ON THE BRUCITE-MARBLE (PREDAZZITE) FROM THE NANTEI MINE, SUIAN,(1) TYÔSEN (KOREA).

The Geology of the Suian Gold Mining District. (1st Report).

By

Takeo WATANABE

With 2 Plates and 1 Text-Figure

Contribution from the Department of Geology and Mineralogy, Sapporo, No. 109

INTRODUCTION

In the course of the geologic study of the Suian mining district the writer found an interesting contact-metamorphosed rock which wholly resembles an ordinary white marble in hand-specimens, notwithstanding the fine aggregate of calcite and brucite.

Predazzite and pencatite are the names given to such brucite-bearing marbles from Predazzo in Tyrol; occurrences of similar rocks seem to be comparatively rare in the world. Especially has there been no known locality of such a rock in Japan.

The purpose of the present article is to give some petrographic descriptions of the brucite-marble found in the vicinity of the Nantei gold mine,(2) and to discuss the genesis of the rock.

Here the writer wishes to express his sincere thanks to Professor T. KATO of Tôkyô Imperial University and Professor K. UWATOKO, Professor Z. HARADA and Mr. T. YOSHIMURA of our Department, for

(1) 遂安 (Suan).

(2) 楠亭金鑛 (The Tul Mi Chung Mine): The Nantei Mine was formerly called the Tul Mi Chung Mine. The geological report of the Tul Mi Chung Mine has already published by D. F. HIGGINS: Geology and Ore Deposits of the Collbran Contact of the Suan Mining Concession, Korea. Econ. Geol., Vol. XIII, 1918, 1–34. The writer's report is now in preparation.

their kind advices and encouragements in his study. And especially he wishes to express his gratitude to Professor J. SUZUKI of this Department, who kindly read the original manuscript. Further, the writer is also glad to acknowledge his deep obligation to officers of the Nantei mine for their kindness in the field.

HISTORICAL SKETCH OF STUDIES OF PREDAZZITE AND PENCATITE

Since the names, predazzite and pencatite, are not commonly known, and, moreover, the definitions of the names have often been used with different meanings among previous workers, it may be worth while to give here a brief account of the history of the study of the rocks.

The name, predazzite, was first given by LEONARDI to a supposed mineral from Predazzo in the Monzoni district. Later PETZHOLDT(1) from chemical analysis assumed that predazzite was a mineral. It had been generally believed to be a simple mineral of which the chemical composition was represented as $2\,CaCO_3\,Mg(OH)_2$, until the thin sections of the rock was examined under the microscope.

But this chemical nature of the supposed mineral was often doubted by succeeding workers (FOURNET, DAMOUR, etc.) and the new name, pencatite, was introduced by J. ROTH(2) to represent a darker variety from the same locality, since its chemical composition corresponded to $CaCO_3.\,Mg(OH)_2$ differs clearly from that of predazzite. Pencatite was named in honour of the famous geologist Marzari Pencati, a pioneer worker on the geology of the Monzoni district.

Although predazzite and pencatite were originally thought to be distinct mineral species, having a definite chemical composition due to their homogeneous appearance and simple molecular ratio shown in their analytical data, later investigators(3) such as RICHTHOFEN (1860), DE LAPPARANT, TSCHERMAK (1869), HAUSENSCHILD (1869), LEMBERG (1872) KALKOWSKY (1891) COSSA, etc. examined

(1) PETZHOLDT: Über den Predazzit. Beit. zur Geognosie von Tyrol, S. 194; Ref. N. J. 1845, S. 700.

(2) ROTH, J.: Über den Kalk von Predazzo. Erdm. Journ., 1851; Ref. Zeit. deut. geol. Ges., Bd. III, 1851, S. 109.

ROTH, J.: Bemerkungen über die Verhältnisse von Predazzo. Zeit. deut. geol. Ges., Bd. III, 1851, S. 140.

(3) The literature was exhaustively cited and explained in Leneček's paper.

chemically and microscopically in detail and refuted the above stated view, showing that both rocks were only a mixture of calcite and brucite.

LEMBERG(1), among others, did not use the name "pencatite" in his paper, owing to the transitional nature of chemical composition among the rocks called predazzite or pencatite.

In 1869, after the examination of abundant slices, LENEČEK(2) presented a different opinion as to the nature of the minerals contained; his conclusion was that the rocks consisted of calcite and hydromagnesite instead of calcite and brucite.

