Bull. Natn. Sci. Mus., Ser. C (Geol.), 1 (4), December 22, 1975

Two Manganiferous Stilpnomelanes from Kanto Mountains Sambagawa Crystalline Schists

By

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The Sambagawa metamorphic terrane of the Kanto Mountains, central Japan, is glaucophanitic. It is characterized by the common occurrences of glaucophanic amphiboles, lawsonite and jadeitic pyroxenes in the middle grade part of progressive metamorphism (SEKI, 1958, 1961; TORIUMI, 1971; TANAKA and FUKUDA, 1974). Stilpnomelane was first described by KOJIMA (1944) from stilpnomelane-quartz-calcite schist of the Nagatoro district, which belongs to the rather high grade part in this terrane. Since then the mineral has been reported to occur widely, if not abundantly, in rocks of the whole terrane (IWASAKI, 1956; SEKI, 1958; TANAKA, SAKAMOTO and HARADA, 1969; TORIUMI, 1971; TANAKA and FUKUDA, 1974). Stilpnomelane seems to be stable in schists of favorable composition under the wide range of metamorphic conditions. This paper gives the chemical and mineralogical descriptions of two manganiferous stilpnomelanes and their host rocks from the rather high grade zones in this metamorphic terrane.

Of the two rock specimens, the first was obtained from an outcrop on the bank of the river Arakawa near the Kami-Nagatoro railway station, Nagatoro-machi, Saitama Prefecture. The locality is in the lower grade part of the subcalcic hornblende zone. The rock is a coarse-grained and strongly foliated schist. On the plane of schistosity radial aggregates and bundles of dark greenish brown flakes of stilpnomelane are visible to the naked eyes. Under the microscope the rock consists mainly of stilpnomelane, quartz, calcite and opaque minerals, accompanied by very small amounts of garnet, apatite and sphene. The opaque minerals include pyrite, magnetite, chalcopyrite and hematite, the last two being rare. The modal composition is given in Table 1.

The second specimen was collected from a cutting along the road near Ôda, Kodama-machi, Saitama Prefecture. Its matemorphic grade is higher than that of the first rocks, judging from the scheme of zonal mapping by SEKI (1958) and TANAKA and FUKUDA (1974). This rock, too, is coarse-grained and strongly foliated. The principal constituent minerals are stilpnomelane, quartz, calcite and opaque minerals with subordinate garnet, chlorite and biotite. The opaque minerals are pyrite, magnetite, chalcopyrite, sphalerite, pyrrohtite and ilmenite, among which the former two are predominant. In Table 1 are listed the modes.

Chemical analyses were made of the two rocks. The results are shown also in

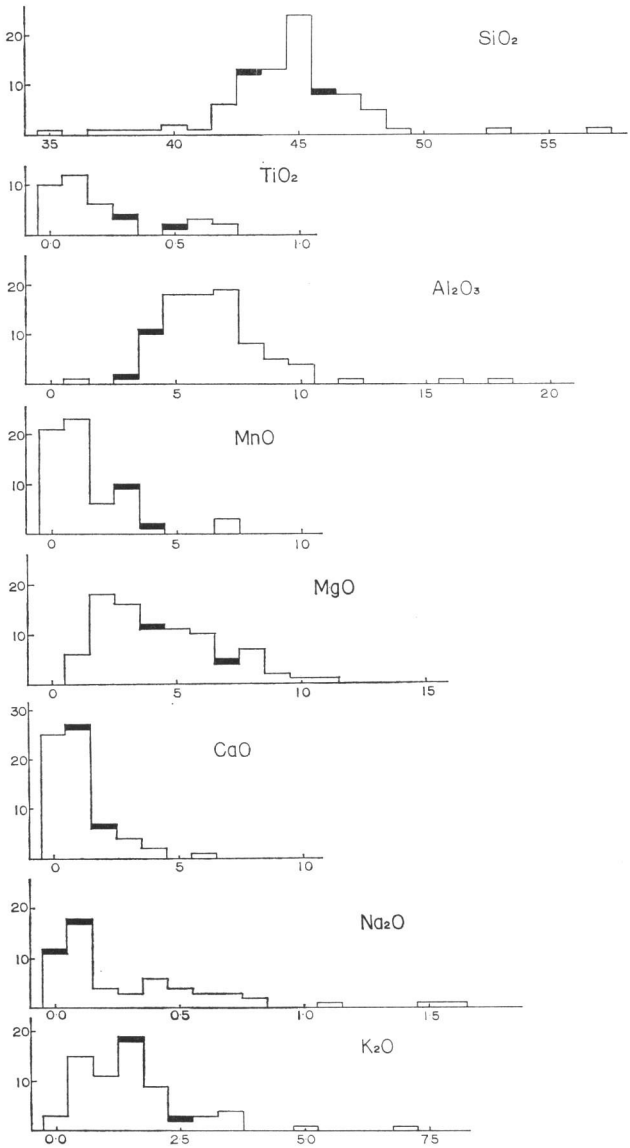

Fig. 1. Histograms of the contents of main oxide other than iron in stilpnomelane analyses. Abscissas indicate the percentage by weight, and ordinates the numbers of analyses. Black shows the analyses in Table 2. Data from CHAUVEL (1973), SATO (1975) and this paper.

