Verh. Geol. B-A.	Jahrgang 1978	Heft 3	S. 285–291	Wien, Dezember 1979
Proceed. 3rd ISMIDA (Leoben, Oct. 7–10, 1977)			S. 111–117	Wien, Dezember 1979

Kies-mineralizations in Ophiolitic Rocks of the Upper Tauern-Schieferhülle

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With 7 figures

Schlüsselwörter
Kiese
Ophiolithe
Obere Schieferhülle
Tauernfenster
Prasinite

Abstract

The Upper Schieferhuelle – of mesozoic age – represents the latest nappe within the "Tauern-window". Here a classification can be done between a kies-ore type bound to thinly banded greenschists (Feingebaenderte Gruenschiefer) and an ore type within prasinites. The geological, petrographic and geochemical results are described, which also make possible a new classification of the eu-geosynclinal penninic trough.

Introduction

The tectonic "Tauern-window" in the Eastern Alps is schematically classified into three main units, respectively nappes. The "Zentralgneiskerne" are situated in the windows core, covered by the "Lower" and "Upper Schieferhuellen".

The youngest nappe, which is dated mesozoically, forms an ophiolite bearing sequence. Several kies-mineralizations and -deposits are bound to metabasites as part of the ophiolite sequence. They are concentrated at both sides, i. e. north and south, of the Alpine main ridge.

This type of mineralization was introduced by FRIEDRICH (1953) as "Type Grossarl". For a long time they were interpreted as alpidic, epigenetic kies-deposition. SCHMID (1973) was able to find indications of syngenetic mineralization by geochemical total rock analyses in the deposit of Prettau, Southtyrol/Italy. In the following years the other kiesmineralizations without the ones of the "Matreier imbrication zone" have been treated. Work was done on occurrences in the Grossarltal, Hierzbach, Kluidscharte, Virgental, Pfitschtal, including the results of Prettau by SCHMID (1973) [map/fig. 1].

Geological environment

The monotonous mineral assemblage of kies-deposits in greenstones is well known, of considerably more interest and importance is their geological position.

The Upper Schieferhuelle has no cristalline basement. Triassic flakes and locally serpentinites form the basis, followed by non-calcareous to carbonate-poor phyllitic series. These

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are overlain by carbonate-rich "schistes lustrées", associated with interbedded ophiolitic rocks. Their thickness can reach up to 1000 m. Uppermost part of the sequence are again carbonate-poor phyllites, the so-called "Fuscher Phyllite". An age determination only was possible by comparation of the Tauriscan schistes lustrées with the ones in the Western Alps (STAUB, 1922; ANGENHEISTER et al., 1975). In younger times also "stratigraphic turns" were used by FRISCH (1976).

The schematic sequence is shown in figure 2. Differences between north-side and south-side greenstone-regions are represented by variations in thickness of the basal serpentinites of the ophiolitic series. The term "Glockner-Fazies" covers only the ophiolitic sequence

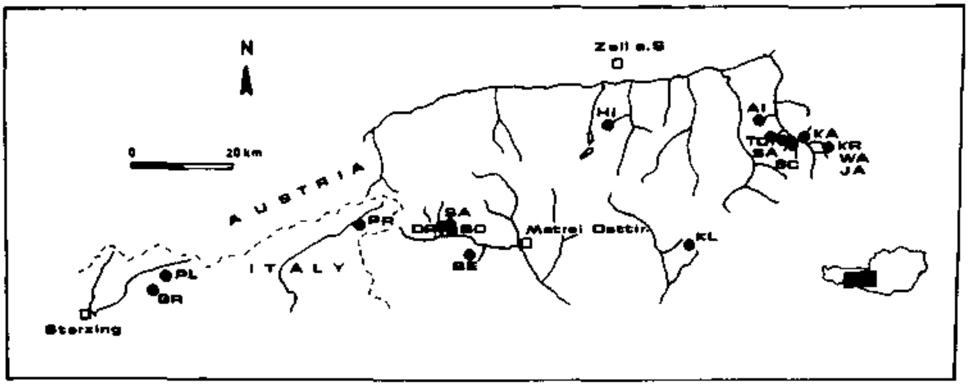

Fig. 1: Location of the studied deposits in the "Tauern-window". Grossarltal: AI – Aigenbach, JA – Jagerspitzl, KA – Karteis, KR – Kreemahd, SA – Schattbachalm, SC – Schwarzwand, TO – Tofern; Fuscher-/Kapruner Tal: HI – Hierzbach; Döllach/Mölltal: KL – Kluidscharte; Virgental: BE- Bergerkogel, BO – Bolach, DR – Dorfertal, SA – Sajat; Ahrntal: PR – Prettau; Pfitschtal: PL – Pletzen, GR – Großbergtal.

with interbedded calcareous schists. In the north it shows only small serpentinite lenses, whereas in the southern part thick serpentinite-complexes ("Heiligenbluter Serpentinite") prevail. The greenstone types differ as well: finely laminated greenstones ("Feingebaenderte Gruenschiefer") in the north and prasinites in the southern part.

