Accurate and Precise Isotopic Compositions of Ultramafic and Mafic Rocks: Reference materials and Application to the Kiglapait Intrusion

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The presence of significant radiogenic isotopic differences in coexisting minerals from a number of major mafic layered intrusions has been a puzzling observation for many years. Either different minerals in cumulates crystallized from magmas of distinct compositions or late-stage magmatic processes disturbed primary signatures. Accurate and precise isotopic ratios of minerals require the analysis of sample-matrix matching reference materials (RM). We have undertaken an analysis of radiogenic isotopic compositions (Pb-Nd-Hf-Sr) by MC-ICP-MS and TIMS from single rock digests for 13 mafic to ultramafic RM, including five basalts (BHVO-2, BIR-1, JB-3, BE-N, GSR-3), an anorthosite (AN-G), a diabase (W-2), a dolerite (DNC-1), a peridotite (JP-1), a serpentinite (UB-N), a pyroxenite (NIM-P), a norite (NIM-N), and a dunite (NIM-D). Acid-leaching prior to dissolution is an important factor in the reproducibility of some RM. BHVO-2 requires leaching to attain reproducible isotopic values, whereas BE-N is more reproducible without. AN-G has heterogeneous isotopic compositions and is an unsuitable RM for plagioclase-rich rocks. The other RM analyzed in this study have reproducible Nd and Sr isotopic ratios (<50 ppm) with Hf isotopes <100 ppm (except NIM-N). The precision for Pb is generally good for basalts (50-250 ppm), and it decreases for the plutonic rocks. A previous study of the troctolitic Kiglapait intrusion (ca. 1307 Ma) in the Nain Plutonic Suite, Labrador, Canada, showed isotopic variation in coexisting minerals throughout the entire body. New MC-ICP-MS and TIMS analyses are in progress to quantify and explain this isotopic heterogeneity. They confirm the existence of Pb isotopic differences between coexisting plagioclases ($^{207}Pb/^{204}Pb_i$ = 14.67-14.94) and mafic minerals ($^{207}Pb/^{204}Pb_i$ = 15.17-15.24). The new results also indicate that some samples have consistent Pb isotopic composition between coexisting minerals. The mafic and ultramafic RM analyzed in this study provide an important new dataset for the isotopic investigation of mafic layered intrusions (e.g., Kiglapait, Stillwater, Bushveld).