Because of his unconvincing methods of identifying hydromagnesite, his conclusion was not reliable enough to be admitted by PERUZZI(3), LINDEMANN(4), etc. They showed that brucite was actually one of principal constituents of the rocks.

TEALL(5) and HARKER(6) found similar brucite-bearing marbles of the predazzite and pencatite type in the contact zone of Skye granite intruding into the Cambrian dolomite. In HARKER's eminent Skye paper, the definition of predazzite and pencatite was clearly stated as follows: "It is most in accordance with the original usage to employ the name pencatite for an aggregate of calcite and brucite in equal molecular proportions, i.e. with the percentage composition of 63.3 calcite to 36.7 brucite, reserving the predazzite for varieties richer in calcite".

Though HARKER's definition has been generally accepted as cited by HOLMS(7) some different and older explanations have still been given in some modern text-books(8)(9) of petrography.

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(1) LEMBERG, J.: Über die Contactbildungen bei Predazzo. Zeit. deut. geol. Ges., XXIV, 1872, 187–264.

LEMBERG, J.: Über Gesteinsumbildungen bei Predazzo und Monzoni. Zeit. deut. geol. Ges., XXIX, 1877, 457–510.

(2) LENEČEK, O.: Über Predazzit und Pencatit. Min. petr. Mitt., Bd. XII, 1891, 429–442, 447–456.

(3) PERUZZI, L.: Sui calcare a brucite di Teulada e sulla composizione mineralica della predazzite. Atti. R. Accad. dei Lincei Rendic. cl. sc. fis., mat. e nat., XIV, 1905, 83–88; Ref. N. J., II, 1906, 329–330.

(4) LINDEMANN, B.: Über einige wichtige Vorkommnisse von Körnigen Carbonatgesteinen mit besonderer Berücksichtigung ihrer Entstehung und Structur. N. J., Beil. Bd., XIX, 1904, 197–318.

(5) TEALL, J. J. H.: On Dedolomitization. Geol. Mag., XL, 1903, 513–514.

(6) HARKER, A.: The Tertiary Igneous Rocks of Skye (Metamorphism of Cambrian Limestone produced by Granite). Mem. Geol. Surv. Unit. Kingdom, 1904, 144–151. HARKER, A.: Metamorphism, 1932, 77–78.

(7) HOLMS, A.: The Nomenclature of Petrology, 1920, 178 & 189.

(8) REINISCH, R.: Petrographisches Praktikum, 1920, 187.

(9) GROUT, F. F.: Petrography and Petrology, 1932, 369.

Further, by their detailed petrographic examinations, EAKLE[1] (1917) and ROGERS[2][3] (1918, 1929) recently described some American rocks similar to predazzite and determined the mineral in question as a brucite. The rare mineral, periclase, was also found in the core of brucite spots of the marble. The occurrence of a periclase in predazzite was first noted by COSSA[4] from Vesuvius and later LENEČEK[5] found it in the rocks from Vesuvius and Predazzo and named a periclase-bearing marble as periclase-predazzite.

With respect to the origin of brucite-bearing marble of predazzite and pencatite type, most of the investigators agreed in the opinion that the rocks were of contact-metamorphic origin and brucite was assumed as a pseudomorph after periclase which was sometimes contained in the core of the aggregates of the former. The writer intends to use the name "brucite-marble" and to discuss the origin in connection with the Nantei rocks later in this paper.

Besides, on this occasion, the writer will record several localities of the brucite-marble as far as he is aware, in the hope that he may hear other localities of the rock:

(1) Predazzo, South Tyrol, Italy.[6]
(2) Monzoni, South Tyrol, Italy.[7]
(3) Sardidnia, Italy.[8]
(4) Vesuvius, Italy.[9]
(5) Skye, Scotland.[10]
(6) Ledberg, Sutherland.[11]
(7) Riverside, California, U. S. A.[12]
(8) Crestmore, California, U. S. A.[13]

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(1) EAKLE, A. S.: Minerals associated with the Crystalline Limestone at Crestmore, Riverside County, California. Bull. Geol. Dep. California Univ. X, 1917, 327–360.