The mineral composition is similiar for both greenstone types: albite + chlorite + actinolite/tremolite + titanite + epidote. Only in the narrow banded greenschists quartz and muscowite make up other typical constituents. In addition the two terms also imply different fabric-types. It shall be noted, that the term "prasinite" is used here according to NIGGLI (1914). Prasinites in this sense imply highly corroded albite-blastes, which form a poikiloblastic structure (fig. 3, 4).

Geochemically, both rock types show tholeiite-basaltic composition, but the elements K, Rb, Sr and Ca show significant variations, which make the division into the two groups evident. Above all, according to PEARCE et al. (1975), the K_2O-value allows a classification into non-oceanic thinly banded greenschists (primary tuffites) and oceanic prasinites (porphyric tholeiite basaltic source rock).

Common properties of the kies-mineralizations in the Tauern-window

The geological position of the kies-mineralizations is bound to the upper part of the ophiolitic sequence (fig. 2). The ore-bearing horizon, which lies always within greenstones,

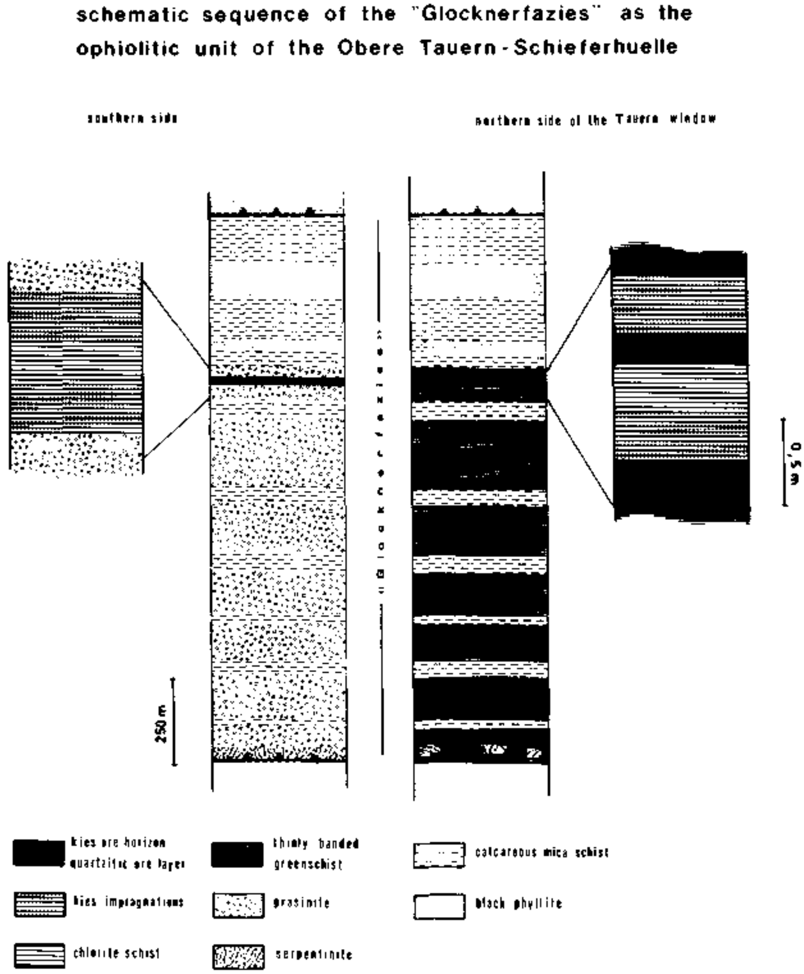

Fig. 2

forms the border horizon of a reversing facies thickness, that means the stratigraphic position, where greenstones decrease and upwards calcareous mica schists increase. The always stratabound and concordant ore-mineralization forms a perfect marker horizon.

In the following the division into two types of kies-mineralizations shall be discussed. The classification is based on differences in the gangue material (thinly banded or prasinitic) as well as on the additional appearance of a quartzitic high-grade oreband in the northern region. For both types a disseminated kies-zone within chlorite-quartzitic matrix is typical, with pyrite as the main ore-mineral (2–15 vol-%). Chalcopyrite is a secondary constituent. The connection of pyrite to the chloritic matrix indicates a possible direct relation between these both minerals. With increasing quartz content (immediate proportional to ore content) the close association of pyrite and chlorite becomes more evident. The results of Bachinsky (1976) make recrystallization seem possible, caused by metamorphism, which leads to accretive crystallization.

