

# ON THE STRATIGRAPHICAL SITUATION AND SHAPES OF PIRIKA TYPE NEOGENE TERTIARY MANGANESE DEPOSITS, SOUTH-WESTERN HOKKAIDŌ.

SHIGEO DOI

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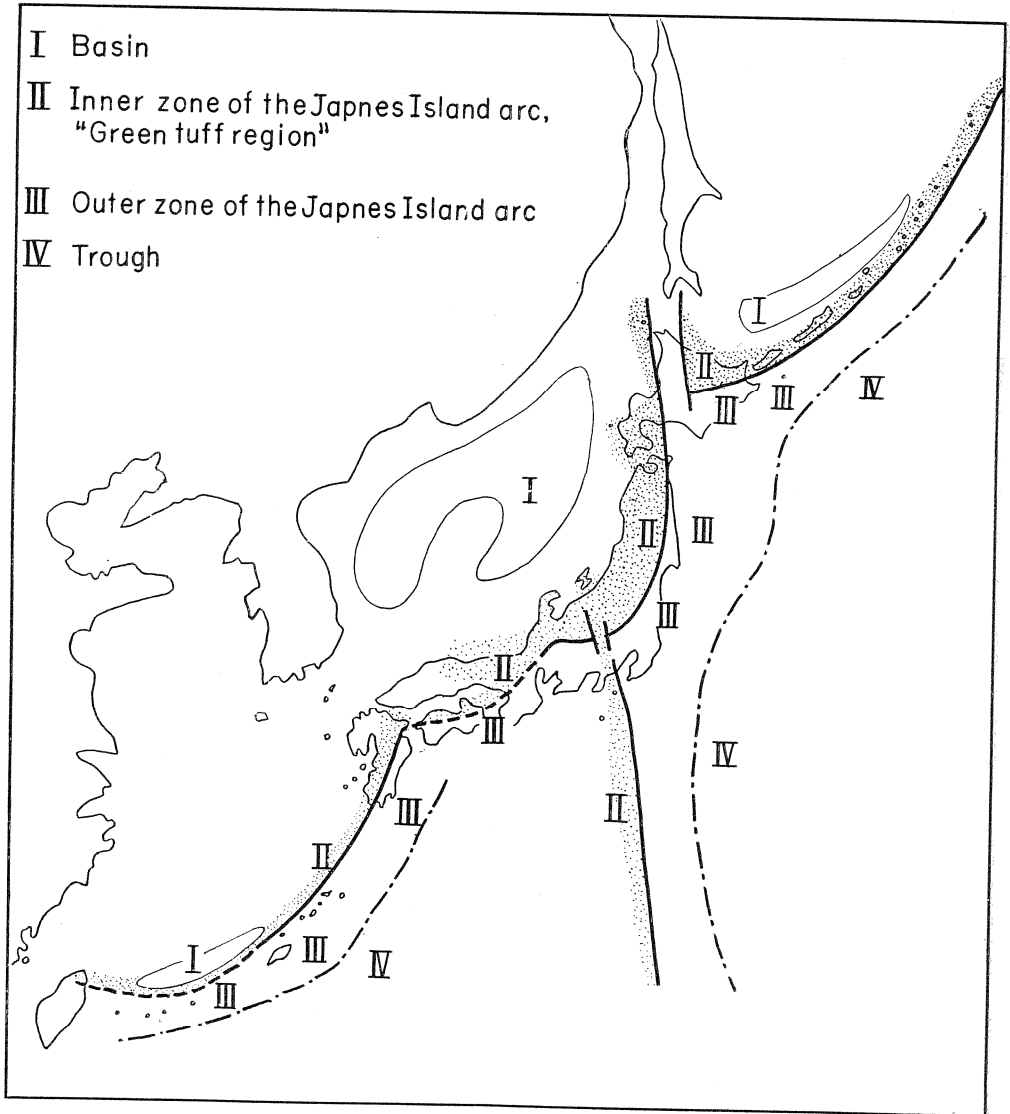
## INTRODUCTION

Some unique bedded manganese ore deposits are known in the so-called "green tuff region" which is developed along the whole inner zone of the Japanese island arc as distinctive products of huge Neogene Tertiary volcanism. Although they occur in various places of the region, they are particularly localized into the northernmost area of the Honshū arc and its northern continuation to the Oshima peninsula, south-western Hokkaidō.

