

U-Pb chronology and geochemistry of detrital monazites from major North American rivers

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The North American continent formed through collisions of Archean cratons which surrounded by Proterozoic orogenic belts, and the outermost parts are enclosed by Phanerozoic orogens. Detrital minerals in river sands have been eroded from basement rocks along rivers, and transported to the river mouth areas. Monazite, one of the robust minerals, is a light rare-earth element phosphate which can be precisely dated by the uranium-thorium-lead method. Monazite occurs as an igneous mineral in low-Ca peraluminous felsic rocks and as a metamorphic mineral in a wide range of metamorphic rocks. Previous monazite chronology and geochemistry revealed that detrital monazites from the African rivers recorded orogenic metamorphic events more accurately than detrital zircons (Itano et al., 2016). In this study, we extend the application of monazite chronology and geochemistry to large rivers of the North American continent in order to better understand orogenic metamorphic events in the continent. To constrain the timing and nature of major orogenic events that formed the continent, we analyzed U-Pb ages and geochemical compositions of 178 detrital monazite grains from the Mississippi (83 grains) and Mackenzie Rivers (95 grains). The U-Pb age distribution of detrital monazite from the Mackenzie River shows large four peaks at 0.15-0.2, 1.8-1.9, 2.0, 2.6 Ga and small peaks at 0.45 and 2.5 Ga. On the other hand, that from the Mississippi River shows large three peaks at 1.45, 1.7, 2.65 Ga and small peaks at 0.4, 1.1, 1.65, 1.85 Ga. Some of the monazite age peaks are not observed in the U-Pb age histograms of detrital zircons from the same rivers (Iizuka et al., 2005; Rino et al., 2004; 2008), suggesting that the age peaks reflect the timing of major metamorphic events. Comparison with geological events, 0.15-0.2 Ga peak of the Mackenzie River reflects contributions from the Cordilleran orogen (Gehrels et al., 2002). Other large peaks around 1.8-2.0 Ga of the Mackenzie River may reflect contributions from the Thelon, Wopmay and Trans-Hudson orogens. The largest peak for monazite from the Mississippi River is observed around 1.4 Ga. It may reflect contributions from anorogenic magmatism (Nyman et al., 1994) or early stage of the Grenville Orogeny (Windley, 1993). The second large peak around 1.7 Ga of the Mississippi River may reflect contributions from the Penoken, Trans-Hudson, and Yavapai-Mazatzal orogens.

Keywords: monazite, U-Pb geochronology, REE