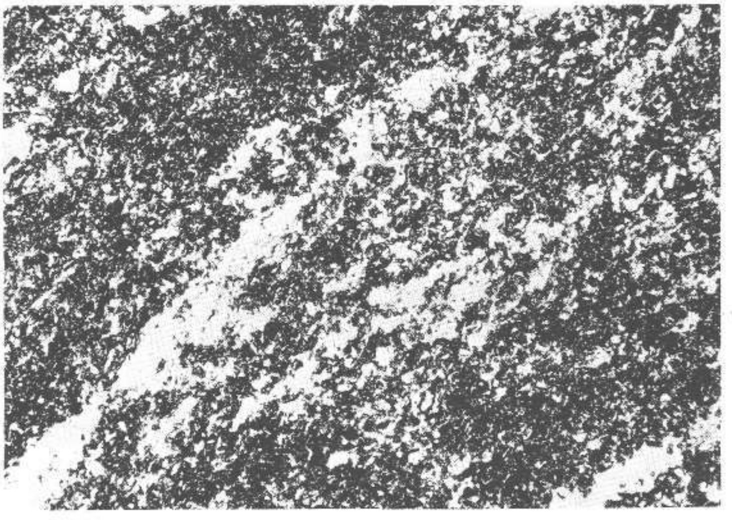

Fig. 3: Thinly laminated greenschist (Feingebänderter Grünschiefer). Locality: Karteis/Grossarltal thin section, air, pol. parall; long side = 0,7 cm.

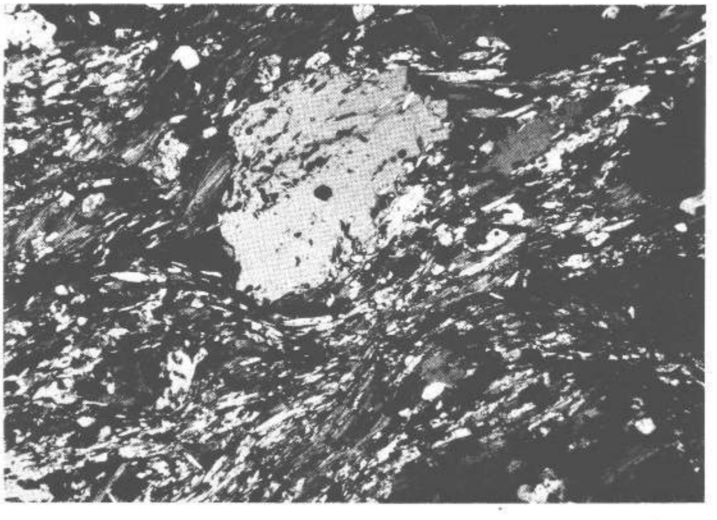

Fig. 4: Prasinite. Locality: Grossarltal thin section, air, pol. parall, long side = 0,7 cm.

From the geochemical point of view the ore-indicating elements show strong similarities, for example the elements Fe, Co, Cu, Pb and Zn. Only the gangue-material-indicating elements, especially Ca, Sr, Rb and Zr allow a twofold division of the disseminated ore-type. This element-variation depends on the two different wall rocks, i. e. the thinly laminated greenschists and the prasinites.

Fig. 5: Disseminated pyritic ore in thinly banded quartzitic-chloritic ganguematerial. Locality: Schwarzwand/Grossarltal handspecimen, magnified; lower side = 3 cm.

The kies-mineralization types in the Northern Tauern-window

Here the ore-bearing horizon is strictly found within the finly banded greenschist. In the lowermost part it starts with a quartzitic pyrite and/or magnetite rich ore layer with well-defined contacts. The thickness varies strongly within 5 to 80 cm.

High Cu-contents, which may exceed 10 weight-%, anomalous Zn-values and the quartzitic matrix are typical for this horizon. In highly deformed parts, e. g. in the Schwarzwand-occurence (Grossarltal), secondary formation of magnetite derived from pyrite can be observed starting along grain margins and fissures. Such magnetite-grains often show pyrite-relics in their middle. Around these pyrite inclusions a deep grey halo marks higher Fe-values than the bright grey outer zone. It cannot be excluded that Zn-concentrations may lead to the lower reflexion around the sulfide inclusion as well (fig. 7).

Additional anomalous high cobalt values up to 950 ppm mark the basic high-grade-horizon. But no independent Co-minerals could be detected.

