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On the Foliation Plane of the Sanbagawa Crystalline Schist in the Tenryu River Basin.

by

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With 1 plate and 7 Figures

Abstract

In the Sanbagawa crystalline schist in the Tenryu River basion, two foliation planes found in phyllites, respectively represent slip planes of separate orogenic movements and indicate that they were not formed in the same orogenic movement.

Introduction

As a result of investigation carried on since 1950 in the Sanbagawa crystalline schist region in the Tenryu river basin, it has been made clear that the geological structure and crystalline schist now seen in the Sanbagawa crystalline schist region were not formed by only one orogenic movement, as was hitherto believed by geologists, but by two great orogenic movements. The problem of the foliation plane must be treated from this angle.

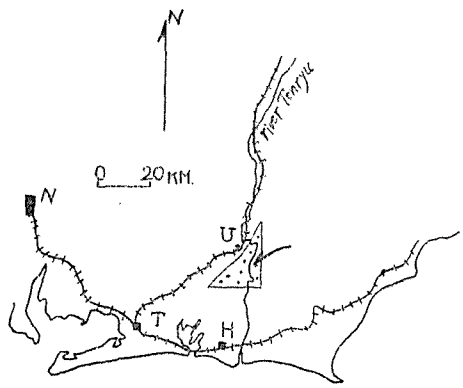


Fig. 1. Index map of the Tenryu field
N: Nagoya T: Toyohashi H: Hamamatsu
U: Uragawa

As to the formation period of the two foliation planes in the flexure fold — bedding plane and axial plane foliation, there is a difference among scholars; some maintain that there is a relative synchronism between the above two foliation planes, while others that there is an interval between them. They agree, however, that the orogenic movement of the same period was the cause of the formation of the foliation plane.

However, in the Sanbagawa crystalline schist region in the Tenryu river basion, two foliation planes found in black phyllite and white phyllite which are both incompetent beds, respectively represenet slip planes of separate orogenic movements and indicate that they were not formed in the same orogenic movement.

Stratification and Geological Structure

The stratification in the Sanbagawa crystalline schist region in this district is as follows.

Upper bed: Alternation bed of green schist (albite spotted & non spotted) and black shist (albite spotted & non spotted)

Middle bed: Quartz schist, limestone schist, alternation bed of white phyllite, black phyllite and green phyllite.

Lower bed: Black phyllite

The geological structure in this district, according to Shigeo Notomi[1], Haku Koide[2], Yoshikazu Horikoshi and Toyo Katano[3], is the monoclinal structure with the slight East — Northern strike and the West — Northern dip, however,

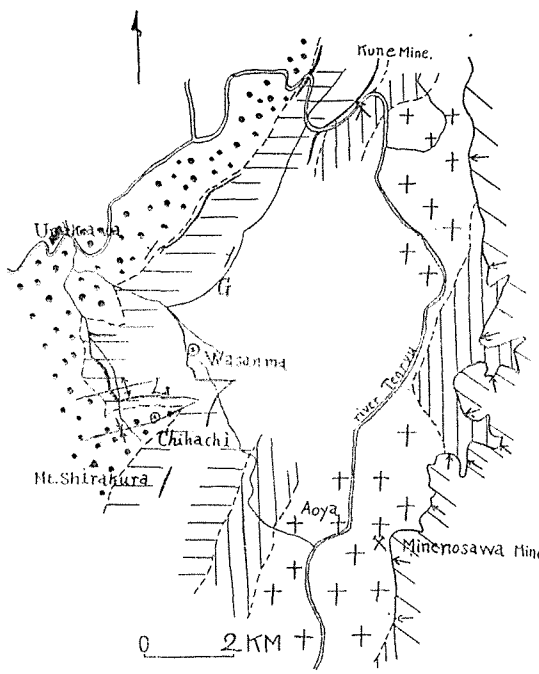
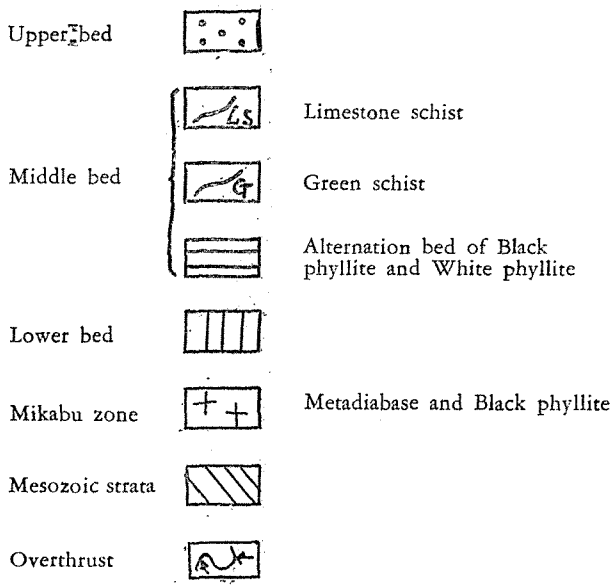