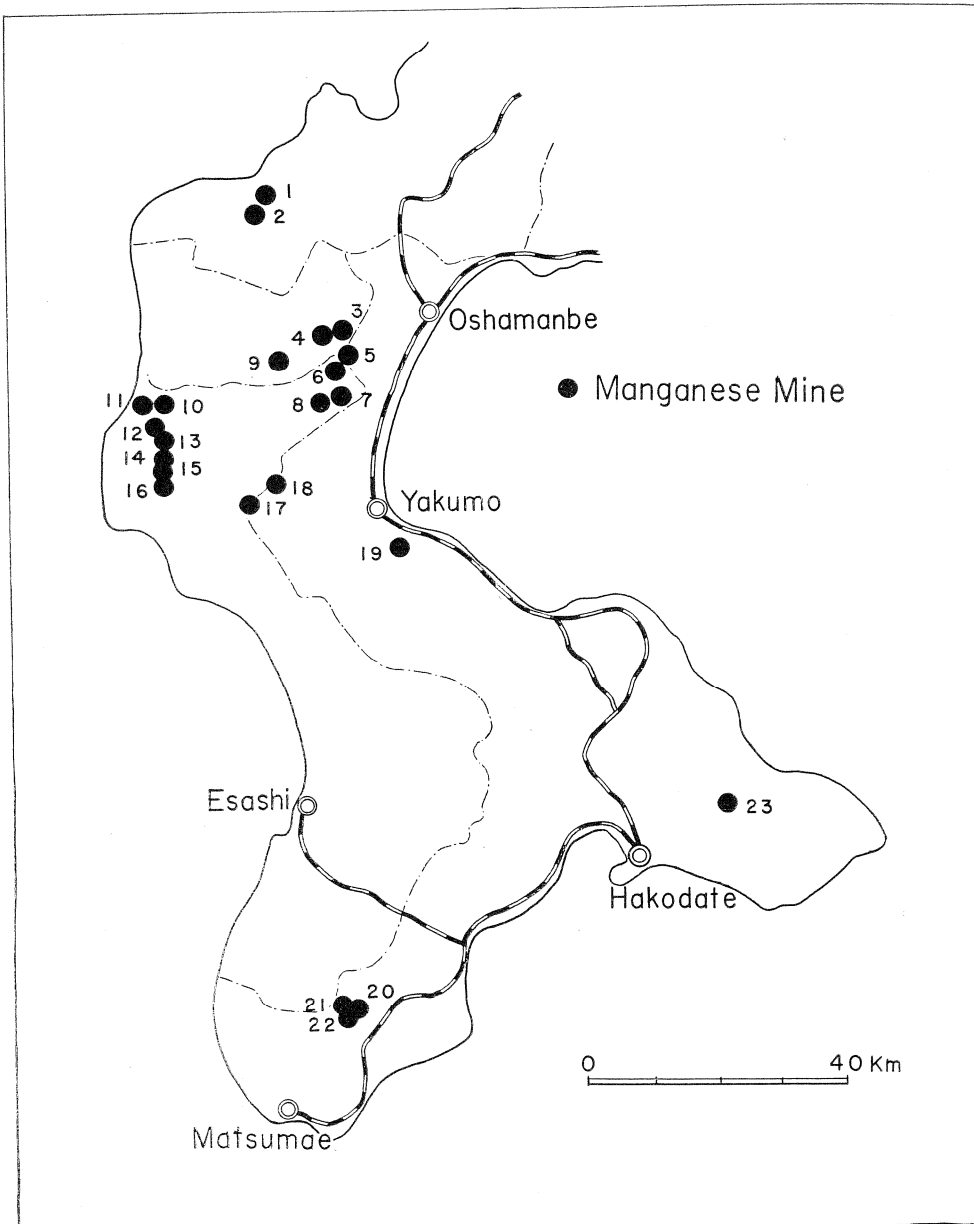
This type of deposit is referred to as "Pirika type" that occupies a peculiar situation in the scheme of classification proposed by Prof. T. Yoshimura for the manganese ore deposits of Japan. It has been considered that the deposits were precipitated from mineral springs which accompanied the Neogene Tertiary volcanism. However, detailed information about them has not yet been obtained.

A detailed study of the pirika type manganese deposits of the Oshima Peninsula, trustworthy basic data by the present writer has revealed some reliable sources for the genetic interpretation. According to data now available it is considered that the primordial circumstances of precipitation of those manganese deposits, although they were disturbed by later tectonic movements, was wholly controlled by the topography of sea bottom. Accordingly, researches on the structural relation of those deposits to the surrounding sedimentary facies are the most reasonable approach to the problem of the mechanism of these ore formations, also to the prospecting for those deposits.

In this paper, the writer proposes to describe the stratigraphical situation of the manganese ore deposits of pirika type among the Neogene Tertiary pyroclastics of the Oshima Peninsula, and their structural relations to the surrounding formations, and further, to discuss the accumulative environment of the ore formation.



