Anoxic bottom water condition during the Deccan volcanism: Multi-proxy evidences from a shallow marine sequence in Rajahmundry, SE India

Sohom Roy[1], Prasanta Sanyal[1]

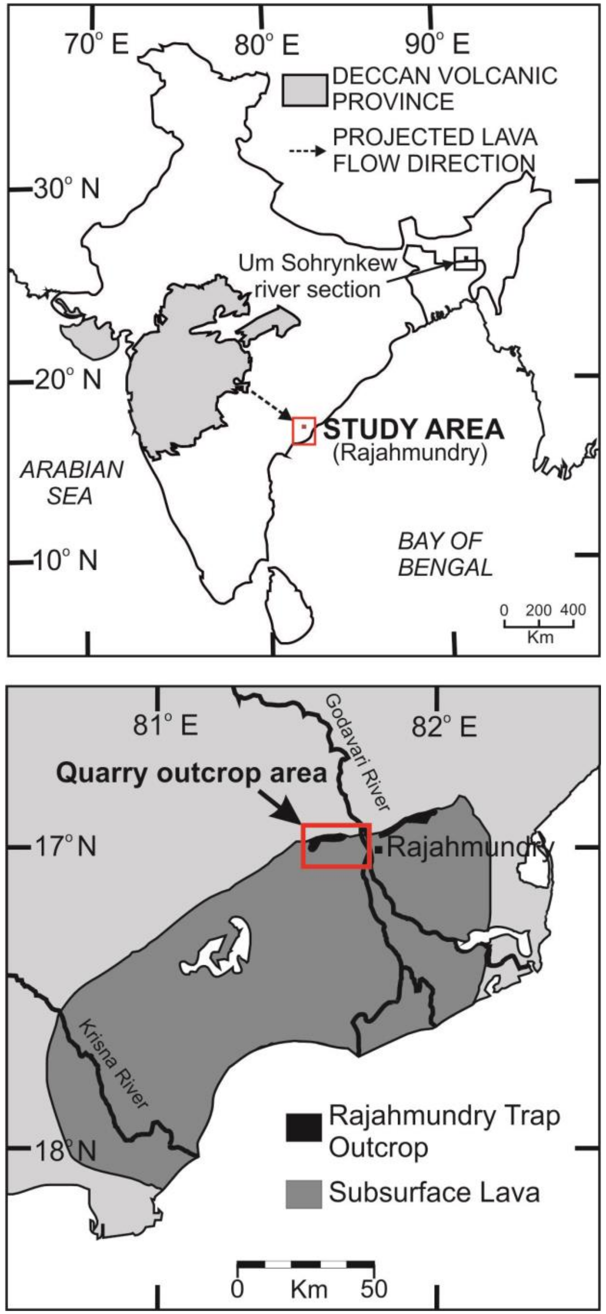
[1]Indian Institute of Science Education and Research Kolkata, India
email id: sohomroy.jugeo@gmail.com

Study Area

Rajahmundry lies >1000 km east of the main Deccan Volcanic Province in India, near Bay of Bengal

Inter-trappean (between lava flow) sediments sampled from two quarries: Balaji and Narsima