Fig. 2. Geological map of the Tenryu field



the structure is not so simple, although the structure of some parts of the district may appear so.

When investigated with the thin bed of the limestone schist and the upper quartz schist as the key bed, the anticline and the syncline with the East—Westward foldimg axis can be found in a large scale in the neighbourhood of the Chihachi pass, as shown in Fig. 2.

The vertical distance from the bottom of the syncline to the top of the anticline is approximately 140 meters. Such a large East—Westward folding structure can now be seen nowhere else. The East—Westward folding structure in a smaller scale can be seen in the neighbourhood of Kune Mine where the plane distribution of the rock bed formes the letter S and the South—Northward folding structure is also found.

The East—Westward strike of the rock bed in the neighbourehood of the Chihachi pass, shown in the geological map by Y. Horikoshi and T. Katano[3], is the indication of the East—Westward folding structure explained above.

In addition to large-scale folding structure mentioned above, there are the East—Westward folding structures in the small-scale, found in the outcrops of about 5 to 10 meters. Fig. 1 of Plate shows one example of the small-scale East—Westward folding structure which can be found in the sandstone schist on the way to the Chihachi pass from Urakawa-machi. Such a small structure, however, can not be represented in the 1/50,000 scale map.

In other regions than the Chihachi pass, the neighbourhood of Kune and the eastern region of the river Tenryu, the monoclinal structure with the North—Eastern strike and West—Northern dip may be considered to exist. Fig. 3 shows the model strcture in this region, with the South—Northern structure

predominating.

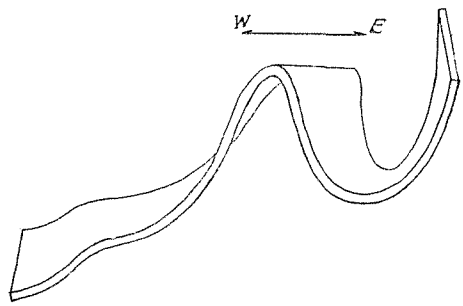


Fig. 3. Model structure of the Tenryu field

Foliation

In the upper bed, the foliation is parallel to the bedding plane and only the foliation plane parallel to the bedding plane exists; the same condition is found both in the region with the South—North monoclinal structure and in the region with the East—West structure. In this foliation plane, the linear structures of East—West and South—North are found in the schist with the albite spot and in the quartz schist. Generally speaking, the East—West linear structure is predominant.

In the middle and lower beds, there is a special structure that can not be found in the upper alternation bed. It is the East—West intraformational folding (Fig 2 of Plate) formed by the slip movement in the plane S_1 parallel to the bedding plane.

On this surface, there can be seen the East—West linear structue parallel to the folding axis and the axis of crenulations. In addition, the foliation plane S_2 can be found in a position corresponding to that of the axial plane in the intraformational folding. This foliation plane S_2 is the slip plane of the South—Northward folding movement and it is folding South—Northward. Furthermore the South—Northward linear structure is found on this surface.

