COLINEARITY OF HOT SPRINGS IN LADAKH, HIMACHAL PRADESH AND TECTONIC ELEMENTS IN WESTERN INDIA

S. P. MISHRA
Geological Survey of India, Jaipur 302006, India.

THE hot springs of Puga in Ladakh, Manikaran in Himachal Pradesh and the Precambrian volcanic vent of Mandli, west of Jodhpur in Rajasthan, lie on a northeasterly (N 35° E) straight line. Projected southwesterly and this line joins the Luni river at a point where the westerly flowing river makes a sharp turn to southwest (figure 1). The Luni is a graben and forms an important tectonic lineament of Western India[1]. Northeast of Mandli the alignment extends closely proximal to another major tectonic feature of the region, the NNE 400 km long Sardarshahr graben which is seismically active even today[2]. Mandli, within the Malani igneous suite (430–740 m.y), is a recently discovered first find of a volcanic vent in the Precambrians of Rajasthan[3]. The alignment deciphered, termed Luni-Puga lineament, shows in parts regional parallelism with approximately NNE-SSW to NE-SW trending LANDSAT megalineament in Ropar-Mandi-Kulu region[4]. A stock-like body of basic-ultrabasic complex, occurring within lens-shaped north-south extending Mandi granite, which is intrusive in Jutogh sediments, is superimposed right over the conceptual lineament east of Mandi about 50 km southwest of Manikaran[5]. The occurrence of saline hot water springs and Precambrian salt deposits, possibly derived mostly from Mandi-Darla volcanics or even from plug-like structures in the initial stage of tectonic evolution, in Mandi region is equally significant[6]. Further northeast a cluster of epicentres of earthquakes with a NE-SW linear trend is conspicuously noted at Jan close to the lineament about 10 km west southwest of Manikaran[7]. At Puga the thermally anomalous zone is suggested to be regularly fed with hot waters from N-S, NE-SW lateral channels of a deep-seated main reservoir[8]. Significantly both the Himalayan geothermal areas *do* have transverse subsurface features which are empirically on the continuation of northeasterly trends in the Peninsular Shield.

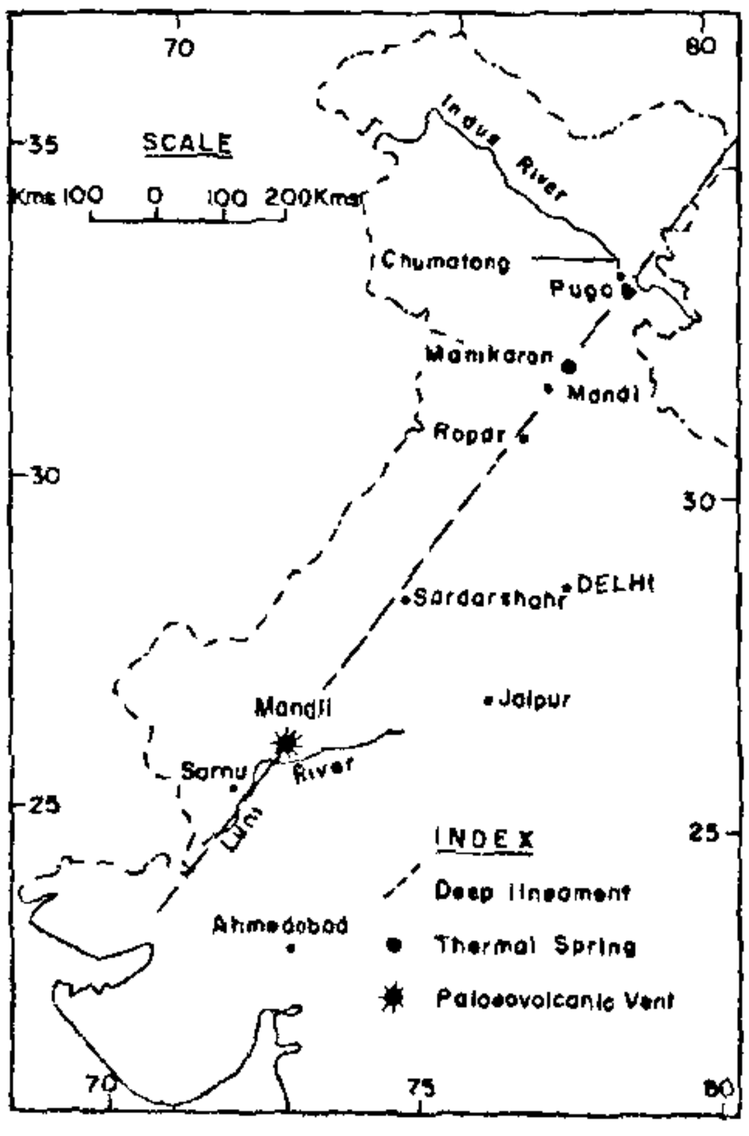


Figure 1. Palaeovolcanic vent and thermal springs.

