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The Fossil Diatoms in the Hirazawa Diatomite, Miyagi-ken, Japan

By
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(With PL. I)

Introduction.

The Hirazawa diatomite deposit is developed in the north-western part of Enda-mura, Katta-gun, Miyagi-ken. Its outcrop occupies an area which is about 3 km from east to west and 3.5 km from north to south.

Up to present only a few geologists⁽¹⁾⁽²⁾ have discussed the origin of this deposit, but none has examined in detail the fossil diatoms themselves in it. It is my intension to describe the more important species of the diatoms with a special reference to the way they were deposited.

In the course of study on the specimens in my collection, I have been able to recognize a number of species of diatoms in them. It is important to note that they are almost all the same species that are common in the fresh-water deposits of the localities in Japan. The purpose of this article is to give a general idea of important relation between ecology and sedimentation.

Mr. S. Hayashi of the Geological Survey of Japan has thoroughly investigated the processes of formation of this deposit in 1949. The several diatomite specimens in my collection realize what is expected from his discussion and it is certain that the specimens originated from the very deposit. For the geological features of some of the locality, therefore the data in his report are introduced.

I wish here to express my sincere thanks to Prof. Dr. I. Hayasaka and Prof. M. Oozawa of our University and Prof. Dr. T. Kobayashi of Tokyo University, for the kind directions and encouragements given in various ways.

The Geology of Hirazawa and Vicinity.

In this region, three different beds of sediments are recognizable. The lower is the Enda-bed which is Pliocene in age. The middle diatom-bearing bed and the upper, composed of loamy clay, belong to the Pleistocene series.

The diatomite deposit under consideration lies on the yellowish-brown sandstone (10

⁽¹⁾ Sato, D., Generality of Japanese Diatomite. Rep. Geol. Sur., Vol. 31, 1911, Geol. Sur. Jap.

⁽²⁾ Hayashi, S., Report on the Diatomite Deposit, Enda-mura, Katta-gun, Miyagi-ken. Hurried Rep., No. 102, 1949, Geol. Sur. Jap.

m in thickness) representing the upper part of the Enda-bed. The deposit measures about three meters in thickness. And it is covered by the pumice-bed and further by the alternating beds of sand, conglomerate, and pumice.

The diatomite deposit which lies between the pumice-bed and the yellowish-brown sandstone, is divided into five parts according to its colour difference, as follows :

Table I

No. of Part	Name of Rock	In Thickness
	Pumice	
	Pumice bearing reddish-purple clay	
I	Bluish-white diatomite	20~ 30 cm
II	Light-yellow diatomite	150~200 cm
III	Bluish-white diatomite	20~ 30 cm
IV	Yellowish-brown diatomite	60 cm
V	Bluish-white sandy diatomite	100~200cm
	Yellowish-brown sandstone	

These five parts (I—V) form the so-called Hirazawa diatomite.

According to the result of chemical analysis which was done by the Geological Survey of Japan in 1949, the compositions of the part II and III are as follows :

Table II

No. of Part	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Na ₂ O	K ₂ O	+H ₂ O	-H ₂ O	S	Total
II	79.56	4.48	1.87	0.02	0.43	0.81	0.29	6.14	6.60	0.01	100.21
III	80.28	5.91	1.61	0.31	0.48	0.10	0.24	5.78	5.28	0.00	99.99

The bluish-white parts (I and III) are the most excellent of the Hirazawa diatomite. The colour difference between II and III depends upon a slight variation of chemical composition.

In Japan, it is customary to characterize diatomites by colour and chemical composition. These features are helpful, really important and useful for a tentative classification, but are by no means final.

The Fossil Diatoms in the bluish-white sandy Diatomite.

Fossils afford testimony as to the environment in which they lived. Many species of diatoms have their particular environments or habitats, which may be rivers, lakes, or oceans.

According to my microscopical examination on the sections of the bluish-white sandy diatomite, there are the following thirty-three species of diatoms. Most of these species belong to the fresh-water type, only two being cosmopolitan in distribution.