Infra-trappean (below first flow) sediments sampled from a river cut section



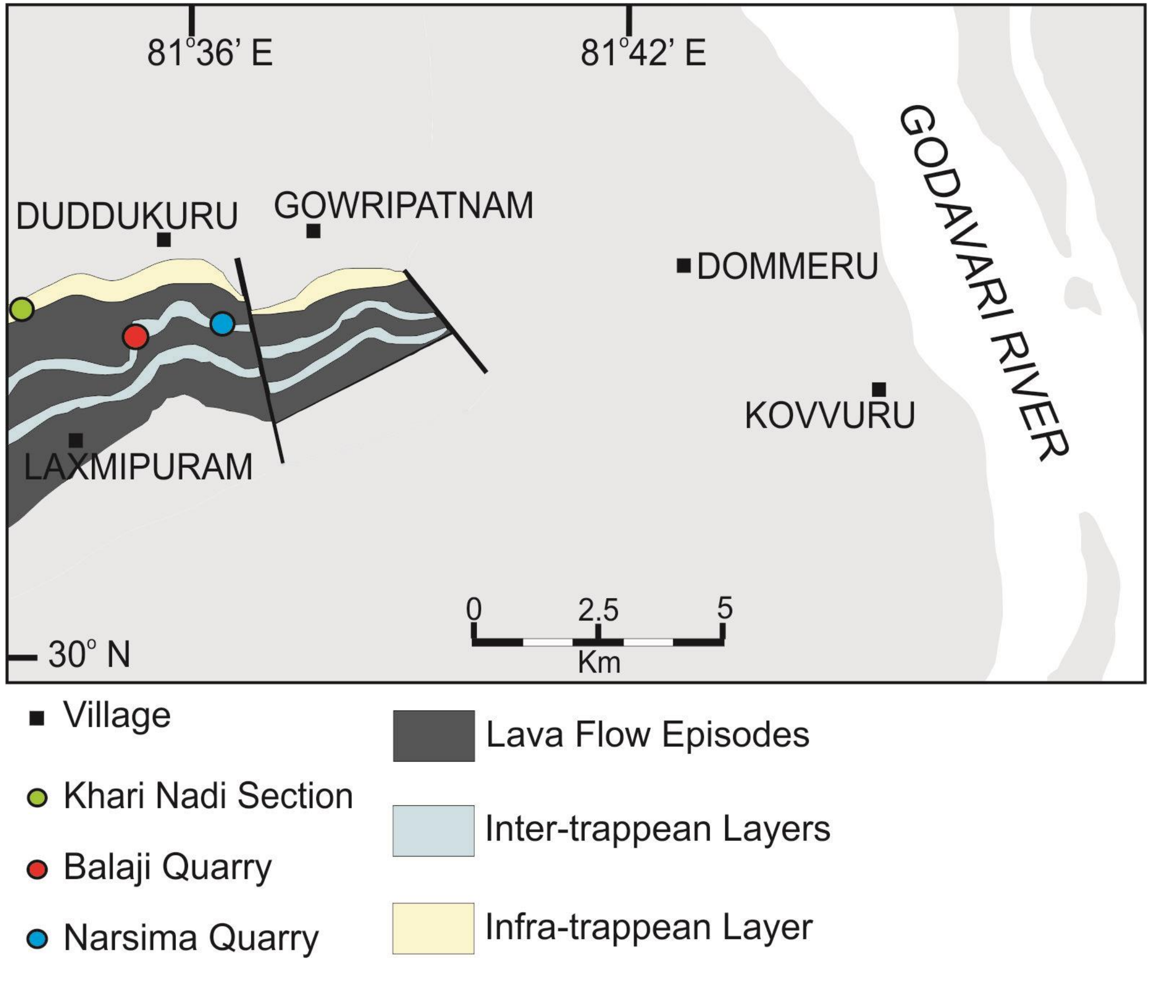


Fig. : Present extent of Deccan Volcanic Province based on outcrop data in the Indian subcontinent, as well as the study area (modified after Keller et al., 2008).