Puga area forms the northern most edge of the Indian plate and comprises predominently of Palaeozoic paragneisses, amphibolites and younger granites[9]. Hot springs are located along a faulted east-west trending anticlinal axis. The fluorite deposits of Chumatang is approximately 18 km north of Puga. The hot springs of Manikaran, consistent with northwesterly faults and fractures, are located within highly fractured quartzite. This Manikaran quartzite is intruded by Precambrian Bandal granite (1200 m.y.) which has been suggested as part of the basement rocks of Peninsular afinities[10]. The outpouring of the Malanis in Western Rajasthan is attributed to closely spaced linear deep fractures and crustal dislocations[1]. The coexistence of acid and basic rocks in the region are interpreted to be indicative of rift environment where magmatism was triggered by mantle plume[11]. A carbonatite (correlatable with Amba Dongar, 37 m.y.) body is located at Sarnu, 25 km west of Luni in Barmer[1]. Carbonatite is again reported within basic volcanics at Drakkarpo about 100 km east of Puga[12]. Both the carbonatites are aligned northeasterly with respect to each other. Isotopic data indicate granites of deep crustal and mantle origin in Ladakh.[13,14].

The empirical model suggests that colinear geological features are related to basement fractures occurring in continuity. The link-up of the fractures through Luni and Sardarshahr grabens resulted in the formation of a continuous lineament extending from Shield region to Himalayas. An analogy could be drawn with many of the grabens in the USSR which meet the orogenic belts at high angles[15]. The Himalayan hot springs, carbonatite and fluorite mineralisation would appear to be located at the intersection of ancient reactivated NE-SW lineaments and the younger WNW lineaments of younger orogenies. This observation is

in conformity with the recent suggestion that thermal springs east of Aravallis are colinear with those in Garhwal-Kumaon region[16].

Grateful thanks are due to Mr. G. M. Banerjea and Mr. V. D. Chande for useful discussion.

25 April 1983; Revised 10 July 1983.

1. Narayan Das, G. R., Bagchi, A. K., Chaube, D. N., Sharma, C. V. and Navaneetham, K. V., *Recent researches in geology*, Vol. 7, Hindustan Pub. Corpn, New Delhi, 1978, p. 203.
2. Ahmad, F. and Ahmad, Z. S., *Tectonophysics*, 1980, **64**, 104.
3. Bhusan, S. K., *GSI News*, 1978, **9**, 3.
4. Virdi, N. S., *Him. Geol.*, Vol. 9, Wadia Institute, Dehra Dun, 1979, p. 293.
5. Chatterjee, B., *Rec. Geol. Surv. India*, 1975, **106**, 97.
6. Srikantia, S. V. and Sharma, R. P., *Him. Geol.*, Vol. 2, Wadia Institute, New Delhi, 1972, p. 230.
7. Chaudhury, H. M. and Chatterjee, S. N., *J. Volcanol. Geotherm. Res.*, 1981, **9**, 37.
8. Gupta, M. L., Singh, S. B., Sharma, S. R. and Saxena, V. K., *Geophys. Res. Bull.*, Spl. Issue NGRI, Hyderabad, 1982, p. 303.
9. Ravi Shanker, Padhi, R. N., Gyan Prakash, Thussu, J. L. and Wangdus, C., *Proc. Seminar on Tectonics and Metallogeny of South and East Asia*, Misc. Publ. GSI, Vol. 34, 1976, p. 50.
10. Bhanot, V. B., Bhandari, A. K., Singh, V. and Kansal, A. K., *Proc. Himalayan Geol. Seminar.*, 1976, New Delhi, Section IB, 1982, p. 272.
11. Kochar, N., *Geol. Soc. Am. Bull.* 1982, **93**, 926.
12. Verma, N. K. R., *Recent geological studies in the Himalayas*, Misc. Pub. No. 24, Pt. I, GSI, Calcutta, 1975, p. 244.
13. Trivedi, J. R., Gopalan, K., Sharma, K. K., Gupta, K. R. and Choubey, V. M., *Proc. Indian Acad. Sci., (Earth Planet Sci.)* 1982, **91**, 65.
14. Bonneger, K., Dietrich, V., Frank, W., Gansser, A., Thoni, M. and Tromm-droff, V., *Earth Planet Sci. Lett.*, 1982, **60**, 293.
15. Mitchel, A. H. G. and Garson, M. S., *Mineral deposits and global tectonic settings*, Academic Press, London, 1982, p. 57.
16. Mishra, S. P., *Proc. Symp. on Precambrian Metallogeny*, IGCP Project, No. 91, GSI, Bangalore, 1982, p. 63.