**Fig. 1** Distribution of the green tuff regions in the Japanese Island arc. (after Ijiri, S. and Minato, M., 1958)



**Fig. 2** Map showing the distribution of the Pirika type manganese mines in South-western Hokkaidō, Northern Japan.

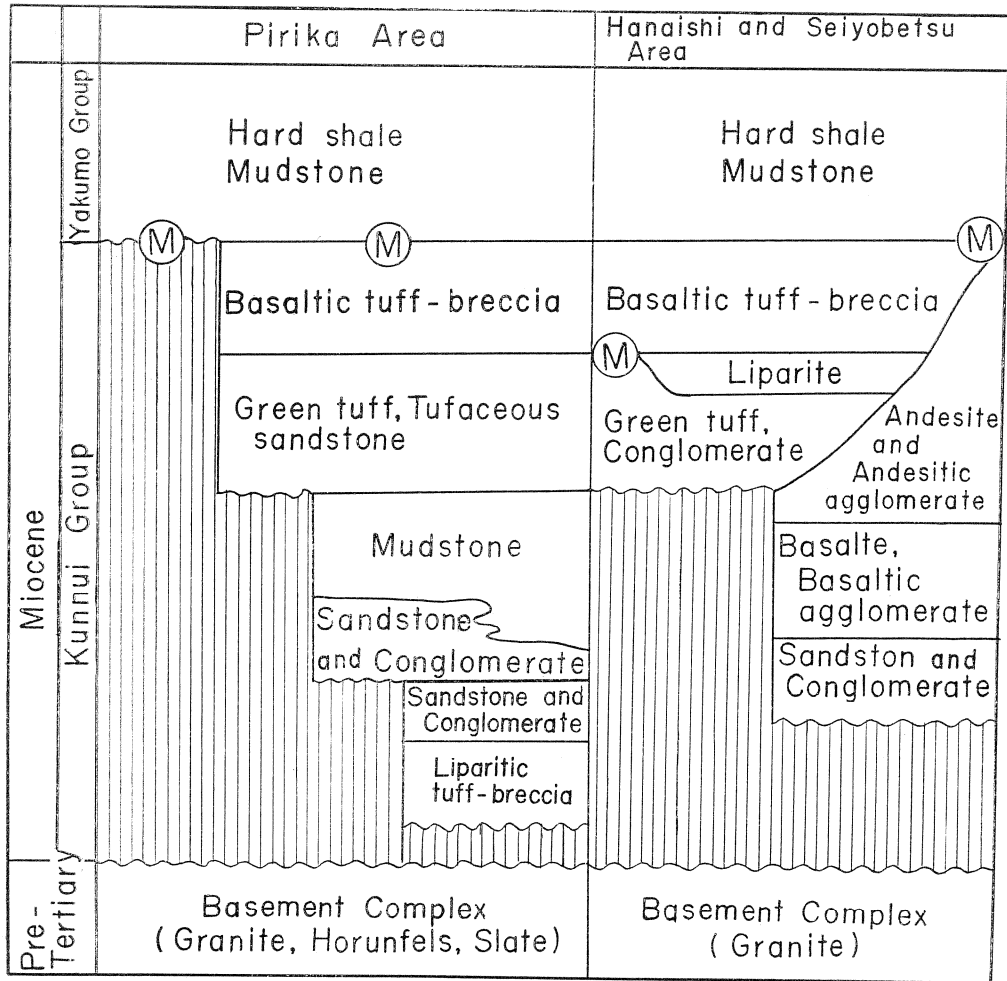
- |               |                  |                     |                    |
|---------------|------------------|---------------------|--------------------|
| 1 Nagatoyo    | 2 Shimamaki      | 3 Pirika (Motoyama) | 4 Pirika (Shinzan) |
| 5 Inaho       | 6 Daikoku        | 7 Takaraoka         | 8 Hanaishi         |
| 9 Meppu       | 10 Ishibuchi     | 11 Seoigoshi        | 12 Hatsune         |
| 13 Sakaide    | 14 Wakamatsu     | 15 Garō             | 16 Ryūbu           |
| 17 Seiyobetsu | 18 Daikan        | 19 Okutsunai        | 20 Hakodate        |
| 21 Eian       | 22 Tōhōfukushima |                     |                    |

STRATIGRAPHICAL SITUATION OF THE BEDDED MANGANESE DEPOSITS AND THEIR SHAPES

From the stratigraphical point of view the pirika type deposits in the Oshima Peninsula may be divided into two groups: the one is disposed directly upon the basal granitic complex of Pre-Tertiary, and the other is arranged into several horizons of the Kunnui and Yakumo groups of Miocene age, as represented in Tables 1, 2.

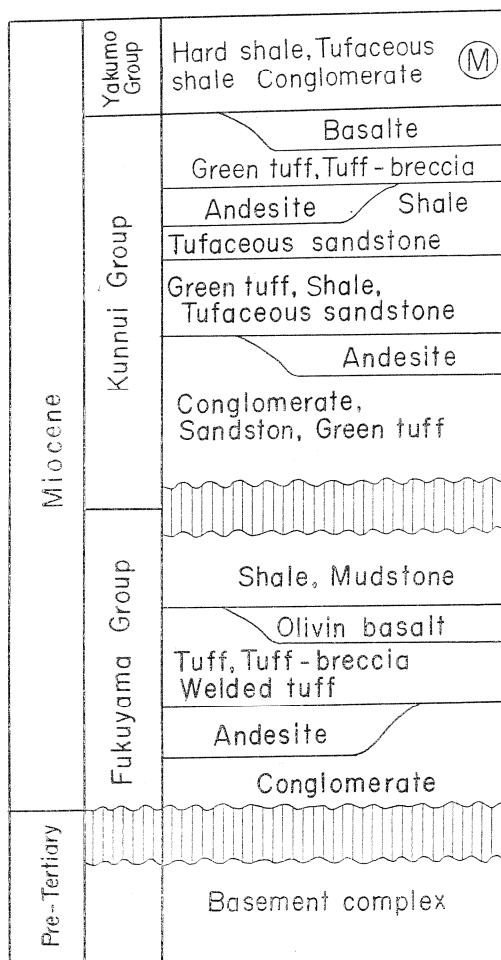
1) **Bedded deposits of the basal horizon.**

As the basement complex for Neogene pyroclastic pileings, the so-called Palaeozoic massif constituted mainly of slates and accompanying granitic intrusions lies in every place sporadically throughout the green tuff region. Bedded deposits of basal horizon lies directly covering the basal granite. Beneath the ore bed, thin layer of clay and



Ⓜ : Pirika type Manganese deposits

Table. 1 Relation of stratigraphical order and manganese deposits in the Imagane District, South-western Hokkaidō.