Lithology and age

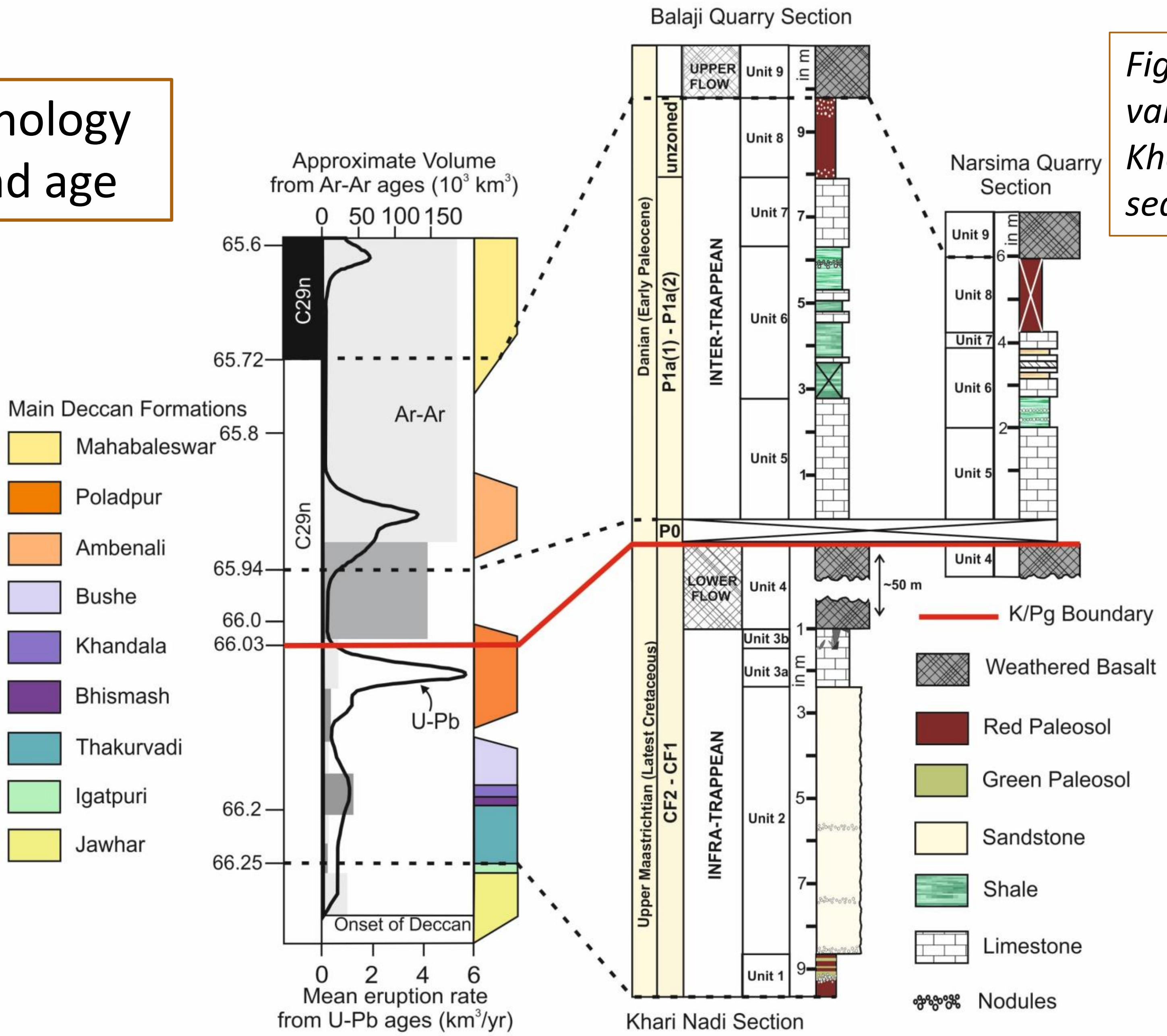


Fig. Composite log showing lithological variations of infra-trappean sequence at the Khari Nadi section and inter-trappean sequences at Balaji and Narsima quarries.

Biostratigraphy have been adopted from Keller et al. (2008, 2011) and compared with recent geochronological ages for correlation (Sprain et al., 2019; Schoene et al., 2019) with the main Deccan Volcanic Province