Table III
List of Diatoms and their Habitats

Specific Name	Habitat	D. C. R.	No. on Plate
1. <i>Amphora ovalis</i> KTZ.	Fresh water : frequent	Rare	28
2. <i>Cocconeis placentula</i> EHR. var. <i>lineata</i> (EHR.) CL.	∥	Subcommon	25
3. <i>Cocconema cymbiforme</i> EHR.	Fresh water	Rare	27
4. <i>Cyclotella operculata</i> EHR.	∥	Dominant	34
5. <i>Epithemia Hyndmanii</i> W. SM.	∥	Subcommon	20,26
6. <i>Epithemia ocellata</i> KTZ.	∥	Rare	23
7. <i>Epithemia porcellus</i> KTZ.	∥	∥	15
8. <i>Epithemia sores</i> KTZ.	Fresh or brackish water	∥	32
9. <i>Epithemia turgida</i> (EHR.) KTZ.	Fresh water	∥	21
10. <i>Eumotia flexuosa</i> (BRÉB.) KTZ.	∥	∥	6
11. <i>Fragilaria construens</i> (EHR.) GRUN. var. <i>venter</i> (EHR.) GRUN.	∥	Subcommon	1
12. <i>Fragilaria mutabilis</i> (W. SM.) GRUN.	Fresh water : frequent	∥	2
13. <i>Fragilaria pinnata</i> EHR.	Fresh water	Rare	10
14. <i>Gomphonema acuminatum</i> EHR. var. <i>brasiliensis</i> FR.	∥	∥	29
15. <i>Gomphonema constrictum</i> EHR.	Fresh water : frequent	∥	7
16. <i>Gomphonema dichotomum</i> KTZ.	Fresh water	∥	14
17. <i>Melosira crenulata</i> (EHR.) KTZ.	∥	Subcommon	4
18. <i>Melosira granulata</i> (EHR.) RALFS.	Fresh water (or sometimes brackish water)	∥	36
19. <i>Melosira nivalis</i> W. SM.	Fresh water	∥	3
20. <i>Melosira Sol</i> (EHR.) KTZ.	Cosmopolitan	Rare	31
21. <i>Melosira varians</i> AG.	Fresh water : frequent	∥	30
22. <i>Navicula elliptica</i> KTZ.	Fresh or brackish water (or sometimes marine)	∥	11,18
23. <i>Navicula gastrum</i> (EHR.) DONK.	Fresh water	∥	12
24. <i>Pinnularia Braunii</i> (GRUN.) CL. var. <i>amphicephala</i> (A. MAYER) HUST.	∥	∥	9
25. <i>Pinnularia nobilis</i> EHR. var. <i>fossilis</i> PANT.	∥	∥	13
26. <i>Pinnularia radiosa</i> (KTZ.) RABENH.	Fresh water : frequent	∥	19
27. <i>Rhopalodia gibba</i> (EHR.) O. MÜLL.	Fresh water	∥	16,17
28. <i>Stauroneis phoenicenteron</i> EHR.	Fresh water : very common	∥	8
29. <i>Stephanodiscus niagarae</i> EHR.	Fresh water : frequent	Dominant	33
30. <i>Surirella oblonga</i> EHR.	Fresh water	Rare	5
31. <i>Synedra rumpens</i> KTZ. var. <i>fragilarioides</i> GRUN.	∥	∥	22
32. <i>Synedra ulna</i> EHR.	Fresh water : common	Common	24
33. <i>Tetracyclus lacustris</i> RALFS.	Fresh water	Rare	35

Table IV
Ecological Indication (Kolbe's Method)⁽³⁾

Specific Name	Ecological Indication	D. C. R.
1. <i>Amphora ovalis</i> K TZ.	Oligohalob.	Rare
2. <i>Cocconeis placentula</i> EHR. var. <i>lineata</i> (EHR.) CL.	Indifferent.	Subcommon
5. <i>Epithemia Hyndmanii</i> W. SM.	Oligohalob.	Subcommon
7. <i>Epithemia porcellus</i> K TZ.	Halophil ?	Rare
8. <i>Epithemia sores</i> K TZ.	Halophil ?	∥
9. <i>Epithemia turgida</i> (EHR.) K TZ.	Indifferent and euryhalin ?	∥
11. <i>Fragilaria construens</i> (EHR.) GRUN. var. <i>venter</i> (EHR.) GRUN.	Indifferent and euryhalin.	Subcommon
13. <i>Fragilaria pinnata</i> EHR.	Indifferent	Rare
14. <i>Gomphonema acuminatum</i> EHR. var. <i>brasiliensis</i> FR.	Oligohalob ?	∥
18. <i>Melosira granulata</i> (EHR.) RALFS.	Oligohalob.	Subdominant
21. <i>Melosira varians</i> AG.	Oligohalob.	Rare
23. <i>Navicula gastrum</i> (EHR.) DONK.	Oligohalob. (Indifferent)	∥
27. <i>Rhopalodia gibba</i> (EHR.) O. MÜLL.	Indifferent and euryhalin.	∥
28. <i>Stauroneis phoenicenteron</i> EHR.	Oligohalob.	∥
31. <i>Synedra rumpens</i> K TZ. var. <i>fragilarioides</i> GRUN.	Oligohalob.	∥
32. <i>Synedra ulna</i> EHR.	Indifferent and euryhalin.	Common