Judging from the above mentioned facts, it is clear that the East—Westward folding, was formed in the earlier period than the Sonth-Northward folding,

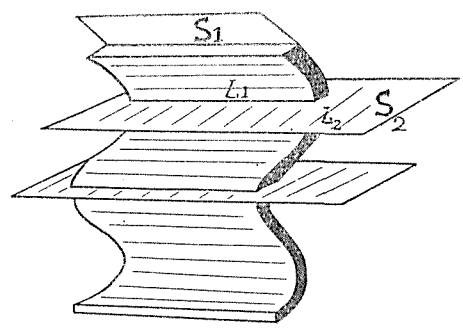


Fig. 4. Scheme of the relation between S_1 and S_2
L_1 & L_2: Linear structures

as is shown Fig. 4. In non-intraformational foldings, the foliation plane parallel to the bedding plane plays the part of the slip plane in the East — Westward and South — Northward folding movements. On such surface the East — Westward linear structure is predominant.

As descrided above, although of the same orogenic movement, the forming structures vary with different beds. This variety is a result of the difference of the physical character of the beds which is generally expressed by the terms, " competent beds " or " incompetent beds ".

Petrofabrics

As is shown in Fig. 3 of Plate, if closely examined under the microscope, a texture can be recognized, with the preparate vertical to the East — Westward linear structure B_1 of the black phyllite which indicate the above mentioned intraformational folding. This is the so-called false cleavage texture[4], the banding structure of which is formed of quartz, sericite, graphite and is parallel to S_1. The parallel structure crossing with S_1 is based on S_2. S_1 and S_2 are respectively folding East — Westward and South — Northward, and S_2 is in a position corresponding to that of the axial plane of S_1; S_2 is formed in a later period than S_1, as mentioned above. This may be confirmed by testing the fabrics of quartz. Fig. 5 and 6 give measurements of quartz in the quartz layers pallalel to S_1, preparate of which are nearly vertical to B_1.

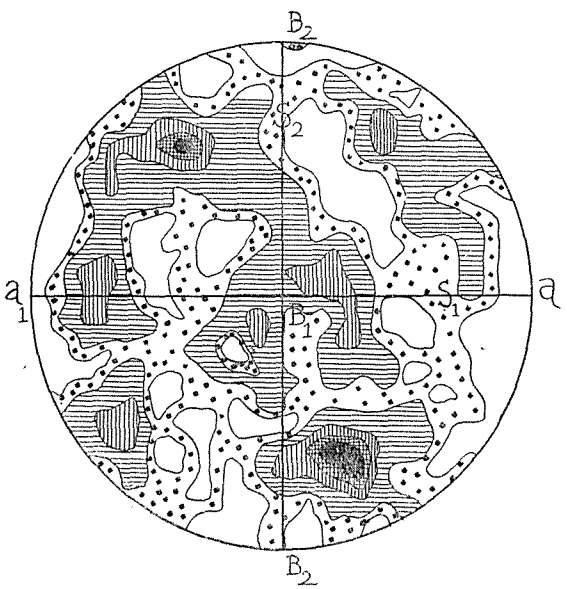


Fig. 5. 200 Quartz axes [O --0.5 — 1 — 2 — 3 — 4 <] %

Rock: Black phyllite (Lower bed)
Locallity: Kune
Number of Specimen: 5110081

Fig. 7 gives measurements of the quartz arranged parallel to S_2 in the quartz layer parallel to S_2, as seen in Fig. 4 of Plate.