(2) ROGERS, A. F.: An American Occurrence of Periclase and its Bearing on the Origin and History of Calcite-Brucite Rocks. Am. Jour. Sci., XLVI, 1918, 581–586.

(3) ROGERS, A. F.: Periclase from Crestmore near Riverside California, with a List of Minerals from this Locality. Am. Min. XIV, 1929, 462–469.

(4) (5) LENEČEK, (1891): Op. cit.

(6) PETZHOLDT, (1845); ROTH, (1851); LEMBERG, (1877); LENEČEK, (1891); LINDEMANN, (1904) etc: Op. cit.

(7) LENEČEK, (1891); LINDEMANN, (1904): Op. cit.

(8) PERUZZI, (1905): Op. cit.

(9) ROTH, (1851); LENICEK, (1891): Op. cit.

(10) HARKER, (1904): Op. cit.

(11) TEALL, J. J. H., (1903): Op. cit.

(12) ROGERS, (1918): Op. cit.

(13) EAKLE, (1917); ROGERS, (1918) & (1929): Op. cit.

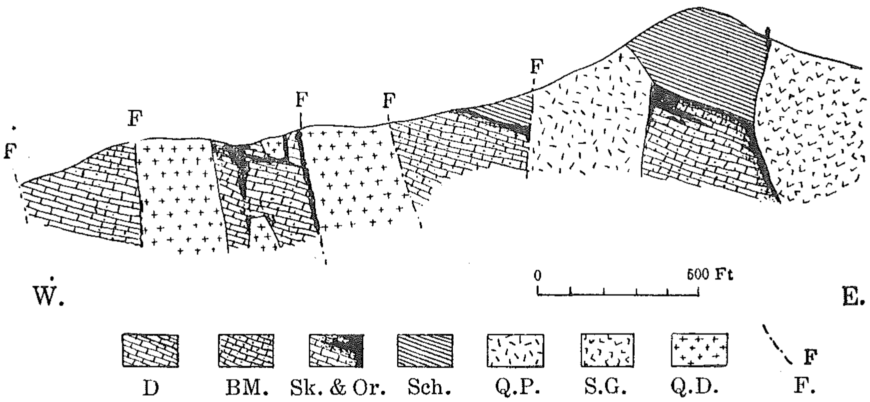
(9) Mountain Lake Mine, near Salt Lake City, Utah, U.S.A.[1]
(10) Philipsburg, Montana, U. S. A.[2]
(11) Honan, China.[3]
(12) Nantei Mine (Tul Mi Chung Mine), Kôkaidô, Tyôsen (Korea).

MODE OF OCCURRENCE

The brucite-marble in question is well developed in the contact zone along the southern border of a small granodioritic batholith which intruded into the Pre-Cambrian sediments mainly consisting of dolomite and slate. The rock is usually associated with biotite-hornfels and calc-magnesian silicate rocks and its occurrence is especially common in the vicinity of the Nantei gold-copper mine.

Though the geologic structure of the mine is somewhat complicated by the minor intrusions of quartz-diorite, quartz-porphyry, etc., mutual relations of prevailing rocks may be understood from the accompanying figure (Fig. 1.)

As seen in the section of Fig. 1, garnet-pyroxene skarn rock containing metallic minerals is usually developed between the



D = Dolomite. BM. = Brucite-Marble. Sk. & Or. = Skarn & Ore.
Sch. = Hornfels. Q.P. = Quartz Porphyry. Q.D. = Quartz Diorite.
S.G. = Porphyritic Granodiorite (Suan Granite). F = Fault.

Fig. 1. Diagrammatic section of the Nantei mine showing relation of the brucite-marble to ore and igneous bodies.

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(1) ROGERS, (1918): Op. cit.
(2) EMMONS, W. H. & CALKINS, F. C.: Geology and Ore Deposits of the Philipsburg Quadrangle Montana. U. S. G. S. Prof. Pap., 78, 1913, 157.
(3) STEUER, A.: Mitteilungen über Gesteine aus den Chinesischen Provinzen Kansu, Schensi, Hupe und Honan. N. J. Beil. Bd. X, 1896, 477–494.

brucite-marble and granodiorite (the Suan granite) or hornfels along the main contact zone of the mine.

The brucite-marble is often penetrated by veinlets or stringers of the skarn minerals as shown in Pl. II, Fg. 3; this relation indicates that the skarnization is clearly posterior to the formation of the brucite-marble. Although this brucite-marble is the most prevalent rock in this mine, no mention of its occurrence has hitherto been given in previous reports.

