Decoding Early Earth Tectonics from Mesoarchaean Metamorphic P-T path of Evolution: New Evidence from Sargur Supracrustals in the Western Dharwar Craton, South India

A. Dasgupta[1], S.K.Bhowmik[1], S. Dasgupta[2], T. R. Ireland[3], J. Avila[3]

[1] Department of Geology & Geophysics, Indian Institute of Technology, Kharagpur 721 302, India

[2] Department of Earth Sciences, Indian Institute of Science Education & Research- Kolkata, Mohanpur-741246, India

[3] Research School of Earth Sciences, Australian National University, Canberra ACT 0200, Australia

Natural rock data and thermo-mechanical model predictions seem to indicate a tectonic transition in planet earth from "pre-subduction" vertical tectonics to "modern subduction" regime of horizontal plate motions between 3.2 and 2.8 Ga. Mesoarchaean metamorphic rocks are, therefore, ideally suited to decipher the early earth tectonic transition. Despite their importance, Mesoarchaean metamorphic history is rather meagre in the rock record due to overprints of younger tectonothermal events that mostly obliterate their early history.

In the Western Dharwar Craton (WDC), ca. 3.3-3.1 Ga Sargur supracrustals in the Holenarsipur greenstone belt (HGB) were intruded by c. 3.2-3.1 Ga felsic plutons. While this makes the middle-amphibolite facies metasediments of the HGB as ideal materials to deduce the Mesoarchaean plate tectonic framework of the Dharwar craton, published garnet Sm-Nd and U-Pb zircon ages reveal a pervasive latest Neoarchaean-earliest Palaeoproterozoic regional metamorphism in the WDC.

In this study, we apply an integrated metamorphic and coupled monazite electron microprobe and sensitive high-resolution ion microprobe U-Pb dating techniques to high-alumina pelitic schist samples from the terrane. Despite overprints of a ca. 2.49 Ga continental collision event, we establish for the first time a Mesoarchaean metamorphism (T_{Max} ~ 640 ^{o}C at ~7.5 kbar between 3.14 and 3.1 Ga), along a hairpin clockwise P-T path in the WDC. We interpret the Mesoarchaean metamorphism in the Holenarsipur greenstone belt as part of a widespread tectono-thermal event that led to the cratonization of the Western Dharwar Craton by c. 3.1-3.0 Ga.