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Tracing water/rock interactions in groundwaters by B isotopes

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The chemical composition of riverine dissolved loads has been studied for many decades to investigate the sources and mechanisms of continental weathering. The motivation of these studies is to better understand the reactions that drive the temporal evolution of seawater chemistry and global climate. Aquifers in particular are the location of inetnse water/rock interactions that can regulate the chemistry of continental waters.

The development of transport-reaction models has demonstrated that the chemical and isotopic composition of groundwaters record changes in the nature and the intensity of the water/rock interactions over a variety of spatial and temporal scales. The duration of the perturbation for a given element is directly controlled by the partition coefficient of the element between the solution and the host rock as well as by the water/rock ratio. Here, we have applied this approach to the boron isotopic system.

Boron is a soluble element that readily absorbs onto clay surfaces and undergoes significant isotope fractionation. It has a great potential for tracing and recording water/rock interactions. Here, we report the B isotope composition of groundwater samples from the Wyodak-Anderson Coal Bed (WACB) aquifer in the Powder River Basin, Wyoming. The B isotopic compositions are compared to major elements concentration and Sr isotopic ratios in order to constrain the rate at which elements are released to or removed from solution. Because the isotope composition of dissolved B is regulated by adsorption onto solid surfaces, the B isotope system is very useful for deciphering between dissolution/precipitation and surface exchange reactions.