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BOOK REVIEW

GEOLOGY AND EVOLUTION OF THE INDIAN PLATE (from Hadean to Holocene - 4Ga to 4 Ka) by S M. Naqvi. Capital Publishing Company, New Dehi-Kolkata-Bangalore, 2005, 496p. Price: Rs.1250, $55.50.

This publication stands out for the vast data base contained in the several well drawn-up regional and continental scale geological maps, stratigraphic, geochemical, geochronological and geophysical data that have been carefully distilled from a very vast volume of literature It fills the much felt need for a comprehensive account of the geology of the Indian Plate as a whole bound by geological rather than political boundaries The book presents a synthesis of several major contributions that provide insights into the evolution of both the continental and oceanic segments of the Indian plate Almost every alternate page of the book has very well drawn illustrations, well-summarized tables or attractive plates, making up for the designed brevity inevitable in covering a very vast area of earth science in just 450 pages The text endeavours to emphasise or is even partial to the more recent advances in earth sciences relating to the Indian Plate and references abound largely in the period 1990 to 2005 More than 300 references are in the time span of 2000 to 2005 The book thereby places the reader at the frontier areas of scientific development in this field today This is a challenging task, accomplished with a fair degree of success, considering the wide diversity of scientific approaches in modelling crustal evolution generating data of wide variability in their meaning and resolution Further, the world-wide interest that is being evinced on the Indian plate since the last half-century necessitates any reviewer to voyage through a multitude of small and big streams of knowledge that empty into the panoramic scenario of the complex evolution of the earth's crust and mantle The author and the publishers deserve to be congratulated on bringing out an up-to-date more or less comprehensive publication with such speed

Twenty-two chapters comprise the main text The geological fabric of the Indian plate is described in a temporal rather than spatial sequence This approach, while it breaks spatial connectivity, brings out the episodes of evolution and overprinting of events more prominently Chapter 1 defines the spatial dimensions of the Indian plate, its broad stratigraphic framework and some select geophysical features Chapters 2 to 9 address aspects of continental evolution and the remaining chapters the oceanic segments of the Indian plate The former traces the evolution of the continent from Hadean to the Neoproterozoic The Sri Lanka and Madagascar linkages with the Indian continent are highlighted in chapter 10 The Gondwana assembly and sedimentation are addressed in Chapter 11 and the late Mesozoic continental basalt events (Rajmahal and Deccan) and mass extinction in chapter 12 Late Mesozoic peri-cratonic sedimentary basins are described in chapter 13 The geology and evolution of the Himalaya are addressed in great depth in the four succeeding chapters (14 to17), successively dealing stratigraphy, models of collision and accretion, impact of collision and the history of sedimentation The text then passes on to the Oceanic segments in the Indian Ocean (chapter 18), Kerguelen hot-spot (chapter 19), Reunion hotspot (chapter 20), and Mid-oceanic ridges (chapter 21) The last chapter (chapter 22) deals with the Rodriquez Triple Junction

and the Eastern, Western and Central Indian Oceans and finally the seismicity of the Indian plate

An effort is made below to highlight the contents of the several chapters Some aspects as the appropriateness of grouping formations, some of the omissions in citations that this reviewer considers as important and possible options in modeling evolution are critically cited

The Archaean formations of the continental segments portray a low level of preservation of the Hadean, Paleo-Archaean and Meso-Archaean crust The presence of protoliths of Palaeo- and Meso-Archaean crust in the Dharwar, the Bastar, Singhbhum and Bundelkhand cratons and segments of the Aravalli Mountains stand out The author raises the query whether the poor preservation of the most ancient formations may not be due to their recycling and return as mantle plumes? However, overprinting by Proterozoic events leading to erasing of earlier signatures is not ruled out The poor presence of Paleoproterozoic orogenic activity in the Dharwar and that of Neoarchaean in the Singhbhum, Aravalli and other cratons is emphasized It is difficult to agree to the total absence of Neoarchaean in especially the Singhbhum craton as the Iron-Ore Group (IOG) of Singhbhum, placed by the author in the Meso-Archaean on the basis of a radiometric date of an intrusive tongue of a granite with a large error band, has many characteristics that it shares with the Neo-Archaean formations, for example, of those of the Dharwar craton, many authors have suggested more than one generation of Iron Formations in this region The Badampahar-Gorumahisani iron ores are placed in the Paleo-Archaean and the IOG may be Neo-Archaean