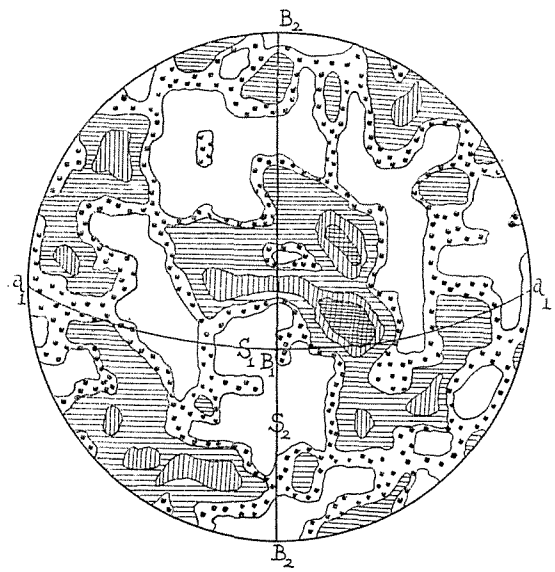


Fig. 6. 150 Quartz axes O−0.5−1−2−3< %
Rock: Black phyllite (Lower bed)
Locallity: Aoya
Number of specimen: 51100604

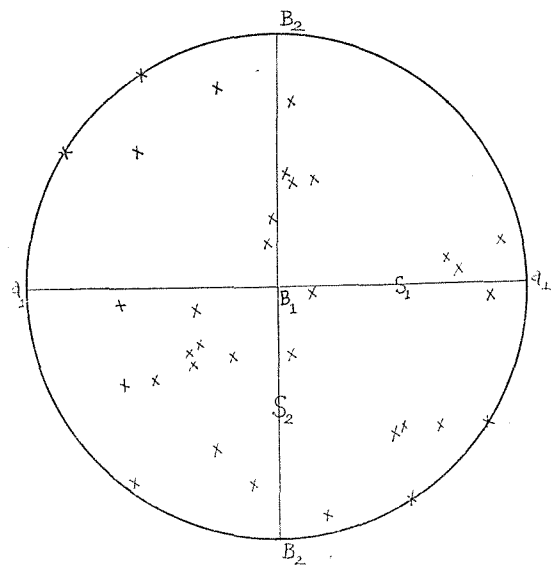


Fig. 7. 31 Quartz axes
Number of specimen: 51100801

These three petrofabric diagrams, compared with one another, indicate that:

1) As to B_1, the fabrics of the girdle type are predominant.

2) As to a_1, B_1, and c_1, (h01) girdle is next predominant.

3) Considerably many gatherings around B_1 is due to slip movements along S_2.

As mentioned above, it is evident that the two folding movements (East—West and South—North) are indicated in petrofabrics, and also that the East—Westward folding has greater effects on petrofabrics. A corresponding relation can be found between the petrofabrics and the structure in the megascopic rock specimen. Further details about fabrics will be treatd in another treatise.

Conclusion

1) In the Sanbagawa crystalline schist region in the Tenryu river basin, the South — Northward orogenic movement took place later than the East — West ward orogenic movement.

2) During the two orogenic movements—1st and 2nd—one part of the incompetent bed formed the slip plane (S_2) at a position corresponding to that axial plane of the intraformational folding when the later orogenic movement was made.

3) In S_1 and S_2, the linear structures (East – West and South – North) characterized by the mineral orientation, which is also seen in petrofabrics, can be found.

Acknowledgement

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References

1) Shigeo Notomi: Explanation Text of the Geological Map of Japan, Shidara. Geological Survey of Japan. 1924. (In Japanese with English Résumé)

2) Haku Koide: Geological and Petrological Study on the Forest Site. Bulletin of the Tokyo University Forests. 1937. (In Japanese)

3) Yoshikazu Horikoshi and Toyo Katano: Geology and Ore deposits of the Minenosawa Mine, Shizuoka Prefecture. The Journal of the Geological Society of Japan. Vol. 47. 1940. (In Japanese)

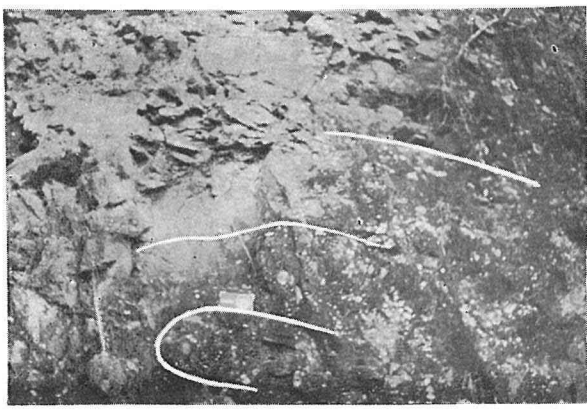
4) Alfred Harker: Metamorphism. p, 157. 1932.

