FIRST RECORD OF *Elaeocarpus* Linn. FRUITS FROM THE UPPER SIWALIK SEDIMENTS (KIMIN FORMATION) OF ARUNACHAL PRADESH

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Carbonised fruits resembling the modern taxon, *Elaeocarpus lanceaefolius* Roxb. of Family Elaeocarpaceae are reported for the first time in India from Siwalik sediments of Arunachal Pradesh. A new fossil species, *Elaeocarpus prelanceaefolius* sp. nov. is proposed for the fruits. Occurrence of these fruits indicates a sub-tropical to temperate, broad-leaved to evergreen forest in the area at the time of deposition.

Introduction

During a palaeobotanical excursion to Arunachal Pradesh, a rich and diverse types of fossil plant remains including carbonised remains of stems, leaves, fruits and seeds were recovered from the Upper Siwalik sediments exposed along the road to Itanagar from Banderdewa, in Papumpare District (Fig. 1). Among the plant remains, fruits resembling *Elaeocarpus* Linn. of family Elaeocarpaceae are described here for the first time from India.

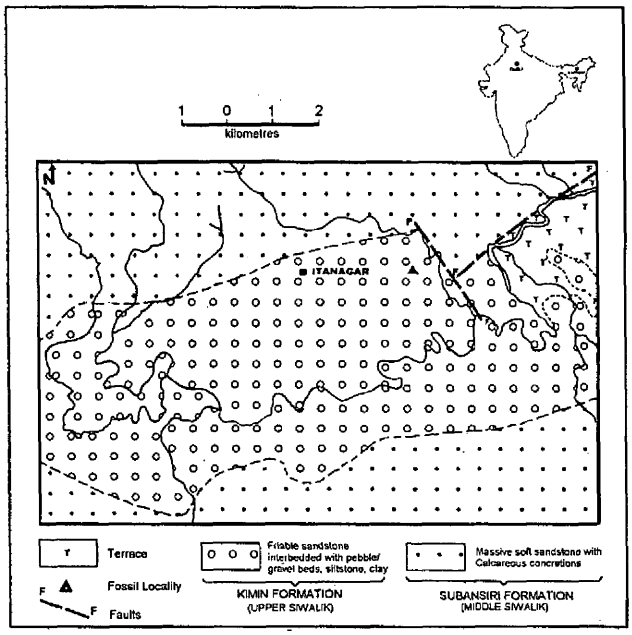

Fig.1. Geological map of area around Itanagar, Papumpare District, Arunachal Pradesh.

Geology

The dominant rock-type of Itanagar area belongs to the Siwalik Group. The fossil fruits and other plant remains were collected along a road-section near the 7 km post between Itanagar and Naharlagun. This particular section consists of grey fragile sandstone, siltstone and shale sequence. The texture, structure and compactness of the rock-types suggest them to belong to the Upper Siwaliks (Kimin Formation) which are considered to be Upper Pliocene – Lower Pleistocene in age (Kumar, 1997).

Carbonised Fruits

Systematic Position: Family : Elaeocarpaceae
Genus : *Elaeocarpus* Linn.

E. prelanceaefolius sp. nov.
Figs. 2a-c, f-i

Material : The investigation is based on five carbonised specimens.

Description: The fruits are drupes, ovoid to ellipsoid, 3 – loculed; mesocarp preserved in traces in the form of thin carbonaceous film; stony endocarp well preserved, pyrenes oblong, terete; longitudinally 29-34 mm in length with equatorial diameter 18-22 mm; endocarp rugose, two-layered, outer light-coloured layer 2.5 mm thick at the central part and gradually tapering towards the two ends, while the inner darker layer is uneven in thickness ranging from 2-3 mm; single-seeded, embryo preserved, dicotyledonous. In T.S. traces of mesocarp consisting of non-compact parenchymatous tissue in which cell dimensions increase from the periphery inwards are found. The endocarp consists of deep, oval-elliptical grooves and is made up of sclereids forming the stone of the fruit (Figs. 2a-c, f-i). Sclereids are mostly brachysclereids, sometimes osteosclereids, with thick wall, narrow lumen and wall with numerous canaliculi (Figs. 2g-h). Sclereids with thinner wall and broader lumen are present in the inner layer of the stone (Fig. 2i).

