Lithium self-diffusion in $LiAlSi_2O_6$ glass and single crystals

A.-M. WELSCH[1]* H. BEHRENS[1], I. HORN[1], S. ROSS[1], P.J. VULIĆ[2], D. MURAWSKI[1] AND A. KREMENOVIĆ[2]

[1]Institut für Mineralogie, Leibniz Universität Hannover, Callinstr. 3, 30167 Hanover, Germany, (*correspondence: a.m.welsch@mineralogie.uni-hannover.de)

[2]Department of Crystallography, University of Belgrade, Đušina 7, 11000 Belgrade, Serbia

Understanding the mechanisms of lithium diffusion is of great interest for geo- and material sciences. Optimizing the performance of Li-bearing solid media has a significant impact in developing new technologies. Knowledge of kinetic Li-isotopic fractionation leads to better understanding of geological processes in which lithium geochemistry plays a major role.

Our ongoing research is aimed to investigate Li diffusion in aluminosilicate media. In the scope of this study, spodumene ($LiAlSi_2O_6$) like materials were selected as representative model system since lithium, as the only mobile species, migrates through a static aluminosilicate network. Crystalline and glassy materials are compared in order to determine the effect of structural order on Li-diffusion. Glasses were produced by melting of oxide and carbonate mixtures as well as by melting natural spodumene. Natural crystals are from different pegmatites worldwide. Synthetic single crystals were obtained in a slow crystallization process using a flux method. The samples were tested by impedance spectroscopy for ionic conductivity in the range between 1 Hz to 10 MHz at temperatures up to 940 K. Additionally, lithium self-diffusion coefficients were determined by diffusion couple experiments using two halves with same base composition but different Li isotopic abundancies. Li isotope profiles were measured using UV fs laser ablation coupled with ICP-MS. Raman spectroscopy aided in better understanding the local structural features which coordinate lithium migration.

Ionic conductivity was found to be 6 - 7 orders of magnitude slower in natural spodumene crystals than in the glasses while the activation energy for Li conduction is about the same for both materials (0.66 kJ/mol for the glass, 0.76. kJ/mol for the crystal). This implies that the barrier for Li-migration is not sensitive to structural order in aluminosilicate materials. Comparison of Li isotope diffusion data and dc ionic conductivity yields a correlation factor of 0.5 for Li-diffusion in $LiAlSi_2O_6$-glasses.

Basin evolution, lithofacies palaeogeography and manganese mineralization in Heqing basin, Yunnan province, Southwest of China

XING-PING WEN[1], RUN-SHENG HAN[1,2] AND XIAO-FENG YANG[3]

[1]Faculty of Land Resource Engineering, Kunming University of Science and Technology, Kunming, 650093, P. R. China (wfxyp2008@gmail.com)

[2]Southwest Institute of Geological Survey, Geological Survey Center for Non-ferrous Mineral Resources, Kunming, 650093, P. R. China

[3]Research Center for Analysis and Measurement, Kunming University of Science and Technology, Kunming, 650093, P. R. China

Heqing basin is located in the northwest of Yungui plateau, southwest of China, a geological conjunction zone of three tectonic units separated by Jinshajiang, Honghe and Xiaojinhe-Lijiang fault belts. Heqing manganese deposit is situated in southwestern margin of Heqing basin. The Songgui formation of the Late Triassic series is the principal ore-host strata, composed mainly of mudstone, limestone and siltstone [1].

Heqing sedimentary manganese deposit formation is associated with Heqing basin evolution. The lithofacies paleogeography of Heqing basin is reconstructed. Sedimentary facies and palaeogeography of the Late Permian Changxingian ages reveal littoral deposits in Heqing manganese deposit. Then the sea level is continuously elevated in the Middle Triassic Ladinian age. Sedimentary facies and palaeogeography of the Late Triassic Carnian age expose shallow sea platform marginal bank facies in Heqing manganese deposit, which is beneficial to accumulation of ore-forming minerals under more stable geological and physicochemical conditions. In the Late triassic Norian age, the region marine regression lead to littoral deposits facies in Heqing manganese deposit, which terminates mineralization.

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