PETROGRAPHIC DESCRIPTIONS

When fresh, the rock is very compact and of homogeneous appearance like ordinary white marble, but on weathering it presents a characteristic feature on its surface by selective action. The brucite being more soluble than the calcite, rectangular or rounded shallow hollows up to 1.5 mm. in diameter appear on the surface of the rock. These features may, however, be overlooked without careful observation.

On the other hand, it is true that the darker varieties are more or less disseminated by magnetite, sometimes arranged in streaks or banded, probably indicating original planes of stratification.

Under the microscope thin sections of the whitish marble show that calcite and brucite are the chief constituents. Minor amounts of serpentine and magnetite also occur. The structure and texture of the rock are quite similar to those of the so-called predazzite and pencatite as shown Pl. I, Fig. 1.

Calcite is very abundant and is granular, the grains being up to 2 mm. in size. In thin sections this calcite is always turbid and not so transparent as the one found in the diopside-bearing marble occurring near the skarn masses. Cleavages and twining are sometimes developed and gliding lamellae || $(01\bar{1}2)$ often appear, crystals of calcite being in places bent as shown in Pl. II, Fig. 2.

Moreover, it is the characteristic feature of the calcite that a biaxial figure with small optic angles $2V=10°–15°(—)$ is always observed conoscopically instead of an ordinary uniaxial figure. This biaxial character of the calcite may be due to a strain-effect by intense compressive forces acting during the time of metamorphism and hydration. Though WALKER & PARSON[(1)] suggested that a biaxial character of calcite indicated that it was formed above 970°C as a high temperature modification, this conclusion was doubted by

(1) See GILLSON'S paper.

SMYTH and ADAMS(1). On the other hand, the formation of biaxial calcite was experimentally observed by S. NISHIO(2), who subjected a marble consisting of uniaxial calcite to very high directed pressure.

Occurrences of biaxial calcite in marbles from various contact zones were pointed out by GILLSON(3) who considered that the anomaly of the calcite would be produced by forces of deformation.

Brucite occurs as rounded or rectangular spots up to 1 mm. in size scattered throughout the rock. Between the crossed nicols, the spots prove to be pisolitic or a scaly concentric aggregate of the mineral, and have often a perfect concentric structure, as shown in the photograph Pl. I, Fig. 4. In some spots fibrous brucite is not concentrically but irregularly arranged as shown in Pl. II, Fig. 1.

These brucite fibres are usually bent or twisted indicating mechanical deformation in their formation like the calcite described above.

As has been said by various investigators, the nature of the structure of brucite shows that it is pseudomorphic after cubic periclase as seen in Pl. I, Fig. 3.

In white marble-brucite is perfectly colourless, while in darker varieties, it has a more or less brown colour, probably, owing to its high content of iron.

The refractive indices of colourless brucite were measured by the immersion method:

Nantei Brucite (T. Watanabe)	Keikansan Brucite(4) (T. Watanabe)
$\varepsilon = 1.584 \pm 0.002$	$\varepsilon = 1.584 \pm 0.002$
$\omega = 1.566 \pm 0.002$	$\omega = 1.565 \pm 0.002$
$\varepsilon - \omega = 0.018$	$\varepsilon - \omega = 0.019$

The character of zone is negative. Due to the strong dispersion, the brucite shows a peculiar anomalous interference colour in the thicker section 0.04 mm. in thickness.

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(1) SMYTH, F. H. & ADAMS: The System, Calcium Oxide-Carbon Dioxide. Jour. Am. Chem. Soc. XLV, 1923, 1167–1184.

(2) NISHIO, S.: Optical Anomaly of Calcite in the Compressed Marble. Jour. Mining Inst. of Japan, XLII, 1926, 479–489. (In Japanese).

(3) GILLSON, J. L.: Biaxial calcite, Am. Min. XII, 1927, 357–360.

(4) The specimen of brucite (nemalite) from Keikansan, (Hsiu-yen hsien), (岫巖), Manchoukuo was kindly offered to the writer by Prof. Z. HARADA. The chemical analysis of this brucite, quoted from the List of Chemical Composition of Minerals in Manchuria published by the Geol. Surv. South Manchurian Rail. Co. in 1932, gave the result: SiO_2=3.10% Al_2O_3=trace MgO=65.39% CaO=1.70% Soluble SiO_2=0.95 H_2O=29.83% Total=100.97% (Anal. Central Exp. Works of South Manchurian Rail. Co.).