Proxies

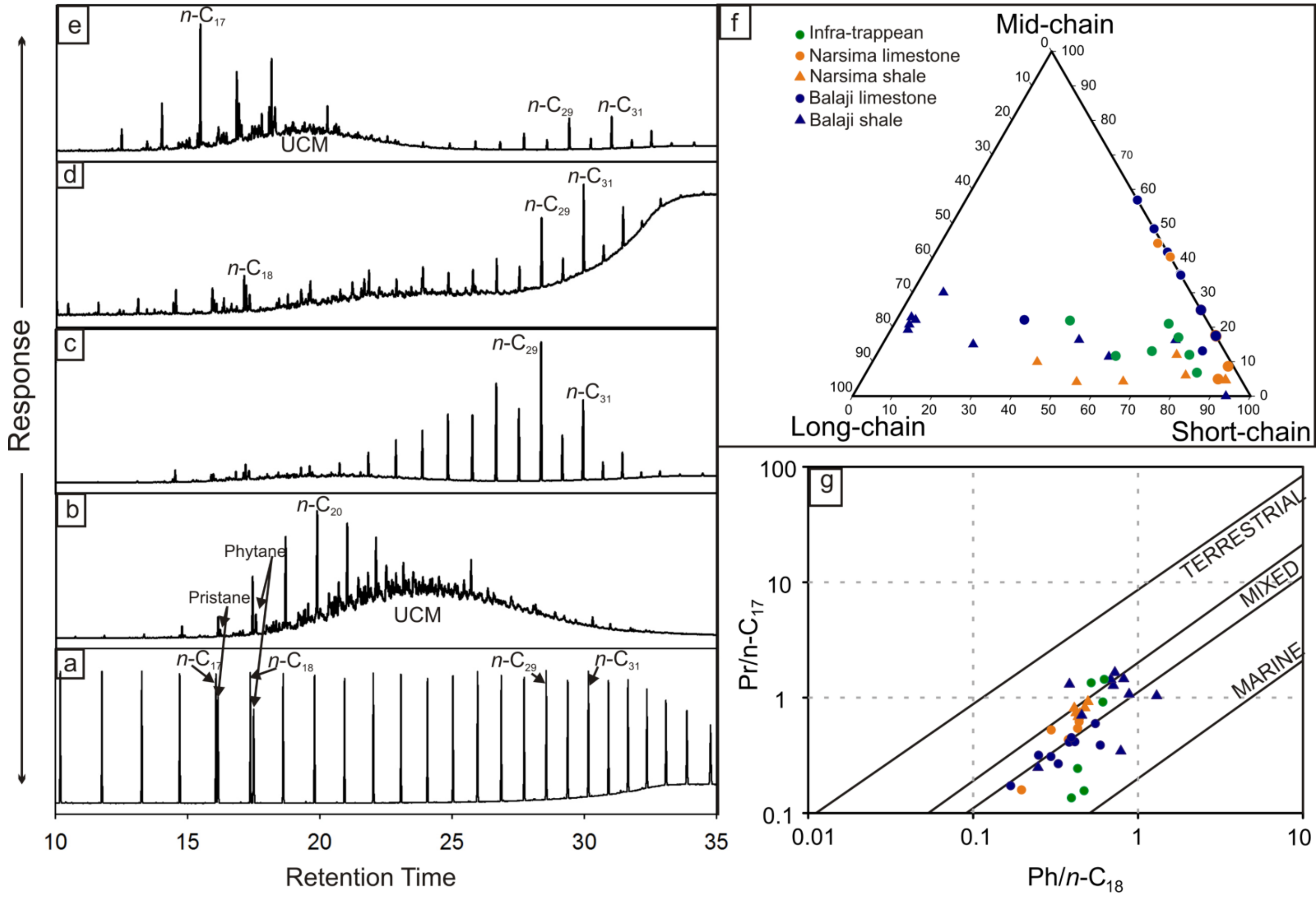
Major and Trace Element Ratios

Concentration of biomolecules: Straight-chain *n*-alkanes and isoprenoids like Pristane (Pr) and Phytane (Ph), and ratios based on the chain-length distribution

Stable isotopes: Bulk organic matter ($\delta^{13}C_{org}$; in ‰ V-PDB)

