Characteristics of O and Si isotope ratios of zircons of silicic rocks from the Izu-Bonin-Mariana (IBM) arc and the Izu collision zone (ICZ)

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The Izu-Bonin-Mariana (IBM) Arc is an active intra-oceanic arc for ~52 million years, and silicic crusts have been generated by subduction zone magmatism [e.g., 1,2]. The north end of the IBM arc has been colliding with the Honshu Arc at the Izu Collision Zone (ICZ) for ~15 million years and voluminous syn-collision granitic plutons are exposed in ICZ [e.g., 3]. Silicic crust formations by intra-oceanic crustal subduction and the following arc-arc collision are probably significant processes of continental crust formation during the early Earth history.

Elevated $\delta^{18}$O values (6.0 –7.5‰, VSMOW) in Hadean and Archean zircons are interpreted as evidence for incorporation of low temperature aqueous alteration products to the zircon-forming magmas as early as 4.3 Ga [4,5]. Similarly, low $\delta^{30}$Si magmas can be caused by incorporation of severely weathered materials [6,7]. Oxygen and Si isotope ratios of zircons can be useful to investigate incorporation of low-temperature weathered material to their parent magmas. We established zircon standards, a kimberlite xenocryst KC-KLV-Zrc1 from Kaalvallei, South Africa ($\delta^{18}$OVSMOW=5.43±0.14‰, $\delta^{30}$SiNBS-28=−0.38±0.19‰, 2SD) and a detrital zircon megacryst KC-MGK-Zrc2 from Mogok, Myanmar ($\delta^{18}$OVSMOW =19.14±0.14‰, $\delta^{30}$SiNBS-28=−0.18±0.09‰, 2SD), for in situ O and Si isotope measurements by SIMS. And we performed O and Si isotope analyses of zircons from IBM Arc (6 granitic rocks and 1 gabbro, ~52 to 0.15 Ma) and ICZ (6 granitic rocks, 15.7 to 4.3 Ma) by SIMS. Typical spot-to-spot reproducibility (2SD) of SIMS measurements was ±0.25‰ for $\delta^{18}$O and ±0.3‰ for $\delta^{30}$Si, respectively. Part of isotope data have already reported in JpGU 2016 [8].

The zircon $\delta^{18}$O values of most IBM granitic rocks (4.9 to 5.2‰) are within the range of the mantle-like zircon value (5.3±0.6‰, [4,9]) with one exception of the Omachi Seamount sample (7.0‰). Zircons from IBM fore-arc gabbro have slightly low values (4.6‰). In contrast, zircons from ICZ tend to have elevated $\delta^{18}$O values (up to 6.4‰), indicating incorporation of accreted sediments in the Honshu Arc. The $\delta^{30}$Si values of all measured zircons (~0.4±0.3‰) are consistent with the kimberlite zircon within analytical uncertainty (~±0.3‰). The present results suggest that incorporation of sediments to produce elevated $d^{18}$O magmas effectively occurs by the arc-arc collision process but production of low $d^{30}$Si magma require further accumulation and incorporation of matured sediments.

References:
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