125. *Stratigraphical Relation of the Poronai and Isikari Groups in the Isikari Coalfield, Hokkaido.*

(Contributions to the Geology of the Isikari Coalfield. I.)

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(Comm. Nov. 12, 1951.)

The marine Poronai group, mostly of shale, and the Isikari group, of coal measures interbedding brackish-water to marine deposits, are two series of geological formations essential to the Isikari coalfield, Hokkaido. That the former everywhere overlies the latter and is the younger of the two formations is now generally accepted, and no objection to this conception has ever been brought forth, since its presentation by the writer as early as 1900.¹⁾ The proper recognition of this geological relation has greatly contributed to the subsequent exploration of the coal-field.

In fact, the Poronai shale always rests on different members of the Isikari group, in most cases with the so-called "green base", glauconitic sandstone, at the base. A distinct trace of erosion, however, has rarely been observed between them. The Poronai is succeeded upwards by another thick complex of shale, sandstone and conglomerate, in alternation, the Kawabata group. The latter has sometimes a conglomeratic deposit with huge boulders of older rocks at the base; usually, however, there is no visible sign of angular unconformity between the two groups.

The Isikari group²⁾ consists of the following formations.

Asibetu coal formation

Upper Corbicula formation (now, Hiragisi formation)

Ikusyunbetu coal formation (= *Woodwardia* zone)

Lower Corbicula formation (now, Akabira formation)

Bibai coal formation

Wakkanabe formation (Wakkanabe shale plus Wakkanabe sandstone)

Yûbari coal formation

Horokabetu formation

Noborikawa coal formation

The geographical distribution of these formations in the coalfield is by no means uniform, except for the Wakkanabe and Ikusyunbetu,

1) Later detailed by H. Imai in his "Relation of the Poronai and Coal-bearing Formation in the Isikari Coalfield," Contr. Inst. Geol. Pal., Tôhoku Imp. Univ., in Japanese Language, No. 1, 1921.

2) H. Imai: Stratigraphical Study of the Coal-bearing Tertiary Formation in the Isikari Coalfield" (in Japanese). Jour. Geogr. Tokyo, No. 421, 1925. S. Tashiro: "Geological Structure of the Isikari Coalfield" (in Japanese). Coal Geology Studies, No. 1, 1951.

which have a rather uniform development over the entire coalfield. Based on the distribution of the other formations of the Isikari group, that of the overlying Poronai and Kawabata, the coalfield is divisible into three parts: the Asibetu section at the northeast, the Sorati at the northwest, and the Yûbari at the south. Both the Poronai and Kawabata groups occur in the Asibetu section, while the two are lacking in the Sorati. Likewise, the Kawabata does not occur in the Yûbari section, where, however, the Poronai attains its maximum thickness 1300 m.

While all the formations of the Isikari group are fully represented in the Asibetu and Sorati sections, this is not the case in the Yûbari; in this section, the Asibetu-, Upper and Lower Corbicula- and Bibai formations are lacking, and the Ikusyunbetu-, Wakkanabe-, and the infra-Wakkanabe formations are directly overlain by the thick Poronai shale. There, the Wakkanabe 150–200 m thick, is of marine origin, with arenaceous deposits dominating in the northern part and shale in the southern. The infra-Wakkanabe deposits, averaged 400 m, are divisible into the Yûbari-, Horokabetu- and Noborikawa formations. The Isikari group in the Yûbari section does not much exceed 600 m in total.

In the Sorati and Asibetu sections, on the other hand, the Isikari group has all its formations well represented; it exceeds at least 2000 m in its thickness, and is more than twice thicker than in the Yûbari section. There, the Wakkanabe formation comprises in part, brackish-water deposits, and in part, poor coal seams. The infra-Wakkanabe deposits, taken alone, are also more than twice thicker in the two former sections than in the Yûbari; they have once been correlated by H. Imai with the Yûbari formation of the latter section, but are thought by Tashiro to comprise all the three formations, Yûbari, Horokabetu and Noborikawa.

Recently J. Tezima and T. Shimokawara³⁾ reported on an unconformity which they could trace between the Yûbari coal formation and the overlying Wakkanabe in the Yûbari section; then it is to be questioned whether the great reduction in the total thickness of the infra-Wakkanabe deposits in the Yûbari section is ascribable to the erosion indicated by this unconformity.

Since the Isikari group, more than 2000 m thick, has marine to brackish-water sediments at several horizons, the original site of the Isikari coalfield, now lying near the middle part of Hokkaido and fairly remote from its present shore line, had certainly somewhere a direct connection with the open sea of that time, which

3) J. Tezima and T. Shimokawara: "Local Unconformity in the Ishikari Series of the Yûbari Coalfield" (in Japanese). *Jour. Geol. Soc. Japan*, Vol. LVII, No. 670, 1951, p. 296.

must be thought to have had a wide extension over the present land area of the island, and in which fairly thick marine sediments should have accumulated. The marine deposits, if present, must occupy a stratigraphical position, like the Isikari group, above the Upper Cretaceous or older formations and below the Poronai group.

