Heavy metal uptake by natural and modified zeolites

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Introduction

The remediation of agricultural land contaminated with heavy metals is often expensive, time consuming and has negative influences on soil fertility, structure and biology. In order to evalutate low cost natural binding agents Lothenbach et al. (1997) investigated the adsorption of Cu, Cd, Pb, Zn, Ni on natural and modified montmorillonite. The modified montmorillonite was found to be an effective binding agent for Cu, Zn and Ni, whereas the immobilisation effect on Cd and Pb was not very pronounced. Zeolites are widely in industry for ion exchange and other processes. They show outstanding properties with respect to adsorption of heavy metals, especially for Pb.

Materials and Methods

Zeolite material originating from Nizn_ Hrabovec (Slowakia) was ground and particle size distribution, cation exchange capacity and the mineralogical composition was determined. The zeolite material was modified by adding Al_{30} nanoclusters or cysteamin.

The unmodified or modified zeolite material was mixed with solutions containing 0.1 mM Cu, Zn, Pb, Cd or 0.1 mM Cu, Zn, Pb, Cd and 10 mM Ca (nitrate salts) and placed in an overhead shaker. Periodically, the suspensions were centrifuged and the supernatant was analysed for concentrations of the heavy metals, Ca, K, Mg and Na.

Hypothesis

It is expected, that the 100-fold excess of Ca will affect the adsorption of the heavy metal cations onto the zeolite. Furthermore, the pretreatments should enhance the adsorption capacity and/or the selectivity of the zeolite material towards the heavy metal cations.

References

Lothenbach, B., Furrer, G. and Schulin, R., (1997), *Environ. Sci. Technol.* **31**, 1452-1462.

Kinetic studies on the trace element distribution of Ca-Al-rich silicates

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Experimental studies on trace element distributions in silicate rocks showed an significant increase of the kinetic forced reactions in the presence of H_2O. While the effect of water as the most common volatile is fairly well understood the knowledge of the effects of fluorine are rather poor.

Experimental method

In this study crystallization experiments on trace element doped glass equal in composition to plagioclase-rich cumulates were performed (Wittenberg et al. 2000). As volatile component either deionized H_2O or HF (3 and 6 mol/l) were added. The amount of the added fluid phase were either 5 or 10 wt%. We also performed both seeded and unseeded experiments. For this purpose garnets from a mantle eclogite (RV-AW1) from Roberts's Victor / South Africa were picked. Crushed to a size of ≈ 5 µm in diameter were used as seed crystals. All experiments were performed in $Ag_{80}Pd_{20}$-capsules at 1000°C / 1.5 GPa for run durations of 168h in a piston cylinder apparatus at Hannover. For some of the experiments were first reached a temperature of 1100°C for about one hour to reduce the amount of possible crystallization seeds to a minimum.

The results are studied with the help of a Cameca SX100.

Observations and Discussion

Either zoisite / clinozoisite, pyroxene, corundum and glass were observed as run products, while the modal composition and the grain size of the resulting phases differ. The grt-seeds could hardly be re-found in most of the experimental results. Nevertheless, seeding experiments lead to a significant increase of the performed grain sizes under all observed conditions. The amount of the added fluid controls mainly the amount of the formed hydrous glass. The composition of the added volatile controls the trace element composition and homogeneity of the resulting phases. In presence of fluorine crystallisation increases as well as in size and in modal proportion except that the formation of corundum decreases. Hence, small amounts of fluorine change the physical properties of a partly molten system dramatically.

References

Wittenberg A., Withers, A.C., Shaw C. & Mengel, K.(2000), *J. Conf. Abs*. **5**, 107