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U–Pb chronology and geochemistry of detrital monazites from major African rivers

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The tectonics of the African continent indicate multiple and diachronous collisions of multiple continents within the Pan-African orogeny. The African continent itself was located in the central part of the Gondwana supercontinent. Thus, the timing of Pan-African orogeny is the key to understanding not only the development of the African continent but also the formation of the Gondwana supercontinent. We conducted U–Pb dating and trace element and rare earth element (REE) analyses of ca. 500 detrital monazite grains from the Nile, Niger, Congo, Zambezi and Orange Rivers. The detrital monazites from all but the Orange River yielded Pan-African ages. They defined age peaks at ~600 Ma for the Nile River, ~580 Ma for the Niger River, ~630, ~610 and ~550 Ma for the Congo River and ~500 Ma for the Zambezi River. These age peaks reflect the timing of the Pan-African Orogeny in each source terranes; however, they are 20–40 Myr younger than the age peaks of the detrital zircon from the same rivers [1]. Moreover, the geochemical compositions of the detrital monazites showed significant variations in REE, Th and U compositions. Compared with the geochemical data of monazite from metasedimentary rocks (e.g., [2], [3] and [4]) and our measured data for monazites from granitic rocks, these significant variations can be attributed to the elemental partitioning with co-genetic feldspar, garnet, zircon and rutile. Although the compositional data of monazite from various rock-types may not be adequate, these geochemical features can be linked to the petrogenesis, including igneous and metamorphic processes. Considering the geochemical features of detrital monazites and differences between the detrital monazite and zircon age peaks, we conclude that the Pan-African monazite ages essentially reflect metamorphic events in the source terranes, especially syn- to post-collisional events that resulted from syn-collisional crustal thickening and/or post-collisional crustal thinning and heating. In contrast, the detrital zircon ages record felsic magmatic events caused by the pre- to syn-collisional subduction of the oceanic plate during the early stages of orogeny.

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