B, Li and Sr isotopes as tracers of seawater-serpentinite interaction at MAR, ODP leg 209

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The samples presented in this study are altered spinel harzburgites from ODP Leg 209 (sites 1272A and 1274A) at the Mid-Atlantic Ridge (MAR) between 14°N and 16°N. The degree of serpentinisation varies between 70 and 100% in site 1272A and from 50 to 97% in site 1274A. Despite the high degree of serpentinisation, some relics of primary phases are still preserved (olivine ≥ orthopyroxene >> clinopyroxene).
In our previous study of the light element concentration in minerals of these samples we could show that boron is enriched in these rocks by reaction with seawater, and that the same process probably leaches lithium. Here, we present the results of strontium-, lithium- and boron-isotope analysis of these samples.

δ^7Li varies between -28.46 and +7.17, δ^{11}B ranges from +29.6 to +40.52. $^{87}Sr/^{86}Sr$ ratios (average 0.708726) are close to seawater values. Using the water-rock-ratio equation of McCulloch *et al* (1980), we obtain a low water-rock ratio (average 38.9).

Using the fractionation factors of Liu and Tossell (2005) for boron, we can model the compositional evolution of seawater to an evolved fluid (up to δ^{11}B +70 in solution, corresponding to δ^{11}B + 40 in the rock) in the course of its passage through the oceanic mantle rocks.

Our results show that at ODP leg 209, B, Li and Sr isotopes can successfully be used to quantify reactions between seawater and very young oceanic mantle rocks. Low water-rock ratios lead to extremely high δ^{11}B values. This signature could potentially be transported into subduction zones. In general, however, the B, Li and Sr isotopic composition of altered oceanic mantle should be highly variable depending on water-rock ratios and on age.

References

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Dynamic of pedogenic carbonates in a climatic gradient: The Kabini river basin, Deccan Plateau, South India

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The chemical weathering of silicate rocks consumes atmospheric CO_2. This has an impact on the long-term carbon cycle. In arid and semi-arid climatic conditions, the precipitation of pedogenic carbonates in soil, developed on silicate bedrock, is a potential carbon sink.

The West-East climatic gradient of the Deccan plateau, South Peninsular India, has induced various pedogenic carbonate occurrences, calcretes and nodules in the semi-arid zone and only nodules in the transition zone. The transition zone appears to be particularly sensitive to climatic changes and thus well designed for assessing the impact of climate change on the dynamic of pedogenic carbonates. In order to constraint the carbon sequestration in pedogenic carbonates, (1) the origin of Ca, (2) their age (U/Th dating) and (3) their current behavior (precipitation or dissolution), have to be determined.

Different types of nodules were sampled according to the structural study of the soil cover, in two representative watersheds of the transition zone. Soils, developed on a gneissic basement, show carbonate nodules either at the top of saprolite or within black soils (vertisols).

The $^{87}Sr/^{86}Sr$ isotopic ratios show that 2/3 of Sr in the carbonates originate from the parent rock and 1/3 from atmospheric inputs. This means that Ca mainly originates from the parent rock.

Preliminary U-Th ages of the well-developed nodules from the saprolite and black soils range from 15 to 23 ky while ages of soft tiny nodules from black soils would be less than 2 ky. Both populations of ages correspond to periods of weakness of the South West monsoon (dryer climate). In this context, the pedogenic carbonates could be considered as paleo-climate proxies.

The current stability of the nodules was assessed by the stream chemistry of the watersheds. It indicates that the nodules are dissolving in the transition zone. The nodules dissolution significantly contributes to the output fluxes of Ca, Mg, U and REEs. However, the nodules trapped in the clayey matrix of the black soils seem to be protected from present-day chemical weathering.