DISCUSSION

MIXED MARINE, BRACKISH WATER AND NON-MARINE MICROFAUNAL ASSOCIATION IN THE INTER-TRAPPEAN BEDS (EARLY PALAEOCENE) OF JHILMILI, CHHINDWARA DISTRICT, MADHYA PRADESH by S.C. Khosla, M.L. Nagori, S.R. Jakhar and A.S. Rathore. Jour. Geol. Soc. India, v.73, 2009, pp.724-732.

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comments:

The diagnostic planktic foraminifera *P. pseudobulloides* reported by Khosla et al. in Jhilmili intertrappeans (JIT), Chhindwara (M.P.), indicating a KTB in Central India, is a significant discovery. However, contrary to the authors' view, marine incursion from west coast through (active) Narmada rift-lineament in Early Paleocene is more plausible than from east coast through Godavari lineament, as given below.

Besides brackish water ostracods (*Neocyprideis, Buntonia*), many foraminifers (Globorotaliidae, Heterohelicidae) reported from Jhilmili (Keller et al. 2009 and references therein) had existed variously in west coast (Sastri, 1988) since Late Cretaceous; similar smaller foraminifera (with some variations) occur in well-studied marine KTB in Um Sohryngkew River, Meghalaya (Pande, 1978). *Turborotalia* (including subgenus *Subbotina*) *pseudobulloides–T. inconstans–T. praecursoria* (=*Globigerina uncinata*) assemblages, abundant *Hedbergella bornholmensis* (vis-à-vis authors' *H.* sp. cf. *holmdelensis*), *Heterohelix* spp., *Neocyprideis vandenboldi*, *Neocytherideis*, *Paracypris*, *Buntonia/Protobuntonia*, *Miocyprideis* and other cytheracea (with Madagascarian/ African affinities) and non-marine cypridacea ostracods had been reported from: subsurface occurrences (of Cambay Basin; Jura Dome, Kutch; Jaisalmer, Rajasthan); Badia and Pipaldehla (~8 km E of Jhabua) of Bagh Group (Sastri, 1988; Nayak, 2004 and references in them; Keller et al. 2008), which are minor variants vis-à-vis those of authors'.

Reported pre-/syn-Deccan intermittent marine conditions, namely: (a) remains of coastal flora and variously occurring *Igdabatis* and *Lepisosteus* (fishes) in inter-trappeans of Mandsaur-Khandwa-Kisalpuri (Dindori) tract, (b) abundant phytoplanktons *Deflandrea*, *Dinogymnium*, *Gonyaulacysta*, *Palmidites*, *Proxapertites* in Lameta type area (Jabalpur) and (c) mangrove, coastal, arborescent palynoforms in Mohgaon Kalan, could be ascribed to following reasons:

The Narmada rift-lineament (including Tapti Fault in Central Indian Tectonic Zone, CITZ) is a 1300 km linear zone of deep crustal faults, magmatic underplating (Acharyya and Roy, 2000), domal uplift, N-S crustal extension, intra-plate rifting, and basalt eruption through ENE-WSW primary feeder dykes and sills (cf. Sen and Cohen, 1994; Bhattacharji et al. 1996), as evident from: tholeiites/MORBs, xenoliths of Bagh/Lameta sediments in flows, pillow lavas in Mandla-Kundam area emplaced from nearby craterlets, high heat flow and gravity, magnetotelluric and geochemical data. This fundamental, ancient fault zone has been episodically active from Paleoproterozoic onwards with resurgent tectonism (e.g. Quaternary vertical movement, intraplate seismicity, Khandwa Lineament). Thus, many ENE-WSW trending linear straits, formed by differential subsidence of basement floor during Deccan eruption, created dynamic accommodation space for sediments. Being open to west, active and nearer to concurrent sub-aqueous lava extrusions/intrusions and feeder dykes (e.g. 66.1±0.5, 65.5 ±0.6 Ma flow/dyke in Narmada, 62.5 Ma Manpur-Bagh basalts, Nisarpur dykes, pillow lavas at Bhimdongri, Chhindwara, Singori, Chargaon, Anjaniya; Solanki and Tiwari, 2005), they would be easily affected by Late Cretaceous rapid and frequent marine incursions (Badve and Ghare, 1977) from Cambay/triple junction side. Thus, an advancing sea from west involving much shorter distance (~450 km) from the earlier existent Bagh-Pipaldehla area to Jhilmili and beyond (upto Jabalpur/ Kisalpuri), due to gradually rising altitudes of lowest basalts from west (e.g. Buldana=410 m, Chikaldara=465 m, Nagpur-Chhindwara=540 m), appears more credible in view of altitudes of JIT(=580 m) and Rajahmundry intertrappeans (RIT=250 m).

