Molybdenum in the mantle

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Precise, double spiking, Mo isotope data ($\delta^{98/95}Mo_{NIST}$) exhibit a significant range of fractionation for terrestrial mafic and ultramafic rocks from globally dispersed locations. The compositions of mid-ocean ridge basalts (MORBs) (+0.00±0.07‰) are relatively uniform and resolved from both CI and ordinary chondrites (-0.14±0.02‰) but contrast with considerable diversity in ultramafic xenoliths from Kilbourne Hole, Lashaine, Tariat and Vitim (-0.39 to 0.41‰). Lashaine xenoliths have Mo that is particularly heavy. Intraplate and ocean island basalts (OIBs) also display significant variability within a single locality from MORB-like to strongly negative (-0.59±0.09‰) for nephelinites. These highly enriched samples also have low Mo/Ce relative to other oceanic basaltic rocks, providing evidence that Mo can be less incompatible than previously thought. This is consistent with the Mg/Mo of the xenoliths which extend from the standard bulk silicate Earth (BSE) value (6×10^6) to much lower values (3×10^5), which is hard to reconcile with it being strongly incompatible. The Mo concentrations ([Mo]) of the xenoliths do not correlate with [La] which might otherwise provide evidence of metasomatic Mo enrichment. Residual sulphides may be partly responsible for the apparently complex behaviour. The Mo concentration and isotopic composition of the BSE are currently poorly constrained because of this. Based on the xenolith data a best estimate of the BSE [Mo] is about 5 times higher than previously assumed, and similar to the levels of depletion in the other refractory moderately siderophile elements W, Ni and Co.