First fossil wood (Lauraceae) from Baratang, Andaman–Nicobar Islands, India

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We describe a carbonized wood fragment referable to *Laurinoxylon* Felix 1883 from flyschoid gritty sandstone (Palaeocene–Eocene) of Baratang Island. We also discuss the provenance and depositional environment of vegetal matter.

WELL-PRESERVED fossil plant materials permitting taxonomic evaluation are rather scarce in flyschoid sediments of Andaman Islands, whereas carbonized-fragmental vegetal matter including thin coal pockets is not uncommon[1]. Small carbonized wood fragments lying parallel to the bedding plane were recovered from a sequence of hard greywacke sandstone intercalated with minor shales and exposed on the banks of Lurujig nala (Figure 1, *a–d*). One such fragment measuring about 1.5 cm and displaying well-preserved essential tissues of secondary wood was studied in ground sections:

Wood diffuse-porous. *Growth rings* not seen. *Vessels* small to medium, 30–140 μm, solitary and in radial multiples of 2–3, generally compressed, circular to oval, evenly distributed, about 20–40 vessels per mm^2; tyloses present (Figure 2, *a–b*); perforations simple; vessel-members attenuate; intervessel pits medium to large, alternate, about 6–8 μm, with circular to lenticular

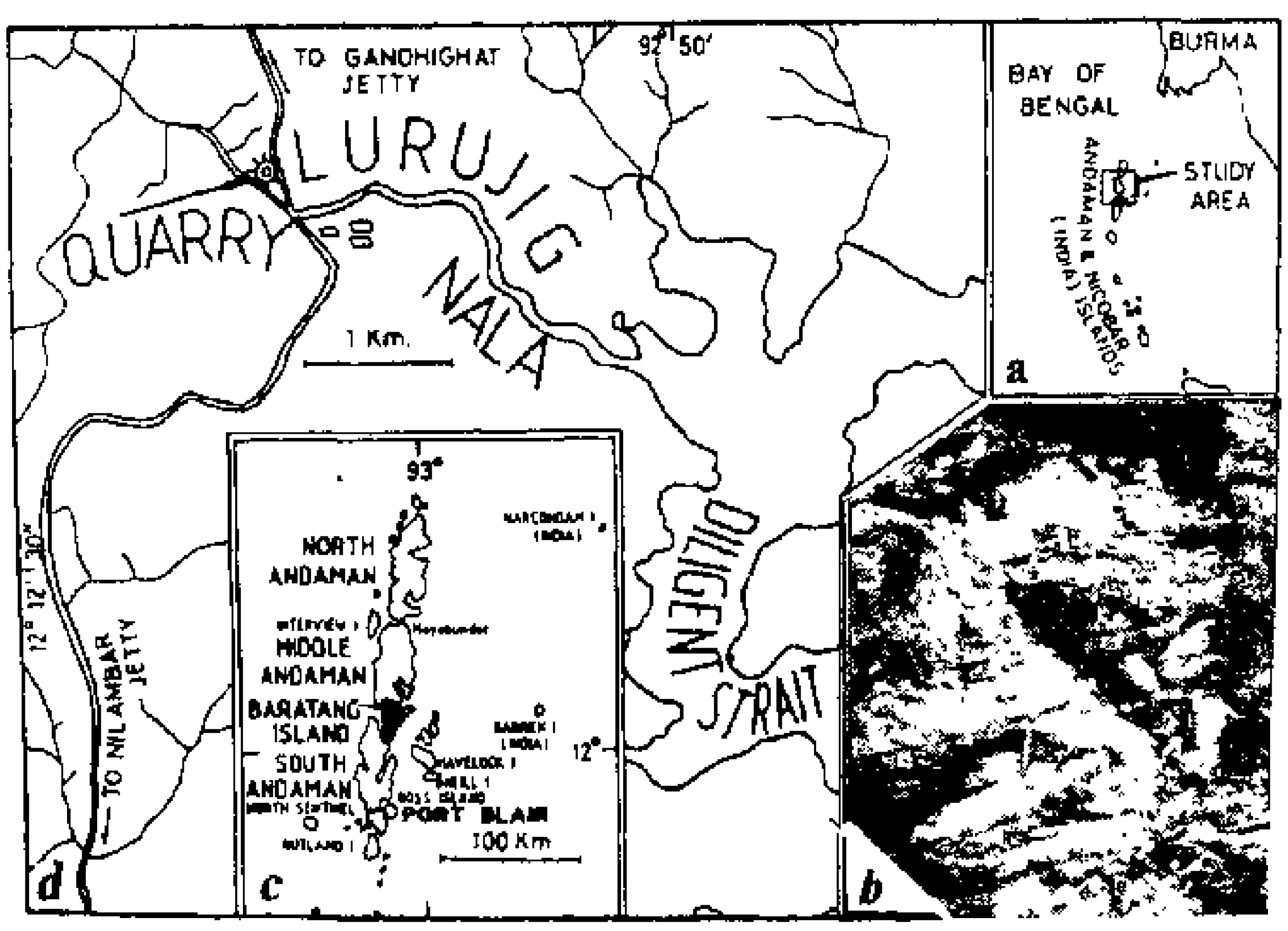

Figure 1. ***a***, Map showing the study area. ***b***, Rhythmic bedding of hard greywacke sandstone intercalated with minor Shale (Flysch) exposed in Lurujig Quarry yielding the fossil wood. Hammer for scale. ***c***, Map showing the position of Baratang Island. ***d***, Map showing the site of Lurujig Quarry on main trunk road of Baratang Island connecting Gandhighat–Nilambar Jetty.

