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Zircon Hf isotopes and U-Pb geochronology of granitoids across the Chad Lineament: Evidence for a Neoproterozoic suture zone in the cental Sahara region

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A key structure of North-Central Africa is the Chad Lineament, an unexposed arcuate gravity anomaly within the continent crust of central Chad. The nature of the Chad Lineament is not fully understood, but it is likely that it represents a major suture zone between two different lithotectonic terranes. Zircon U-Pb geochronology and Hf isotopes from I- and A-type granitoids of the Lake Fitri Inlier and Guéra Massif of central Chad demonstrate that there are distinct periods of magmatism that correspond to a changing geodynamic regime from subduction to post-collision. The oldest rocks from the Guéra Massif (591.0 ± 3.7 Ma, 594.2 ± 2.5 Ma, 589.2 ± 3.5 Ma), to the east of the Chad Lineament, are collisional I-type granitoids and have enriched $\varepsilon_{Hf}(t)$ values ($\varepsilon_{Hf}(t)$ = +2.0 to -15.7). The post-collisional A-type granitoids are younger (569.8 ± 2.8 Ma, 562.4 ± 2.6 Ma, 560.6 ± 4.6 Ma, 558.0 ± 2.7 Ma) and have highly enriched $\varepsilon_{Hf}(t)$ values ($\varepsilon_{Hf}(t)$ = -5.0 to -28.9). Although there is isotopic overlap between the I- and A-type granitoids, it is likely that there was a magma source change from north to south that was mostly mantle wedge to one that was mostly continental crust. In contrast, the granitoids from the Lake Fitri Inlier, to the west of the Chad Lineament, are the youngest magmatic rocks (552.4 ± 3.8 Ma, 550.7 ± 4.3 Ma, 548.7 ± 4.1 Ma, 546.9 ± 6.2 Ma) in the region and have moderately depleted $\varepsilon_{Hf}(t)$ values ($\varepsilon_{Hf}(t)$ = +5.5 to -0.2). The positive $\varepsilon_{Hf}(t)$ values and younger model ages (T_{DM}^{C}= 1551-1148 Ma) of the Lake Fitri granitoids contrasts with the negative $\varepsilon_{Hf}(t)$ values and older model ages (T_{DM}^{C}= 3342-1403 Ma) of the granitoids from the Guéra Massif. Moreover, the inherited zircons reveal a similar distribution of Hf isotopic values and model ages as their host rocks suggesting the isotopic differences are intrinsic to their crustal domains and that the Chad Lineament is a suture zone that separates two isotopically distinct lithotectonic terranes that collided during the Late Ediacaran.