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U-Pb geochronology and rare earth element characteristics of uraninite from peraluminous leucogranites, Sikkim Himalayas, India

TANYA SRIVASTAVA[1], NIGEL B W HARRIS[2] AND CATHERINE MOTTRAM[3]

[1]Department of Geology, Sikkim University, Gangtok, India
[2]School of Environment, Earth & Ecosystem Sciences, Open University, Milton, Keynes, UK
[3]University of Portsmouth, UK

Presenting Author: tanya.srivastava1711@gmail.com

The U-Pb chronology of peraluminous leucogranites from the Himalayas is largely based on monazite and zircon studies. Uraninite studies are relatively rare though this accessory phase has been reported from granites across the orogen. This contribution provides the first uraninite study from the Eastern Himalayas and is a preliminary study on how effective a chronometer uraninite provides and what determines its crystallization. A sample of peraluminous two-mica leucogranite (2mg) from the Sikkim Himalayas has been analyzed for U-Pb dating of uraninite; coexisting accessory minerals include zircon and monazite. U-Pb dating of uraninite, using laser ablation-inductively coupled plasma mass spectrometry (LA-ICP-MS), yielded the mean $^{206}Pb/^{238}U$ age of 16.13 ± 0.32 Ma and a concordia age of 15.73 ± 0.25 Ma. The U/Th ratio for these uraninites ranges from 22.59 to 63.45. The uraninite ages are indistinguishable, within error, from the monazite ages obtained from similar leucogranites of the Sikkim Himalayas which range from 14.23 ± 0.23 Ma to 15.44 ± 0.33 Ma.

The U abundance for the bulk rock of the uraninite-bearing leucogranite sample is 19.8 ppm, significantly greater than the mean value for other two-mica leucogranites from the Sikkim Himalaya (9.6 ppm). This suggests that uraninite crystallizes from the melt when the U abundance exceeds the value for saturation of uraninite in the melt at the prevailing temperature.

The chondrite-normalized REE plots for uraninite peak across the mid rare earth elements (MREE) except for Eu which shows a marked negative anomaly indicative of reducing conditions during crystallization. Overall REE abundances for uraninite are significantly lower than those of monazite, hence the fractionation of uraninite from a magma, facilitated by its extreme density, would have much less impact on REE in the melt than the fractionation of monazite but could result in the preferential depletion of MREE.