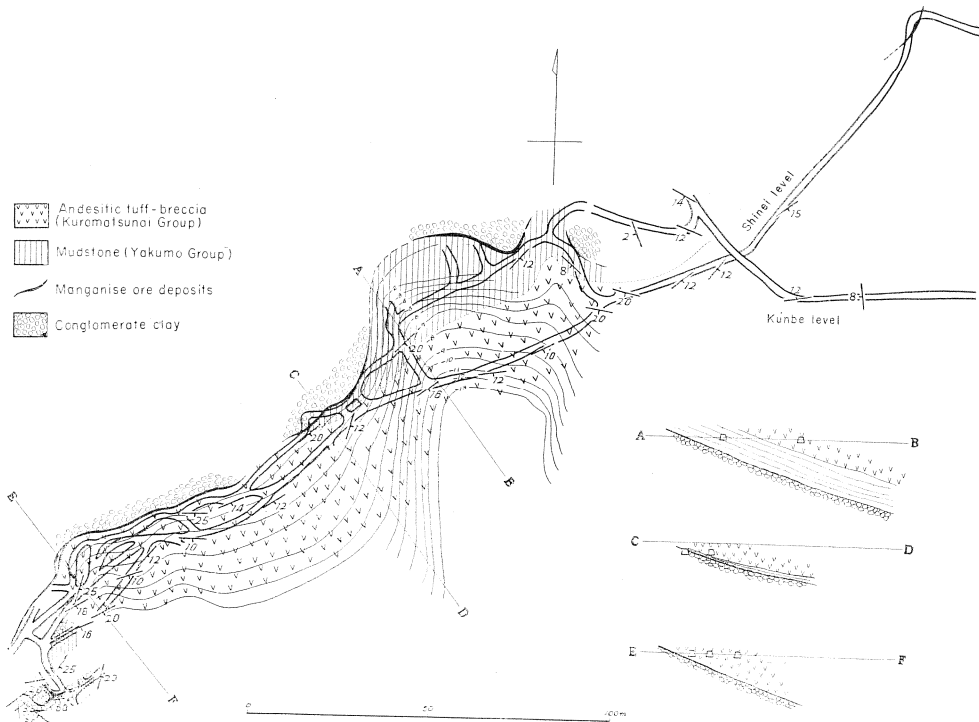


(M) : Pirika type Manganese deposits

**Table. 2** Relation of stratigraphical order and manganese deposits in the Fukushima District, South-western Hokkaidō.

conglomerate of granitic boulders are insignificantly developed. As the covering of the ore bed, thick alternation of sandy mudstone and tuffaceous sandstone is strongly developed. These covering formations are referable to the Yakumo or Kuromatsunai group, both of Miocene age.

As an excellent instance of this group, the Shinzan deposit of Pirika mine may be mentioned. The deposit develops in stratiform that covers uneven surface of basal granite. Between the ore bed and the basal granite, a thin layer of reddish yellow clay that contains granite boulders is always observed. The spatial spreading of the ore bed is always concordant with this layer of conglomeratic clay as illustrated in Fig. 3.

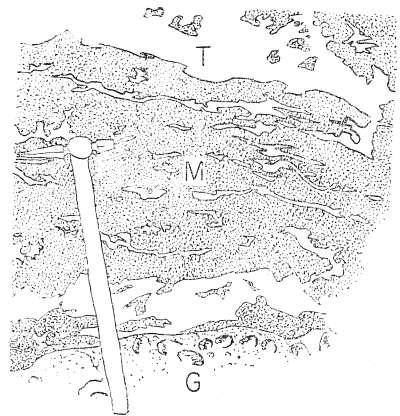


**Fig. 3** Plane showing manganese bedded deposits at the Shinei level, Shinzan deposits of Pirika mine, South-western Hokkaidō.

The thickness of the ore bed is not constantly developed but it varies from 0.2 m to 2.0 m. It thins above the large granite boulders, and swells in the clay part between large boulders.