As a matter of fact, no trace of such marine deposits has been discovered in Hokkaido to date. The questions which follow are:

1. Did there once actually exist marine formations coeval with the Isikari group, which are still to be discovered somewhere in Hokkaido in the future?

2. Has this marine formation totally disappeared, being deprived off by later erosion?

3. Is the Poronai group not the marine deposits in demand?

1. Whereas the possibility of the future discovery of the marine formation somewhere in Hokkaido can not with any confidence be denied, it is almost certain that no one now bears in mind an expectation of finding it around the Isikari coalfield.

2. When one assumes that the land of Hokkaido was once covered by marine deposits coeval with the Isikari group, the only possible way to let them entirely disappear is by the general upheaval of the land, soon after the deposition, without a time-interval of crustal deformation, so much as the latter sediments to be totally deprived off by denudation, while the basin occupied by the former sediments continued its downward sagging by which the greater part of the sediments would be left unaffected by the erosion:—a rather incredible assumption, being too arbitrary.

3. While no one can positively reject the above two cases as improbable, the third question can not be answered in the affirmative without introducing a new conception in regard to the boundary plane between the Poronai and Isikari groups.

As stated at the outset, the Poronai group rests on every member of the Isikari group in such a state to warrant the interpretation, that the two are in paraunconformity and that the former is chronologically younger one of the two. To mention one example, S. Tashiro¹ lately stated his observation in the Asibetu section, where the top members of the Asibetu coal formation are cut progressively deeper from north to south by the basal plane of the Poronai at an angle of about 2° or less for a distance over 3000 m, and the latter usually has its “green base”. This is the usual habit of the two groups contact, and in very rare cases an irregular erosion surface is exhibited by the underlying strata.

In the writer's opinion, here is a particular case of marine transgression; marine deposits of the Poronai sea transgressively

overlapping the older rocks of the post-Cretaceous land, were interferred with the contemporaneous terrestrial deposits of the Isikari group in their front, which were building a seaward enlarging alluvial land; elsewhere creeping up on the ancient land surface toward the inland, here the marine invasion was hindered by the terrestrial deposits. But as the whole, the marine transgression got supremacy over the terrestrial deposits, replacing them toward the inland, though temporarily several times the reverse prevailed, as shown by the interfingering marine to brackish-water deposits of the Ishikari group. He is now tending to prefer this new interpretation of the stratigraphical relation of the Poronai and Isikari groups to the older one, which implies the decidedly younger geological age of the former group than the latter.

In this sense, the Isikari coalfield was not a gradually sinking basin completely filled up by the Isikari group; it was an alluvial lowland extended forwards into the Poronai sea.

The Isikari group yields many plant remains, and especially the Ikusyunbetu coal formation (*Woodwardia* zone) is very rich of them. The fossil flora with a great many of its elements in common or in close affinity with the "Arctic Miocene flora" of O. Heer, is aptly regarded to be Palaeogene in age.⁵⁾ This age-determination gets support on one side in the marine molluscan fauna of the Wakkanabe formation with related elements of the Asiya formation of northern Kyûsyû,⁶⁾ and on the other side in *Amynodon watanabei* (Tokunaga) whose occurrence in the Tatibetu group is recently recorded by F. Takai⁷⁾ from the adjacent Uryû coalfield, a formation generally believed to be an equivalent of the Isikari group; the other known locality of the same fossil mammal is the latest Eocene coal formation of the Ube coalfield⁸⁾ in Yamaguti Prefecture, which also once yielded *Desmatotherium grangeri* Tokunaga.

On the other hand, the Poronai group entombs numerous marine fossils, mostly mollusca and foraminifera, in several hori-

4) S. Tashiro, op. cit., p. 53. The same state has been observed by S. Takao between the older members of the Isikari group and the Poronai in the Yûbari section. S. Takao: "Poronai Beds" (in Japanese). Tankô Gijutsu (Colliery Technology), Vol. IV, No. 9, 1949.

5) Thought by S. Endô to be late Eocene on its fossil flora. S. Endô: "Cenozoic Plants" (in Japanese). Iwanami Kôza, Geology and Palaeontology, 1931.

6) The the Wakkanabe is thought by T. Nagao to be early Oligocene on its molluscan fauna. T. Nagao: "Palaeogene Series" (in Japanese). Ibid., 1933.

7) F. Takai: "*Amynodon watanabei* from the Latest Eocene of Japan, with a Brief Summary of the Latest Eocene Mammalian Faunule in Eastern Asia." Rep. Geol. Surv. Japan, No. 131, 1950.

