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UNIVERSAL COMPASS AND THE PLUNGE OF THE BEDDED CUPRIFEROUS PYRITIC ORE DEPOSIT IN JAPAN

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In 1942, Earl Ingerson[1] devised a universal compass in order to measure the angle and direction of pitch of lineation in the field. In 1943, Ingerson and Tuttle[2] drew a graph, which is convenient for the determination of a lineation in the plane of schistosity. Also, D. J. Fisher[3] proposed the stereographic and gnomonic solution of the lineation. K. E. Lowe[4] described another geometrical method of determination.

[1] Ingerson, Earl, Apparatus for direct measurement of linear structures: *Am. Mineral.*, **27,** 721–725 (1942).

[2] Ingerson, Earl, and Tuttle, O. F., A graph for determining angle and direction of pitch of lineations in the field: *Am. Mineral.*, **28,** 209–210 (1943).

[3] Fisher, D. Jerome, Measuring linear structures on steep-dipping surfaces: *Am. Mineral.*, **28,** 204–208 (1943).

[4] Lowe, K. E., A graphic solution for certain problems of linear structure: *Am. Mineral.*, **31,** 425–434 (1946).

In Japan, the determination of linear schistosity is important from the point of prospecting of the bedded cupriferous pyritic deposits in the crystalline schists and phyllites. In southwestern Japan a zone of metamorphic rocks extends along the "Median Tectonic Line," which runs from northeast to southwest (Fig. 1). The rocks are composed of albite epidote chlorite schist, amphibole chlorite schist, glaucophane schist,

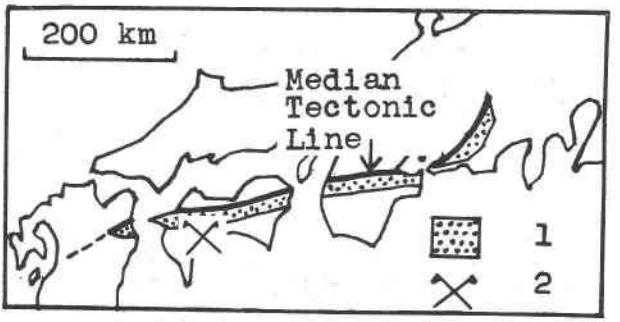

FIG. 1. Index map. 1. Crystalline schists and phyllites. 2. Besshi mine.

piedmontite quartz schist, stilpnomelane-bearing green schist, graphite quartz schist, sericite quartz schist, graphite phyllite, etc. intruded by amphibolite, meta-diabase schist, meta-diabase and serpentine. Throughout this elongated area, many deposits of cupriferous pyrite occur along the planes of schistosity, commonly as lenticular or bedded deposits. The largest deposit of this type is that of the Besshi mine, which has a strike length of more than 1600 m., extends over 1000 m. down the dip and is up to 10 m. thick. The mineralizing solution may have originated in the same deep seated magma from which the basic and ultrabasic rocks such as amphibolite, meta-diabase and serpentine were derived. No particular type of schist constitutes the sole host rock, but green-colored schist is more common. It is noticeable that a lens of piedmontite quartz schist is sometimes accompanied by an ore body.

A critical feature is that the ore bodies have the direction of elongation parallel to the orientation of the elongated minerals and of the microfolding in the host rocks and it is of great value in predicting the direction of plunge of ore shoots.[5] This direction also coincides with the axis of folding (Fig. 2).