aperture (Figure 2,*c*). Parenchyma paratracheal, scanty vasicentric, forming 1–2 seriate sheath around vessels, occasionally fine extension of paratracheal parenchyma also seen. Xylem rays 1–3 (mostly 2–3) seriate, 6–26 cells high, heterocellular, consisting of procumbent cells and single row of swollen upright (oil) cells at one or both ends (Figure 2,*b*). Oil cells also occurring scattered among the fibres. *Fibres* rectangular, small, 8–20 μm, moderately thick-walled, about 2–4 μm in thickness, septate.

The essential characters of carbonized wood, particularly the presence of characteristic oil-cells suggest assignment to Lauraceae. The genera of Lauraceae displaying rather homogeneous wood structure are difficult to differentiate on the basis of wood anatomy alone, hence the wood fragment is conventionally placed under the genus *Laurinoxylon* Felix 1883.

The oldest record of Lauraceae is from the Late Cretaceous Flysch sediments of Europe[2]. In India, Late Cretaceous occurrences are not known but the earliest records are well-preserved leaves of *Neolitsea* and *Cinnamonum* from the Eocene of Tura Sandstone of Garo Hills, Meghalaya[3], and Kutch[4] respectively. Fossil woods of Lauraceae are fairly well known from Neogene of Assam, Arunachal Pradesh, Bengal and Kerala[5–8]. Leaves of *Cinnamonum*, *Litsea* and *Persea* are also recorded from the Lower Siwalik sediments (Middle Miocene[9–10]). Lauraceae is presently distributed in tropical to subtropical belt including southeastern Asian region, with only a few species surviving in European and African continents[11]. Occurrence of lauraceous element in the Andaman Flysch sediments, thus reflects warm humid conditions in the source area of vegetal matter.