Holotype specimen No.: CU / PPL / AP 1-5.
Horizon : Upper Siwaliks (Kimin Formation)
Age : Upper Pliocene – Lower Pleistocene.

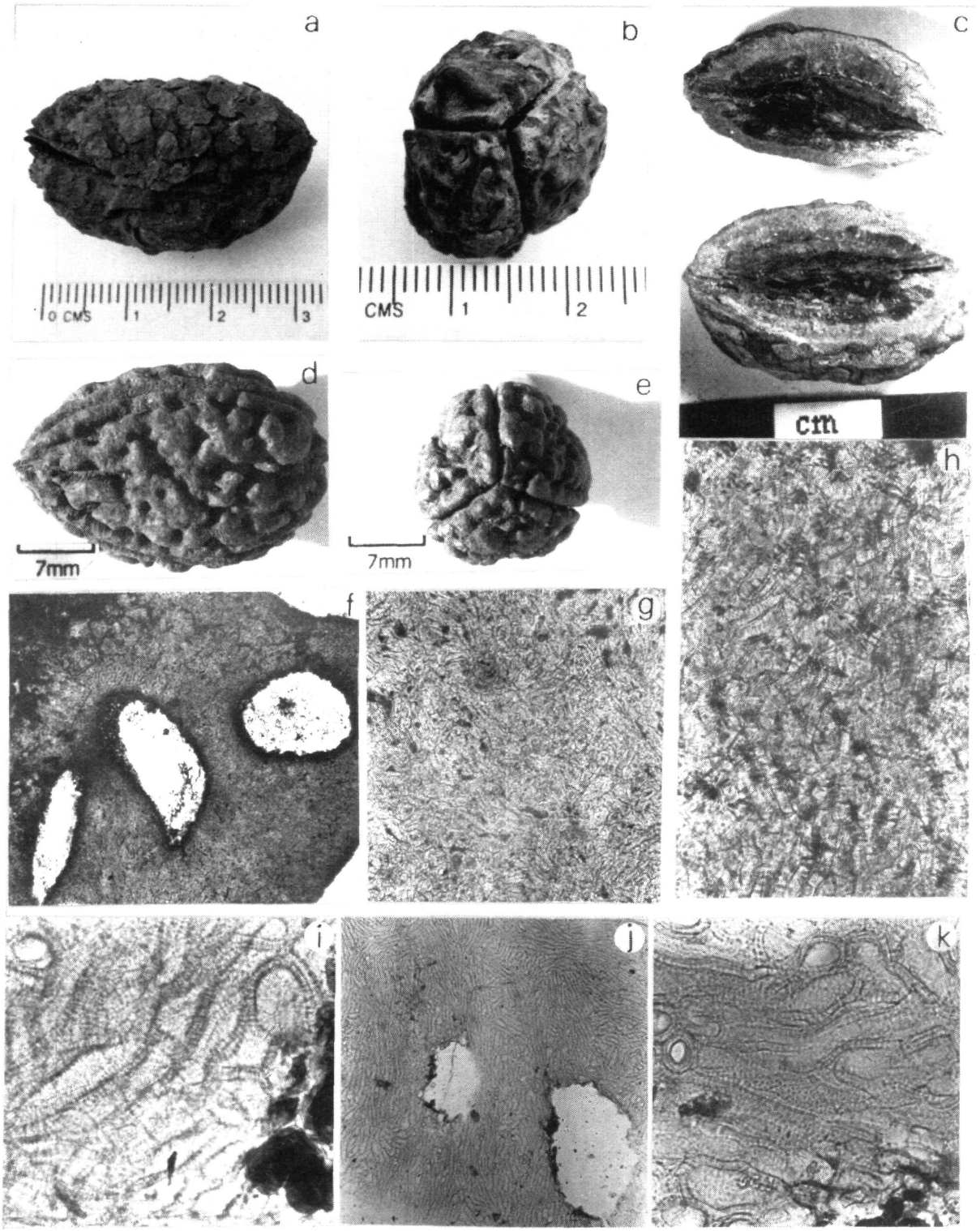

Fig.2. (**a**) A fruit of *Elaeocarpus prelanceaefolius* sp. nov. in lateral view showing mesocarp and stony endocarp. (**b**) Same in polar view showing three locules and rugose endocarp. (**c**) Same, showing internal organization of the fruit. (**d,e**) Endocarps of the modern fruit of *Elaeocarpus lanceaefolius* Roxb. (lateral and polar view) showing rugose ornamentation on the stony endocarp. (**f**) T.S. through the stone of fossil *E. prelanceaefolius* sp. nov. showing oval-elliptical grooves. (**g,h**) Same showing sclereids with thick wall and narrow lumen at the peripheral region of the stone. (**i**) Same showing sclereids with thin wall and wide lumen at the central part of the stone. (**j,k**) T.S. through the stone of modern fruit of *E. lanceaefolius* Roxb. showing grooves and thin walled sclereids at the central part of the stone.

Affinities: The fossil fruits are comparable to the fruits of family Elaeocarpaceae, and shows close resemblance to extant species of *Elaeocarpus*, especially *E. lanceaefolius* Roxb. (Figs. 2d,e). The comparison is confirmed with the Herbarium sheets preserved in the Central National Herbarium, Sibpore, Howrah (Acc. No. 179932). Therefore, a new fossil species, *Elaeocarpus prelanceaefolius* sp. nov., is proposed.

Discussion and Conclusions

Earlier, fossil fruits recorded from NE India are *Mesua* (Clusiaceae), *Entada, Leguminocarpon* (Fabaceae), (Palmae), *Sterculia* (Sterculiaceae), *Barringtonia* (Lecythidaceae), *Nypa* (Arecaceae) from the Oligocene beds of Assam (Awasthi et al. 1992; Awasthi and Mehrotra, 1995; Mehrotra, 1995; Mehrotra, 2000; Mehrotra et al. 2003) and that of *Terminalia* (Combretaceae) and *Leguminocarpon* (Tiliaceae) from Eocene beds of Garo Hills, Meghalaya (Bhattacharyya, 1983, 1985). Recently, *Terminalia* (Combretaceae) and *Leguminocarpon* fruits have been recorded from the Miocene