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Diatom analysis of Hirpur Locality III (Lower Karewa), Kashmir Valley

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This paper embodies the results of diatom analysis of 54 samples covering all the lithofacies in Hirpur Locality III, Kashmir Valley. Out of 54 samples, only 16 samples have yielded diatoms whereas rest of the samples proved barren. Diatom analysis has enabled to present two-fold comments: (i) the sediments are poor in diatoms and most of the frustules are ground, and (ii) these sediments are rich in Pennales. Furthermore, the frequency and nature of diatoms in the samples have revealed that the depositional environments were not wholly ponding rather there might have been violent floodings of the lake which perhaps hampered the growth of diatoms and their preservation too.

Key-words—Diatoms, Palaeoclimate, Lower Karewa, Upper Pliocene (India).

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साराँश

काश्मीर घाटी में हिरपुर संस्थिति-तृतीय (अधरि करेवा) का डायटम विश्लेषण

हरीपाल गुप्ता एवं आशा खण्डेलवाल

इस शोध-पत्र में काश्मीर घाटी की हिरपुर संस्थिति-तृतीय में सभी शैल-संलक्ष्णीयों से एकत्रित 54 नमूनों के डायटम विश्लेषण के परिणाम प्रस्तुत किये गये हैं। एकत्रित 54 नमूनों में से 16 नमूनों से डायटम उपलब्ध हुए हैं तथा शेष सभी नमूने अधारक पाये गये हैं। डायटम विश्लेषण से दो प्रकार की टिप्पणियाँ की गई हैं : (अ) डायटमों की अवसादों में अल्प मात्रा है तथा अधिकतर फ्रस्ट्यूल भौमिक हैं, तथा (आ) ये अवसाद पिन्नेल्स से प्रभावी हैं। इसके अतिरिक्त नमूनों से उपलब्ध डायटमों की प्रकृति एवं बारम्बारता से व्यक्त होता है कि निक्षेपणीय वातावरण पूर्णतया सरोवरी नहीं थे बल्कि झील भीषण बाढ़ से सम्भवतया प्रभावित थी जिसके कारण शायद डायटमों की वृद्धि तथा इनका परिरक्षण रुक गये थे।

THE Hirpur Locality III (33°41′N, 75°41′E) exposed along the Rimbiara River, southwest of Srinagar in Anantnag District, forms a part of Hirpur Formation and marks the basal part of Lower Karewa in Kashmir Valley. These sediments are subjected to diatom analysis. However, there are reports on diatom floristics from Karewa sediments exposed elsewhere in the valley. The information available on the occurrence of diatoms in Kashmir Valley is meagre and largely deals with the enumeration of diatom taxa.

The diatom study of Karewas dates back to the early twentieth century when Conger (in de Terra & Paterson, 1939) could enumerate about 70 species of diatoms from lignite bearing beds at Handawor and in Shaliganga Valley. The information of diatom study by Lundquist (1936) was briefly summarized by de Terra and Paterson (1939). Iyengar and Subrahmanyan (1943) analysed Karewa shale exposed at about 9,000 ft at Gulmarg for diatom recovery and recognised 10 genera, 13 species, two varieties, one new variety and one new form. Thereafter, Karewas did not receive any attention from scientists of this discipline and after a lapse of about two decades, the Karewa sediments from clayey blocks at Laredura in Kashmir Valley were investigated by Rao and Awasthi (1962) who made a short report of centric diatoms belonging to *Melosira, Cyclotella* and *Stephanodiscus* and they also noted the occurrence of pennate diatoms. Puri

