RESEARCH COMMUNICATIONS


Received 16 July 2003; revised accepted 13 November 2003

Additional information on palynological dating of Chhongtash Formation in eastern Karakoram and its palaeogeographical significance

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Palynological studies were carried out on additional samples of marine sedimentary succession of Chhongtash Formation, in eastern Karakoram, India. The present study revealed the presence of Lower Gondwana (Early Permian Asselian–Sakmarian) palynomorphs.

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The characteristic taxa reported in the assemblage include *Parasaccites, Plicatipollenites, Caheniasaccites* and some striate disaccates, viz. *Striatopodocarpites and Faunipollenites*. These taxa are definite indicators of the close relationship between Karakoram and Early Permian sequence of the Indian subcontinent. The palynoflora shows typical Gondwana aspect. There is little resemblance with Euromarian or Angara flora. The present finding of Gondwana microfossils from additional samples of the Karakoram further supports the contention that during Early Permian, the Karakoram plate was Peri-Gondwanan and it was not far from the Salt Range.

Karakoram is a 800 km long and 150 km wide tectonic unit situated between north Pamir and northwestern Tibet\(^1\). It lies along a critical geological juncture to the north of two suture zones, the Shyok Suture Zone and Indus Suture Zone (Figure 1) that mark the closing of different branches of Tethys ocean and finally the collision of India and Asia (60–50 Ma).

Chhongtash Formation\(^4,5\) is a 1500–2000 m thick unit consisting of interbedded pillow lava and sediments. The outcrop yielding plant fossils (Figure 2) consist of grey-brown sandstone and shales and lie a few metres above the pillow lava horizon. The upper part of Chhongtash Formation comprises grey limestones and calcareous sandstones (Figure 3). Based on the occurrence of fusulinid-bearing limestone and siltstone the age of the Chhongtash Formation has been assigned as Permian\(^4,5\). Earlier studies on plant megafossils and microfossils recorded from the Chhongtash Formation have suggested Early Permian age equivalent to Talchir Formation and Upper Karharbari Formation of India\(^6\).

Further palynological studies were carried out on additional samples in order to add more information on dating and correlation of the Chhongtash Formation. The palyno-assemblage recovered from these sediments shows dominance of radial monosaccates, chiefly *Parasaccites*. The other monosaccates recorded in the assemblage include *Plicatipollenites, Divarisaccus* and *Caheniasaccites*. Striate disaccates are represented by *Faunipollenites* and *Striataites* while non-striate disaccates by *Scheuringipollonites*. All these taxa, except *Ginkgodendrophytus* (Figure 4) were recorded in earlier studied samples\(^6\).

This palynoflora of Chhongtash Formation in eastern Karakoram shows greater similarity with that of the Gondwana region. The dominance of monosaccates during Early Permian has been recorded from all Gondwana continents, i.e. Africa (Dwyka Tillite\(^7\)), Australia (Bacus Marsh Tillite\(^8\)), Antarctica (Bukye Formation\(^1\); Darwin Tillite\(^12\); Roaring Formation\(^11\); Mackellar Formation\(^7\)), South America (Lower Itarare Formation of Brazil\(^9\)), India (Talchir and Karharbari formations\(^10,11\)), and Salt Range (Amb Formation\(^11,12,13\)). The overall composition of palynoflora suggests Early Permian (Asselian–Sakmarian) age equivalent to Talchir/Upper Karharbari Formation of peninsular India.

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**Figure 1.** Map showing location of samples from where the Early Permian palynomorphs have been recovered.
India. Presence of acritarchs shows marine conditions during the deposition of these sediments. From the present study, a closer affinity of Karakoram Tethyan zone with central Gondwana continents is evident. Occurrence of Lower Gondwana plant micro- and megafossils in Western Garo Hills\textsuperscript{21} and occurrence of early Permian microflora from Darjeeling, Siang and Barpater regions\textsuperscript{22} have also indicated resemblance of Himalayan Tethyan zone with central Gondwana continents.

Abundance of \textit{Vittatina} and disaccate pollen in Asselian and \textit{Vittatina}, \textit{Cordaitina}, \textit{Limitisporites}, \textit{Cycadopitys}, \textit{Crucisaccites} and \textit{Azonotriletes} in Sakmarian has been recorded from Mid and South Urails\textsuperscript{23}.

The most abundant form in Angara flora is \textit{Cordaitina} and \textit{Luberisaccites}, while in the south Cathaysia flora the most abundant form is \textit{Florinutes}, \textit{Torispore} and \textit{Thymostora}. Hence, there is little resemblance with Euromarian or Angara flora because the present assemblage shows dominance of \textit{Parasaccites} along with some striate disaccates, viz. \textit{Faunistopollenites}, \textit{Striatopodocarpites} and non-striate disaccate, \textit{Scheiringipollenites}. Leaf impressions of \textit{Noeggerathiopsis}, a definite gymnosperm seed, probably \textit{Samaropsis}, a large portion of \textit{Ganamooptera} leaf and equisetalean axis along with some unidentifiable plant type have been reported from the Chhongtash Formation\textsuperscript{24}. These plant microfossils and megafossils from the Chhongtash Formation of Karakoram region indicate that these

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\textbf{Figure 2.} Chhongtash Formation, eastern Karakoram.

\textbf{Figure 3.} Lithostratigraphic column of part of Chhongtash Formation near Chhongtash showing plant fossils and palynomorphs bearing sandstone and shale (after Sinha et al\textsuperscript{25}).
Figure 4. a–m. Palynomorphs recovered from Chongtash Formation. a. Parasaccites BSIP slide no. 12892, M54/4, × 500; b. Ginkgocycadophytes BSIP slide no. 12894, Q48/1, × 500; c. Parasaccites BSIP slide no. 12894, E44/1, × 500; d. Cordaitina BSIP slide no. 12892, L52/3, × 500; e. Parasaccites BSIP slide no. 12892, P55/3, × 500; f. Faunipollenites BSIP slide no. 12892, N57/3, × 300; g. Parasaccites BSIP slide no. 12892, M54/4, × 500; h. Cohenisaccites BSIP slide no. 12894, O48, × 500; i. Parasaccites BSIP slide no. 12892, J51/4, × 300; j. Parasaccites BSIP slide no. 12895, H62/1, × 500; k. Parasaccites BSIP slide no. 12893, I34/4, × 300; l. Parasaccites BSIP slide no. 12894, R59/1, × 300 and m. Parasaccites BSIP slide no. 12894, K59/2, × 300.
sediments have basic Lower Gondwana composition. The present study further supports the contention that during Early Permian, the Karakoram was located along the northern margin of Gondwana, i.e. the Karakoram plate was Peri-Gondwana, as envisaged by Upadhyay et al. 


Received 14 July 2003; revised accepted 6 November 2003

Evidence of formation of potholes in bedrock on human timescale: Indrayani river, Pune district, Maharashtra

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In resistant strata, potholes require hundreds to thousands of years to form. Here we report evidence for the formation of several potholes (0.2–1.0 m in diameter) in about 60 years, within man-made channels and pits carved in bedrock basalt in the channel of the Indrayani river. Although documentary evidence is lacking, available information indicates that the man-made channels and pits were most likely carved in mid-1940s. The evidence demonstrates that even in resistant bedrock, such as basalt, measurable bedrock erosion can take place in a few decades. This finding has enormous implications for improving the understanding of the rates of formation of rocky channels and gorges in large Indian rivers, where the energy levels are higher by several orders of magnitude.

POTHOLES are one of the most common and spectacular features formed in bedrock by rapidly flowing rivers. It is generally assumed that due to considerable resistance to

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