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Versatile monazite: Resolving geological records and solving challenges in materials science

Carboniferous inherited grain and age zoning of monazite and xenotime from leucogranites in far-eastern Nepal: Constraints from electron probe microanalysis†

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Abstract

Chemical Th-U-total Pb isochron method (CHIME) of monazite and xenotime from three leucogranites in far-eastern Nepal revealed the presence of Carboniferous inherited grains of monazite and intense intrusion of leucogranites around 18–16 Ma in the High Himalaya. In garnet-bearing sillimanite-muscovite-biotite leucogranite, most monazite grains have inherited cores with the chemical dates of ~504–418 and ~342–272 Ma, which were overgrown by Early Miocene mantles and rims of 17.9 ± 1.5 Ma. Early Ordoviciain and Carboniferous ages are rarely found in the same euhedral-subhedral cores. In addition to the previously recognized Early Paleozoic magmatism, monazite cores with Carboniferous ages in Early Miocene leucogranites provide evidence for two periods of magmatism at the base of the High Himalaya prior to the Cenozoic Himalayan orogeny. In muscovite-biotite leucogranite, no inherited domains were observed in monazite and xenotime grains. They yielded the CHIME monazite and xenotime dates of 16.1 ± 2.0 and 19.8 ± 6.5 Ma, respectively. Monazite grains adjacent to xenotime have significantly lower concentrations of UO_2 and Y_2O_3 compared to those isolated from xenotime. These results imply that xenotime influences Y and U contents in monazite, reflecting local equilibrium system. In aplitic leucogranite, monazite grains yielded the mean of apparent chemical date of 18.0 ± 2.2 Ma. The CHIME monazite ages of ~18–16 Ma in three leucogranites reflect the timing of melt crystallization.

Keywords: Himalayan leucogranite, Carboniferous monazite, chemical age, xenotime, age zoning