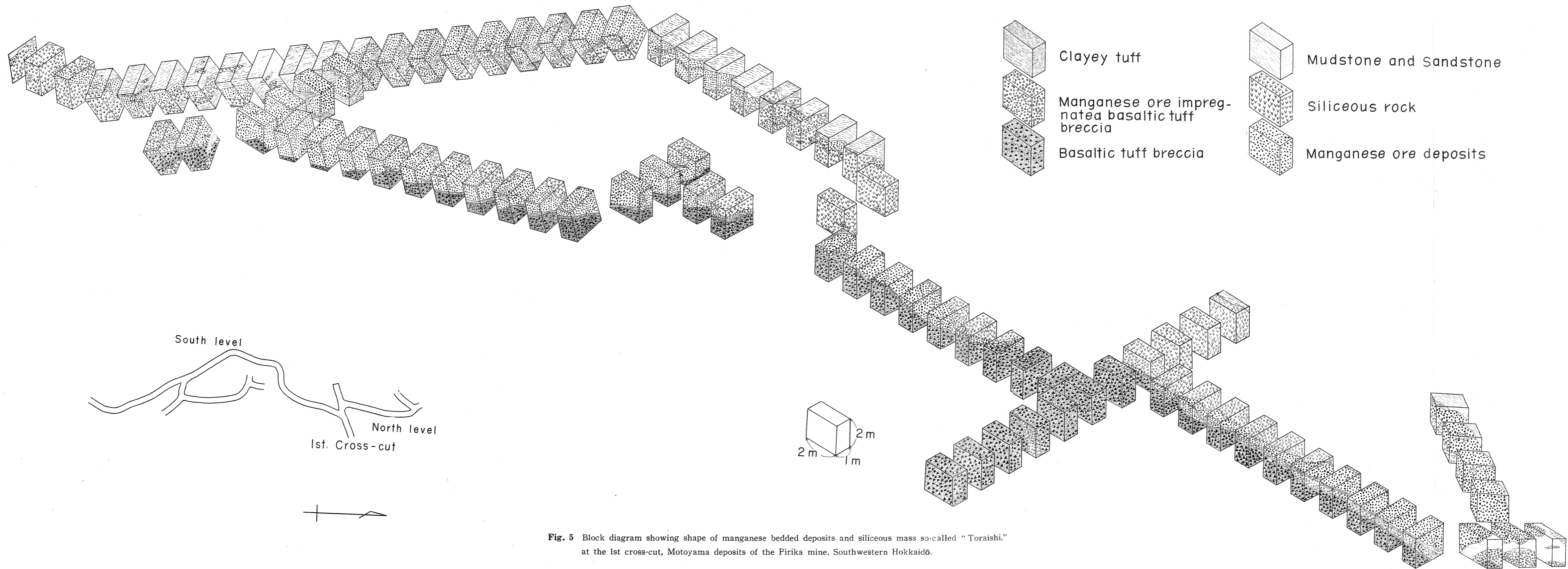
The bedded deposits are not composed exclusively of manganese ore, many small seams of argillized tufaceous mudstone are inserted with the ore as illustrated in Fig. 4. In some cases, banded alternation of clay and ore on the scale of a few centimeters is formed.

Above-mentioned features are the characteristics of the type which is succeeded by the thick sedimentation of dark grey coloured mudstone referred to the Yakumo group. However, when the ore deposition is succeeded by accumulation of tufaceous sandstone and andesitic tuff breccia belonging to the Kuromatsunai group, some different features distinctive from those of preceding one are observed. There are no seams of clay or



**Fig. 4** Sketch of clayey tufaceous mudstone patches in manganese bedded deposits at the Shinei level, Shinzan deposits of Pirika mine, South-western Hokkaidō.

- T: Clayey tufaceous mudstone, storm grey in colour.
- M: Manganese ore.
- G: Conglomerate clay.



**Fig. 5** Block diagram showing shape of manganese bedded deposits and siliceous mass so-called "Toraishi," at the 1st cross-cut, Motoyama deposits of the Pirika mine, Southwestern Hokkaidō.

tufaceous material in the ore bed as observed in above-mentioned type. The ore bed is composed exclusively of massive ore and interfilling earthy ore.

## 2) Bedded deposits of upper horizons.

Three horizons containing manganese ore deposition are revealed. The 1st type of deposit lies in an upper horizon of the Kunnui group. It occupies the horizon between basaltic tuff breccia and tufaceous sandstone. Seiyobetsu mine works a representative deposit of this type. The ore bed is underlain by an alternation of tufaceous sandstone and conglomerate, and is overlain by basaltic tuff breccia. The ore bed is not composed of a continuous mass of manganese ore, but of irregularly formed lumps imbedded in the deep purplish coloured clayey tuff are scattered in a horizon of 0.3 m to 2.0 m thickness. The so-called "Toraishi," a compact siliceous rock of amber grey colour, is always found beneath the ore horizon; its precipitative laminae will probably indicate the original plane of sedimentation. Where siliceous rock is well represented, a thin continuous layer of manganese ore develops as its top-covering.

The 2nd type of bedded ore deposit is divided into two subtypes. The one is restricted to the boundary horizon between the Kunnui and Yakumo groups; the other is referred to a still upper horizon of the Yakumo group.

Each type is associated with siliceous rock, Toraishi, as that above-mentioned. For instance, the Motoyama deposit of Pirika mine is a representative of the former, and Tōhōfukushima mine works the later. The schematic relation between bedded manganese deposits and associated siliceous rocks of those types is illustrated in Fig. 5. As is shown, manganese ore wraps up the siliceous mass. Further more manganese ore intervenes between siliceous masses and upper or lower wall rock. Sometimes, the ore is irregularly commingled with siliceous rocks as is shown in Fig. 6. Such a case is rather often met with in the thinning marginal part of thick siliceous rocks.

