Zircon trace element chemistry as a function of metamorphic grade along a traverse of lower Archean crust, Shevaroy Block, southern India

DANIEL E. HARLOV[1], DANIEL J. DUNKLEY[2], EDWARD HANSEN[3] AND C. ISHWAR-KUMAR[4]

[1]GeoForschungsZentrum, Telegrafenberg, 14473 Potsdam, Germany (dharlov@gfz-potsdam.de)

[2]Department of Applied Geology, Curtin University, Perth, Western Australia 6845, Australia

[3]Department of Geology, Hope College, Holland, Michigan 49422, USA

[4]Centre for Earth Sciences, Indian Institute of Science, Bangalore 56012, India

Trends in whole-rock and mineral chemistry are seen along a north-south 95 km traverse of late Archean tonalitic-granodioritic lower crust, Shevaroy Block, Eastern Dharwar craton, southern India (Hansen and Harlov, 2007, J Petrol, 48, 1641-1680). SIMS analysis of zircon (Zrn) from 29 samples reveals domains of magmatic zoning, mostly with ca. 2550 Ma ages, recording the emplacement of granitoid protoliths. Magmatic Zrn was modified during metamorphism in two distinct stages: replacement and overgrowth by variably U-Hf enriched, slightly Th-Y-HREE depleted Zrn (Type (i)), followed by replacement and overgrowth by U-Th-Y-HREE depleted Zrn (Type (ii)). Type (i) Zrn is dominant in the amphibolite-facies gneisses and formed at ca. 2540-30 Ma, predating retrograde titanite growth at ca. 2500 Ma. Type (ii) Zrn appears near the Opx-in isograd and increasingly consumes protolith Zrn with increasing metamorphic grade. Type (ii) ages spread from 2530 to 2500 Ma. With increasing metamorphic grade southwards, whole-rock compositions become decoupled from magmatic protolith Zrn, and in correspondence with U-Th-Y-HREE depleted Type (ii) Zrn demonstrate open system chemical depletion during 2530-2500 Ma metamorphism event. In contrast, Type (i) Zrn records an earlier stage of metamorphism, probably associated with anatexis, that does not involve significant bulk depletion. Mineralogical and whole-rock compositional changes can be accounted for by progressive dehydration and oxidation reactions. Although in situ anatexis and melt extraction could play a role, whole rock and Zrn trace element depletion data can also be explained by the action of externally-derived low-H_2O activity brines migrating up through the lower crust during orogenesis similar to that described by (Newton and Manning, 2010, Geofluids, 10, 58-72).