(1948) has also made a passing reference of diatoms so far worked out by the earlier workers. Nevertheless, Roy (1974, 1980) collected about 1,000 samples from 32 measured sections between Nichahom and Kurigam for biozonation of Karewas in Kashmir Valley. He also emphasized that the Lower Karewa is quite rich in fossil diatoms while the Upper Karewa is devoid of them. It is further observed that there is an uniformity in the trend of distribution and assemblage of fossil diatoms in the Lower Karewa beds. Based on these studies, Roy (1974, 1980) divided Lower Karewa into: (i) the lower Centrales assemblage zone, and (ii) the upper Pennales assemblage zone and assigned Miocene and Pliocene age respectively. Earlier, Roy (1971) recorded 72 species of diatoms belonging to 29 genera from the Lower Karewa in Kashmir Valley. Gandhi and Mohan (1983) and Gandhi *et al.* (1985, 1986) while studying Bal Tal and other samples in Kashmir Valley have noted a rich assemblage of diatoms.

The object of undertaking diatom study of Hirpur (Lower Karewa) was firstly to work out the depositional environments as an ancillary to the pollen and spore analysis and secondarily to confirm the observations of Roy (1974, 1980) as regards the age of Karewas which has been a matter of discussion amongst Cenozoic geologists, sedimentologists, palynologists, palaeobotanists and magnetostratigraphers.

MATERIAL AND METHOD

The samples were procured from scarpment exposed along the Rimbiara River and have been recognised as Hirpur Locality III. About 10 gm of material from each sample was first gently ground and boiled in concentrated HCL for about an hour in order to remove the carbonates present in the matrix. Then the material was kept in distilled water for 4-5 hours to settle down. Later the fluid was decanted out and the residue was boiled in concentrated HNO_3 with a few crystals of $K_2Cr_2O_7$ to remove organic material. Thereafter, the samples were washed repeatedly with distilled water and allowed the residue to settle down. The permanent slides were prepared in canada balsam and traverses were counted under 40× objective of microscope. The slides have been deposited in the repository of Birbal Sahni Institute of Palaeobotany, Lucknow.

In all, 54 samples were studied for diatoms in varying frequencies. The frequency of the various components was assessed on four point scale (abundant, frequent, occasional and rare) as given below:

Sample no.	33	36	38	72	80	95	109	111	123	141	164	202	212	225	230	247
Nature of sediments	Lig-nite	Lig-nite	Lig-nite	Mud	Sand	Lig nite	Clay	Sand	Sand	Lig-nite	Lig-nite	Muddy sand	Muddy sand	Lig-nite	Lig-nitic Mud	Clay
Taxa																
Cocconeis	—	R	O	—	—	R	—	—	R	O	—	—	—	—	—	—
Cyclotella	—	—	O	—	—	O	—	O	F	R	R	—	—	—	—	R
Fragilaria	—	O	O	—	—	—	O	—	O	R	—	R	—	—	O	O
Gomphonema	—	R	R	—	—	—	O	—	F	F	F	F	—	F	R	O
Melosira	F	F	A	F	—	—	—	—	R	R	R	—	—	R	O	—
Navicula	A	F	A	F	—	—	F	—	F	O	A	R	—	F	F	A
Nitzschia	A	A	A	—	F	—	A	R	—	A	F	F	—	F	R	O
Pleurosigma	—	—	—	—	—	—	—	R	R	R	—	—	—	—	—	—
Surirella	—	—	—	—	—	—	—	—	—	—	—	—	—	—	R	—
Synedra	A	—	—	F	F	A	—	—	O	A	O	—	R	—	O	O
Unidentified	—	R	R	R	R	—	—	—	—	—	R	—	R	—	—	—

A = Abundant; F = Frequent; O = Occasional; R = Rare.

DIATOM COMPOSITION

The samples have been analysed from all the three lithounits, viz., laminated muds, lignitic muds and sands which yielded diatoms. However, most of the samples from laminated muds have not shown the positive results. On the whole, the diatom assemblage from Hirpur Locality III is poor. The diatom assemblage depicts the preponderance of Pennales as compared to Centrales.

