New insights into secular variations in the Mo-Zn-Fe isotopic composition of the Earth's mantle

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There are few unambiguous tracers of secular variations in the oxidation state of subducted surface material and its impact on mantle chemical evolution. For example redox-sensitive tracers, such as the vanadium concentrations [1] and iron stable isotope compositions of igneous rocks [2] do not record any systematic variations in mantle oxidation state with time. Molybdenum stable isotopes provide an extremely sensitive redox tracer and have been widely used to reconstruct transitions in sedimentary palaeo-redox environments from euxinic (S-dominated) to oxic conditions that typify modern oceans ([3]; $\delta^{98/95}$Mo ≈ 0.5–1.5 ‰). Previous work focussing on Archean komatiites has shown they range from 0.02–0.19 ‰ ([4]; ± 0.16 ‰; 2SD), although altered samples produce significantly heavier compositons up to 0.7 ‰. Due to these large analytical uncertainties, it is not possible to resolve the effects of any primary magmatic differentiaiton or alterantion and hence properly assess temporal variablity.

To elimate the effects that long-term weathering ± seprentinistation may have had on these mafic rocks we have focused on their modern equivalents. Two Phanerozioc examples of extremly fresh high degree paritally melts the ~69 Ma Baffin Island picrites [5] and the ~90 Ma Gorgona komatiites [2] have been analysed here. Improved long-term analytical reproducibility in this study (Romil $\delta^{98/95}$Mo ± 0.031 ‰; n = 48 and Molybdenite 2706 ± 0.022 ‰; n = 29; 2SD) will allow resolution of high temperature magmatic fractionations. These analyses will be coupled with stable Zn and Fe isotopic measurements on the same samples to better understand the proccess causing isotopic variablity.

[1] Canil, *EPSL* **195**, 75 (2002); [2] Hibbert et al., *EPSL* **322** 98 (2011); [3] Archer et al., *Nature Geosci* **1**, 597 (2008); Duan et al., *GCA* **74**, 6655 (2010); [4] Greber et al., *AGU* V31A-4722 (2014); [5] Dale et al., *EPSL* **278**, 267 (2009).