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Redox control on chromium isotope behaviour in silicate melts in contact with magnesiochromite

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Transition metals are of special interest for understanding the conditions of differentiation processes such as core formation. Those that have more than one oxidation state can also provide powerful constraints on changing redox conditions in the mantle over time. The ability to determine isotopic fractionations associated with differentiation processes has provided a new dimension to exploration of the conditions in the early Earth in particular. It has been recently shown that Cr isotope variations in igneous systems are strongly affected by redox conditions and chromite crystallisation.

In this study, we have investigated the variations in chemical composition and Cr isotopic compositions in both magnesiochromite and silicate melts during experiments performed under controlled redox conditions. The Cr isotopic compositions measured in the silicate melts in our experiments are strongly influenced by oxygen fugacity and experiments performed at 1300 °C and $-12 < \log fO_2 < -6$ are correlated with fO_2. This suggests that Cr isotopes are a powerful tool to study changes in redox conditions in high temperature processes. The Cr isotopic composition of silicate melt reacted under more oxidising conditions ($\log fO_2 > -6$) are isotopically much lighter compared to melts reacted at lower oxygen fugacity. Three hypotheses are proposed to explain such variations: (i) a change in Cr bonding environment in the silicate melt (ii) a change in Cr bonding environment in the chromite (iii) volatile loss of Cr from the silicate melt. More work is needed to definitively determine the factors that control the isotopic behaviour of Cr in silicate melts.