In contrast, the relatively inactive Godavari lineament in Asifabad-Rajahmundry stretch is without: (a) *sensu stricto* riftogenic basalt outcrops (except domed basement, Mishra et al. 1989), (b) pillow lavas and (c) Tertiary sedimentation. Moreover, against the Deccan basalts flowing east from Kolhapur (eruptive source) and reaching Rajahmundry area through ancient Krishna or Godavari river-canyons (cf. Self et al. 2008 and references therein), any northwesterly marine incursion for relatively longer (800 km) distance (via

Rajahmundry-Asifabad-Daiwal-Takli-Pench course by negotiating Mailaram and Chinnur basement highs enroute) to deposit planktic foraminifera by storms, high tides (cf. Keller et al. 2009) may be unrealistic due to: (a) no previous (Cretaceous) undisputedly marine sedimentation in Godavari lineament and impracticality of hypothetical Jurassic seaway upto Kota, (b) terminal Cretaceous greenhouse eustatic sea-levels (straddling KTB) showing gradual low-amplitude short-term rises causing less extensive flooding of lands vis-à-vis abrupt and steep falls (e.g. 50 km sea-regression and 80 m fall) and (c) primarily terrestrial setting of emplacement for lower traps (P0/P1a) during low sea-levels and prior to emplacement of upper trap (P1a/P1b) in Rajahmundry correlating with global regressions (cf. Keller et al. 2008 and references therein).

Further data integration showed: (a) probable correlation of upper Pipardahi and lower Dhuma (˜Shahpura Fm.) flows in Jhilmili respectively with the neighboring 65.5±0.3 Ma Chakhla-Delakhari Sill (˜Desur Fm. of WDVP) at 900-975 m altitude (Srivastava and Ahmad, 2005) with (?)N-polarity (besides nearby younger 63.3 Ma Pachmari dykes) and lower (?)R-polarity 60-68 Ma Linga basalts (at 600 m altitude), (b) magnetic susceptibility/polarity of inter-trappeans of Jhiraghat, Lametaghat, Buti Bori, Takli, Kholdoda, Daiwal, Asifabad indicating C29R, whereas Dongargaon showing C30N, (c) the lower (65.0±1.1 Ma) and upper (64.5±0.3 Ma) traps of Rajahmundry as well as of Jhilmili indicating respectively C29R and C29R-C29N transition (65.030-64.750 Ma), when considered from: Deccan main eruption=65.4 to 65.1 Ma, Takli (Nagpur) flow-I=63.6±0.2 Ma ages, FAD of *P. pseudobulloides* 100-150 ky after KTB (65.580 Ma) indicating ~230-730 ky depositional time in overall transgressive scenario, the 330 m (i.e. altitudinal difference between JIT and RIT), 5-10 cm/ky sea-level rise, and 25 m fall and 5 km regression in 85-65 Ma and 125 m and 26 km regression in 65-45 Ma Phanerozoic durations following Pitman, 1978 (in Hallam, 1981, p.143), negate the authors' views but are compatible with marine incursion from west. Also, the doming caused by local eruptive source (cf. ash layers at Kaldeota, Rajahmundry, Hansen et al. 2005) would only cause sea-level falls locally.

The occurrence of (a) lacustrine condtions in Nand-Dongargaon, (b) fishes (*Clupeids*, *Lepidotes*), non-marine dinoflagellates (*Palaeoperidinium*, *Selenopemphix*), diatoms (*Aulacoseira*) and freshwater algae *Pediastrum* in Daiwal River section and Anandvan, (c) predominance of freshwater palynoforms, mangrove palms, diatoms besides few dinoflagellate cysts and rarity of *Igdabatis* (marine fish adapted to freshwater) in Naskal etc do not conclusively establish Trans-Deccan (marine) Strait through Godavari lineament; whereas: (a) occurrence of *G. uncinata-G. pusilla* assemblage in Jaisalmer (Sastri, 1988), (b) intermixing of African, Tethyan, fauna, (c) endemic ostracods in intertrappeans from Mamoni to Yanagundi (Whatley and Bajpai, 2005) and Anjar to Kisalpuri, (d) *Igdabatis indicus* and *Lepisosteus indicus* and vertebrate fauna etc variously reported around Lotkheri (Mandsaur), Bagh area, Jabalpur, Mohgaon Kalan and Nand-Dongargaon, though similarly speculative, may indicate incursion as well of Tethyan sea from northwest via these localities and need further work.

