THE USE OF BORON ISOTOPES TO EXPLORE CRITICAL ZONE PROCESSES

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The Critical Zone is the thin and reactive layer at the Earth's surface fuelled by solar energy. Because boron isotopes are largely fractionated by a number of low temperature processes including biological processes, they appear as a well adapted tracer of critical zone formation and evolution, i.e. the conversion of rocks into soils and sediments mediated by biological processes.

Measured boron isotopic composition in the weathering environment varies over a considerable range of about 70‰. Precipitation, rivers and biomass are usually enriched in ^{11}B, while a complementary depletion in ^{11}B (enrichment in ^{10}B) is observed in clay minerals and on organic or inorganic surfaces. At the ecosystem scale, boron appears to behave as a micronutrient with a major flux of boron associated with biological recycling. The inputs of boron to ecosystems by chemical weathering or from the atmosphere are usually minor. Boron is mainly added to the ocean by rivers, while the most important sink of boron is adsorption on clay minerals. This makes boron a particularly good tracer of the critical zone processes in addition to its capacity for tracing the pH of ancient seawater.

A lot remains to be done to better understand the behavior of boron and boron isotopes at the Earth's surface and on the secular evolution of boron isotopes in the ocean but our review of the available literature shows that this tracer has a great potential at a local (ecosystem) and global (ocean) scale.