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Relative Chronology in High-Grade Crystalline Terrain of the Eastern Ghats, India: New Insights

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ABSTRACT

The two major lithology or gneiss components in the polycyclic granulite terrain of the Eastern Ghats, India, are the supracrustal rocks, commonly described as khondalites, and the charnockite-gneiss. Northern Eastern Ghats belt, north of the Godavari rift has been defined as the Eastern Ghats Province, while that to the south has been defined as the Ongole domain; and although, these distinct crustal domains also record different ages of granulite metamorphism, both of these domains are dominated by the two lithologies. Many of the workers considered the khondalites as the oldest component with unknown basement and the charnockite- protoliths as intrusive into the khondalites. However, published geochronological data do not corroborate the aforesaid relations. Onset of khondalite sedimentation in the Proterozoic Eastern Ghats Province, constrained by detrital zircon data, as around 1.3 Ga and the charnockite-protolith emplacement between 1.9 and 2.9 Ga, argue against intrusion of felsic magma (tonalite, now enderbite!) in to the khondalites. The field relations of the hornblende-mafic granulite with the two gneiss components together with Sm-Nd isotopic data of the hornblende-mafic granulites (both the xenoliths within charnockites and those interbanded with the khondalites) indicate that khondalite sediments were deposited on older mafic crustal rocks. Mafic basement and supracrustal rocks were subsequently deformed and metamorphosed together during collisional orogeny at high to ultra-high temperatures – partial melting of mafic rocks producing the charnockitic melt; and partial melting of pelitic sediments producing the peraluminous granitoids. This is compatible with all the geochronological data as well as the petrogenetic model of partial melting for the charnockitic rocks in the Eastern Ghats Belt. The Ongole domain, south of the Godavari rift, though, is distinct in terms of the age of first/ earliest UHT metamorphism, but here too the charnockite-protoliths are older mafic rocks evidently not intrusive in to the khondalites.

KEYWORDS

Hornblende-Mafic Granulite, Xenolith, Interbanded, Mafic Basement, Partial Melting.

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References

[1] J. Rey and S. Galotti (Eds.) "Stratigraphy: Terminology and Practice," Editions Technip, Paris, 2008.

[2] S. Bhattacharya, S. K. Sen and A. Acharyya, "The Structural Setting of the Chilka Lake Granulite-Migmatite- Anorthosite Suite with Emphasis on the Time Relation of Charnockites," Precambrian Research, Vol. 66, No. 1-4, 1994, pp. 393-409. doi:10.1016/0301-9268(94)90060-4

[3] S. Bhattacharya, "Eastern Ghats Granulite Terrain: An Overview," Journal of Southeast Asian Earth Science, Vol. 14, No. 3-4, 1996, pp. 165-174. doi:10.1016/S0743-9547(96)00055-4

[4] S. Bhattacharya, "Evolution of Eastern Ghats Granulite Belt of India in a Compressional Tectonic Regime and Juxtaposition against the Iron Ore Craton of Singhbhum by Oblique Collision—Transpression," Journal of Earth System Science, Vol. 106, No. 3, 1997, pp. 65-75.

[5] S. Dasgupta, S. Sanyal, P. Sengupta and M. Fukuoka, "Petrology of Granulites from Anakapalle-

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Evidence for Proterozoic Decompression in the Eastern Ghats, India," Journal of Petrology, Vol. 35, 1994, pp. 433-459.

[6] S. K. Sen, S. Bhattacharya and A. Acharyya, "A Multi-Stage Pressure-Temperature Record in the Chilka Lake Granulites: The Epitome of the Metamorphic Evolution of the Eastern Ghats, India?" Journal of Metamorphic Geology, Vol. 13, No. 2, 1995, pp. 287-298. doi:10.1111/j.1525-1314.1995.tb00219.x

[7] S. K. Sen and S. Bhattacharya, "Dehydration Melting of Micas in the Chilka Lake Khondalites: The Link between the Metapelites and Granitoids," Proceedings of the Indian Academy of Sciences (Earth & Planetary Science), Vol. 106, 1997, pp. 277-297.