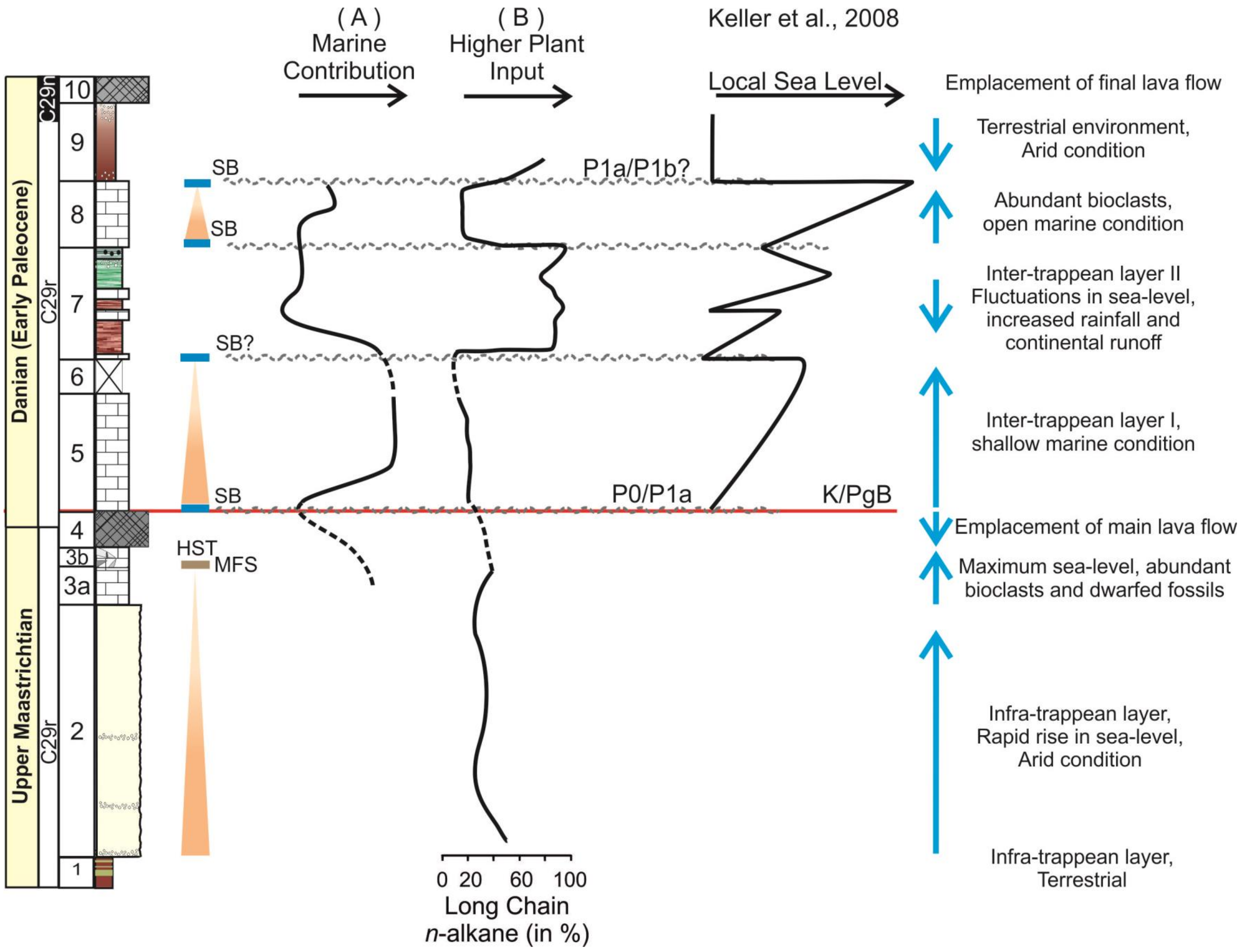
Organic matter composition

Fig. Characteristic n-alkanes spectra (total ion chromatogram) with retention time between 10–40 mins of (a) SUPELCO alkane mixture standard; (b) trappean limestone units showing large occurrences of Unresolved Complex Mixtures (UCM); (c) Balaji shale showing dominance of higher-chained homologues (>n-C_{26}) with odd-over-even predominance (OEP), suggestive of terrestrial signature; (d) infra-trappean paleosols with OEP in higher-chains; and (e) Narsima shale and upper paleosol Unit 9 showing minor occurrences of UCM in the short-chains (<n-C_{22}) and OEP in the higher-chains. (f) Ternary diagram representing n-alkane chain length distribution. (g) Cross-plot between Ph/n-C_{18} and Pr/n-C_{17} representing n-alkane provenance of hydrocarbon in inter-trappean limestones (after Limjback et al., 1985). See (f) for legend.