The Singhbhum mobile belt and the Aravalli are placed in the Palaeoproterozoic bridged by the Central Indian formations of Mahakoshal, Kotri-Dongargarh, Sakoli, Sausar, Bijawar and Gwalior groups and dissected by the Central Indian Suture zone, the region being subjected to Plate-Plume –accretion tectonics The Eastern Ghat Mobile belt (EGMB) and the co-spatial Nellore Greenstone belt are described in a separate chapter under the Meso-and Neoproterozoic (chapter 5) The Southern Granulite Terrain is described under a separate chapter on Palaeo and Mesoproterozoic (chapter 6) The Delhi supergroup is the subject of a separate chapter (chapter 7) under Meso-Neoproterozoic rocks The Chotanagpur Gneissic complex (CGC) of Eastern Indian shield is dealt with in a separate chapter on Proterozoic rocks along with some Himalayan formations While the stratigraphic records in each of the areas are well summarized, the grouping seems to ignore the widespread Neoproterozoic overprinting in the Madurai and Kerala blocks of the SGT, the Neoproterozoic anorthositic and granitic emplacements in the EGMB in its northern sector and the low data base of radiometric ages in the CGC The impact of the Pan-African thermal event in the SGT and the EGMB possibly needs a greater emphasis In fact episodes of formation of charnockitic rocks as a result of the Pan-African thermal event has been proposed in several recent publications The Himalayan formations of Lesser Himalaya, the Salkhala, Chail, Dalings and their equivalents in table 8 4a have very little in common with the Chotanagpur Gneissic Complex and the succeeding Blaini-Krol-Tal are better correlatable with the Vindhyans as is brought out in the table 8 4b on page 103 It may have been more appropriate to refer to the latter in the succeeding chapter of Proterozoic sedimentary basins, wherein the Cuddapah-Kurnool, Chattisgarh, Vindhyan and other basins are described The Malani plutono-volcanic suite, the Newania carbonatites and kimberlites are dealt with in the chapter on Proterozoic sedimentary basins Such a grouping possibly arises from the fact that the time of emplacement of these magmatic rocks spans the evolutionary time span of the Vindhyans Proterozoic platformal sedimentation of the Cuddapah and the Vindhyans has overlapped with orogenic phases of development of the EGMB and with the Aravalli-Delhi orogenic belts The development of the Vindhyan and Cuddapah basins may have been related to processes of evolution of the cratonic regions and the Malani Igneous suite or the dyke swarms of the Dharwar craton may be the magmatic emplacement along deep tensional fractures It may be more appropriate to describe these rocks in chapter 7 as a part of the culminating phase of the Neoproterozoic evolution of the Delhi Group

Chapter 10 on Sri Lanka-Madagascar connection with the Indian plate brings to focus the various reconstructions of the Neoproterozoic super continent Chapter 11 on Gondwana, including the Rajmahal basin presents a comprehensive account of the geology and development of the unique basins evolved through relatively slow distension (290 to 110 My time band) and their possible linkages with plumes /hot spots This reviewer would have liked to see a reference to the work of Veevers and Tewari, 1995 (Mem Geol Soc Amer , 187), a classic effort towards lithostratigraphic correlation of the Gondwana supergroup of the Indian segment of the Pangea A reference to recent advances is the use of ichnofossils that help to infer environment may have rendered the text more complete

Chapter 12 on the Deccan and Rajmahal continental basalt volcanism synthesizes the petrology and geochemistry of Deccan trap flows in the Western Ghats, the extensions into the Narmada –Son region in the east and the distinctive

alkaline phases in Kutch. The Lonar impact crater is described The Rajmahal Continental Basalt Province is distinguished Linkage with the K/T boundary mass extinction is alluded to

Chapter 13 presents a detailed account of the Jurassic-Cretaceous formations of the Kaveri basin, Krishna – Godavari basin, the Cretaceous basins of the West Coast, and Meso-Cenozoic basins of Rajasthan.