Flyschoid turbiditic sediments of Baratang Formation consisting of shale–greywacke sandstone sequence and typically exposed in Baratang Island were earlier assigned broad Late Cretaceous–Eocene age owing to nearly complete absence of fossils[12]. Recent recovery of over 120 species of marker nannofossils including both coccoliths and discoasters in mud exuded from the Nayagarh Mud volcano, offers more precise, though indirect, evidence of the presence of uninterrupted subsurface sedimentaries of Early Campanian–Priabonian age with conspicuous absence of Oligocene marker[13]. Despite lack of any direct fossil evidence, the field data coupled with the rate of geosynclinal filling by turbiditic sediments, indicate more probable Palaeocene–Eocene rather than Late Cretaceous age for greywacke sandstone yielding plant fossils. Sole markings coupled with typical and varied sedimentological data indicate the provenance of vegetal matter from 'northeastern' Burmese region[14]. Recovery of exclusively agglutinated foraminiferal assemblage without calcareous types[15] together with trace fossils and sedimentological data suggest the deposition of greywacke sandstone together

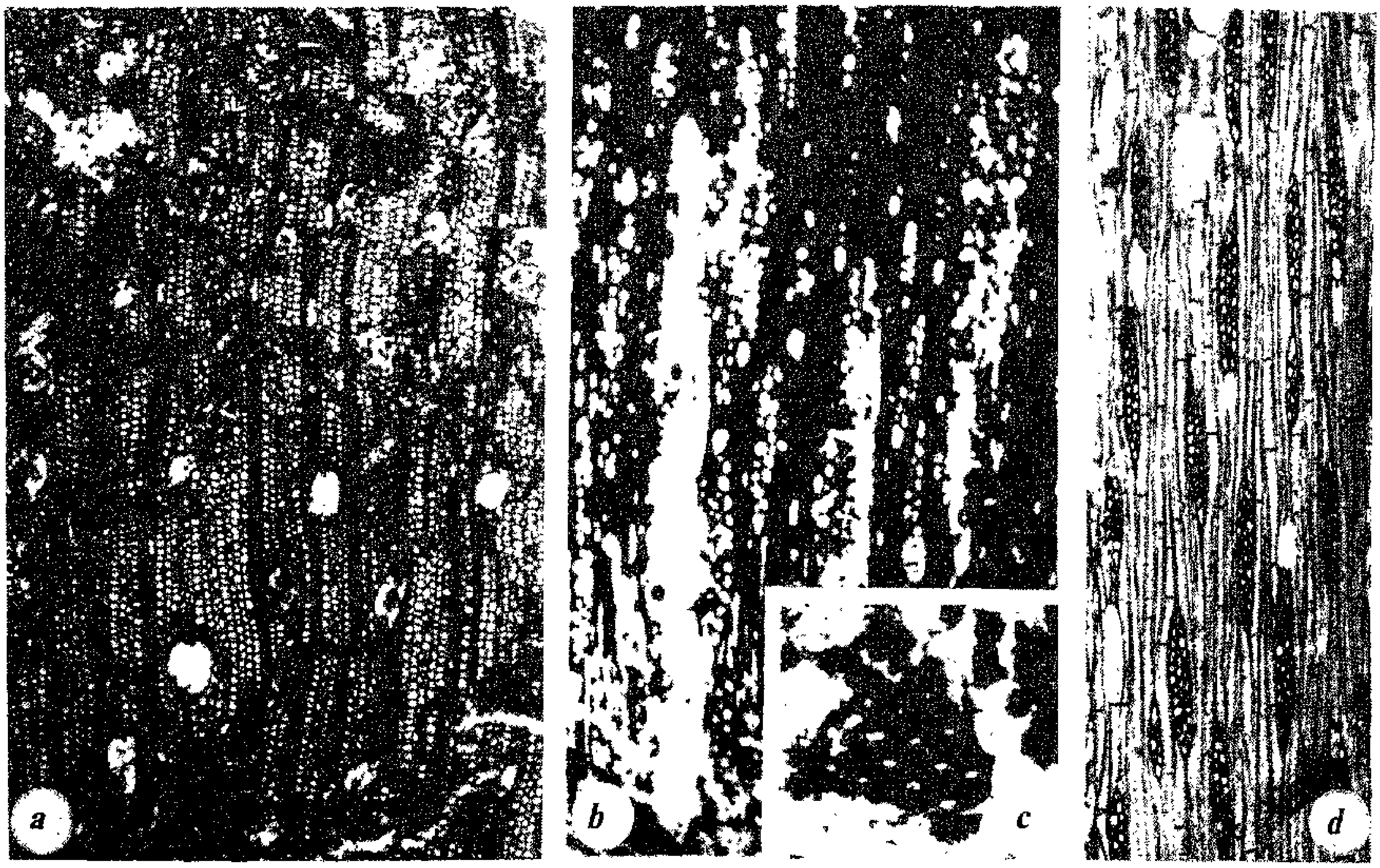

Figure 2. a, Cross-section of carbonized fossil wood: *Laurinoxylon* Felix, showing vessels, paratracheal parenchyma and oil-cells (× 50). b, Tangential-longitudinal section of the same specimen showing 2-3 seriate rays with swollen oil-cells (× 100). c, Intervessel pits (× 400). d, Tangential-longitudinal section of extant *Litsea reticulata* wood to show similar rays with swollen upright (oil) cells.

with vegetal matter in dark, cold and high-pressure conditions prevailing in the deep-sea basin. In a situation analogous to that prevailing for modern deep-sea fan deposits, the vegetal matter together with coarse clastics was flushed down the submarine canyons and transported by episodic high-density turbidity currents. Depending on the quantum of vegetal matter available at a site, carbonized