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# Sanukitoid granitoids as indicators of accretionary tectonics from the late Mesoarchean to the Archean-Proterozoic boundary

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Sanukitoids were identified in the 1980's as a distinct geochemical group of Archean granitic rocks consisting of diorites, quartz diorites, monzodiorites, quartz monzodiorites, granodiorites, and monzogranites as well as more alkaline varieties. They intruded into Meso- to Neoarchean granite-greenstone terrains as batholiths and stocks between 3.0 and 2.5 Ga, some tens of Ma after the latest stage of regional TTG magmatism.

Sanukitoid granitoids share several common characteristics in their element contents, such as a contradictory combination of high incompatibles (especially K, Ba, Sr, P, and LREE) and compatibles (Mg, Cr, and Ni) requiring both crustal input and mantle involvement in the petrogenesis. Observed crustal Hf, Nd, Pb, and Sr isotope signatures sustain the contribution of recycled continental crust. Sanukitoids are interpreted to be cogenetic and they are typically associated with coeval mafic enclaves and facies. In addition to the age difference and mode of occurrence, sanukitoids are distinguishable from TTGs mainly by their lower SiO2 content, higher K2O and MgO content, and higher incompatible element contents. Geochemical and isotopic characteristics of sanukitoids point to an enriched mantle source that has interacted with felsic material and indicate their formation in water-rich and oxidizing conditions typical to modern subduction environments. Sanukitoids were thought to be restricted exclusively to the Archean, but recently their Paleozoic equivalents, high Ba-Sr granites, have been recognized e.g. among the Caledonian granites in the Northern Highlands from Scotland.

Based on current geochronology, the sanukitoid magmatism was a temporally restricted and spatially progressive event signifying an emergence of a new geodynamic process. Sanukitoids appeared in the Archean rock record at around 3.0-2.87 Ga in the Pilbara (West Australia) and Amazonian (South America) cratons and continued to form progressively from craton to craton (western Yilgarn at 2.76 Ga; eastern Karelia at 2.74 Ga; western Karelia at 2.72 Ga; northern Superior at 2.70 Ga, southern Superior at 2.68 Ga, and eastern Yilgarn at 2.66 Ga) until the end of the Archean; the latest sanukitoids were formed between 2.6-2.5 Ga in South Africa and North China. In each area, the period of sanukitoid magmatism was very limited.

The sudden emergence of sanukitoid magmatism in the transition of Meso- to Neoarchean has invoked the debate of the onset of modern plate tectonics, since the enrichment of the subcontinental lithospheric mantle with incompatible elements requires recycling of crustal material into the mantle, which in turn is a process attributed to subduction. A suggested process for triggering sanukitoid magmatism is a slab breakoff that follows an attempted subduction of buoyant continental lithosphere during continental collision. Oceanic lithosphere detaches from, and hot asthenosphere upwells into the slab causing melting and metasomatism in the overriding mantle lithosphere. The slab breakoff hypothesis for sanukitoids is supported by numerical geodynamic modeling results suggesting a frequent occurrence of slab breakoff in the Archean. If this hypothesis was correct, then the sanukitoid intrusions could be used to trace the collisional accretionary history of Meso- to Neoarchean terrains.