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Stable Cr isotope compositions of modern silicate mantle reservoirs

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In Earth's mantle chromium occurs in bivalent (Cr^{2+}) and trivalent (Cr^{3+}) oxidation states in proportions strongly dependent on the prevailing oxygen fugacity (fO_2) [1]. The different ionic substitution affinities of Cr^{2+} and Cr^{3+} between melt and minerals results in small Cr stable isotope fractionation during igneous processes such as fractional crystallization and partial melting [2, 3, 4]. However, knowledge of the Cr isotopic compositions of different mantle domains and potential correlations to mantle fO_2 is still very limited.

This study aims at characterizing mafic rocks derived from distinct modern mantle reservoirs in order to investigate potential variations in the Cr stable isotopic compositions of different magma source regions. Different mantle reservoirs are thereby identified and characterized in radiogenic Sr-Nd-Pb isotopic space.

Our results show significant deviation of some mantle reservoirs from the Cr isotope composition of the recently defined bulk silicate Earth (BSE) value of -0.12 ± 0.06 ‰ in $\delta^{53/52}Cr_{SRM979}$ [4]. Influence of various processes on the observed Cr isotopic fingerprints, such as mixing of different mantle reservoirs, lithospheric interaction, redox cycling, melt differentiation and prevailing oxygen fugacity have yet to be established and will be discussed.

[1] Berry et al. (2006); Amer. Min., 9, 1901-1908. [2] Bonnand et al. (2020); EPSL 532, 116028. [3] Shen et al. (2020); GCA 278, 289-304. [4] Wagner et al. (2021); Chem. Geol. (in press).