laminae of less than a millimetre to a couple of centimetre thick coal seams, laterally pinching could be formed. The entire process of carbonization starting from raw vegetal matter took place after being flushed in the deep-sea basin, as suggested by the interstratified and compressed nature of thin carbonized wood and coal pockets frequently observed within the flysch sediments, demanding more intensive studies.

1. Gee, E. R., *Rec. Geol. Surv. India*, 1927, **59**, Pt. 2, 208.
2. Süss, H., *Abh. Dtsch. Akad. Wiss. Berl. Jahrgang*, 1956, **8**, 1.
3. Lakhanpal, R. N., *Palaeobotanist*, 1955, **3**, 27.
4. Lakhanpal, R. N., Guleria, J. S. and Awasthi, N., *Palaeobotanist*, 1984, **33**, 228.
5. Prakash, U. and Tripathi, P. P., *Palaeobotanist*, 1974, **21**, 305.
6. Lakhanpal, R. N., Prakash, U. and Awasthi, N., *Palaeobotanist*, 1981, **27**, 232.
7. Awasthi, N. and Ahuja, M., *Geophytology*, 1982, **12**, 245.
8. Bande, M. B. and Srivastava, G. P., *Geophytology*, 1989, **18**, 217.
9. Lakhanpal, R. N. and Awasthi, N., in *A. K. Ghosh Commemmoration Volume*, 1979; *Curr. Trends Life Sci.*, 1984, **10**, 587.
10. Lakhanpal, R. N. and Guleria, J. S., *Geophytology*, 1978, **8**, 19.
11. Pearson, R. S. and Brown, H. P., *Commercial Timbers of India*, Calcutta, 1932, vol. 2, p. 833.
12. Chatterjee, P. K., in *Proc. Symp. Upp. Mantle Proj. Hyderabad*, 1967, p. 348.
13. Jafar, S. A., Mainali, U. C. and Singh, O. P., *INSA Newslett.*, 1989, **11**, 66.
14. Karunakaran, C., Pawde, M. B., Raina, V. K., Ray, K. K. and Saha, S. S., *Proc. 22nd Int. Geol. Congr. New Delhi*, 1964, Pt. 2, p. 79.
15. Pandey, J., *Proc. 2nd Indian Colloq. Micropal. Stratigr., Lucknow* (ed. Singh, S. N.), 1972, p. 66.

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Evaluation of VA mycorrhizal inoculation in micropropagated *Populus deltoides* Marsh clones

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Using the method of axenic establishment, the effect of mycorrhizal inoculation at three different stages of