A new Cenozoic marine δ^7Li record based on authigenic smectites

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Continental silicate weathering removes CO_2 from the atmosphere and thus plays a critical role in regulating global climate over geological timescales. During silicate weathering Li is released, providing one of the main inputs of this element to the ocean. As Li isotopes are fractionated during alteration processes, in particular by clay neoformation at low T, changes in the seawater Li isotope composition provide an excellent tool for studying variations in silicate weathering intensity. Effective use of this tool requires a marine record that faithfully traces past seawater δ^7Li variations.

We have developed a new Cenozoic marine δ^7Li record based on the analysis of authigenic smectites. We analyzed δ^7Li values by MC-ICP-MS in clays extracted from oceanic sediments, after removal of exchangeable Li components. Samples come from DSDP and IODP sites 464, 1218 and 1219 in the Pacific Ocean, and sites 522, 523 and 524 in the Atlantic Ocean, and range in age from 70 Ma to the present. We first show that lithium trapped in clay octahedral sites during their formation are preserved from external exchange and thus reflect the Li isotope composition in the ocean at the moment the clays formed.

The Cenozoic curve determined by marine clays is compared to the δ^7Li record obtained from planktonic foraminifera shells by Misra and Froelich (2012). While there is good agreement between the two records from 0 to 15 Ma and near the K-T boundary, a marked contrast is observed in the period from 15 to 55 Ma, with the smectite record displaying much higher values comparable to those of the modern ocean. We will discuss possible reasons for this strong divergence and explore consequences for models of global silicate weathering and the carbon cycle during the Cenozoic Era.