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Polyhalite microfabrics in an Alpine evaporite mélange: Hallstatt, Eastern Alps

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Polyhalite [K2Ca2Mg(SO4)4 . 2H_2O] commonly occurs in sedimentary evaporite successions and was described first from the salt mine Bad Ischl-Perneck in Austria (province Upper Austria) and has since been known from many salt deposits (Warren, 2006; Springer-Verlag Berlin Heidelberg, 1035 p.). The study is undertaken for 40Ar/39Ar dating of tectonic processes of various polyhalite fabrics of Hallstatt, which have likely different formation ages, in order to supplement and extend further dating to further microfabric types as shown in Leitner (2011, Ph.D. thesis, University of Salzburg, 177 p.).
In the Hallstatt salt mine, polyhalite rocks occur in 0.5 to 1 m thick tectonic lenses within the protocataclasite to protomylonite matrix of ductilely deformed halite of cataclastic clay-/mudstone. Thin section analysis of Hallstatt polyhalites reveal various fabric types including (1) polyhalite mylonites, (2) metamorphic reaction fabrics, (3) vein-filling, fibrous polyhalite and (4) cavity filling polyhalite.
The polyhalite mylonites most likely formed along shear zones at high strain rates due to intracrystalline deformation and recrystallization. They may have developed from a more coarse-grained precursor metamorphic rock. Texture measurements by the electron back-scattered diffraction technique are in progress. The mylonites show a wide range of shear fabrics commonly known in mylonitic shear zones of the ductile crust. The mylonites are partly overprinted by recrystallized polyhalite grains, which are probably indicating a static growth.
Metamorphic reaction fabrics of blödite (or astrakanite) [Na2Mg(SO4)2 . 4 H_2O] between polyhalite seams and anhydrite has been found, too. According to Schauberger (1986, Archiv für Lagerstättenforschung der Geologischen Bundesanstalt, v. 7, p. 217–254), blödite of the Alpine Haselgebirge may occur primary as nodules or, more common, intergrown with the mineral löweite, which has a nearly identical chemical composition and is stable at higher temperatures. Reaction fabrics are commonly characterized by the control of the orientation of one mineral by another. They may be formed by exsolution, (re-)crystallization, parallel growth or replacement. This fabric type was only found in one sample in relation with blödite, for which formation temperatures of 6.2 – 61.4 °C in the presence of halite have been postulated by Autenrieth and Braune (1960, Kali und Steinsalz, v. 3, p. 15-30). Furthermore, some of the measured (microprobe data) polyhalite grains of one sample are extraordinarily rich in Na. Autenrieth (1958, Kali und Steinsalz v. 2/6, p. 181-200), who examined the six component system K+,Na+,Mg2+,Ca2+,SO42-,(Cl-), H_2O, reported during polyhalite precipitation the formation of a new, metastable sediment – Na-polyhalite (formula: 25 CaSO4 . 2 K2SO4 . 3 Na2SO4 . 15 H_2O, Autenrieth, 1959; Kali und Steinsalz, v. 2/2, p. 395-405). These prismatic-shaped Na-polyhalites are converted after a while to fine-grained, milky to dumbbell-shaped polyhalite.