Experimental studies of lepidolite stability in saline solutions at 22°C - 25°C with respect to Li, Si, Rb & Cs

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In salt research and safety analysis for nuclear waste disposals geochemical studies of brines and their genesis are of special interest. In contrast to bromine, comparatively little knowledge exists about the behavior of trace elements (e.g. lithium) in evaporites. Depending on the lithology where brines occur, Li amounts of 91 µg/g [1] respectively 383 µg/g (BGR, unpublished) in Permian salt clay and up to 401 µg/g in Zechstein brines were detected [2]. These values are significantly higher than in the highest evaporated seawater (26 µg/g) [3], therefore it is assumed that phyllosilicates in clay strata are the main source of Li [4].

Based on this assumption, 18 leaching experiments at 22°C - 25°C were performed. For each experimental run, 8 g pink colored lepidolite ($K(Li,Al)_{2-3}[(OH,F)_2/Si_3AlO_{10}]$) with a grain size < 200 µm was added to 100 g solution. The composition of the solutions vary from bi-dest. H_2O, NaCl-, KCl-, $MgCl_2$-solutions over solution Q, R and Z to seawater. Except of seawater and bi-dest. H_2O, the solutions were prepared using pure NaCl, KCl, $MgCl_2*6H_2O$ and $MgSO_4*H_2O$. The samples were shaken for more than one year, filtrated, washed with bi-dest. H_2O, cleaned with ethanol and dried at room temperature. The filtrate was analyzed using XRD, XRF, ICP-OES and ICP-MS. Density, electrical conductivity, pH, main, minor and trace components of the solutions were determined.

The resulting solutions are enriched in SiO_2 (≤ 34 µg/g), Rb (≤ 40 µg/g), Cs (≤ 6 µg/g) and Li - up to 1.7 times higher than in the highest evaporated seawater. Depending on the geochemical composition of the solutions, following Li enrichments were detected: 33 µg/g (bi-dest. H_2O), 35 µg/g – 37 µg/g ($MgCl_2$-sol.), 37 µg/g – 38 µg/g (sol. Q, R, Z), 33 µg/g – 39 µg/g (KCl-sol.), 39 µg/g (seawater), and 33 µg/g – 45 µg/g (NaCl-sol.). The increase of electrical conductivity documents that the reactions were not completed after one year.

It can be assumed that in geological times much more Li might be leached. This proves that the sources of Li in brines are mainly clay strata and the fluids have an intrasalinar origin.

[1] Ohrdorf (1968) *Geochim. Cosmochim. Acta*. **32**, 191-208. [2] Kühnlenz et al. (2010) *Kali und Steinsalz.* **3**, 32-43. [3] Schmidt et al. (1995) *unpublished BMBF-Report*. [4] Braitsch (1971) *Salt Deposits, Their Origin and Composition* **4**, 297.