Immobilization of boron in groundwaters by combination of MgO with woodchips

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Boric acid is one of the most diffucult species to immobilize in aqueous environments, because it predominantly exists as a molecular form. Boron specific resin is widely used and well known to immobilize with N-methyl-glucamate groups. However, it requies alkaline pHs and is unsuitable to apply to contaminant sites in a large scale like groundwaters. In the present work, permeable reactive barrier column tests were conducted to remove boron (B) in groundwaters in a laboratory scale for 11 months by using combination of MgO agglomerates with woodchips instead of boron specific resin. MgO agglomerates are one of engineering-assisted geomaterials for handling and main reactive materials here, while woodchips are natural and suppremental ones. ^{11}B-NMR and XRD results revealed that boron was mainly immobilized as $^{[3]}$B by co-precipitation with $Mg(OH)_2$ through destructive sorption of MgO and as $^{[4]}$B with woodchips through complexation which is in complementary mechanism and facilitated after alkalization by hydration of MgO. SEM images of solid residues MgO agglomerates after immobilization of B were quite different from without woodchips, suggesting that a variety of organic acids in leachate from woodchips affects to Mg^{2+} species as a precursor for $Mg(OH)_2$ precipitate. This affected also to increase the permeability because of avoiding the formation of bulky and needlelike-shaped precipitates of $Mg(OH)_2$. As a result, boron specific resin can be alternatively replaced with combination of engineering geomimetics with natural materials, which improved the efficiency to immobilize boron in groundwaters.

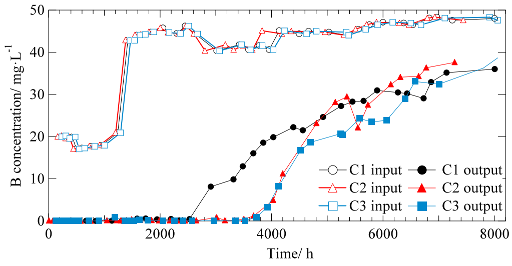

Fig. 1 Changes in B concentrations in input and output solutions with time. C1, MgO; C2, MgO + woodchips; C3, MgO + B specific resin

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Investigation of ancient fluid migration in Ordovician carbonates in the Michigan Basin using secondary minerals

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Investigations of the Upper Ordovician Trenton and Black River group argillaceous limestones in southwest Ontario, Canada, indicate that secondary calcite, dolomite, celestite and anhydrite occur in fracture-filling veins, with dolomite also replacing primary calcite in the limestone. The objectives of this study were to define the paragenetic sequence, identify the source(s) of the fluids, and if possible, place time constraints on the formation of these minerals.

Petrographic studies were conducted by optical and scanning-electron microscopy (SEM). Analyses of $\delta^{18}O$ and $^{87}Sr/^{86}Sr$ were conducted by isotope-ratio and thermal ionization mass spectrometry, respectively. Measurements of $\delta^{18}O$ were also conducted by ion microprobe. Microthermometric data were collected from doubly-polished 150 μm thick sections.

The paragentic sequence, from oldest to youngest, is replacement dolomite, vein dolomite, calcite in veins, and late-stage sulphate minerals. Mass-balance calculations indicate that replacement dolomite in the Trenton Group formed under closed conditions, while replacement dolomite in the Black River Group required an external source of Mg. Depth profiles of $\delta^{18}O$ and $^{87}Sr/^{86}Sr$ in vein carbonates suggest they formed as ^{18}O-depleted and $^{87}Sr/^{86}Sr$-enriched fluid ascended from the underlying shield. The $^{87}Sr/^{86}Sr$ composition of late-stage sulphate minerals suggests they formed from sedimentary basin brine. Fluid-inclusion investigations of the calcite in veins indicate four fluid migration events with homogenization temperatures in the range of 40 to 90 ºC. These temperatures are consistent with predictions of temperature associated with peak burial during the Late Carboniferous.

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