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Relative timing of crustal contamination processes: Carlingford Igneous Centre, Republic of Ireland

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Magmatism at the Palaeogene Carlingford Igneous Centre is represented by a major gabbro sill and a microgranite ring-dyke, both of which are crosscut by a series of aphyric to highly porphyritic basaltic cone-sheets with subordinate rhyolite, basaltic-andesite and basaltic-trachyandesite. These lithologies, plus local crust, were analysed for major and trace elements and whole-rock Sr, Nd and Pb isotopes to assess the processes and extent of magma-crust interaction.

All samples (^{87}Sr/^{86}Sr 0.7057-0.7201) deviate markedly from mantle values towards local Silurian siltstones (^{87}Sr/^{86}Sr 0.7144-0.7276). While the majority of trends for basaltic samples can be explained by bulk contamination, the cone-sheet rhyolites (^{87}Sr/^{86}Sr 0.7098-0.7100) lie within the basalt/basaltic-andesite range, suggesting fractionation after initial contamination (from a basalt). In contrast, the microgranite (^{87}Sr/^{86}Sr 0.7067-0.7127) seems to have incorporated partial melts of the Silurian crust, rather than bulk material. K-rich basaltic-trachyandesites (^{87}Sr/^{86}Sr 0.7198-0.7201) experienced initial bulk rock contamination and were further contaminated by (high-K) hornfelsed xenoliths (restite of siltstone remaining after loss of partial melt). Plagioclase phenocrysts from the porphyritic basalt show that An generally decreases with growth (An 91-34), with resorption surfaces marking compositional steps. Convection and re-equilibration in a heterogeneous magma chamber may therefore be an important process affecting these phenocrysts, especially considering that groundmass values are also highly variable and range ^{87}Sr/^{86}Sr 0.7064-0.7092 (with matrix feldspar values of An 62-46). Micro-drilled Sr isotope analyses of individ-

ual plagioclase zones show strong variation, with high-An cores yielding both high (0.7070-0.7077) and low (0.7063-0.7067) Sr ratios compared with low An rims, suggesting some variation may be due to the presence of xenocrystic cores, rather than classical replenishment and magma mixing.

Despite the involvement of just a single crustal contaminant, our data imply contamination was not straightforward. Rather, we see a succession of variably overprinted processes that form a time sequence of contamination; from initial contamination by crustal partial melts to bulk contamination as the system heats up, and final contamination by the remaining restite during cone-sheet emplacement. Processes such as xenocryst entrainment, post-contamination fractionation and magma chamber convection were also found to be significant during magma evolution.