Identification of the brucite was secured by the further tests by LEMBERG's[1] staining method, using $AgNO_3$ solutions, and also by chemical analysis of the rock.

No periclase was found in the core of brucite in the Nantei marble. Serpentine is rather rare and seems to be pseudomorph after forsterite.

Magnetite appears abundantly as small grains in some darker varieties. Dolomite is also found in microscopic secondary veinlets penetrating irregularly through the rock (Pl. II, Fig. 3). The distinction between dolomite and calcite in the thin section was also noted by the writer, who used the staining method developed by LEMBERG.[2]

Within the narrow zone near pyroxene-skarn the brucite-marble passes gradually into the coarse calcite-marble containing abundant grains of forsterite or diopside in which the calcite is perfectly clear and brucite wholly absents.

On the weathered surfaces of the rock an amorphous white mineral often covers the brucite and the former will be hydromagnesite (n_2=1.545) as already described by ROGERS[3].

CHEMICAL COMPOSITION

The rock yields much water when heated in closed tubes, and a white-marble is perfectly soluble in dilute hydrochloric acid. Chemical analysis of a white brucite-marble made by Mr. A. KANNARI of our Department gave the following result:

TABLE I.

The Chemical Composition of Brucite-marble.

	A	B	C	D
SiO_2	0.22	0.4	0.3	—
Al_2O_3	} 0.56	—	—	—
Fe_2O_3		—	—	—
MgO	21.56	21.4	22.2	25.46
CaO	38.01	38.5	37.9	35.40
CO_2	30.52	30.2	29.7	27.77
$H_2O(+)$	9.36	9.5	9.9	11.37
$H_2O(-)$	0.01	—	—	—
Total	100.24	100.0	100.0	100.00

(1) LEMBERG, J.: Zur mikroskopischen Untersuchung von Calcit, Dolomit und Predazzit. Zeit. deut. geol. Ges., XXXIX, 1887, 489–492; XL, 1888, 357–359.
(2) LEMBERG, J., (1888): Op. cit.
(3) ROGERS, A. F., (1918): Op. cit.

(A) Brucite-marble (S. 29) from the Nantei mine; Locality 36-C; The actual analysis was made by A. Kannari.
(B) Ditto (S. 29): The calculated composition from the relative proportions of the constituents of the analysed rock determined by Rosiwal's method. Cf. Table II (B).
(C) Brucite-marble (S. 701) from the Nantei mine; Locality 30-J; The calculated composition was also obtained by using the same method as mentioned above. Cf. Table II (C).
(D) Pencatite ($CaCO_3$: $Mg(OH_2) = 1:1$): Theoretical composition.

In order to compare the calculated mineralogical composition with the actual, the volume percentages of the same rock as analysed, together with another one from the same mine, were measured by ROSIWALD's method. Assuming the density of the minerals as written in Table II the weight percentages were also calculated from all results as shown in Table II.

TABLE II.

The Mineralogical Composition of Brucite-marble.

	Sp. gr. (assumed)	A	B		C		D	
		cal. wt.%	vol.%	cal. wt%	vol.%	cal. wt%	vol.%	cal. wt%
Calcite	2.71	68.6	66.1	68.7	64.9	67.6	60.4	63.18
Brucite	2.40	30.9	32.9	30.3	34.3	31.6	39.6	36.82
Serpentine	2.50	0.5	1.0	1.0	0.8	0.8		
Total		100.00	100.0	100.0	100.0	100.0	100.0	100.00
Density obs.		2.59	2.59		2.60			
Density cal.			2.60		2.60		2.58	

(A) Brucite-marble (S. 29): The weight percentage of the constituents was calculated from actual analysis. Table I, (A).
(B) Ditto (S. 29): The weight percentage was calculated from the volume percentage determined by Rosiwal's method. Table I, (B).
(C) Brucite-marble (S. 701): The volume and weight percentages were obtained using the same method as (B).
(D) Pencatite: The percentages were calculated from Table I, (D).

