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The influence of temperature on the behaviour of Cr and its isotopes in mantle processes : an experimental approach

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Non-traditional isotopic systems (e.g. Mo, Si, Cr, Ce, Fe...) are increasingly used to study mantle processes. Chromium is an element that is sensitive to redox conditions and temperature (e.g.[1]). It is present in the mantle with at least two redox states (Cr^{2+} and Cr^{3+}) and behaves compatibly during high temperature processes like partial melting and fractional crystallization (e.g. [2]). Chromium has four stable isotopes (^{50}Cr, ^{52}Cr, ^{53}Cr and ^{54}Cr) whose ratios have been used in the literature to study mantle processes ([3] ; (4) ; [5] ; [6]). It has been shown that Cr isotopes equilibrium between chromites and silicate melts are influenced by redox conditions [7] . This study proposes to explore the influence of temperature and pressure on chromium isotope fractionation. To this end, piston-cylinder experiments have been carried out at 1GPa and a range of temperature from 1250°C to 1500°C. The effect of oxygen fugacity was also studied, using two different capsule types (Au-Pd and graphite). The experimental samples are made from a primitive MORB and a natural spinel. The experimental results show Cr_2O_3 contents in the liquid increasing (0.04 wt.% to 1.25 wt.%) with increasing temperature and oxygen fugacity. The same correlation is observed in chromites (from 26.2 wt.% to 46.0 wt.%) at equilibrium with the silicate melt. In agreement with previous studies, Cr becomes less compatible at high temperature and low fO_2, while pressure (between 1atm and 1 GPa) does not seem to have a strong role on Cr behaviour. The Cr isotopic compositions measured on experimental silicate melts and chromites in equilibrium, but also on natural samples, such as well constrained MORBs and pyroxenites, will enable us to assess the potential of Cr stable isotopes as a redox proxy during mantle processes.

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