Explanation of plate

Fig. 1 A minor folding structure of the East-Westward in sandstone schist.

Fig. 2 The East-Westward intraformational folding in the middle bed
B: Black phyllite W: White phyllite

Fig. 3 So-called False cleavage texture Rock: Black phyllite
Number of Specimen: 51100301



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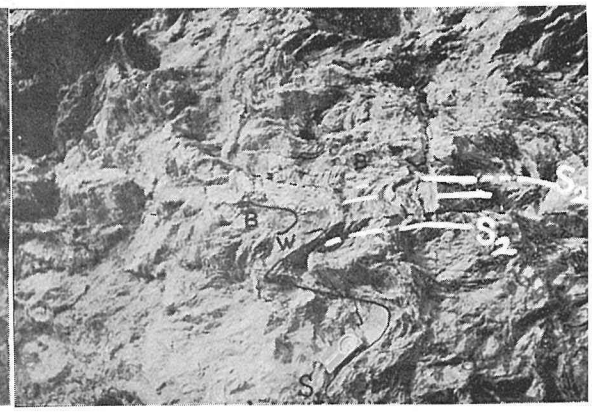

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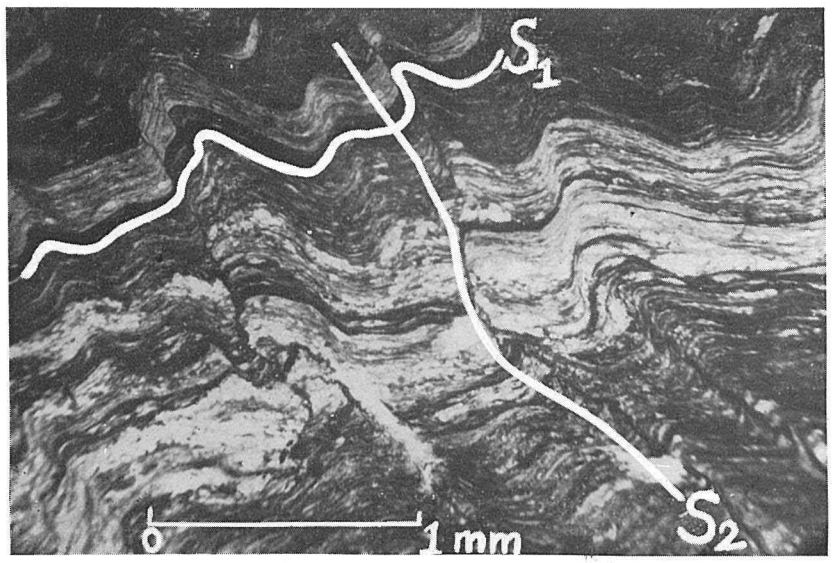

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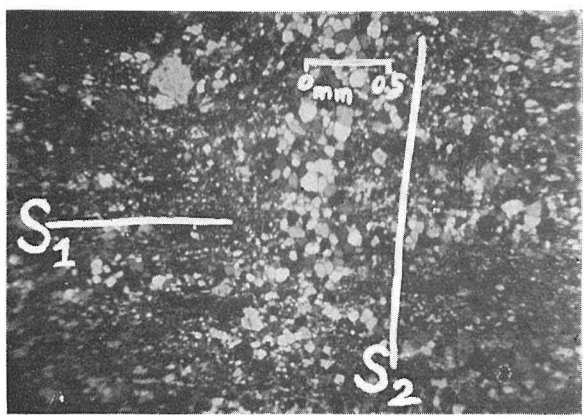

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