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The Archean Dharwar craton, southern India: A wide time window to acretionary orogenesis, continental growth and assembly of micro-blocks

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The Dharwar craton (3.8-2.5 Ga) is a composite Archean protocontinent that exposes a large tilted section of continental crust offering wide time window for understanding the accretionary orogenesis, continental growth and cratonization through assembly of microblocks. This craton comprises most voluminous TTG-type gneisses, two generations of volcanic-sedimentary greenstone sequences, calc-alkaline (sanukitoids) to high-potassic plutons. U-Pb Zircon ages together with Nd isotope data reveal that major periods of continental growth occurred in successive stages during 3.4-3.2 Ga, 3.1-2.9 Ga, 2.7-2.62 and 2.56-2.52 Ga [1.2]. The distinct lithological associations, metamorphic records and ages of the basement rocks of the Dharwar craton reveal several microblocks (western block, central block, eastern block, Coorg and Nilgiri block) evolved independently with distinct accretionary histories and thermal records [3,4]. U-Pb zircon ages together with Nd isotope data of the TTG-greenstone volcanics in the western block suggest juvenile crustal formation during 3.8-2.7 Ga and two reworking events ca.3.1-3.0 and 2.62 Ga which are spatially linked to cratonization . In the central block the major phase of continental growth occurred during 3.23-3.0 Ga and 2.7-2.52 Ga with remnants of >3.3 Ga crust and reworking events and spatially linked thermal records ca. 3.2, 2.64 and 2.5 Ga. On the other hand the preserved crust in the eastern block accreted during 2.7-2.54 Ga that involved in a major reworking event ca.2.52 Ga. The Coorg block contain 3.5-3.2 Ga TTG gneisses and interlayred volcanic-sedimentary sequences with remnants of ca. 4.0 Ga crust which involved in granulite facies metamorphism prior to 2.5 Ga [4] whilst the preserved high pressure granulitic crust in Niligiri block accreted during 2.7-2.52 Ga [5]. In summary petrologic, geochronologic and Nd-Hf isotope data of the five micro-blocks show independent accretionary histories and pre-2.5 Ga thermal records. These micro-blocks appear to be amalgamated into cratonic framework at the end of Archean as all of them involved in a common granulitic thermal event ca. 2.5 Ga.

Petrologic, elemental and Nd-Hf data show a progressive change in crust accretion patterns from dominant TTG accretion during Paleo-to Mesoarchean to transitional TTG to sanukitoid magmatism during Neoarchean. On the other hand greenstone volcanism dominated by komatiite to high-Mg basalts during Paleoarchean whilst basalt-boninite-adakites during Neoarchean. These changes in elemental data of TTG, sanukitoids and potassic granites reveal a secular changes in composition of felsic crust (increase of MgO, CaO, K_2O, Ni,Cr, REE and other HFSE). Further, greenstone volcanics also show decrease of MgO, Ni, Cr with coupled increase of Al_2O_3 in from Paleoarchean to Neoarchean. Such changes imply evolving geodynamic processes from plume –dominate to arc dominated processes through time which in turn probably linked to decreasing thermal gradients.

The contrasted thermal records of the micro-blocks reflect their accretion age(s) and degree of involvement in a wide latest Archean hot orogen, which sets the capacity of these lithospheric segments to be impact by deformation and mantle fluxes. The tectonic setting of amalgamation of micro-blocks in the context of latest Archean hot orogeny is compatible with active plate margin processes having interacted with mantle instabilities (i.e., plumes?). The tectonic setting of pre-2.5 Ga thermal pulses is difficult to assess, but considering their systematic links with documented magmatic pulses, they may have been generated in contexts comparable that of end Archean hot orogeny [6].

[1] Jayananda et al. J. Asian Earth Sciences, 78: 18-38.

[2] Lancestor et al. Gondwana Res. 28: 1361-1372.

[3]] Santosh et al.   Gondwana Res. 27: 165-195.

[4]Jayananda et al. Precamb.Res., 268: 295-322

[4 [5] Peucat et al   Precam Res. 227: 4-29.

[6] Chardon et al Geochim. Geophys. Geosyst., 12: 1-24.