Table 1. As the table reveals, both rocks are highly calcic owing to their high contents of calcite. But, when we calculate $CaCO_3$, combining CaO and CO_2, only a very small amount of CaO remains. The silicate parts of the two rocks are, therefore,

Table 1. Chemical and modal compositions of stilpnomelane-quartz-calcite schists from the Kanto Mountains Sambagawa terrane.

	1	2
SiO_2	51.99	37.70
TiO_2	0.33	0.16
Al_2O_3	1.16	0.90
Fe_2O_3	4.12	3.61
FeO	7.16	8.12
MnO	2.30	1.93
MgO	2.33	1.18
CaO	14.48	24.04
Na_2O	0.30	0.20
K_2O	0.49	0.67
H_2O+	3.36	2.31
H_2O-	1.02	0.51
P_2O_5	tr.	0.03
CO_2	10.91	18.50
Total	99.95	99.86
CaO for $CaCO_3$	13.89	23.55
CO_2 for $CaCO_3$	10.91	18.50
Remains of CaO	0.59	0.49

Analyst: T. TIBA

	1	2
Stilpnomelane	41	28
Quartz	34	4
Calcite	23	56
Garnet	—	7*
Opaque minerals	2**	5***

* $n=1.800$, $a=11.632\pm0.001$ Å
** Pyrite, magnetite, chalcopyrite, hematite.
*** Pyrite, magnetite, chalcopyrite, sphalerite, pyrrohtite, ilmenite.

Table 2. Chemical analyses of stilpnomelanes

	1	2
SiO_2	46.11	43.19
TiO_2	0.47	0.33
Al_2O_3	3.02	3.50
Fe_2O_3	19.10	6.94
FeO	7.59	24.00
MnO	4.39	3.16
MgO	7.00	4.34
CaO	1.14	1.82
Na_2O	0.76	0.04
K_2O	1.46	2.33
H_2O+	6.62	7.89
H_2O-	2.70	2.24
Total	100.36	99.78
$Fe_2O_3/(Fe_2O_3+FeO)$	0.72	0.22
Color in thin section	green brown	green
$\beta\fallingdotseq\gamma$	1.602	1.596
d_{001} (Å)	12.138 ± 0.002	12.120 ± 0.004

Analyst: T. TIBA

practically free from CaO. On the other hand, the rocks are poor also in Al_2O_3, and this oxide would be mostly fixed in stilpnomelane. So, the lack of Ca-Al hydrous silicates in these rocks results, in spite of their high CaO contents. A fairly large amount of MnO in the rocks is also noticed.

Stilpnomelanes were separated from their host rocks by means of magnetic separator and heavy liquid (methylene iodide diluted with acetone). Little impurities are found in the obtained samples. Chemical analyses, optical properties and the basal spacings are listed in Table 2. The mineral from the first schist is ferristilpnomelane and its $Fe_2O_3/(Fe_2O_3+FeO)$ ratio by weight is 0.72, whereas that of the second rock is a ferrous variety, the ratio being 0.22.

Fig. 1 shows the frequency distribution of the main oxide contents in stilpnomelane analyses published up to now. As will be perceived in the figure, the minerals dealt with in this paper are poorer in Al_2O_3 and richer in TiO_2 and MnO than the commonest stilpnomelanes. The richness of the last oxide in the studied samples is illustrated

