Climate and elevation influence the geochemistry of large-volume silicic magmas: new δ^{18}O data from the Central Andes: with comparison to N America and Kamchatka

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New delta^{18}O data from magmatic quartz, plagioclase and zircon crystals in Neogene large-volume, rhyodacitic ignimbrites from the Central Andean Ignimbrite Province reveal uniformly high-delta^{18}O values (delta^{18}O(Qtz) from +8.1 to +9.6 ‰; delta^{18}O(Plag) from +7.4 to +8.3 ‰; delta^{18}O(Zrc) from +6.7 to +7.8 ‰). These data, combined with crustal radiogenic isotopic signatures of Sr, Nd and Pb, implicate progressive contamination of basaltic magmas with up to 50 volume per cent upper crust in these large volume silicic systems. The narrow range of O-isotope values also demonstrate that surprising homogeneity was achieved through space (100's km) and time (10 Ma) in these large-volume magmas, via convection and residence in their parental upper crustal bodies.

In contrast, large-volume ignimbrites erupted during the Cenozoic North American ignimbrite flare-up of the North American Cordillera, whilst achieving equally high Sr and Nd isotope values, and by extension, amount of crustal assimilation, exhibit a much wider range in delta^{18}O(Qtz) (+2.6 to +10.1), delta^{18}O(Fspar) (-1.3 to 8.4) and delta^{18}O(Zrc) (-1.3 to +6 ‰) values. Large volume Kamchatkan ignimbrites, discussed here for comparison, are also universally lower in delta^{18}O. Based on oxygen and radiogenic isotope character and geochemical parameters, we demonstrate that despite vastly different tectonic associations, the fundamental control of basaltic magma assimilating many tens of percent of crust at each of these provinces remains robust, and broadly requires equal proportions of upper crust in the final magmas. The low-delta^{18}O values of many large volume silicic magmas in North America and Kamchatka reflect the influence of meteoric-hydrothermal events in lowering these delta^{18}O values. The lack of a low-delta^{18}O signature in the Central Andes and a few instances in North America, like the Great Basin of Nevada, may thus reflect a lack of meteoric hydrothermal events in these regions leading us to speculate that this portends a link between the O-isotope values of large volume silicic magmas and regional climate. In the Central Andes, and the Great Basin of Nevada, a heavy-delta^{18}O signature is interpreted as a reflection of how high elevation, aridity and evaporation rates limit the retention of large amounts of surface meteoric water and hydrothermal alteration of the shallow crust.

If as we propose, regional elevation and climate influences the geochemical signatures of the large volume magmas, O-isotope data can potentially be used to track the effects of a meteoric-hydrothermal derived delta^{18}O signature from upper crustal rocks that are subsequently assimilated to produce these magma types, and may provide a useful proxy for paleoclimate and paleoelevation.