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Origin and evolution of Baekdusan (Changbaishan) magma as traced by U-Th geochronology and O-Hf isotope geochemistry of zircon from the Millennium Eruption

YOUN-JOONG JEONG[1*], ALBERT CHANG-SIK CHEONG[1]

[1]Division of Earth and Environmental Science, Korea Basic Science Institute, Chungbuk 363-883, Republic of Korea (*hero0123@kbsi.re.kr)

The silicic volcanism of Baekdusan (Romanized as Changbaishan or Baitoushan in China), located on the border between North Korea and China, was initiated in the Late Pleistocene and culminated in the 10th century with the tremendous "Millennium Eruption." The origin and evolutionary pathway of Baekdusan magmas remain uncertain despite the ample whole-rock geochemical and radiogenic isotope data that have been collected since the early 1980s. Here, we present in-situ isotope data of zircon in pumices ejected during the Millennium Eruption. Zircon grains were extracted from white-gray trachydacitic pumices embedded in lahar deposits located about 30 km to the north of Cheonji Lake atop the summit of Baekdusan. The zircon grains yield $\delta^{18}O$ values (3.69–5.03‰) consistently lower than the normal mantle range, indisputably indicating the involvement of low-$\delta^{18}O$ materials in the magma source. We interpret that these low values resulted from the digestion of meteoric-hydrothermally altered intracaldera rocks in the shallow magma chamber beneath Baekdusan just prior to the crystallization of the zircons, rather than from derivation from low-$\delta^{18}O$ sources deep in the mantle. The Hf isotopic composition and ^{238}U-^{230}Th age of the zircons will be analyzed using a laser ablation multi-collector inductively coupled plasma-mass spectrometer at the Korea Basic Science Institute. The combination of radiogenic and stable isotope tracers in precisely dated zircons would be particularly useful for delineating the evolution pattern of the Baekdusan magma.