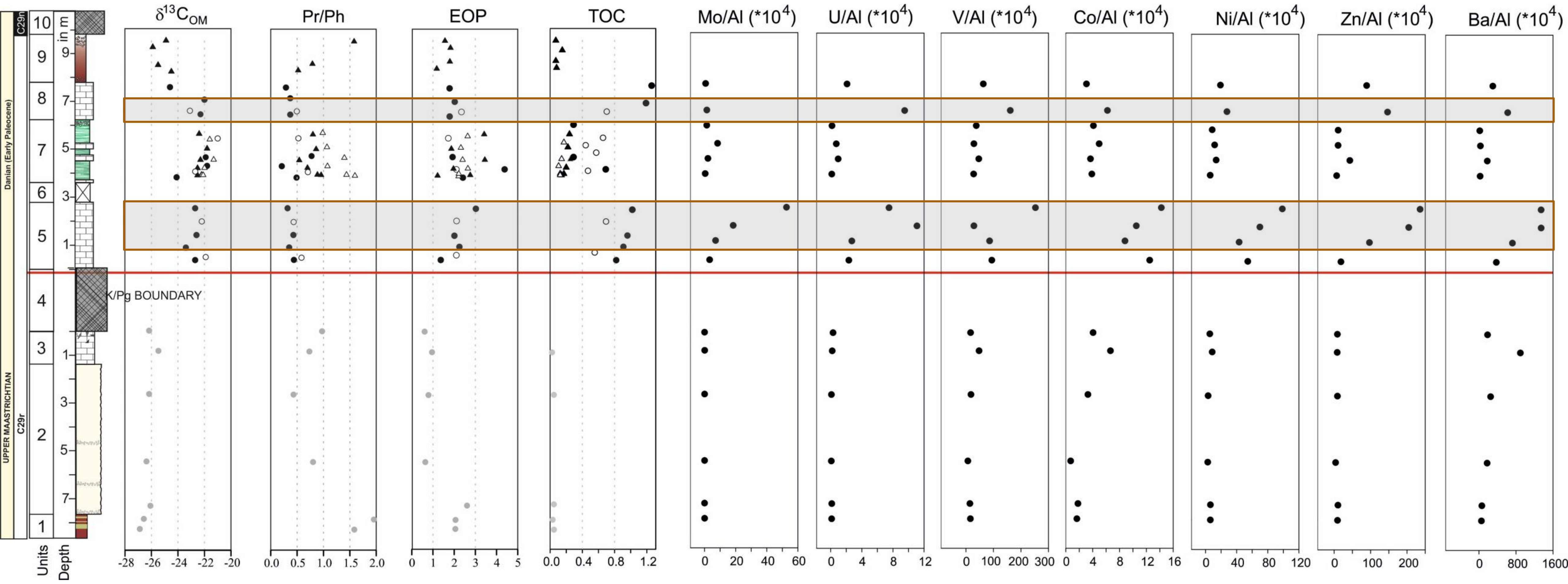


Sea-level variations

Fig. Local sea-level reconstruction in Rajahmundry area based on (A) marine water contribution calculated from $\delta^{18}O_{carb}$ values, and (B) long-chain (>n-C_{25}) n-alkane percentage. The sea-level variations lie in accordance with previous sea-level reconstructions by Keller et al. (2008). Sequence stratigraphy have been adapted from Lakshminarayana et al. (2010); where SB: Sequence Boundary, HST: Highstand System Tract, MFS: Maximum Flooding Surface.



Redox condition



Reducing condition

Concluding Remarks

- First instance of reducing condition in adjacent shallow marine environment observed due to emplacement of the Deccan Traps
- Advent of reducing condition in the shallow marine environment after the main phase of volcanism in Rajahmundry as indicated by the increase in redox sensitive elements (Mo, V, U, Co, Zn, Ni), increase in EOP (even-over-odd preference in the short-chains) and decrease in Pr/Ph ratio (<0.6) in the inter-trappean
- Eutrophication, as evident by increase in TOC, Ba concentration and $\delta^{13}C_{org}$ values, may have exacerbated a reducing condition after the volcanism in Rajahmundry
- Increase in bio-limiting nutrients from weathering of the basalts possibly led to proliferation of producers (*Guembelitria cretacea*?) that occupied the niche after the extinction in Rajahmundry
- Reaction of trace metals with oxides in the reservoir and/or increase in temperature due to CO_2 expulsion further might have led to decrease in dissolved oxygen

thank you!