Trace fossils from the Ranipat sediments (Early Cretaceous), Saurashtra Basin, Gujarat, Western India

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Field investigation of the Ranipat Formation (Early Cretaceous) of the Dhrangadhra Group of Surendranagar district, Saurashtra basin (Gujarat) has led to the discovery of trace fossils *Opalinomorpha* (?), *Planolites*, *Skolithos* and *Thalassinoides* (ichnofossil, *Lebensspuren*) in crossbedded white to dirty-white sandstone, siltstone and clay. Preliminary investigations of well-preserved physical and biogenic structures of the Ranipat sediments reveal that the succession represents deposition in a nearshore-coastal, shallow-water or littoral-marginal marine setting. Indeed, the characteristic ichnofacies and lithofacies of the Ranipat Formation should provide a potentially useful model for reconstruction of nearshore to coastal marine sequences.

Most trace fossils occur in characteristic, albeit intergradational lithofacies of nearshore-coastal to offshore sequences. Landward facies are typified by clean, well-sorted, well-stratified, sparsely burrowed sandstones. Seaward facies, except where interrupted by hummocky cross-stratified sandstones, exhibit successively less pure, less well-sorted and stratified, more intensely bioturbated, finer-grained sandstones, siltstones, and mudstones. Examination of Early Cretaceous (Upper Tithonian–Albian) deposits of the Saurashtra basin (Dhrangadhra Group), Surendranagar district, Gujarat, at sites near Chului (23°00'N 71°21'E) and Sarla (22°42'N 71°23'E) of the Ranipat Formation led to the discovery of *Opalinomorpha* (?), *Planolites*, *Skolithos* and *Thalassinoides*. Trace fossils (ichnofossils, *Lebensspuren*), being increasingly used in palaeoenvironmental interpretation of nearshore-coastal and marine deposits. In field applications, the relative abundance of dominant species is as important for local environmental reconstruction as the diversity and composition of the respective ichnofacies.

To my knowledge this is the first report of such fossils in the Early Cretaceous deposits of Saurashtra basin. The burrows discovered are assigned to ichnogenera but the identifications must remain tentative at present.

The Mesozoic rocks of Kutch (Jurassic–Early Cretaceous) are well known for the occurrence of fauna, ammonoids, plant fossils, as well as trace fossils, and have been extensively studied. The Early Cretaceous rocks of Saurashtra peninsula lie mostly covered underneath the younger Deccan Trap, and only in the central part around Surendranagar do they occur as inlier, occupying an outcrop area of about 1000 km² (refs. 7, 8). The Mesozoic sequence of Dhrangadhra Group has been differentiated into four formations, viz. the Than at the base, succeeded by Surajdeval, Ranipat, and Wadhwan at the top. The Ranipat Formation (≈200 m) overlies the Surajdeval Formation conformably. The sedimentary sequence consists of recurring fining upward cycles comprising coarse, medium- to fine-grained sandstone, interbedded fine sandstone (Figure 1), siltstone and clay. Coarse- to medium-grained sandstones occur as thick bodies (5–10 m), lenticular and channel-shaped, and display large- and small-scale planar and trough cross-bedding, including herringbone cross-bedding and hummocky cross-stratification (?) depending upon grain size. The cross-bedded sandstone bodies are white to dirty white in places, moderately sorted, locally containing thinner interbeds of white silty mud (5–10 cm thick), and occasionally ferruginous. Medium to fine sandstone occurs as laterally persistent bodies, interbedded with white siltstone and clay. The associated clay and mudstone beds are massive or show well-developed parallel laminations. The ichnofossils reported here are commonly associated with medium, to fine sandstone and interbedded fine sandstone, siltstone, clay and mudstones. In the road cut, some 15 km west of Muli on the Sarla road, at least 4–8-m-thick sequence of interbedded fine sandstone, siltstone, clay and mudstone is exposed in various road cuts and excavations (quarries) in and around Chului and Dhrangadhra towns. The following ichnofossils are recognized from Sarla and Chului sections of the Ranipat Formation (species are listed alphabetically).

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**Figure 1.** Successive sets of large- and small-scale trough cross-bedded coarse, medium to fine-grained sandstone, showing fining-upward cycles. Ranipat Formation, road-slice section, 10 km north of Chotila on Than road.
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Ichnogenus *Ophiomorpha annulata* (?) (Ksiazkiewicz, 1977)
(Figure 2), size: diameter 0.6–2.5 cm.
Walls consisting of evenly spaced, transverse rows of elliptical pellets; more or less continuous rings or annulations around burrow segments. Horizontal segments more abundant than vertical segments. Vertical segments possibly connected the burrow system with the original surface, although true apertures of the burrow have not been observed owing to poor preservation. Scarcity of forms prevented a true identification. These burrows occur in fine to medium, parallel-laminated or associated hummocky cross-stratified (?) sand in the vicinity of Sarla. This specimen has also been reported from the Jurassic of Kutch6.8 and the Upper Cretaceous of east-central Utah (USA)1.

Ichnogenus *Planolites* Nicholson, 1983

*Planolites* sp. (Figure 3), size: diameter 0.6–20 cm.
Unlined, simple non-branching, straight to slightly arcuate, mostly irregular on the outer surface, and subcircular in cross-section (1–2.5 cm). These burrows, occurring in fine to medium sandstone and associated silt and clay exposed in the vicinity of Chuli and Nalkahmba (22°38'15" N, 71°16' E), are ascribed to ichnogenus *Planolites* Nicholson. This form is known to range in age from Precambrian to Recent. It is reported from the Jurassic of Kutch6.9, Bagh beds of Narmada Valley9, Cretaceous of Trichinopoly10, Cambrian of Spiti Valley11, and Upper Cretaceous of east-central Utah1.