MORPHOLOGICAL DESCRIPTION

Genus—*Cocconeis* Ehrenberg

Cocconeis placentula Ehrenberg

Text-fig. 8

Valve broad, elliptical, length 27.0 μm, breadth 18.0 μm. Striae punctate, linear and in longitudinal series, 18-20 in 10 μm.

Nature—Fresh and brackish water.

Genus—*Cyclotella* Kutzing

Cyclotella meneghiniana Kutz.
Text-fig. 17

Valve discoidal, diameter 23.5 μm, valve margin striated. Striae wedge-shaped, short, 9-11 in 10 μm.
Nature—Fresh to marine water.

Cyclotella sp. 1
Text-fig. 20

Valve discoidal, diameter 30.0 μm, valve margin striated. Striae long, 8-9 in 10 μm.

Cyclotella sp. 2
Text-fig. 24

Valve discoidal (pressed rectangularly in permanent slide), diameter 25.0 μm, valve margin striated. Striae short, 9-10 in 10 μm.

Genus—*Fragilaria* Lyngbye

Fragilaria construens (Ehrenberg) Grun.
Text-fig. 29

Valve lanceolate with apices rostrate, inflated in median portion, length 10-20 μm, breadth 5-7 μm. Striae very delicate.
Nature—Fresh water.

Fragilaria sp.
Text-fig. 14

Five valves in chain, length of valve 19.5 μm.

Genus—*Gomphonema* Agardh

Gomphonema augur Ehrenberg
Text-fig. 13

Valve cordate-cuneate, with upper apex obtuse-apiculate, lower apex attenuate, slightly subrostrate, length 30 μm, breadth 13.0 μm. Striae distinct, 10-14 in 10 μm.
Nature—Fresh water.

Gomphonema olivaceum (Lyngb.) Kutz.
Text-fig. 19

Valve clavate, with broadly rounded apex and attenuated base, length 27.5 μm, breadth 13.0 μm. Striae indistinct.
Nature—Fresh water.

Genus—*Melosira* Agardh

Melosira ambigua (Grun.) O. Muller
Text-fig. 6

Valve cylindrical, in chains, height of one semicell 11.0 μm, diameter 9.0 μm. Punctae and sulcus indistinct.
Nature—Fresh water.

Genus—*Navicula* Bory

Navicula sp. 1
Text-fig. 4

Valve linear-lanceolate with capitate ends, length 64.5 μm, breadth 23.5 μm. Striae and nodules faint.
Nature—Fresh Water.

Navicula sp. cf. *N. exiqua* (Gregory) O. Muller
Text-fig. 5

Valve elliptic-lanceolate, with capitate-rostrate ends, length 63.0 μm, breadth 13.5 μm; central area distinct with more or less radial striae.
Nature—Fresh water.

Navicula sp. 2
Text-fig. 11

Valve attenuate, rounded at the ends, length 25.0 μm, breadth 10.0 μm. Striae indistinct.
Nature—Fresh water.

Navicula sp. 3
Text-fig. 25

Valve broadly lanceolate with feeble constriction and capitate ends, length 38.0 μm, breadth 12.0 μm. Raphe thin and straight. Striae 8-13 in 10 μm.
Nature—Fresh water.

Navicula sp. 4
Text-fig. 26

Valve elliptical-lanceolate with slight constriction and broadly produced rounded ends, length 46.0 μm, breadth 15.0 μm. Striae indistinct.
Nature—Fresh water.

Navicula sp. 5
Text-fig. 28

Valve linear-lanceolate with pointed ends, length 26.0 μm, breadth 6.0 μm at the broadest. Striae indistinct.
Nature—Fresh water.

Genus—*Nitzschia* Hassall

Nitzschia obtusa W. Smith
Text-fig. 1

Valve linear, slightly constricted towards the centre and tapering towards the truncate ends, length 105.0 μm, breadth 10.5 μm. Keel punctae 9-10 in 10 μm. Striae indistinct.
Nature—Fresh and brackish water.