[8] S. Bhattacharya and R. Kar, "High-Temperature Dehydration Melting and Decompressive P-T Path in a Granulite Complex from the Eastern Ghats, India," Contributions to Mineralogy and Petrology, Vol. 143, No. 2, 2002, pp. 175-191. doi:10.1007/s00410-001-0341-6

[9] R. Kar, S. Bhattacharya and J. W. Sheraton, "Hornblende Dehydration Melting in Mafic Rocks and the Link between Massif-Type Charnockite and Associated Granulites, Eastern Ghats Granulite Belt, India," Contributions to Mineralogy and Petrology, Vol. 145, No. 6, 2003, pp. 707-729. doi:10.1007/s00410-003-0468-8

[10] K. Rickers, K. Mezger and M. M. Raith, "Evolution of the Continental Crust in the Proterozoic Eastern Ghats Belt, India and New Constraints for Rodinia Reconstruction: Implications from Sm-Nd, Rb-Sr and Pb-Pb Isotopes," Precambrian Research, Vol. 112, No. 3-4, 2001, pp. 183-210. doi:10.1016/S0301-9268(01)00146-2

[11] C. J. Dobmeier and M. M. Raith, "Crustal Architecture and Evolution of the Eastern Ghats Belt and Adjacent Regions of India," Geological Society Special Publication, Vol. 206, 2003, pp. 145-168.

[12] P. Sengupta, S. Dasgupta, P. K. Bhattacharya, M. Fukuoka, S. Chakraborti and S. Bhowmmik, "Petrotectonic Imprints in the Sapphirine Granulites from Anantagiri, Eastern Ghats Mobile Belt, India," Journal of. Petrology, Vol. 31, 1990, pp. 971-996.

[13] A. Mohan, P. Tripathi and Y. Motoyoshi, "Reaction History of Sapphirine Granulites and a Decompressional P-T Path in a Granulite Complex from the Eastern Ghats," Proceedings of the Indian Academy of Sciences (Earth & Planetary Science), Vol. 106, 1997, pp. 115-129.

[14] S. R. Bohlen, "Pressure-Temperature-Time Paths and Tectonic Model for the Evolution of Granulites," Journal of Geology, Vol. 95, No. 5, 1987, pp. 617-632. doi:10.1086/629159

[15] S. Bhattacharya, P. Das, A. K. Chaudhary and A. K. Saw, "Mafic Granulite Xenoliths in the Eastern Ghats Grannulite Belt: Implications for Lower Crustal Processes in the Southeastern Peninsular India," Journal of the Geological Society of India, Vol. 80, 2010, pp. 55-69.

[16] A. B. Thompson, "Clockwise P-T Paths for Crustal Melting and H2O Recycling in Granite Source Regions and Migmatite Terrains," Lithos, Vol. 56, No. 1, 2001, pp. 33- 45. doi:10.1016/S0024-4937(00)00058-X

[17] R. Simmat and M. M. Raith "U-Th-Pb Monazite Geochronometry of the Eastern Ghats Belt, India: Timing and Spatial Disposition of Poly-Metamorphism," Precambrian Research, Vol. 162, No. 1-2, 2008, pp. 16-39. doi:10.1016/j.precamres.2007.07.016

[18] D. Mukhopadhyay and K. Basak, "The Eastern Ghats Belt—A Polycyclic Granulite Terrain," Journal of the Geological Society of India, Vol. 73, No. 4, 2009, pp. 489-518. doi:10.1007/s12594-009-0034-8

[19] P. Richard, N. Shimizu and C. J. Allegre, "143Nd/144Nd a Natural Tracer: An Application to Oceanic Basalts," Earth and Planetary Science Letters, Vol. 31, No. 2, 1976, pp. 269-278. doi:10.1016/0012-821X(76)90219-3

[20] D. J. DePaulo, "Neodynium Isotopes in the Colorado Front Range and Crust-Mantle Evolution in the Proterozoic," Nature, Vol. 291, 1981, pp. 193-196. doi:10.1038/291193a0

[21] S. Bhattacharya, "Dehydration Melting in Mafic Rocks in the Eastern Ghats Belt, India: Implications for Variable Composition of Charnockitic Melt and Heterogeneity of Source Rocks," Geological Society of India Memoir, Vol. 52, 2003, pp. 131-144.

[22] S. Bhattacharya, A. K. Chaudhary, A. K. Saw and P. Das, "Mafic Granulite Xenoliths from the East Indian Shield: Evidence for Recycled Continental Crust in the Archean Mantle," Lithosphere, Vol. 3, 2011, pp. 155-169. doi:10.1130/L120.1

[23] C. Dobmeier and M. Raith, "On the Origin of "Arrested" Charnockitization in the Chilka Lake Area, Eastern Ghats Belt, India: A Reappraisal," Geological Magazine, Vol. 137, No. 1, 2000, pp. 27- 37. doi:10.1017/S0016756800003472

[24] M. V. Subba Rao and V. Divakara Rao, "Chemical Constraints on the Origin of the Charnockites in the Eastern Ghats Mobile Belt, India," Chemical Geology, Vol. 69, No. 1-2, 1988, pp. 37-48. doi:10.1016/0009-2541(88)90156-8