sediments of Mizoram (Agarwal and Mandaokar, 2002; Mehrotra and Mandaokar, 2002). The present record of the fruits of *Elaeocarpus* is the first of its kind from India. Fossil woods (Lakhanpal et al. 1978; Nambudiri and Tidwell, 1975; Prakash and Tripathi, 1975) and pollen grains (Gupta, 1973; Gupta and Prasad, 1985) of *Elaeocarpus* are, however, known to occur in the Cenozoic sediments of India.

Elaeocarpus Linn. is a large genus of trees distributed from South and East Asia through Malaysia to Australia and the Pacific islands. Among 25 extant species occurring in India, 14 species are found in 6 districts of Arunachal Pradesh (Hazra et al. 1996). They occur in low altitudes of 100-500 m in tropical forests (*E. tectorius*), in altitudes of 800-1000 m in evergreen forests (*E. stapfianus*) to altitudes of 1400-1800 m in dense moist forests (*E. prunifolius*).

Elaeocarpus lanceaefolius Roxb., called *Bhadras* in Nepali and *Sakalang* in Assam, is a medium to large sized tree (up to 30 m high and 4 m girth), with greyish-brown fibrous bark, occurring in the Eastern Himalayas and hills of Assam (up to 2700 m), Khasi Hills, Sylhet and Tenasserim (Gamble, 1972). In Arunachal Pradesh, the species occurs at altitudes of 1600-2000 m, in dense broad leaved sub-tropical to temperate forests in Changlang, Subansiri and Tirap districts (Hazra et al. 1996).

Therefore, the occurrence of fossil fruits resembling those of extant *Elaeocarpus lanceaefolius* Roxb. indicates the presence of sub-tropical to temperate broad leaved to evergreen forests in the area during the time of deposition. However, presently a tropical semi-evergreen forest cover is found in the area of investigation.

Acknowledgements: Grateful acknowledgements are due to the officers of Geological Survey of India, Op. Arunachal Pradesh, especially Sri Mohan Lal, Director and Sri S.K. Patel, Geologist for their help during collection of samples.

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(Received: 23 June 2003; Revised form accepted: 6 November 2003)