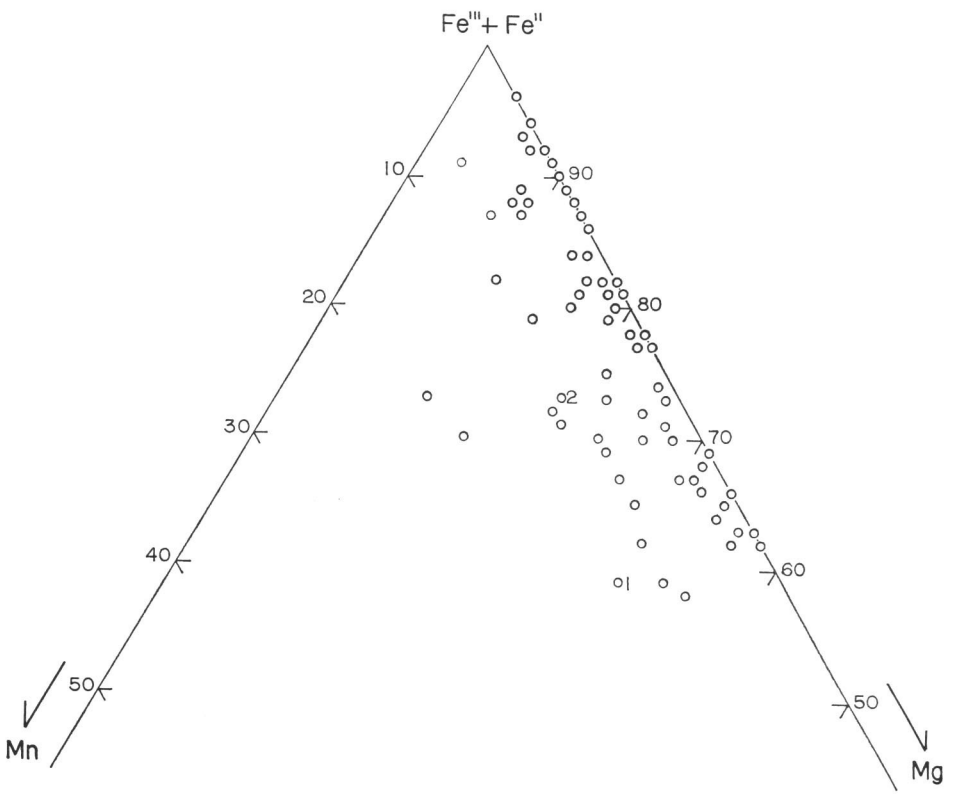

Fig. 2. Atomic proportions of Fe'''+Fe'', Mn and Mg of stilpnomelanes. Numbered circles indicate the analyses in Table 2. Data from CHAUVEL (1973), SATO (1975), LIOU, HO and YEN (1975) and this paper.

also by a triangular diagram of Fig. 2, whose apices indicate the atomic proportions of $Fe'''+Fe''$, Mn and Mg. The stilpnomelanes similarly rich in MnO (about 3.1% by weight) have been reported recently from a glaucophane schist of the Juisui district of Taiwan by LIOU, HO and YEN (1975).

Acknowledgements:—Thanks are due to Dr. T. TIBA for chemical analyses and to Dr. A. KATO for X-ray works.

References

CHAUVEL, J. J., 1973. Matériaux pour la connaissance des minéraux du groupe des stilpnomélanes. *Bull. Soc. géol. minéral. Bretagne*, (C), **5**: 51–91.

IWASAKI, M., 1956. A note on the occurrence of the mineral of stilpnomelane group in the Sambagawa crystalline schist region, Japan. *J. Gakugei, Tokushima Univ.*, **7**: 1–17.

KOJIMA, G., 1944. On stilpnomelane in greenschists in Japan. *Proc. Imp. Acad. Jap.*, **20**: 322–328.

LIOU, J. G., C. O. HO & T. P. YEN, 1975. Petrology of some glaucophane schists and related rocks from Taiwan. *J. Petrol.*, **16**: 80–109.

SATO, K., 1975. Stilpnomelane from the Fujigatani skarn ore deposit, Japan, and its bearing on the problem of ferric and ferrous stilpnomelanes. *N. Jb. Miner. Mh.*, Jg. 1975, **4**: 179–192.

SEKI, Y., 1958. Glaucophanitic regional metamorphism in the Kanto Mountains, central Japan. *Jap. J. Geol. Geogr.*, **29**: 233–258.

———, 1961. Pumpellyite in low-grade metamorphism. *J. Petrol.*, **2**: 407–423.

TANAKA, K. & M. FUKUDA, 1974. Geologic structure and metamorphic zoning of the northern extremity of the Sanbagawa metamorphic terrain in the Kanto Mountains, with special reference to the occurrence of biotites. *J. Jap. Ass. Miner. Petrol. Econ. Geol.*, **69**: 313–323. (In Japanese.)

TANAKA, K., O. SAKAMOTO & K. HARADA, 1969. Sanbagawa metamorphic rocks in the vicinity of Nagatoro of the Kanto Mountains, central Japan. *Bull. Chichibu Mus. Nat. Hist.*, **15**: 19–25. (In Japanese.)

TORIUMI, M., 1971. Sanbagawa metamorphic rocks of the Onishi-Manba area, Kanto Mountains, Japan. Thesis, Univ. Tokyo.