Towards the hangingwall disseminated pyritic ore in thinly laminated gangue material is following (fig. 2, 5), which changes into barren chlorite schist. This rhythm of quartzitic rich ore band, disseminated pyritic ore horizon and barren chlorite schist repeats itself up to three times.

The kies-mineralizations on the Southern side of the Tauern-window

The kies-mineralizations on the southern side of the Tauern-window is always connected to prasinitic wall rocks. Basal quartzitic high-grade ore is absent, locally a barren boudinaged quartzband can be observed (fig. 2, 6).

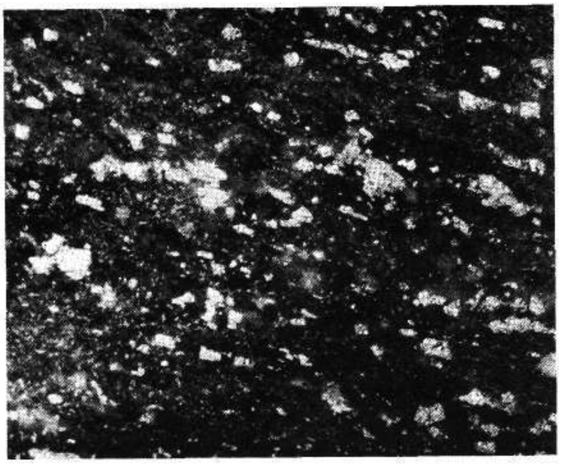

Fig. 6: Disseminated pyritic ore in prasinitic matrix. Locality: Dorfertal handspecimen, magnified; lower side = 3 cm.

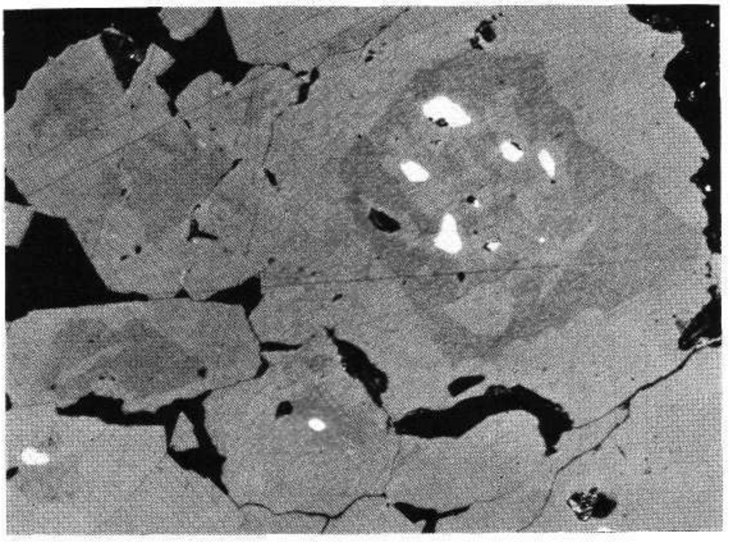

Fig. 7: Secondarily formed magnetite-grains (grey) with pyrite-relics (bright). Deep grey halos around the pyrite inclusions mark enriched iron as compared to the bright grey outer zones. Locality: Schwarzwand/Grossarltal polished section, oil, pol. inclined; long side = 95 μm.

Pyrite-disseminations predominate in two or three 0,5 to 1 m thick horizons interbedded by strongly chloritized prasinites. For tectonically high deformed parts secondary formations of magnetite is characteristic, like mentioned above.

Conclusions

The results of geochemical investigations along a profile, which included the subjacent greenstones, the kies-mineralized horizon and the hanging wall rocks might indicate synsedimentary ore mineralization by volcanic eruptive phases. Rhythmical oscillations in the underlying wall rocks, represented by variations in Ni- and Cr-content, to a certain extend also in Co- and Zn-contents, likewise are repeated in the ore mineralized zone.

The absence of silica-rich, mangenese-enriched horizons in the hangingwall of the Tauern-kies-mineralizations is in contrast with the observations from most deposits of the kies-type, where secondary postvolcanic processes are held responsible (BONATTI et al., 1976).

For the type of kies-deposits treated, a exclusively synsedimentary-submarine-exhalative ore-mineralization is suggested.

Additional Fe-enrichment by metamorphic processes ("Tauernkristallisation") is possible (BACHINSKY, 1976).

In addition to these results, the classification into thinly laminated greenschists in the northern Tauern-window and into prasinites in the south permits a new sub-division of the eu-geosynclinal penninic trough:

– An axial zone with prasinites and serpentinite-complexes.
– A marginal zone with the greenschists and small serpentinite lenses.

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