Lithium isotopes of the early solar system and terrestrial planets

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Despite large mineralogical, textural and chemical differences between carbonaceous chondrites, ordinary chondrites and achondrites, the range of δ^7Li is restricted from +0.5 to +5.4‰. Hydrous alteration and metamorphism are extremely variable in chondrites but Li isotopes show no obvious correlation with petrological types. Neither carbonaceous or ordinary chondrites, nor achondrites exhibit a correlation between their Li abundances and δ^7Li, suggesting that Li isotopes did not fractionate during early stages of our solar system nor during magmatic differentiation on smaller asteroidal bodies.

Based mainly on the composition of basaltic and ultramafic rock types from Earth, Seitz *et al*. [1] and Magna *et al*. [2] suggested a δ^7Li-value for BSE (bulk silicate Earth) of ~ +4‰. Elliott *et al* [3] derived a weighted average of +3.4‰ for unmetasomatised mantle peridotites. Seitz *et al*. [4] and [3] concluded that a δ^7Li of ~ +4‰ should also be the value for the inner planets, because rocks from the Moon and Mars give on average similar values. McDonough *et al*. [5], on the other hand, suggested a δ^7Li-value of 0‰ for the solar system, an average of a restricted number of measurements on chondrites. More recent work by McDonough *et al*. [6] revealed a slightly heavier average composition (δ^7Li = +1.3‰). However, such low values are not supported by our measurements which comprise a much wider range of chondrite types. We find an average of +3.3‰ for carbonaceous chondrites. Ordinary and enstatite chondrites give a lighter average of +2.3‰.

The previously suggested 'BSE' value of ~ +4‰ by [1,3,4] was based mainly on basaltic rock types. The average δ^7Li-value of unmetasomatised peridotites [3,7] and of olivines from relatively pristine spinel peridotites [1] is +3.3‰, indistinguishable from carbonaceous chondrites.

We therefore suggest, in agreement with Elliott *et al*. [3], that the δ^7Li-value for BSE and also for the inner planets is +3.3‰. In turn, the different isotope signatures of carbonaceous chondrites on one side and of ordinary chondrites on the other are interpreted to reflect distinct reservoirs in the early solar nebula.

References

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Re-Os isotope systematics of kimberlites from SW Greenland: Implications for an isolated lithospheric mantle during 500m.y.

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Kimberlite magma is well known to entrain many xenoliths and diamonds, which suggest that the magma originated from a source at the depth deeper than 200km. However, the nature of this source material is still highly debated. Here, we report the Re-Os data for kimberlite dykes from the Sarfartoq area, SW Greenland. In this area, the alkaline ultramafic dykes intrude into the boundary between the Archean craton and the Palaeo-proterozoic orogen. The kimberlites were erupted around 600Ma with a large carbonatite complex, which is located at the center of a widely distributed kimberlite swarm (Larsen *et al*., 1983; Larsen and Rex, 1992).

The Re-Os whole rock reference age of 1100 Ma is significantly older than the eruption ages of the Sarfartoq kimberlites, determined by K-Ar and U-Pb methods (Larsen *et al*., 1983; Bizzaro *et al*., 2002). It implies that the kimberlite source mantle was separated from convecting mantle at the time of the Re-Os reference isochron age and remained isolated until eruption. The Re-Os T_{MA} ages of the kimberlites, however, are similar to the eruption ages. Thus, in this case it appears that Re-Os T_{MA} ages record the eruption. The initial $^{187}Os/^{188}Os$ ratio of the kimberlites, 0.113, is in the range of the continental lithospheric mantle. The γOs values of the kimberlites at 1100 Ma are also similar to those of the lithospheric mantle peridotite xenoliths from Somerset Island (Irvine *et al*., 2003), rather than the primitive upper mantle estimated by Meisel et al. (1996), supporting the isolated source hypothesis.

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