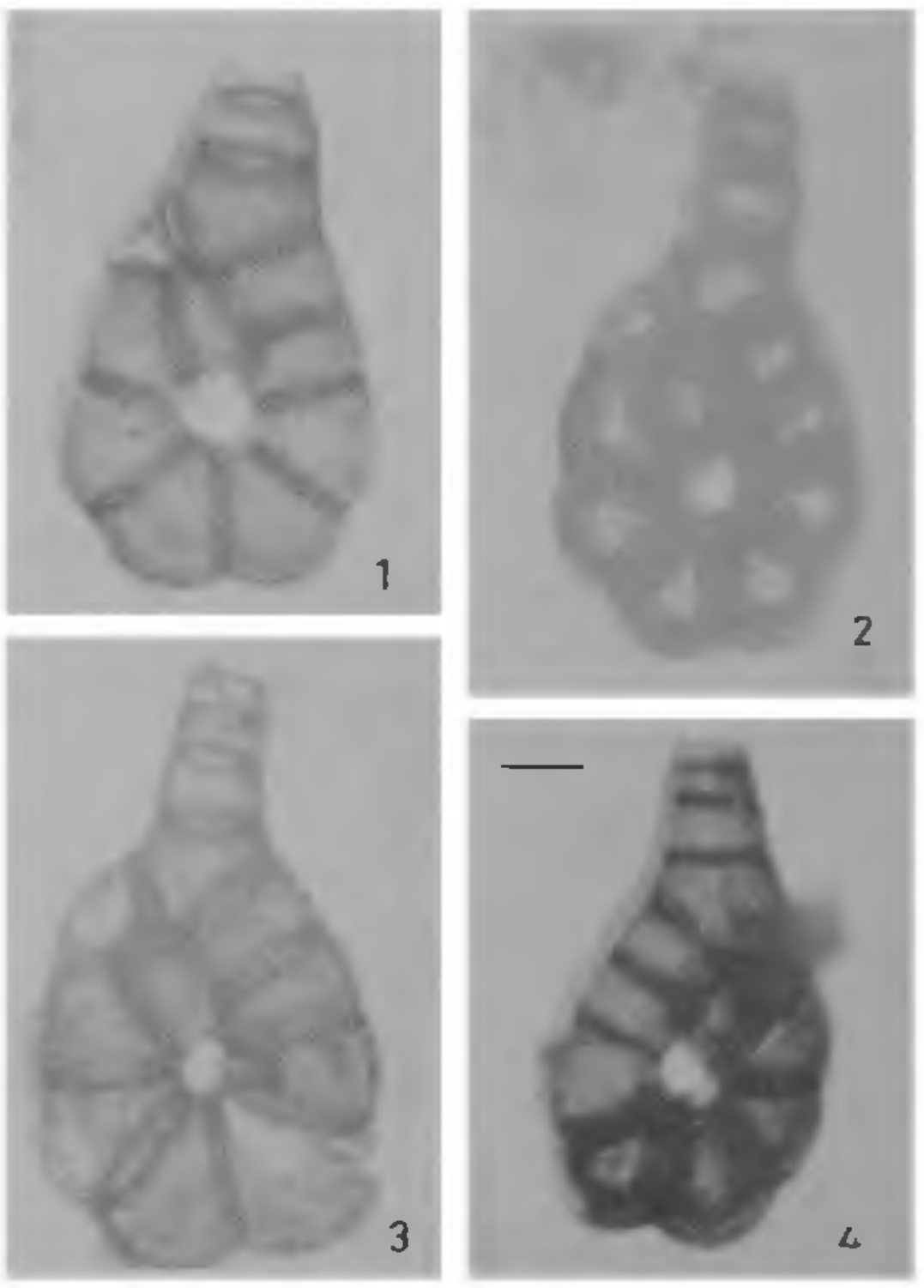
FIRST RECORD OF *CIRCINOCONIS* CONIDIA FROM THE HOLOCENE FORMATION OF TRIPURA, INDIA

M. N. V. PRASAD and N. R. RAMESH*

Department of Botany, North-Eastern Hill University, Shillong 793014, India.

**Quaternary Geology and Geomorphology Division, Geological Survey of India, North-Eastern Region, Shillong 793001, India.*

PALYNOLOGICAL studies of the peat samples collected from a freshly dug tank at Sekerkot village, West Tripura District, Tripura showed dispersed conidia of *Circinoconis* Boedijn, 1942, a Hyphomycetous (Helicosporae) fungus *Circinoconis* has not so far been reported from India[1,2] (also personal communication with Prof. C. V. Subramanian 16 August 1983). However, it is known from Sumatra (Krakatoa island)



Figures 1-4: Dispersed conidia of *Circinoconis* Boedijn from Tripura peat. The bar in figure 4:14 μm for all figures. The slides are kept in author's (MNVP) palaeobotanical collection.