Under the ore bed, where siliceous are well developed, exactly base is composed chiefly of argillized tuff breccia dark grey in colour. However, where siliceous rocks are completely lacking, the wall rock is silicified and small manganese ore masses are scattered through it. Large scale silicification of exactly what kinds is often met with in the bedded manganese ore deposits of the region. The ore deposits of Kinjō mine, Daikoku mine and Ryūbu mine are the representative types of such deposits.

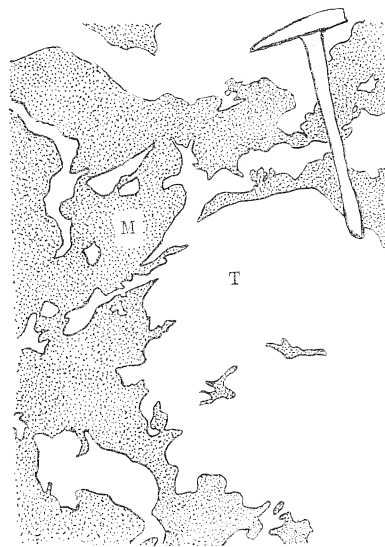


Fig. 6 Sketch of manganese ore grown in siliceous rock so-called "Toraishi" at the Manei level, Pirika mine, South-western Hokkaidō.

T: Amber grow coloured siliceous rock.

M: Manganese ore.



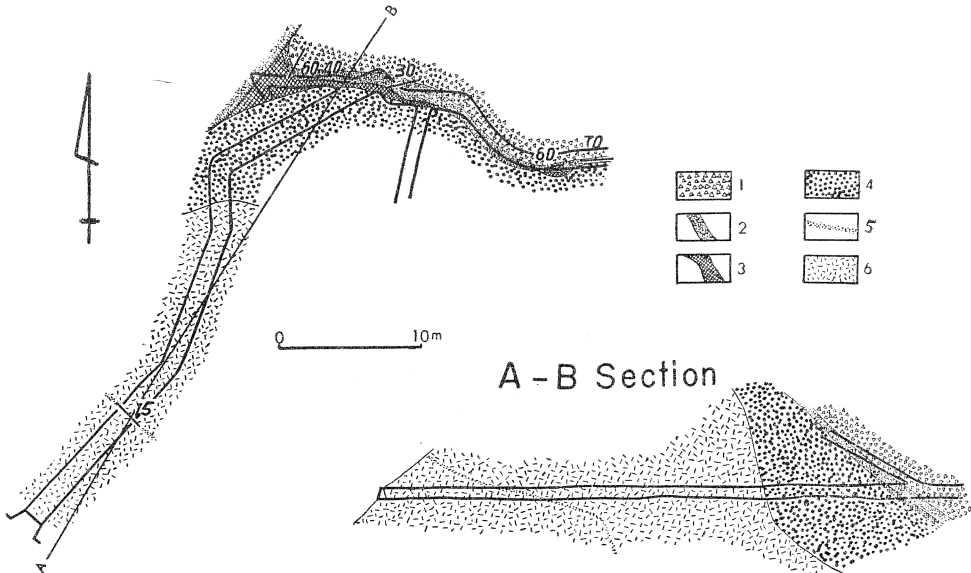
Of the 2nd sub-group, Tōhōfukushima mine works the typical deposit. The deposit lies on the lower horizon of the Yakumo group as presented in Table 2. The top covering bed of the deposit is composed of tuffaceous shale of fine bedding plane; the underlying base is formed of an alternation of tuffaceous sandstone and conglomerate, which is considered as the basal part of the Yakumo group.

Siliceous rock is also associated with this type of deposit, however, the ore is not massive as the deposits of above described type but powdery.

#### RELATION BETWEEN SHAPES OF MANGANESE DEPOSITS AND GEOLOGICAL STRUCTURE

Generally speaking, there is a tendency that above-mentioned deposits are disposed at a changing point of dip of country formations, particularly, of foot wall bed of the deposit from gently inclined part to steep slope. The present writer has revealed such tendency in every deposit of south-western Hokkaidō. Details of that tendency are described as follows.