All these constraints will help to correlate Indian KTB occurrences and enrich Deccan trap geology.

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We are thankful to H.K. Sabot for showing interest in our paper and address his main comment about the marine seaway to Jhilmili as under:

The planktic foraminifers recorded from the intertrappean beds of Jhilmili might have been carried there by marine transgressive waters either from the west coast through the Narmada-Tapti rift zones or from the east coast through the Godavari rift zone.

Marine incursions in Peninsular India during Cenomanian-Turonian times along the Narmada-rift zone are well documented by the Bagh Formation, but highly controversial during the Maastrichtian where different workers have differently interpreted the environment of deposition of the Lameta Formation succeeding Bagh Formation. Mostly on sedimentological data some workers (e.g. Singh, 1981) interpreted the Lameta beds deposited in estuarine to tidally influenced marine environments, while others (e.g. Tandon et al. 1995) interpreted them deposited in semi-arid fluvial environments. On paleontological data Brookfield and Sahni (1987) considered the Lameta Formation semi-arid and pedogenic deposits.

The Cambay Basin situated at the mouths of Narmada and Tapti Rivers on the northwest coast is a NNW-SSE trending graben with a width of 40 to 80 km and a depth of 5 to 7 km. It came into existence during Late Cretaceous Deccan Trap volcanism with outpouring huge volumes of basaltic lava flows over 2000 m thick in the basin (Chowdhary, 2004). The succeeding Paleocene beds are poorly fossiliferous and only one planktic foraminifer *Praemurica inconstans* Zone with two species, *P. inconstans* and *Parasubbotina pseudobulloides* has been recognized from them (Sastri, 1988).

In view of the facts that the Paleocene beds of Cambay Basin are poorly fossiliferous and no other definite marine Maastrichtian and early Danian sediments have been recorded from the Narmada-Tapti rift zones it is doubtful that they might have served as seaway for marine incursions to Jhilmili particularly when foraminiferal assemblages recorded from Jhilmili are much more diversified comprising 14 species (Keller et al. 2009a). Jaisalmer shelf in Rajasthan from where Kalia and Kintso (2006) have recorded Danian P1c to 5 planktic foraminiferal zones was distally located from Narmada-Tapti rift zones and could not have contributed to Jhilmili marine transgressions.

Alternately as the intertrappean section at Jhilmili is situated on the west bank of the Pench River which is a tributary of the Wainganga River, that in turn of the Pranhita River and the latter further of the Godavari River there was a direct link for marine transgressive waters from the east coast open sea to Jhilmili through these rivers. Pranhita-Godavari Rivers flow in faulted valley roughly trending in NW-SE direction and were existing from Early Gondwana times. Occurrence of correlative shallow marine, Inter-trappean sequence with early Danian Zone P1a planktic foraminifera and C29R and C29N magnetic polarity of the lower and upper basalt traps exposed in Rajahmundry quarries (Keller et al. 2008) and brackish water ostracod, *Neocyprideis raoi*, in great profusion in the intertrappean beds of east and west Godavari districts (Khosla and Nagori, 2002) strongly support this hypothesis. This is further corroborated by the occurrence of marine-brackish water fish assemblages with freshwater fauna in the Infra- and Inter-trappean beds at Marepalli and Timsanpalli in Rangareddi (Prasad and Singh, 1991) and at Asifabad (Prasad et al. 1986); in the Lameta Formation at Pisdura (Jain and Sahni, 1983); in the intertrappean beds at Nagpur (Sahni et al. 1982); and marine algae and coastal plants in association with freshwater faunal and floral assemblages in the intertrappean beds at Mohgaonkalan (Bande et al. 1981; Bande and Prakash, 1982; Mehrotra, 1989). Besides there are records of occurrence of marine foraminifers in the intertrappean beds of Asifabad (Prasad, 1986). The occurrence of early Danian Zone P1a planktic foraminifera in Meghalya, Andaman and Pondicherry and brackish water ostracod, *Neocyprideis raoi*, in West Bengal Basin also supports the hypothesis that marine transgressions to Jhilmili might have been from eastern India rather than from western India.

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