It appears that the agreement between calculated and actual is fairly good on account of the simple mineralogical composition and homogeneous character of the rocks. Besides, the measured densities of the rocks also coincided well with those calculated, so the existence of brucite leaves no room for doubt. Therefore, according to HARKER's definition the rock in question may be called as predazzite.

GENESIS OF THE BRUCITE-MARBLE

Brucite-marble (the predazzite or pencatite) has generally been thought to be derived from periclase marble, which was formed by thermal metamorphism from pure dolomite-rock, the process of metamorphism being called dedolomitization. The equations representing the formation of brucite are shown below:

$$\underset{\text{Dolomite}}{CaMg(CO_3)_2} = \underset{\text{Calcite}}{CaCO_3} + \underset{\text{Periclase}}{MgO} + CO_2 \quad \text{(Dedolomitization)}$$

$$\underset{\text{Periclase}}{MgO} + H_2O = \underset{\text{Brucite}}{Mg(OH)_2} \quad \text{(Hydration)}$$

This conclusion has already been accepted by most previous workers and it seems to admit of no further discussion. But it is noteworthy that the brucite-marble is not the only resulting rock from original dolomite-rock; dolomite-marble is also often formed in some cases as already described by HARKER(1), HATCH and RASTALL(2), TILLEY(3), WATANABE(4), etc. As the formation of brucite-marble is probably due to the fact that the dissociation of the dolomite molecules was favoured by the local condition at low pressure during the time of metamorphism, the abundant occurrence of such a rock in the Nantei mine may be explained by that there are many fissures and faults through which CO_2 gas produced by dissociation escaped easily.

As to the succession of events of metamorphism in the contact zone, it may be safely stated that the stage of pyrometasomatism was clearly posterior to that of dedolomitization, according to the field observations of the mutual relation of skarn and marble.

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(1) HARKER, A., (1904): Op. cit.

(2) HATCH, F. H. & RASTALL, R. H.: Dedolomitization in the Marble of Port Shepstone. Q. J. G. S., LXVI, 1910, 507–522.

(3) TILLEY, C. E.: The Metamorphism of the Pre-Cambrian Dolomites of Southern Eyre, Peninsula, South Australia. Geol. Mag., LVII, 1920, 440–462, 492–500.

(4) WATANABE, T.: On the Gold-Copper-Bismuth Ores of the New Ore Body, Hol Kol Gold Mine, Suan Korea. Jour. Geol. Soc. Tôkyô., XL, 1933, 70–85, 125–148, 188–209. (In Japanese).

Conversion of periclase into brucite was a later process of hydrothermal action, succeeding the pyrometasomatic stage, to which some copper-zinc-lead ores of the mine have been attributed.

SUMMARY AND CONCLUSIONS

Brucite-marble was found as one of the most common country rocks in the Nantei ore-bodies lying within the contact zone of the batholithic mass of granodiorite "Suan Granite".

Petrographic and chemical examinations show that the rock is quite similar to the so-called predazzite from Tyrol, and the presence of brucite and biaxial calcite was also ascertained by both chemical and microscopic methods.

The history of the formation of the rock is summarized as follows:

1) *Stage of Dedolomitization.* In the earlier stage of contact metamorphism pure dolomite rock was thermally metamorphosed into periclase-marble.

2) *Stage of Pyrometamorphism.* Subsequent to the dedolomitization, the ore-bearing solutions in high temperature emanated from magma were introduced into its surrounding rocks and they formed important skarn of the mine.

3) *Stage of Hydration.* Following the second stage, the periclase-marble, together with other country rocks, was attacked by hypogene hydrothermal solutions from the same magma and was converted wholly into brucite marble.

PLATE I

PLATE I

(Photomicrographs)

Fig. 1. Brucite-marble (predazzite) from the Nantei mine.
Ordinary light. Magnified 15 diameters.
b=brucite c=calcite

Fig. 2. Ditto between crossed nicols.

Fig. 3. Brucite-pseudomorph after idioblastic periclase.
Ordinary light. Magnified 65 diameters.
b=brucite c=calcite

Fig. 4. Ditto, between crossed nicols.
Brucite (b) showing scaly-concentric structure.

Fig. 5. Brucite-marble rich in iron.
Brucite (ferrobrucite) is darker in color.
Ordinary light. Magnified 19 diameters.
b=brucite c=calcite

Fig. 6. Veinlet of dolomite cutting the brucite-marble.
This thin section was treated by LEMBERG's solution.
b=brucite, c=calcite (stained),
d=dolomite (unstained).