8) H. Yabe: "Palaeogene Age of the Coal Formation of the Ube Coalfield, Yamaguti Prefecture". Proc. Imp. Acad. Tokyo, Vol. XX, 1944, p. 725. F. Takai: "Eocene Mammals from the Ube and Hôzan Coalfields in Nippon". Ditto., p. 20.

zons; the molluscan fauna is rather poor in the number of species, though relatively rich in that of individuals. The most common fossils are *Bullimina* spp. among the Foraminifera, *Nuculana* spp., *Yoldia* spp., *Malletia poronai* (Yokoyama), *Acila* (*Truncacila*) *picturata* (Yokoyama), *Venericardia compressa* Yokoyama, *V* spp., and *Trochocerithium wadanum* (Yokoyama) among the Mollusca, and *Callianassa muratai* Nagao among the Crustacea. This is a peculiar fauna, with only a distant affinity to the other Tertiary faunas of Japan, of which the geological age is better known.

The studies of the Poronai mollusca and foraminifera are now in progress, the former by H. Takeda and the latter by K. Asano; until these studies are completed, the predication of the geological age of the group should be suspended. Hitherto some geologists assigned it to the youngest Palaeogene and others to the oldest Neogene, both chiefly based on the stratigraphical relation to the Isikari group and to the Lower Neogene Kawabata.

Whether the stratigraphical relation of the Poronai and Isikari groups really indicates a true unconformity, which signifies a time-gap between their sedimentation (early interpretation) or the two groups are contemporaneous (new interpretation), is desirable to be settled on a pure palaeontological standpoint.

There are many conditions more favourable for the new interpretation than for the other; these are enumerated below, including some in recapitulation:

1. Some marine shales interbedded in the Isikari group closely resemble the Poronai shale, and Tashiro⁹ reported on a find in a shale in the basal part of the Upper Corbicula formation exposed along the stream Simoutasinai (Sorati section), of *Yoldia* and *Nuculana* apparently similar to some forms of the Poronai shale, and *gennoisi*. The last one is a mineral, an aggregate of small xenomorphic crystals of reddish ferruginous calcite and externally assuming the shape of a scalenohedron and often twinned. The *gennoisi*, once thought by T. Hiki as a calcite-pseudomorph after *gaylucite* and resembling *glendonite* from Australia, is very common in the Poronai group and especially in its *gennoisi* zone. It serves as an indicator of the Poronai shale, being almost as important as leading fossils, since it is unknown from the other formations

9) S. Tashiro, op. cit., p. 35.

In a letter, Y. Sasa informed the writer that the small species of *Thyasira* not rare in the Poronai group also occurs in the Lower Corbicula formation of the Mitui-Asibetu mining district, exposed at the west bank of the river Asibetu; such occurrence of one or other elements of the Poronai fauna in the Isikari group can be explained by assuming downward extension of the life-range of the respective species, as he thought, and can not of course be taken as a positive evidence for the contemporaneity of the two formations.

in Hokkaido. Its occurrence in a shale of the Upper Corbicula formation is therefore important.

2. The peculiar distribution of the Poronai group in the coalfield has already been noted above. It has its best development in the Yûbari section, where the upper members of the Isikari group entirely and its middle formations partly are lacking, and the infra-Wakkanabe formations are thin in their total thickness, while the former group is either entirely (in the Sorati section) or feebly developed (in the Asibetu section), where the latter group is fully represented. This different development of the two groups can easily be explained by the new interpretation.

3. Likewise, the different development of each formations of the Isikari group in the two northern sections and the southern one is easily explained by the new interpretation, but can not by the older, unless supplemented by another assumption, the relatively different up- and-down motion of two partial troughs, one northern and the other southern, not only once, but several times repeatedly:—an assumption of no use in accepting the new interpretation.

4. K. Asano verbally informed the writer that *Cyclammia pacifica* Beck, one of its common forms is a species confined to the Eocene in the Californian side; this species is also recently reported by S. Murata¹⁰⁾ from the middle division of the Kyôragi formation of Amakusa-Kami-sima, Kumamoto Prefecture, stratigraphically and palaeontologically proven to be Eocene in age.

The Urahoru group of the Kusiro coalfield is correlated with the upper part of the Isikari group; *Cornuspiroides oinomikadoi* Hanzawa and Asano which is a very peculiar form, as large as 5 mm in diameter and simulating an *Operculina* in its external aspect, is now known only from the Sitakara formation, a marine member of the Urahoru group, and the Poronai, according to Asano. These evidences speak for the Eocene age of the Poronai.

5. It is true that the boundary between the Poronai and Isikari groups is as a rule distinct, but if the writer's remembrance is correct, there are sometimes the cases in which it is rather obsolete, being shown only by a more or less abrupt change of the material from one side to the other.

10) S. Murata: "The Occurrence of the Genus *Cyclammia* in the Tertiary of Kyushu." Trans. Proc. Pal. Soc. Japan, N.S., No. 3, 1951, p. 65.