The book now passes on to the four chapters on the Himalaya In chapter 14, evolution of the Himalaya is viewed as a continuum wherein "Satpura mountains Orogeny migrated through Purana Sea ,Proto-Tethys, Palaeo-Tethys and Tethys towards north and that from Mesoproterozoic onwards an open sea existed along the northern margin of India and possibly Rodinia and Gondwana supercontinents" Such a fertile view while emphasising the several layers of memory stored in the Himalayan region, does not focus on the episodic nature of events, some of which have been non-orogenic as for example the rift-controlled Gondwana sedimentation and volcanism It may be difficult to sustain a totally orogenic continuity in such a vast span of time The episodic nature is brought out while presenting the broader aspects of Palaeozoic, Mesozoic and Cenozoic stratigraphy in this chapter Some of the recent data on geochronology, radiometric dates, P-T-t paths of exhumation, high pressure and inverted sequences of metamorphism and models of geodynamic evolution of the Himalaya and tomographic model of crustal structure based on seismic tomography are outlined The next chapter on models of collision and accretion focuses on the characteristics of the ophiolite belts in the Indus-Tsangpo suture zone (ITSZ), the Spongtang ophiolites, the Ladakh-Zanskar-Nanga Parbat-Harmosh Massifs of western Himalaya, formations of the Western Syntaxis and some of the recent advances in Karakoram and Lessei Himalayan Geology It may have been desirable to include in this chapter a summary of the various models of tectonic evolution such as the steady state and evolutionary models, to which the text alludes in later sections, though it is being established by geophysical and micro-earthquake studies that these models may not be applicable to the whole of the Himalaya The next chapter on impact of collision outlines the recent researches into the trans-ITS belt—the Bela-Khuzdar region and the Kohistan Arc on the west, Ladakh-Karakoranm region on the east and formations of the ITS in the west and south of Tibet that have a similarity to Andean type of plate margin, the ITS in Eastern Himalaya, emphasizing the geochemistry of the rock suites The chapter also addresses the geochemistry of the Permian rift-related "continental flood basalt" volcanic rocks of the Pir Panjal and their extensions into Zanskar and Spiti and the Precambrian metavolcanic rocks of Higher and the Lesser Himalaya The history of the Himalayan sedimentation presents an updated account of the dominant Proterozoic and Palaeozoic sedimentary formations of the Lesser and Higher Himalaya, formations, the Precambrian to Jurassic succession of Kashmir basin, and the Precambrian to Eocene succession in the Zanskar basin, the Precambrian to Cretaceous strata of Spiti , the Proterozoic-Phanerozoic succession in the Tethys Himalayan Tectogen (NE of Panjal-Jutogh-thrust) , the lithostratigraphic successions in the Eastern Himalaya and the eastern syntaxial bend and the Indo-Burmese Andaman Arc The Abhor volcanics and the Naga Hills and Andaman Ophiolites and their geochemistry find special mention The concluding sections of this chapter deal with the Indus, Ganges and Brahmaputra foreland basins and the Thar Desert The East Coast deltas of the Godavari, Krishna and the Cauvery are described in this chapter

Of the oceanic segments of the Indian plate, the Indian ocean, characterized by the "most complicated tectonic history ", the Kerguelen hot-spot , the Reunion hotspot , the Mid-Ocean Ridges are sequentially described, the major emphasis in these chapters being on the characteristic geochemistry of the volcanic manifestations of these hot spots and their mantle chemistry The last chapter describes the Roderquez Triple Junction and the Eastern, Western and the Central Indian Ocean An interesting digression is the analysis of some of the current models of Australian Gondwana from Permian through the Cretaceous, that has relevance to understanding what has been now seen as the Indo-Australian plate Geology and seismicity of the Andaman –Sunda region receives pointed attention, possibly dictated by concerns of the seismicity of highest order comparable with the greatest seismic belts of the world