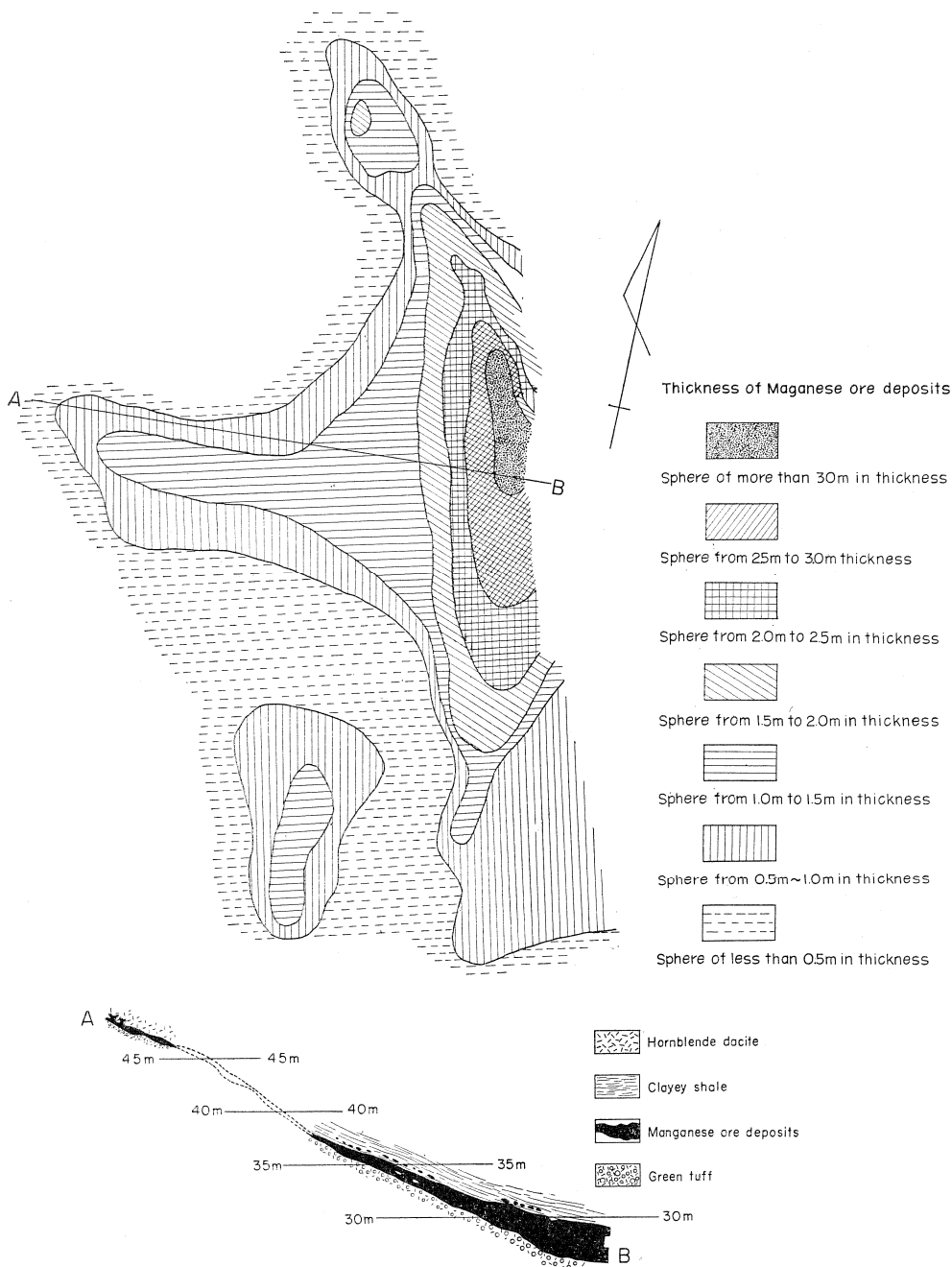
In the first level of the Seiyobetsu mine, general strike of foot wall bedding is  $N 5^{\circ} - 45^{\circ} W$   $15^{\circ} - 45^{\circ} NE$ . Above-mentioned bed of reddish purple coloured clayey tuff including manganese ore lumps is traceable to some extent. Its richest part is disposed



**Fig. 7** Plan showing shape of manganese bedded deposits existing at 2nd level, Seyoetsn mine, South-western Hokkaidō.

- 1 Basaltic tuff-breccia.
- 2 White grey coloured tuff.
- 3 Manganese ore lumps bearing tuff, deep purplish in colour.
- 4 Siliceous rock so-called "Toraishi".
- 5 Conglomerate.
- 6 Tuffaceous sandstone

to the steep inclination of  $45^\circ$ , however, when its continuation varies to the low angle of  $15^\circ$ , the ore is wholly lacking. In the second level, the ore is most suitably



**Fig. 8** Plan showing the relation between thickness of manganese bedded deposits and geologic structure of lower wall rock, Kinjō mine, South-western Hokkaidō. (after Banba, T., Watanabe, Y. and Hashimoto, T., 1955)

developed at about 30° as represented in Fig. 7.

In the deposit of kinjō mine, the circumstances are the same as above noted. Its thickest part is fixed at the transitional part of inclination as shown in Fig. 8.

Peculiar characters are also indicated in every deposits. However, from the view point of geologic structure of the environment, they are fixed as usual to the transitional point from low to steep inclination of foot wall bedding.

### SUMMARY

The manganese ore deposits of the Pirika type are found at several horizons from the upper Kunnui group to the lower Yakumo group, of Miocene age. Especially, numerous deposits have developed at the boundary horizon between the Yakumo and Kunnui groups.

The shapes of the ore deposits are irregular formed bedded deposits; occasionally, they are accompanied by siliceous rock, so-called "Toraishi." In this case, the manganese ore has grown so as to surround the siliceous rock mass.

Furthermore, the manganese deposits have developed at the transitional portion changing from steep to low angles in dip of the foot wall formation. This fact leads to the consideration that the primitive shape of precipitated ore beds was controlled by the topography of the sea bottom at the depositional stage.

