

A new approach to quantify the mineralogical make-up of the mantle sources

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Mantle heterogeneity has a first-order control of the petrological and geochemical differences of erupted mafic lavas worldwide. Whether this heterogeneity reflects only chemical variations or also lithological heterogeneity in source regions is debated. Because of their contrasted partitioning behaviors between mantle phases, First Row Transition Elements (FRTEs) are considered as potential lithological tracers. Using a combination of published data on natural and experimental samples and new high current microprobe analyses on a variety of pyroxenite samples, we investigated the parameters that control FRTE exchange coefficients (K_d) between common mantle minerals and performed inverse modeling to test if FRTE ratios from oceanic basalt compositions can be used to solve for modal proportions in their mantle source. We applied the K_d determined from mantle lithologies in this study, along with experimental melt-mineral partitioning coefficients and a simplified melting model, on two basalt suites selected for their contrasted Mn/Fe and Zn/Fe ratios. Our results show that a same FRTE ratio can be explained by a range of modal proportions in the source. However, when combined, FRTE ratios become a powerful tool to constrain the nature of the source.