The publication, viewed as an up-date on the geology and evolution of the Indian Plate based on the researches carried out in the last few decades, is indeed a magnificent contribution that will help every student of earth sciences to sit up and have a panoramic view of some of the great advances made in this area in recent times Notably, there is a more wholesome and indeed welcome integration between geology and geochemistry (as can be expected of a experienced geochemist) Geophysics is more seen in the background The index of three pages does not do full credit to the extensive coverage Some typographic errors do mar the text, a small price paid for a speedy publication These and some of the preferences of this reviewer regarding

presentation referred to earlier in this text should not in any way lessen the great value of this contribution. It is the only one on the Indian plate as a whole as we see it today. This reviewer has no doubt that this publication can brighten the shelves of any earth science library and will help to update teachers, researchers and students alike.

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PETROGRAPHIC ATLAS OF INDIAN COAL by Shibananda Sen Gupta and Banani Bardhan, Geological Survey of India, Catalogue Series No.7, 2005, 149 pp., Rs.384; £13; $ 21.50.

An appropriate title for this publication could have been – "An Atlas of Petrological Constituents of some Indian Lignites and Coals". The Atlas devotes 46 pages to History of Coal Science, Formation of Coal, Development of Petrographic Study, Petrography of Coal, Application of Coal Petrography, Acknowledgements, and 128 references. These are not relevant to the album of photomicrographs. Instead, a description of the lignite and coal fields of India would have supplemented the source of samples of lignite/coalfields included in this presentation. The names of the persons who collected the field-samples, and the ages of the coals included are absent.

Names of earlier workers like Acharyya, Banerjee, Bardhan, Chakrabarti, Chandra, Chatterjee, Ghosh, A., Ghosh, P.K., Laskar, T., Mishra, Mukherjee, Sanyal and Sen Gupta appear amongst Indian names on "Petrographic Atlas"; other contributors like Bharadwaj, Casshyap, Chaudhuri, Ghosh, T.K., Misra, B.K., Moitra, Navale, Pareek, Prakash Anand, Ramana Rao, Singh, A., B.D., M.P., R.M., Srivastava, Varma, amongst others, are left out.

Under "Photomicrographs" (pp. 47-149), 187 photos are included. These are classified under vitrinite/huminite (42) (separation line between the two is not delineated), inertinite (24), liptinite (74), mineral matter (14), microlithotype (8), and tectonics and thermal effects (18). The distribution of the photographs is not in equilibrium. Mineral matter in coal and associated with coal is not included, fluorescing mineral matter is not incorporated, descriptions of the micro-constituents appearing in each of the photos is very very short, not explanatory and highly sketchy. Some of the identifications appear wrong and misleading. Many of the photomicrographs are dull, out-of-focus and lack sharpness.

The "Petrographic Atlas" does not mention of vitrinite oil reflectance in any of the photomicrographs, the corresponding microlithotype, and quantitative estimation of the macerals/group macerals/microlithotypes identified/recorded. Only 18 lignite/coal fields are included, which does not represent "Indian Coal". The ages of the coalfields are not mentioned anywhere.

The coalfields, included are Sohagpur (55), Makum (32), South Karanpura (21), Talchir (18), Panandhro (18), Tamil Nadu (9), Neyveli (8), Barmer (6), Palana (4), Arunachal Pradesh (5), Andaman (3) Raniganj (3) East Bokaro (2), Tatapani – Ramkola (2), Birbhum (2), Jharia (1), Bokaro (1), Sikkim (1), Microlithotypes – no sources. The size of the photos is too small for such a large-sized publication.

A proper pre-publication review by a competent coal petrologist would have eliminated many of the deficiencies noted. However, the authors are to be congratulated for putting in their best efforts to bring out this atlas.

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CORRIGENDUM

In the advertisement of Mangalore University (J.G.S.I., v.66 (4), 2005, p. 523), calling for research proposals in Marine Geology and Geophysics, the correct e-mail and Website addresses should read as follows: E-mail : ostcmgg@yahoo.co.in Website : www.ostcmu.ac.in