Geology and age of molybdenum mineralisation at Alpeiner Scharte, Tyrol, Austria

(2 figs)

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Regional setting

The subeconomic Alpeiner Scharte Mo-deposit, which was explored during World War II, is located in the western Tauern Window in Northern Tyrol, Austria, in the deepest tectonic unit of the Eastern Alps. It is the largest concentration of Mo in the Eastern Alps.

In this part of the Tauern Window Palaeozoic medium-grade supracrustal rocks, metagranitoids (central gneisses) of Variscan age and Permo-Mesozoic (para)autochtonous metasedimentary cover rocks are exposed (Lammerer and Weger, 1998). Most granitoids in the Tauern Window represent fractionated calc alkaline I-type magmas with minor S-type components, which were emplaced at the southern flank of the Variscan fold belt (Finger and Steyrer, 1990); they were emplaced over a considerable time span between ~370 Ma to ~280 Ma (Eichhorn et al., 2000).

At Alpeiner Scharte three types of orthogneisses (granitoids) containing variable amounts of quartz, alkali feldspar, plagioclase, muscovite, biotite, ± garnet, ± epidote and accessory zircon are distinguished. They intruded a sequence of Pre-Alpine supracrustal rocks (biotite-muscovite ± garnet schist, quartzite, minor metabasite) of unclear age.

The goals of this study were to (a) constrain the age of Mo-mineralisation and associated intrusive host rocks, (b) unravel the Alpine structural and tectonic evolution of the area and (c) estimate the P-T conditions for Alpine regional metamorphism.

Deformation and metamorphism

The Mo-deposit and its intrusive host rocks were affected by four Alpine deformation events and coeval upper greenschist to lower amphibolite facies metamorphism. Distinguished events include penetrative foliation with isoclinal to recumbent intrafolial folds (D_1), up to 10 m thick local mylonitic shear zones (D_2), large- to small-scale open folds (D_3), and younger flat to SW dipping local shear zones with top to the SW movement (D_4). N-S oriented unmineralised extensional veins and fractures formed during D4. P-T conditions of Alpine peak metamorphism (~40–35 Ma), calculated for three samples, gave 7.9 ± 0.6 kbar and 560 ± 30 °C.

Mineralisation

The Alpeiner Scharte Mo deposit is restricted to a coarse-grained biotite and alkali feldspar-rich orthogneiss. Mo-mineralisation is hosted in E-W trending mostly sub-vertical quartz veins, which are surrounded by thin discontinuous garnet- and biotite-rich selvages (Melcher et al., 1996). The mineralised veins are deformed (Fig. 1) and were affected by all four Alpine events. Garnet-biotite-epidote vein selvages represent metamorphosed alteration zones; these mineral assemblages developed during Alpine metamorphism.

U-Pb and Re-Os dating

Zircon grains from two orthogneiss samples were dated with the U-Pb method using ion probe techniques at the NORDSIM laboratory in Stockholm. Magmatic zircon domains, characterised by oscillatory growth zoning (visible under CL) and high Th/U (>0.2), were dated. Zircon grains from the immediate granitic host rock of the Mo mineralisation yield a concordia age of 305.4 ± 6.3 Ma (Tera Wasserburg plot, 95% confidence; Fig. 2A). The second sample from a coarse-grained more leucocratic orthogneiss from the nearby Fußstein area yielded an age of 304.4 ± 7.1 Ma (2 sigma, regression through 6 spots; Fig. 2B).

Extremely low Re concentrations made Re-Os dating of molybdenite using the single spike approach difficult

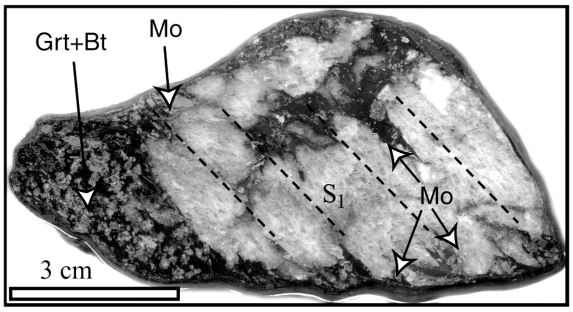

Fig. 1 Hand specimen of deformed molybdenite-bearing quartz vein with relicts of a metamorphosed vein selvage containing garnet (Grt) and biotite (Bt). Molybdenite (Mo) is partly aligned parallel to S_1 foliation planes.

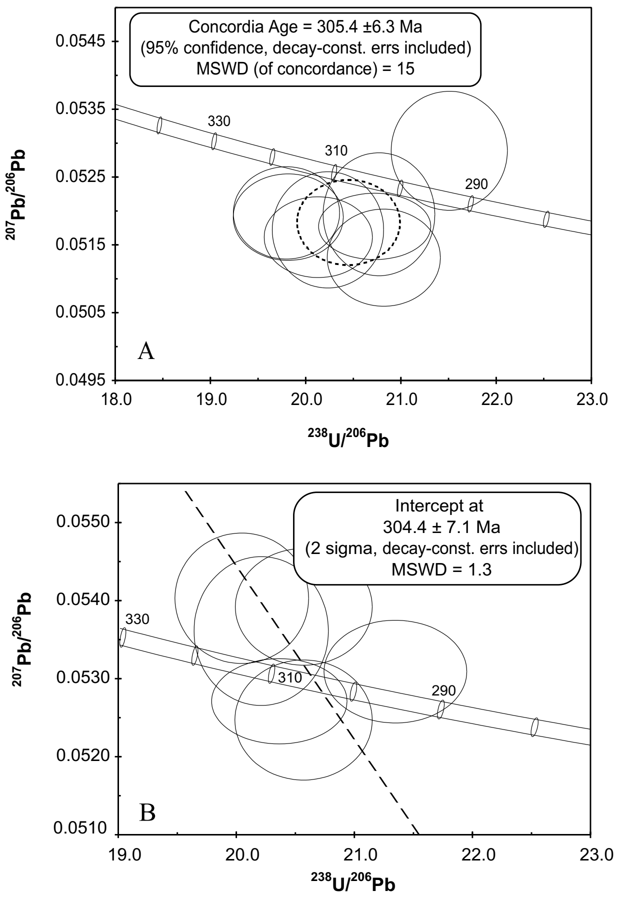

Fig. 2 Tera-Wasserburg diagrams for orthogneiss samples from Alpeiner Scharte. Error ellipses are 1 sigma; uncertainties of ages are 2 sigma. A. Sample APL-2 – the immediate host of molybdenite-bearing quartz veins B. Sample AG2-1 from nearby Fußstein area.

(Stein et al. 2001), but a late Variscan age for mineralisation is clearly indicated. The sample with the highest Re concentration (36 ppb) yielded a 2-sigma age of 306.8 ± 1.4 Ma, after blank correction. This age is in good agreement with the U-Pb results.

We conclude that (a) metagranitoids in the western Tauern Window are of Late Carboniferous age and represent late to post-orogenic Variscan magmatism and (b) Mo mineralisation in the western Tauern Window is about the same age as metagranitic host rocks. We suggest that the Alpeiner Scharte vein-type Mo mineralization is a granite-related magmatic-hydrothermal and that the deposit was metamorphosed and deformed during Alpine orogenic cycles.

References

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