

The uptake of Sr(II) by Calcium Silicate Hydrates: Adsorption versus co-precipitation

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The uptake of radionuclides by calcium silicate hydrates (CSH phases) could play an important role in retarding the migration of radionuclides in the near field and the altered far-field of a cementitious radioactive waste repository. In the near field, CSH phases are a major component of hardened cement paste. In the altered far-field, the interaction of hyperalkaline fluids from the cementitious repository (pH plume) with the sedimentary rock produces a range of CSH-type secondary minerals with high sorption capacities. Studies concerning the retention of radionuclides by CSH phases have focused predominantly on adsorption as the relevant uptake process. However, there is now considerable evidence existing in the open literature to indicate that co-precipitation with CSH phases is a potentially significant retention mechanism for metal cations under high pH conditions. A detailed assessment of the importance of co-precipitation processes with CSH phases in comparison to adsorption is still lacking.

The main objective of the present study is to evaluate the potential role of co-precipitation processes with CSH phases in the retardation of Sr(II) in the near field. The sorption of Sr(II) was studied using CSH phases of different composition. Prior to sorption studies the CSH phases were characterised by means of chemical analysis, XRD, SEM/EDS and TG/DTA. Co-precipitation experiments were conducted under conditions corresponding to weak and strong super-saturation with respect to CSH phases. The uptake of radionuclides during the formation of CSH phases was determined from measurements based on the partitioning of Sr(II). The distribution ratios (R_d 's) determined from co-precipitation experiments were compared with the values deduced from the sorption studies. The studies indicate that both types of processes give R_d values of similar magnitude. This suggests that both the external and internal sorption sites of CSH are readily accessible to Sr(II).

Metamorphic evolution of the Western Tatra, Slovakia: new geochemical and geochronological data

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The Western Tatra Mountains

The Western Tatra Mountains belong to the so-called Tatric unit of the Central Western Carpathians in Slovakia. Several metamorphic rocks (micaschists, orthogneisses and amphibolites) were investigated in order to reconstruct the pre-metamorphic protoliths and timing of recrystallization. We carried out isotope analyses and U-Pb single zircon dating by means of the CLC method (Poller, 2000).

The pre-Alpine basement of the Western Tatra belongs to two tectonic units juxtaposed during the Variscan orogeny. The metamorphic sequence is inverted. Lower unit micaschists and paragneisses reached only medium-grade metamorphism, whereas the upper unit gneisses, amphibolites and migmatites show high-grade metamorphism and partial melting (Janák et al., 1999). Relics of eclogites occur in some amphibolites (Janák et al., 1996).

Results and Conclusions

Sr, Nd and Pb-Pb analyses constrain the crustal origin of the lower unit metasediments with $^{87}\text{Sr}/^{86}\text{Sr}_{(330\text{Ma})}$ above 0.720 and $\epsilon\text{Nd}_{(330\text{Ma})}$ around -10. U-Pb dating of zircons in the micaschists yields lower intercept as well as concordant ages of around 500 Ma. This age reflects primary crystallization of zircons, suggesting the pre-Variscan protolith of the micaschists.

In the upper unit, magmatic age of orthogneisses (406 Ma), as well as their metamorphic recrystallization at 360 Ma was constrained (Poller et al., 2000). Pb-Pb whole-rock data as well as Sr and Nd isotopes indicate the protolith of the amphibolites as no typical MORB basalt. The isotopic signatures of amphibolites are rather crustal $^{207}\text{Pb}/^{204}\text{Pb} > 15.60$. This could be due to mixing of e.g. a MORB source with essential amount of crustal material. Preliminary Pb-Pb data indicate an age of 530 Ma for the amphibolites. Sm-Nd analyses on whole-rock, garnet and amphiboles are in progress.

References

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