters of calcic amphiboles (in preparation).

— (1970c): Submicroscopic twinning in lunar and experimentally deformed pyroxenes. Contrib. Mineral. Petrol.

Manuscript received April 15, 1970.