Nitzschia sp. 1
Text-fig. 7

Valve linear, elliptical with rounded ends, length 36.5 μm, breadth 12.5 μm. Keel punctae 10-12 in 10 μm.
Nature—Fresh water.

Nitzschia sp. 2
Text-fig. 10

Valve linear, lanceolate, length 24.0 μm, breadth 5.0 μm. Keel punctae 10-12 in 10 μm.
Nature—Fresh water.

Nitzschia sp. 3
Text-fig. 12

Length of the valve 50.0 μm (girdle view), keel punctae distinct.
Nature—Fresh water.

Nitzschia sp. 4
Text-fig. 15

Valve linear, lanceolate, length 60.5 μm, breadth 10.0 μm. Keel punctae generally indistinct.
Nature—Fresh Water.

Nitzschia sp. 5
Text-fig. 16

Valve narrowly lanceolate with tapering ends, length 90.0 μm, breadth 3.0 μm. Keel punctae and striae indistinct.
Nature—Fresh Water.

Nitzschia sp. 6
Text-fig. 18

Valve broadly elliptical-lanceolate, ends somewhat rounded, length 27.0 μm, breadth 15.0 μm. Striae distinct.
Nature—Fresh Water.

Nitzschia sp. 7
Text-fig. 23

Valve linear-lanceolate, slightly inflated in the middle part, length 40.5 μm, breadth 4.0 μm. Keel punctae 10-12 in 10 μm.
Nature—Fresh Water.

Nitzschia sp. 8
Text-fig. 27

Valve broadly linear with slightly concave sides, length 45.0 μm, breadth 10.0 μm. Striae distinct.
Nature—Fresh Water.

Genus—*Pleurosigma* W. Smith

Pleurosigma sp.
Text-fig. 3

Valve elongate-elliptical, sigmoid. Subacutely, rounded at the poles, length 100.0 μm, breadth 13.0 μm. Raphe sigmoid. Striae faint.
Nature—Fresh to brackish water.

Genus—*Surirella* Turpin

Surirella sp.
Text-fig. 21

Valve heteropolar, ovate with broadly rounded apex and acutely cuneate base, length 62.5 μm, breadth 20.0 μm at the broadest point. Flap margins, windows, costae and striae indistinct.
Nature—Fresh to brackish water.

Genus—*Synedra* Ehrenberg

Synedra ulna Nitzsch
Text-fig. 9

Valve linear, apices more or less long-rostrate, generally broken lengthwise, breadth 10.0 μm. Striae distinct.
Nature—Fresh water.

Synedra sp.
Text-fig. 2

Valve linear, apices more or less long-rostrate, length 75.0 μm, breadth 12.0 μm. Striae distinct, leaving a quadrangular hyaline space in median portion.
Nature—Fresh water.

