RESOLVING MAGMA CHAMBER PROCESSES AND MANTLE SIGNALS USING THE RE-OS ISOTOPE SYSTEM

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Radiogenic isotopes have provided a wealth of information on the nature of the chemical heterogeneities that have persisted in the convective mantle through time. However, the effects of magma chamber processes on such isotopes are rarely considered. This is in part because such isotopes are unlikely to ‘evolve’ through radiogenic ingrowth on magmatic timescales, but also because the concentrations of these elements in many magmatic phases are low and thus details of phase equilibration cannot be observed and interaction is considered likely to have little consequence. The decay of $^{187}$Re to $^{187}$Os provides a unique tracer of recycled crustal materials in the convective mantle. The Re-Os system also holds key information on the nature of magmatic processes in affecting oceanic basalts. This is partly because Re and Os (unlike the lithophile elements, such as Sm-Nd) can be measured in all magmatic phases. But also because magmatic phases (such as olivine and plagioclase) possess exceptionally high Re/Os ratios, and therefore evolve to radiogenic Os isotope compositions in very short periods of time. Consequently, such minerals yield precise information on both the timing of igneous crystallisation and the details of equilibration between phases. Here we present Re-Os isotope data from MORB (FAMOUS and S. Atlantic) and OIB (Cameroon Line volcanics) that clearly demonstrates the effects of assimilation of xenocrysts (of both mantle and magmatic origin), mixing, and fractional crystallisation. Re-Os data for mineral phases from FAMOUS basalts clearly shows the presence of xenocrystic phases (such as spinel and clinopyroxene) that must have been assimi-
lated from previously solidified basalts or cumulates through which the present basalts have ascended. Phenocryst phases yield precise Re-Os ages and provide information on the composition of the mantle source. Oceanic basalts from the Cameroon Line show isotopic and elemental data consistent with assimilation of mantle xenocrysts, and continental basalts have been affected by fractional-crystallisation and assimilation. "Are ocean floor basalts primary magmas?"; the Re-Os isotope data suggests that some parts of some basalts are indeed primary, but that primary information can only be accessed through detailed petrological and geochemical study.