[25] K. Mezger and M. Cosca, "The Thermal History of the Eastern Ghats Belt (India), as Revealed by U-Pb and 40Ar/39Ar Dating of Metamorphic and Magmatic Minerals: Implications for the SWEAT Correlation," Precambrian Research, Vol. 94, No. 3-4, 1999, pp. 251-271. doi:10.1016/S0301-9268(98)00118-1

[26] U. K. Bhui, P. Sengupta and P. Sengupta, "Phase Relations in Mafic Dykes and Their Host Rocks from Kondapalle, Andhra Pradesh, India: Implications for the Time- Depth Trajectory of the Palaeoproterozoic (Late Achaean?) Granulites from Southern Eastern Ghats Belt," Precambrian Research, Vol. 156, No. 3-4, 2007, pp. 153- 174. doi:10.1016/j.precamres.2007.03.005

[27] V. P. Kovach, R. Simmat, K. Rickers, N. G. Berezhnaya, E. B. Salnikova, C. Dobmeier, M. Raith, S. Z. Yakovleva and A. B. Kotov, "The Western Charnockite Zone of the Eastern Ghats Belt, Indian Independent Crustal Province of Late Archean (2.8 Ga) and Paleoproterozoic (1.7 - 1.6 Ga) Terrains," Gondwana Research, Vol. 4, No. 4, 2001, pp. 666-667. doi:10.1016/S1342-937X(05)70462-7

[28] D. Upadhyay, A. Gerdes and M. M. Raith, "Unraveling Sedimentary Provenance and Techtonothermal History of High-Temperature Metapelites, Using Zircon and Monazite Chemistry: A Case Study from the Eastern Ghats Belt, India," Journal of Geology, Vol. 117, 2009, pp. 665-683. doi:10.1086/606036

[29] R. Kar and S. Bhattacharya, "New Experimental Constraints: Implications for the Petrogenesis of Charnockite of Dioritic Composition," Natural Science, Vol. 2, 2010, pp. 1085-1089. doi:10.4236/ns.2010.210135

[30] S. Bhattacharya, R. Kar, W. Teixeira and M. Basei, "High-Temperature Crustal Anatexis in a Clockwise P-T Path: Isotopic Evidence from a Granulite-Granitoid Suite in the Eastern Ghats Belt, India," Journal of Geological Society, Vol. 160, No. 1, 2003, pp. 39-46. doi:10.1144/0016-764902-063

[31] P. Sengupta, J. Sen, S. Dasgupta, M. Raith, U. K. Bhui and J. Ehl, "Ultrahigh Temperature Metamorphism of Metapelitic Granulites from Kondapalle, Eastern Ghats Belt: Implications for the Indo-Antarctic Correlation," Journal of Petrology, Vol. 40, 1999, pp. 1065-1087. doi:10.1093/petrology/40.7.1065

[32] S. Neogi, S. Dasgupta, P. Sengupta and N. Das, "Ultrahigh Temperature Decompression in a Suite of Grannulites from the Eastern Ghats Belt-Bastar Craton Contact and Its Significance," Memoir Gondwana Research Group, Vol. 5, 1999, pp. 115-138.

[33] S. Dasgupta, P. Sengupta, M. Fukuoka and S. Chakraborti, "Dehydration Melting, Fluid Buffering and Decompressional P-T Path in a Granulite Complex from the Eastern Ghats, India," Journal of Metamorphic Geology, Vol. 10, No. 6, 1992, pp. 777-788. doi:10.1111/j.1525-1314.1992.tb00122.x

[34] A. K. Saw, "Structural Setting and Petrogenesis of the Granulite-Granite-Migmatite Suite of Sunki, Koraput District, Orissa, in the Eastern Ghats Granulite Belt," Ph.D. Dissertation, Calcutta University, Kolkata , 2007

[35] S. Gupta, A. Bhattacharya, M. Raith and J. K. Nanda, "Contrasting Pressure-Temperature-Deformation History across a Vestigal Craton-Mobile Belt Boundary: The We- stern Margin of the Eastern Ghats Belt at Deobhog, India," Journal of Metamorphic Geology, Vol. 18, 2000, pp. 683-697. doi:10.1046/j.1525-1314.2000.00288.x

[36] M. Ramakrishnan, J. K. Nanda and P. F. Augustine, "Geological Evolution of the Proterozoic Eastern Ghats Mobile Belt," Geological Survey of India, Vol. 44, 1998, pp. 1-21.