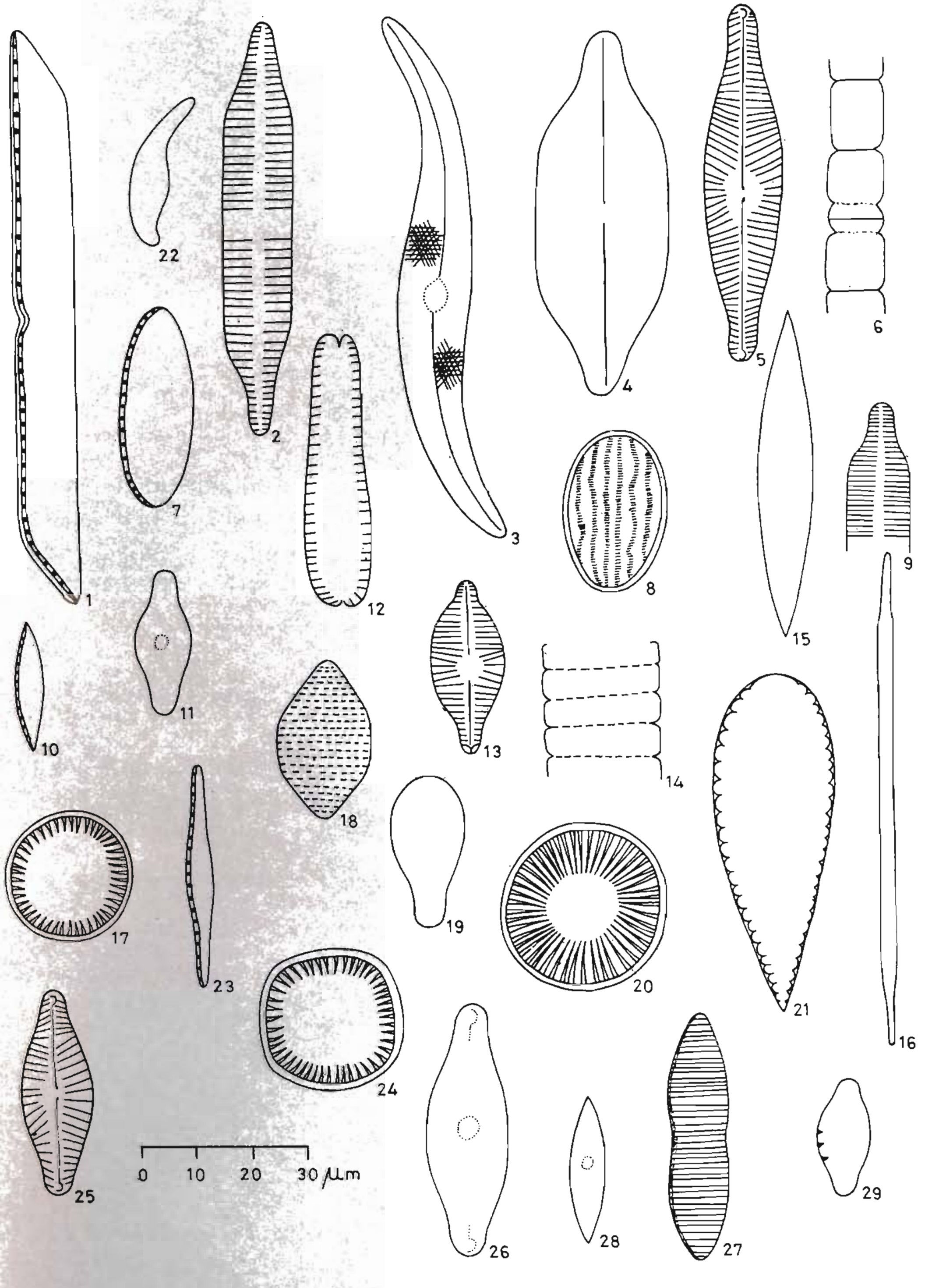
Unidentified form
Text-fig. 22

Valve asymmetrical with indistinct characters.

DISCUSSION AND CONCLUSION

The diatom analysis of Lower Karewa samples from Hirpur Locality III in Kashmir Valley has been assessed in the light of depositional environments as well as the age of Lower Karewa as suggested by earlier workers.

1. The sediments exposed at Hirpur Locality III are all the more poor in diatoms. However, diatoms could be recovered from all the three lithofacies.
2. The diatom assemblage is predominated by Pennales, whereas Centrales are scarce. The stratigraphical distribution of diatoms has revealed that the occurrence of *Nitzschia, Navicula* and *Synedra* is more frequent as compared to other diatom taxa.
3. Most of the diatom frustules are either broken or ground suggesting their allochthonous nature of deposition. Thus, the frequency and nature of diatoms recovered from the sediments portray