Description of Species.

Family *DIATOMACEAE*

Section A. *Centricae*

Sub-family I. *Discoideae*

Tribe 1. *Coscinodisceae*

Sub-Tribe a. *Melosirinae*

Genus *Melosira* AG., 1824

Melosira crenulata (EHR.) K TZ.

Pl. I, fig. 4.

SMITH, W., British Diatomaceae. Vol. II. (1856), p. 61, Pl. LIII, fig. 337.

RABENHORST, L., Flora Europaea Algarum. Sectio I. (1864), p. 41.

Valve punctate, file of spots somewhat curved ; line of junction with more or less distinct denticulation ; size of valve large compared with *M. granulata* and *M. nivalis*. Length and diameter variable, but diameter 15 μ in common.

⁽³⁾ Kolbe, R. W., Zur Ökologie, Morphologie und Systematik der Brackwasser diatomeen : Die Diatomeen des Spenberger Salzgebietes. Pflanzenforschung, Heft 7, 1927.

Melosira granulata (EHR.) RALFS.

Pl. I, fig. 36.

SMITH, W., British Diatomaceae. Vol. II. (1856), p. 62, Pl. LIII fig. 339.

SKVORTZOV, B. V., The Neogene Diatoms from the Ampen District, S. Kankyodo, Eastern Coast of Tyosen. Rep. Geol. Sur. Tyosen. Vol. 12. (1936), p. 336, Pl. I, fig. 8.

OKUNO, H., Studies on Japanese Diatomite Deposits. Bot. Mag. Tokyo. Vol. 57. (1943), Nos. 683—684, p. 366, fig. 1.

ICHIKAWA, W., Geological Studies on the Diatom Earth in Japan. Jour. Geog. Vol. 59. (1950), Nos. 1—2, p. 17, fig. 14.

Valve punctate, file of spots direct, or slightly curved ; in sizes small and slender compared with *M. crenulata*. Length and diameter variable, but diameter 8μ in common.

Melosira nivalis W. SM.

Pl. I, fig. 3.

SMITH, W., British Diatomaceae. Vol. II. (1856), p. 58, Pl. LIII, fig. 336.

Valve subhemispherical, distinctly cellulate ; extremities of valve somewhat truncate. Diameter 10μ .

Melosira Sol (EHR.) KTZ.

Pl. I, fig. 31.

SKVORTZOV, B. V., Neogene Diatoms from Saga. Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, Vol. XII. (1937), p. 159, Pl. IX, fig. 6.

ICHIKAWA, W., Geological Studies on the Diatom Earth in Japan. Jour. Geog. Vol. 59. (1950). Nos. 1—2, p. 17, fig. 15.

Valve circular, surface separated into two areas, outer portion strongly marked with closely set radiating costae ; inner portion almost hyaline. Diameter 75μ .

Melosira varians AG.

Pl. I, fig. 30.

SMITH, W., British Diatomaceae. Vol. II. (1856), pp. 57—58, Pl. LI, fig. 332.

MUROBUSE, T., Fossil Diatoms of Lake Ashi. Suisankenkyushi. Vol. 31. (1936), No. 6, p. 2, Pl. I, fig. 2.

SKVORTZOV, B. V., Neogene Diatoms from Saga. Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, Vol. XII. (1937), p. 158.

Valve cylindrical, with truncated extremities. Length 45μ . Diameter 13μ .

Genus *Cyclotella* KG., 1833.

Cyclotella operculata KTZ.

Pl. I, fig. 34.

SMITH, W., British Diatomaceae. Vol. I. (1853), P. 28, Pl. V, fig. 48.

Valve somewhat depressed in the center ; striae obscure, short. Diameter variable