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Epidote in Mafic Rocks of the Sobotín (Zöptau) Massif (Czech Republic)

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Epidot in basischen Gesteinen des Zöptauer Massivs (Tschechische Republik)

Zusammenfassung

In alpinen Klüften der Knappenwand (Salzburg, Österreich) und des Zöptauer Massivs (Altvatergebirge, Nord-Mähren, Tschechische Republik) treten ähnliche Epidotmineralisationen auf. Auch in Geologie, Petrologie und Geochemie der beiden Gebiete gibt es gemeinsame Züge. In beiden Fällen geht die Entstehung des Epidots auf Umwandlung ultrabasischer Gesteine unter dem Einfluß wässeriger Lösungen zurück.

Abstract

Similar epidote crystals occur in alpine-type veins of the Knappenwand (Salzburg, Austria) and Sobotín (Zöptau) in Hruby Jeseník Mountains (Northern Moravia, Czech Republic). Several similarities were found in geology, petrology and geochemistry of both regions. In both cases the alteration of ultrabasic rocks under the influence of metamorphic water played an important role in the creation of epidote.

1. Introduction

Similar types of epidote crystals in alpine type veins occur in two regions – the area Knappenwand (Hohe Tauern, Österreich) and in the Sobotín (Zöptau) basic massif in Hruby Jeseník Mts. (Altvatergebirge) in Northern Moravia, Czech Republic. The famous minerals from Pfarrerb and other localities near Sobotín were described by F. KOLENATI (1854), V. v. ZEPHAROVICH (1859) and many others. The detailed mineralogy and petrology of the Sobotín massif was studied by F. KRETSCHMER (1895 and 1911). His papers were excellent mineralogical and petrological studies at that time, based on detailed geological maps, profiles, petrological studies of the thin sections, chemical analyses of the main rocks and chemical investigations of the minerals.

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2. Geological Settings

Within the Jeseníky Mountains the Sobotín (Zöptau) massif belongs to the metamorphosed Paleozoic cover of the Precambrian core of the Desná dome. The cover complex consists of volcano-sedimentary and intrusive rocks, similar to those of the Knappenwand area (Habach Formation) in the Hohe Tauern (R. SEEMANN & F. KOLLER, 1988). Both groups were metamorphosed, the Sobotín complex probably only once (with some influence of retrograde metamorphism) during the Variscan orogeny, the Knappenwand area probably twice, during both the Variscan and the Alpine orogenesis.

The Paleozoic rocks of the Jeseníky Mts. are mainly of Devonian age, based on the fossils found in the quarzites of the Vrbno group which are cut and overlain by basic magmatites. This synsedimentary volcanism has a bimodal character with basalt and keratophyre, some parts consisting of tuffs and other extrusive rocks, others of ultrabasic and basic intrusives.

3. Petrography and Geochemistry

The basis of the Sobotín massif represents a deeper structure with basic and ultrabasic intrusives. Small metamorphosed ultrabasic bodies are present within the main mass of amphibolites. They were originally probably pyroxenites and peridotites, situated along two parallel NE–SW tectonic lines. Due to the primary structure and polyphase prograde- and retrograde metamorphism they have an onion-type structure. The central part of the bodies is formed by soapstones ("Topfstein") and talc-schists, sometimes with large dolomite crystals in places. The next layer consists of talc schists without dolomite and coarse grained actinolite rocks, so called "Strahlstein", with transition to chlorite schists. The outer rim of the bodies often contains massive epidote rocks and amphibolites. These last two are the main host rocks of the Alpine type veins containing epidote.

Similar metamorphosed ultrabasic rocks – serpentinites, talc schists, "Strahlstein", chlorite and epidote schists are present in the close vicinity of the Habach emerald locality. They are also situated around important tectonic lines (G. GRUNDMANN & G. MORTEANI, 1982).

The geochemistry of the Sobotín (Zöptau) massif was studied by a group of authors (J. FIALA et al., 1980). It has been demonstrated by detailed geochemistry that serpentinites, talc schists and the main part of the chlorite schists (green schists) are the products of a metamorphic alteration of ultrabasic rocks, originally situated in a sequence of oceanic tholeiitic basalts of Devonian age.