Text-fig. 1—1, *Nitzschia obtusa* W. Smith: Slide no. BSIP 36(1); **2**, *Synedra* sp.: Slide no. BSIP 141(4b); **3**, *Pleurosigma* sp.: slide no. BSIP 141(4); **4**, *Navicula* sp. 1: slide no. BSIP 141(2); **5**, *Navicula* sp. cf. *N. exiqua* (Gregory) O. Muller: slide no. BSIP 247(2); **6**, *Melosira ambigua* Muller: slide no. BSIP 38(3); **7**, *Nitzschia* sp. 1: slide no. BSIP 38(3); **8**, *Cocconeis placentula* Ehrenberg: slide no. BSIP 38(2); **9**, *Synedra ulna* Nitzsch: slide no. 95(4); **10**, *Nitzschia* sp. 2: slide no. BSIP 33(1); **11**, *Navicula* sp. 2: slide no. BSIP 33(10); **12**, *Nitzschia* sp. 3: slide no BSIP. 38(2); **13**, *Gomphonema augur* Ehrenberg: slide no. BSIP 141(5); **14**, *Fragilaria* sp.: slide no. BSIP 141(1); **15**, *Nitzschia* sp. 4: slide no. BSIP 141(1a); **16**, *Nitzschia* sp. 5: slide no. 230(4); **17**, *Cyclotella meneghiniana* Kutz.: slide no. BSIP 141(6); **18**, *Nitzchia* sp. 6: slide no. BSIP 141(6); **19**, *Gomphonema olivaceum* (Lyngb.) Kutz: slide no. BSIP 141(2,4); **20**, *Cyclotella* sp. 1: slide no. BSIP 95(7); **21**, *Surirella* sp.: slide no. BSIP 230(4); **22**, Unidentified form: slide no. BSIP 141(4); **23**, *Nitzschia* sp. 7: slide no. BSIP (2); **24**, *Cyclotella* sp. 2: Slide no. BSIP 123(1); **25**, **26**, *Navicula* sp. 3 and 4: slide no. BSIP 38(3); **27**, *Nitzschia* sp. 8: slide no. BSIP 36(3); **28**, *Navicula* sp. 5: slide no. BSIP 38(3); **29**, *Fragilaria construens* (Ehrenberg) Grun.: slide no. BSIP 38(3).

that depositional environments were not wholly ponding/lacustrine. Instead, there might have been periodical violent floodings of the lake which perhaps hampered the growth of diatoms and their preservation too. Another possibility could be that most of the diatoms were drifted from elsewhere along with water streams.

The diatom study could be of paramount importance to work out the palaeo-drainage system with a greater precision provided the finer details of the ecological range of each diatom species are available. Nevertheless, future work on diatoms will also have its impact on determination of palaeo-temperatures. However, the total diatom assemblage indicates fresh water conditions.

4. The age of Lower Karewa had been a matter of controversy since the time of Lydekkar (1883) and there had been practically no unanimity amongst the subsequent workers as regards to the age and thickness of Lower Karewa.

Roy (1974, 1980) based on the concept that the sediments exposed between Nichahom and Kurigam are the sole representatives of the entire Lower Karewa and applied diatom analysis to the sediments for the purpose of biozonation and their age. He formulated two biozones, viz., the lower Centrales Zone and upper Pennales Zone. Considering the monophyletic origin of diatom and in connivance with the general consensus of opinion amongst diatomists that Miocene enjoyed the profusion of centric diatoms, Roy (1974, 1980) envisaged Miocene and Pliocene age respectively.

However, our studies on diatoms from Hirpur Locality III, a part of Hirpur Formation (Bhatt, 1976) and supposed to be the basal part of the Lower Karewa, do not support the hypothesis postulated by Roy (1974, 1980). Our observations, however, reveal the predominance of pennate diatoms which in any case do not suggest Miocene age. We are as a matter of fact afraid to comment on the age on the basis of diatoms alone. Nevertheless, when seen in context with palynostratigraphy and magnetostratigraphy this column of stratigraphy may be put up in Upper Pliocene Age.

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