

Lithium in silicate bearing Upper Permian salt rocks of the Morsleben salt mine, Germany

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Li can be detected in salt rocks, although no known naturally formed salt mineral incorporates Li in the crystal lattice [1]. In salt minerals, very low Li concentrations (few $\mu\text{g/g}$) can be related to fluid inclusions, but higher concentrations must originate from other sources, e.g. phyllosilicates [1, 2]. To verify, which minerals are Li-hosts, samples from the upper Staßfurt-Formation (Deckanhydrit, z2DA) to the lower Leine-Formation (Grauer Salzton, z3GT; Leinekarbonat, z3LK; Hauptanhydrit, z3HA) were investigated. The succession contains salt clays, anhydrite and carbonate bearing salt rocks of the Upper Permian (Zechstein) from the Morsleben site (Germany).

The samples were investigated using ICP-OES, ICP-MS, XRD, SEM and thin section microscopy. Exemplarily, four samples with the highest Li content were chosen for a detailed silicate characterization.

The z2DA shows a Li content of ca. 4 $\mu\text{g/g}$ to 159 $\mu\text{g/g}$. The sample with the highest Li content is characterized by quartz, illite-muscovite, chlorite (clinochlore), halite, anhydrite, magnesite, kaolinite, koenenite, biotite and hydrotalcite. The z3GT is composed of quartz, illite-muscovite, halite, sylvite, anhydrite, carnallite, hydrotalcite, chlorite (clinochlore), anatase, biotite and tourmaline, with a Li content of 146 and 154 $\mu\text{g/g}$. In the z3LK, the Li content varies from 11 to 46 $\mu\text{g/g}$ and in the z3HA from 5 to 116 $\mu\text{g/g}$. The Al, K and Rb components show positive relations to Li in all samples. For the Al/Li ratio a R^2 of 0.7581 (0.098 to 6.90 wt.% Al), for the K/Li ratio a R^2 of 0.6319 (0.026 to 3.67 wt.% K) and for the Rb/Li ratio a R^2 of 0.8129 (0.878 to 113 $\mu\text{g/g}$ Rb) were determined. The B content varies between ca. 2 and 581 $\mu\text{g/g}$, whereby the highest B content was detected in the tourmaline bearing z3GT.

Depending on the mineralogical composition of the lithology, the Li content varies significantly. Li probably originates in the z2DA from illite-muscovite, in the z3GT probably from illite-muscovite and a Li-bearing variety of a tourmaline (elbaite). The Li content of these minerals could not directly verified.

[1] Braitsch (1971) Salt Deposits, Their Origin and Composition 4, 297.

[2] Mertineit & Schramm (2019) Minerals 9, 766; doi:10.3390/min9120766.