### ACKNOWLEDGMENTS

It is a great pleasure for the writer to record here his sincere gratitude to Dr. Masayuki Saito of the Geological Survey of Hokkaidō, who kindly gave much precious advice. The writer wishes to express his thanks to Mr. Kenji Daido and Mr. Tomohiro Egami of the Pirika mine, who gave special help to enable the present investigation.

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## 要 旨

## ピリカ型マン鉱床の層位学的位置とその賦存形態について

土 居 繁 雄

ピリカ型マン鉱床は、地質学的に、本州弧の内帯で、いわゆるグリーン・タフ地域とよばれている、新第三紀中新世の火成活動がはげしくおこなわれた地域に、分布している。

とくに、この型に属するマン鉱床の大部分のものは、東北日本の秋田県から西南北海道の渡島半島にいたる地域に、ひじょうに多く分布しているという、特ちょうをしめしている。

このピリカ型マン鉱床は、吉村豊文によつて分類されたもので、単に層状鉱床とされ、新第三紀中新世のグリーン・タフをもたらした、きわめて旺盛な火山活動の末期に、温泉作用によつて、沈澱した鉱床であるとされている。しかし、この層状鉱床の具体的な賦存形態や、地質構造との関係は、まったく明らかにされていない。

これらのピリカ型マン鉱床の賦存形態と、地質構造との関係を詳細にみていくと、鉱層を沈澱した当時の形態は、新第三紀後半に行なわれた、造構造運動によつて、複雑に変位しているとはいえ、その初生形態は、沈澱した当時の海底地形にまったく支配されていることがしめされている。

したがつて、鉱床の賦存形態と、地質構造との関係を具体的に明らかにすることは、この種の鉱床の形成機構を究明するという問題だけでなく、開発とむすびついた探査という立場からも、ひじょうに重要なことである。

PLATES

and

EXPLANATIONS

- 1) Patches of clayey tuffaceous mudstone in manganese bedded deposits at the Sinei level, Shinzan deposits of the Pirika mine.

T: Patches of clayey tuffaceous mudstone.

M: Manganese ore.

- 2) Manganese ore grown in the side of hanging wall in siliceous mass so-called "Toraishi" at the Manei level, Motoyama deposits of the Pirika mine.

S: Siliceous rock so-called "Toraishi."

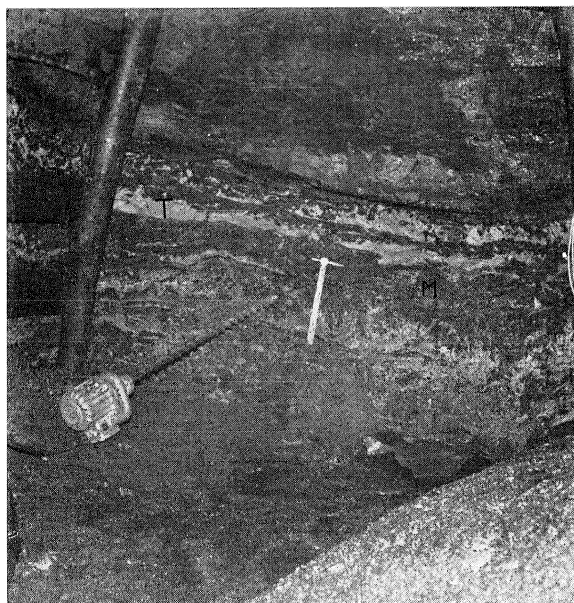
M: Manganese ore.

T: Patches of clayey tuffaceous mudstone.

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PLATE 1

1)



2)



3) Manganese bedded deposits grow the under portion of siliceous mass at the Manei level, Motoyama deposits of the Pirika mine.

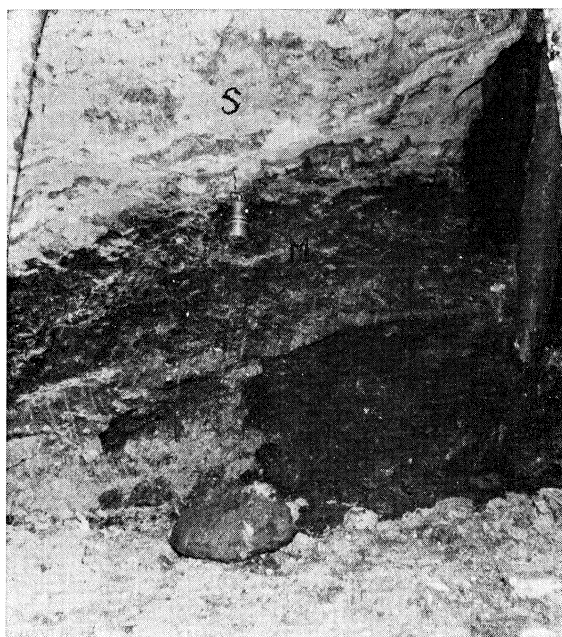
M: Manganese bedded deposits.

S: Siliceous rock, so-called "Toraishi."

4) Photograph showing manganese ore spottedly impregnated in the foot wall at the Manei level, Motoyama deposits of the Pirika mine



3)



4)