[5] This fact was described by E. Sagawa in 1910 [Résumé of a report on the geology of the cupriferous pyrite deposits in the crystalline schists of the northern part of Awa and northwestern part of Iyo in the Island of Shikoku: *Bulletin of the Imperial Geological Survey of Japan*, vol. **22**, No. 1 (In Japanese)]. Recently, T. Kamiyama and Y. Horikoshi noticed this fact again and applied it to the prospecting and developing of the ore bodies (Collins,

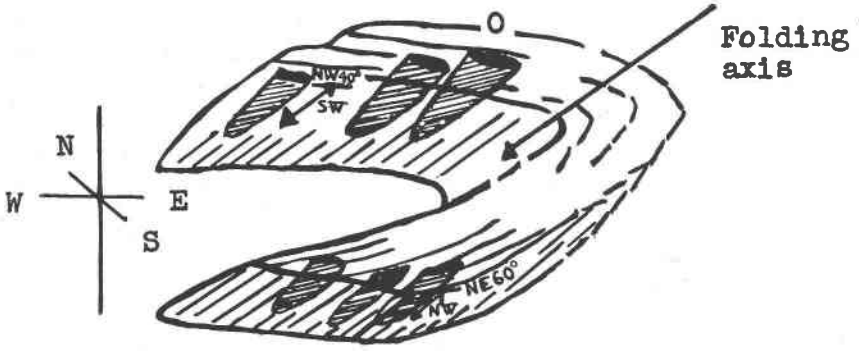

FIG. 2. The relation between lineation, folding axis and shoot of ore body near the Izushi mine (After Y. Horikoshi). O, ore body.

FIG. 3. Universal compass. W, water level.

In 1946, the writer drew the graph for the determination of linear schistosity which is very similar to Ingerson's.[6]

J. J.; A summary of Horikoshi's structure of cupriferous pyrite in schist: *Econ. Geol.*, **45**, 480–481 (1950).

[6] Ingerson and Tuttle had already prepared the graph in 1943, as stated above. But the writer did not know of their publication. Correspondence was impossible until just after the war.

Imai, H., and Kato, Y., On the direction of the lineation in crystalline schist: *Mineralogy and Geology*. **1**, 245–247 (1947) (In Japanese).

In 1948, Professor Nishio[7] of our department devised a compass similar to Ingerson's and made it in his laboratory (Fig. 3). Ten instruments were made there and then about fifty have been manufactured in Katsushima Seisaku-sho (Katsushima Factory).[8] The price of it is $8 to $10. It is used by Japanese geologists in universities, the Geological survey and mining companies. They say that it is convenient not only for the determination of direction of lineation but also of flow structure in igneous rocks and slicken grooves in fault planes.

The writer is indebted to Dr. Ingerson for his kindness in recommending that he prepare this paper and in reading the manuscript.

LEAD CONTAMINATION IN DUCO CEMENT

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Because of its availability and adaptability, Duco cement has become widely employed as a binding agent in powder x-ray work in the United States. Recently investigators (e.g., G. T. Faust, *Am. Mineral.*, **36**, 813, 1951) have observed that Duco gives a broad, diffuse but characteristic band on powder photographs. This contamination is of minor importance and normally does not jeopardize accurate interpretation.

In the course of powder work on fine-grained micas, several x-ray photographs revealed mica lines of unusual intensities, as well as extraneous lines, which made accurate crystal structure determination impossible. At first these photographs were put aside in the belief that they were obtained from micas with a hitherto unreported structure. After several such photographs had accumulated out of a total of 50, some type of contamination was suspected. However investigation showed that the mica samples themselves were pure and therefore that the contamination was introduced during or after the preparation of the mount.

When the Duco was studied microscopically, small black specks, occasionally in considerable quantities, were observed in it as it emerged

[7] At that time, journals of the United States of America were very sparsely distributed in Japan. Nishio was not aware of Ingerson's paper.

Nishio, S., Measurement of linear schistosity in crystalline schists: *Mining Geology and Applied Geophysics*, compiled by H. Sano. 1951 (In Japanese).

This apparatus has a water-level, as shown in Fig. 3, so we can also determine the dip and strike of the schistosity plane or of bedding plane by using it.

[8] Katsushima Seisaku-sho, 17, 2 chome, Nippori-machi, Arakawa-ku, Tokyo, Japan.