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Young zircon Hf-O isotope constraints on the dynamics of magmatic reservoirs below Changbai (Paektu) volcano, China/North Korea

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The Changbai Volcano is well-known for its major caldera-forming Millennium Eruption (ME) at 946 CE. We report Hf-O isotopes in zircons from pre-caldera, syn-caldera, and post-caldera eruptions of the Changbai (Paetku) volcano to constrain magma chamber processes.

Zircons from the pre-caldera Qixiangzhan (QXZ) comendite lavas on the northern slope of the Changbai Volcano have $d^{18}O$ ranging from 4.46 to 5.16 and e_{Hf} ranging from -4.47 to +4.37.

Zircons from the syn-caldera ME charcoal-bearing non-welded comendite pyroclastic flow deposit on the southern slope of Changbai Volcano have $d^{18}O$ ranging from 2.25 to 5.51 and e_{Hf} from -3.75 to +3.31. Zircons from the post-caldera welded trachytes on its southern slope have $d^{18}O$ ranging from 3.56 to 6.10 and e_{Hf} from -1.97 to +6.23. There are no significant correlations between O and Hf isotopes for all zircons in QXZ and ME comendite and post-caldera trachyte.

The ubiquitous occurrence of low $d^{18}O$ zircons in QXZ and ME comendites relative to mantle zircon $d^{18}O$ values may indicate assimilation of hydrothermally altered low-$d^{18}O$ juvenile rocks into the comendite magma chamber or addition of surface water to magma. By contrast, all trachyte zircons (except for two zircons) have $d^{18}O$ (5.66 to 6.10) higher than those from QXZ and ME comendites and mantle values, indicating relatively lack of such assimilations or surface water-magma interactions for Changbai trachytes.

Similar zircon Hf-O isotopes between pre-caldera QXZ comendites and syn-caldera ME comendites indicate tapping of the upper portion of a zoned magma chamber or an individual shallow magma chamber. Higher $d^{18}O$ in trachyte zircons indicate tapping of the lower portion of a zoned magma chamber or an individual deeper magma chamber.

The lack of significant correlations between zircon O and Hf isotopes, and the relatively high eHf values for all Changbai zircons, argue against partial melting of ancient continental crust or significant contaminations by ancient crustal rocks, as an origin for these felsic magmas. Instead, the Changbai trachytes were formed by evolution of mantle-derived basaltic magmas, and the Changbai comendites were formed by further magma evolution with assimilation of hydrothermally altered juvenile volcanic rocks or addition of surface water to magma.