

ACTINIDES IN GEOLOGY, ENERGY, AND THE ENVIRONMENT†

Petrography and geochronology of the Pele Mountain quartz-pebble conglomerate uranium deposit, Elliot Lake District, Canada

LAURA BERGEN* AND MOSTAFA FAYEK

Department of Geological Sciences, University of Manitoba, 125 Dysart Road, R3T 2N2, Winnipeg, Manitoba, Canada

ABSTRACT

Uranium deposits older than about 2200 Ma are generally hosted within quartz-pebble conglomerates and are a source of economic uranium. The genesis of these deposits is controversial and genetic models include hydrothermal, detrital/placer, and modified placer. Petrography of the uranium mineralogy from the Pele Mountain quartz-pebble conglomerate uranium deposit of the Elliot Lake district, Canada, shows that the dominant uranium minerals are thorite [(Th,U)SiO₄] and brannerite [(U,Ca,Ce)(Ti,Fe)₂O₆]. Uranium-lead (U-Pb) and lead-lead (Pb-Pb) isotopic analyses of thorite, brannerite, and galena were obtained using secondary ion mass spectrometry. Thorite has U-Pb age of 2489 ± 24 in the quartzose conglomerate and 280 ± 67 Ma in the quartz arenite. Brannerite has a U-Pb age of 2403 ± 120 Ma. Thorite Pb-Pb ages range from 521 ± 19 to 248 ± 8 Ma in the arenite and from 2453 ± 12 to 935 ± 27 Ma in the conglomerate, whereas brannerite Pb-Pb ages are between 1335 ± 0.11 and 848 ± 13 Ma. Galena has a Pb-Pb age of 2659 ± 8 Ma, which likely represents the age of the source formation that produced detrital galena. The rounded texture and U-Pb age of the conglomerate thorite corresponds to the depositional age of the host conglomerate bed of the Matinenda Formation, suggesting a detrital origin. The young U-Pb age of the thorite in the arenite represents the age of a resetting event. The brannerite, which replaces rutile, has a U-Pb consistent with fluid events associated with the Blezardian or Penokean Orogenic events, and is likely of hydrothermal origin. Therefore, based on the textures and variable ages of the uranium and sulfide minerals, the Pele Mountain quartz-pebble conglomerate uranium deposit is interpreted to be a modified placer-type deposit.

Keywords: U-Pb geochronology, thorite, brannerite, galena, SIMS analysis, quartz-pebble conglomerate, uranium deposit, modified placer, Elliot Lake, Ontario