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The origin of Archean continental crust revealed by water and oxygen isotopes of TTGs in the Eastern Block, North China Craton

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Major advancements in understanding the formation and evolution of early continental crust have been made following the study on origin of tonalite–trondhjemite–granodiorite (TTG) rocks, which dominate in Earth's earliest-formed continental crust. The tectonic mode that produced Archean continental crust (plate tectonics or pre-plate tectonics) remains a topic of ongoing controversy. To differentiate plate tectonic subduction zone settings and pre-plate tectonic settings such as mantle plumes, zircon water content and oxygen isotope of TTG rocks can provide a good proxy for water content and oxygen isotope of TTG magma and primordial source materials, which is proved by comprehensive analyses. Zircons from ca. 2.5 Ga TTG gneisses in the Eastern Block (EB) of the North China Craton (NCC) show relatively low zircon water content (median 263 ppm) and yield high oxygen isotopes (median 6.22 ‰) associated with negative correlation between water content and oxygen isotopes, indicating that the source of TTG should be a hybridized hydrated mafic source derived largely from slightly hydrous low-$\delta^{18}O$ oceanic plateau and a minor component of high-$\delta^{18}O$ supracrustal materials. Such features are consistent with a combined two-stage mantle plume-sagduction model, where minor TTG (mantle-like $\delta^{18}O$, low H_2O) and voluminous TTG (relatively high $\delta^{18}O$, low H_2O) could be formed respectively in two stages at ca. 2.7 Ga and ca. 2.5 Ga in the EB of NCC. Through our study, Earth's earliest-formed Archean continents were suggested to be most likely originated from oceanic plateaus, which was formed by mantle plumes associated with sagduction, relative to the island arcs via oceanic subduction under a plate tectonics regime.

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