All the Ni in the ultrabasic rocks is located in the silicates and there is none in the sulphides. All the sulphur was consumed in the formation of the Fe- and Cu-Fe sulphides during the low grade metamorphism. In the Vrbno group – near Zlaté Hory – a Cu deposit with Pb–Zn is present. Gold in pyrite and in quarz veins is also present in this region. A greater part of the Fe remained in the form of oxides as beautiful magnetite crystals, mainly in chlorite schists. There are W anomalies in some places in the Vrbno and Sobotín regions. Scheelite crystals were found by M. NOVÁK (personal communication). A Be anomaly and, near Marsíkov (Marschendorf) a famous mineralogical locality of chrysoberyl and beryl are present in the Sobotín massif.

Amphiboles from the Sobotín massif were studied by M. BUKOVANSKÁ-POUBOVÁ (1978). Tremolite is present predominantly in the core of the ultrabasic body of the Sobotín massif while hornblendes occur towards the marginal zones. Tremolites in ultrabasic rocks were formed at the expense of pyroxenes. Later, magnesio-hornblende and ferrotschermakitic hornblende were formed during the metamorphism. The youngest amphiboles are the retrograde actinolites. Actinolite- and hornblende- bearing rocks often with epidote constitute the source rocks of the epidote-bearing veins.

Epidotes from the host rocks, together with single epidote crystals, were newly analysed using the ARL SEM electron microprobe at the Naturhistorisches Museum Vienna, analyst F. BRANDSTÄTTER (Tab. 1). Epidotes from alpine type veins from Pfarrerb were studied also by M. NOVÁK (this volume).

Table 1.
Electron microprobe analyses of epidotes from the Pfarrerb locality, Sobotín.

SiO_2	38.70	38.47	37.95	38.70	38.73
TiO_2	0.16	0.21	0.06	0.11	0.14
Al_2O_3	25.10	22.12	20.67	24.20	23.78
FeO	10.30	14.51	15.60	11.44	12.13
MnO	0.03	0.29	0.09	0.30	0.20
MgO	0.04	0.03	0.33	0.02	–
CaO	21.05	22.91	22.75	21.36	20.90
Na_2O	–	0.01	0.01	0.01	0.03
K_2O	–	0.01	–	–	–
Totals	95.38	98.56	97.46	96.14	95.91
Rocks	albite epidote amphibolite	chlorite hornblende epidote rock	albite epidote amphibolite	Alpine-type vein	Alpine type vein

It follows from the comparison of the minerals of the altered host rocks of epidote-bearing veins (massive epidotic rocks and amphibolites) and the minerals of the unaltered Sobotin massif that:

- Epidotes from unaltered rocks of the Sobotín massif and from the host rocks of the Alpine type veins are similar to the single well crystallized epidote crystals. They are pure Fe_3Al_2 epidote. According to M.J. HOLDAWAY (1972) and J.G. LIOU (1973) the high pistacite value (29.6 –32.5 mol. %) of the epidotes indicates higher oxygen fugacity, which influenced the mineral paragenesis, originating during the Alpine type of the Variscan metamorphism, the last phase in the polyphase metamorphic history of the Jeseniky Mountains.
- Albites are present in altered and unaltered rocks, K-feldspars are present mainly in altered rocks.
- The chemical composition of hornblendes is similar in altered and in unaltered rocks, actinolite in the host rocks has a low Al content.
- Neither biotite nor chlorite were found in the host rocks.
- Fe in the host rocks is present only in mafic minerals, no magnetite crystals were observed.
- All the differences between the primary and host rocks indicate considerable mobility of K, Al, Fe, very probably due to the higher water pressure connected with retrograde metamorphism.

4. Conclusions

- There are several similarities between the main and accompanying acid, basic and ultrabasic rocks of the Habach series and Sobotín (Zöptau) massif. The age of the Sobotín massif is probably Middle Devonian, Upper Proterozoic to Paleozoic age is assumed for the Habach formation. Both areas form geological units accompanying the marginal part of Moldanubicum (Sobotín North-East, Habach South).
- The geochemistry of both massifs reveals a coincidence in the presence of W and Be anomalies, the Ni and Cr contents in silicates, the high Fe concentration and the presence of Cu ores.
- The alteration of the ultrabasic rocks under the influence of metamorphic water played an important role in the creation of epidote in Alpine type veins.

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