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Geochemical evolution and radiogenic Sr, Pb and Nd isotopic ratios of discrete rhyolitic melt bodies at Ōkataina Volcanic Centre, New Zealand: implications for plutonic evolution at a young, active caldera volcano.

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The isotopic signatures of volcanic rocks provide important insights into magmatic systems together their evolution in time and space and how such evolution is represented in the plutonic record. Most isotopic data on volcanic products represent whole-rock analyses. However, open magmatic systems can be affected by foreign material, which skews whole-rock isotopic and geochemical data away from that of the melt phase. The large, caldera-bearing Ōkataina Volcanic Centre, New Zealand, is one such system where xenocrysts (foreign crystal cargo) are found in some of its erupted products, suggesting that existing whole-rock isotopic data for Ōkataina requires treating with caution.

We here present TIMS-derived isotopic data representing the melt phases of discrete magma batches erupted over the past ~25,000 years, obtained by analysis of pure volcanic glass separates obtained from the various erupted lavas and pyroclastic deposits. This approach avoids any potential xenocrystic contamination, while taking advantage of the fact that the isotopic signatures of a magma remain the same despite any fractionation of phenocrysts (crystals that truly belong to the system) from the melt phase.

Current data indicate that the three main vent regions at Ōkataina (the Tarawera, Haroharo, and Ōkareka vent zones) are often geochemically and isotopically distinct, yet are still related and follow coherent overall trends with time. Further, individual magma batches can often be geochemically and isotopically fingerprinted, however, Haroharo and Ōkareka-derived magmas show greater variability than those from Tarawera. There are system-wide trends where $^{86}Sr/^{87}Sr$ and $^{143}Nd/^{144}Nd$ ratios become more radiogenic with time, and all eruptions lie on the same trend in $^{207}Pb/^{206}Pb$ vs. $^{208}Pb/^{206}Pb$ space. The data demonstrate a step change in the geochemical behaviour of the volcano around 16 ka. Overall, these data show that the deep plutonic roots of the Ōkataina Volcanic Centre have systematically evolved with time and space, implying that any future geological exposure of these roots would encompass complex isotopic characteristics.