Chromium and Cerium mass dependent isotopic variations during fractional crystallisation in terrestrial basalts

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The chemical compositions of the Earth reservoirs have been strongly affected by magmatic processes such as partial melting and fractional crystallisation. A better understanding of the chemical reactions responsible for these heterogeneities is essential to ultimately constrain the evolution of the Earth system. In the last decades, major and trace elements have been extensively used to constrain the chemical evolution of terrestrial basalts and their mantle sources. More recently mass dependent isotopic variations in basalts has also been investigated as the advances in high precision measurements allow the determination of small isotope variations typical of high temperature settings.

Chromium and Cerium are two chemical elements with distinct geochemical behaviour. Chromium is compatible during partial melting and fractional crystallisation whereas Cerium behaves incompatibly. Therefore, mass dependent variations of these elements can help us constrain the conditions under which magmas generation and evolution happened. Recently, it has been demonstrated that chromium isotopes are fractionated during fractional crystallisation on the Moon [1]. Furthermore, isotopic variations in achondrites could also be explained by magmatic processes. But chromium isotopes data on terrestrial suites affected by fractional crystallisation are still lacking.

In this study, a suite of well characterised basalts from Fangataufa (French Polynesia) have been analysed. These samples are characterised by chemical variations typical of partial melting and fractional crystallisation in an oceanic island setting. Across our sample range, chromium concentrations decrease from 500 to 20 $\mu g.g^{-1}$ while Ce concentrations increase from 30 to about 60 $\mu g.g^{-1}$. In this contribution, we show that chromium and cerium isotopes are fractionated during magmatic differentiation which allow to track their chemical evolution through time and to go back to the initial isotopic composition.

[1] Bonnand et al. 2016, GCA.