Ichnogenus *Skolithos* Haldeman, 1840

*Skolithos* sp. (Figure 4), size: diameter, 0.5–1 cm.
Predominantly vertical, cylindrical to slightly subcylindrical about 0.5–1 cm, distinctly walled burrows were collected from white quartz-rich fine to medium sandstones in the vicinity of Chuli, Nalkahmba, and 2 km south of Palasan (22°38'30" N, 71°20' E). It shows simple non-branching burrows. Vertical pipe-like sandy burrow tubes are more or less circular in cross-section, and occur in dense cluster colonial form (Figure 4). The pipe-like sandy burrow tubes are assigned to ichnogenus *Skolithos* Haldeman. The genus ranges from Precambrian to Cretaceous. The burrows described above have been widely reported from different geological records. Bhargava et al.11 reported the occurrence of *Skolithos* Haldeman from the Cambrian sediments of Spiti Valley, Howard and Singh16 and Cashyap et al.8 from the Mesozoic sediments of Kutch, and Chiplonkar and Ghare10 from the Cretaceous sediments of Trichinopoly.

Ichnogenus *Thalassinoides* Ehrenberg, 1944

*Thalassinoides* sp. (Figure 4), size: diameter, 0.5–1.5 cm.
*Thalassinoides* differs from *Ophiomorpha* in having ornamented walls. These burrows, of variable diameter (0.5–1.5 cm), and consisting of coarse to fine sandy material, circular to subcircular in cross-section, are

Figure 2. Sketch of *Ophiomorpha* (?) sp. showing probable transition to *Ophiomorpha annulata* (?) (Ksiazkiewicz, 1977).

Figure 3. Typical occurrence of pipe-like tubes of *Planolites* species, occurring in fine to medium-grained sandstone and siltstone.

Figure 4. *Skolithos* Haldeman, 1840, and *Thalassinoides* Ehrenberg, 1944, occurring in dense cluster colonial form.
referred to ichnogenus Thalassinoides Ehrenberg. Large burrow smooth-walled, essentially cylindrical, oriented vertically, whereas small burrow inclined or oriented horizontally, mostly in Y-shaped branches, typically enlarged at points of bifurcation. They occur frequently around the quarries of Nalkahmba and Palasan. These burrows have been widely reported from the Cretaceous sediments of Bhuj6-16. Upper Cretaceous of Germany (Sax)14, and from east-central Utah1.

The Ranipat Formation containing an assemblage of ichnofossil, including Ophiomorpha, Planolites, Skolithos and Thalassinoides, belongs to the Skolithos–Cruziana ichnofacies3,13,14, which is characteristic of nearshore-coastal, shallow-water, littoral and intertidal environments. Howard and Frey1,14 attributed Skolithos to nearshore to offshore-marine environment. Seilacher15 reported the presence of Skolithos in both shallow-water non-marine and marginal-marine environments. Camerlain and Clark13 documented Cruziana ichnofacies in shallow marine environment. Thus the presence of ichnogenera, as described above, may indicate nearshore-marine or littoral-marginal-marine environment for the deposition of the Ranipat sediments. Coarse to medium sandstone bodies showing opposite to diagonally oriented cross-bedding (herringbone cross-bedding) may be attributed to sandy tidal-channel facies, and nearshore (barrier associated) facies15, whereas associated fine sandstone, clay and mudstone resemble intertidal mudflat facies. The locally associated hummocky cross-stratification may indicate occasional record of stormy conditions in the tidally influenced deposits.

5. Spath, L. F., Palaeontol. Indica (Geol. Surv. India), 1933, 9, 945.

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An articulated rhychosaur fossil from Maleri Formation (Upper Gondwana), Andhra Pradesh, South India


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Rhychosaurus were a widespread group of reptiles during the Triassic period. We report the finding of a nearly complete articulated skeleton of a rhychosaur from a new locality, in the Upper Triassic Maleri Formation in the Pranhita-Godavari valley in Andhra Pradesh. The specimen preserves the postcranial skeleton but for the left forelimb down to the tail in a pose that is reminiscent of the living posture and suggests quick burial before scavengers could disrupt the carcass. The skull was fragmented but could be restored.

Rhychosaurus have been recorded from all continents except Australia and Antarctica1. The highly specialized Upper Triassic Rhychosauridae comprise three interrelated1 genera, Paradapedon from India2-6, Hyperoapedon from Scotland1, and Scaphonyx7,8 from South America. These are known through partial skeletons, disarticulated bones, and restorations1,6,7 based on these. In India, early records of rhychosaurus were on the basis of tooth plates from Upper Gondwana rocks belonging to the Upper Triassic Maleri Formation in the Pranhita-Godavari valley of Central India and Tiki Formation of the Sone-Mahanadi valley2,3. Initially compared with Hyperoapedon gordonii2, the Indian forms were renamed as H. huxleyi by Lydekker4-5. Huene5-10 erected the genus Paradapedon for the species huxleyi and also provided a partial reconstruction from the fragmentary material4. An excellent collection of disarticulated skull and postcranial bones belonging to six skeletons allowed Chatterjeeb a more complete osteological description as well as restoration of the species Paradapedon huxleyi. The Elgin rhycho-
saurs Rhychoapedon gordonii from northeast Scotland has been restored on the basis of skulls and partial skeletons from a collection of 31-37 individuals1. Scaphonyx fisheri from Santa Maria Formation of Brazil is also represented by a restoration7.

The rhychosaur skeleton reported here was found in red clays which along with sandstone lenses and lime