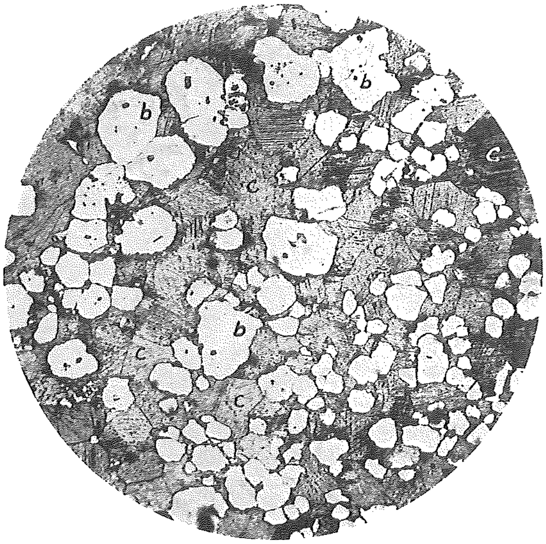


Fig. 1.

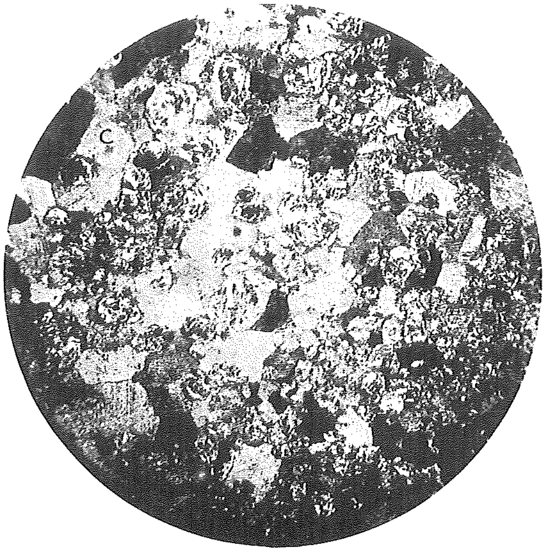


Fig. 2.

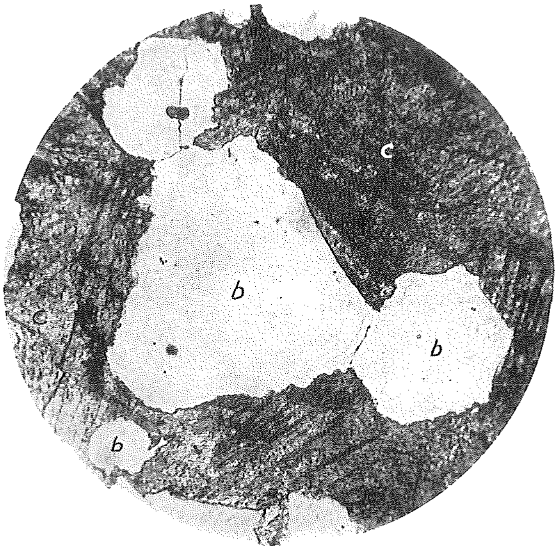


Fig. 3.

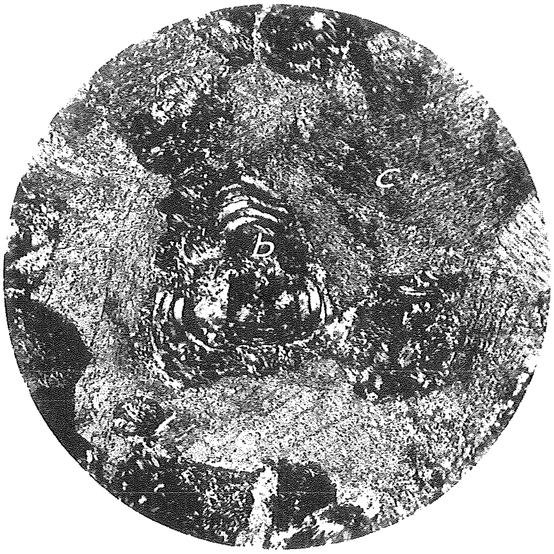


Fig. 4.

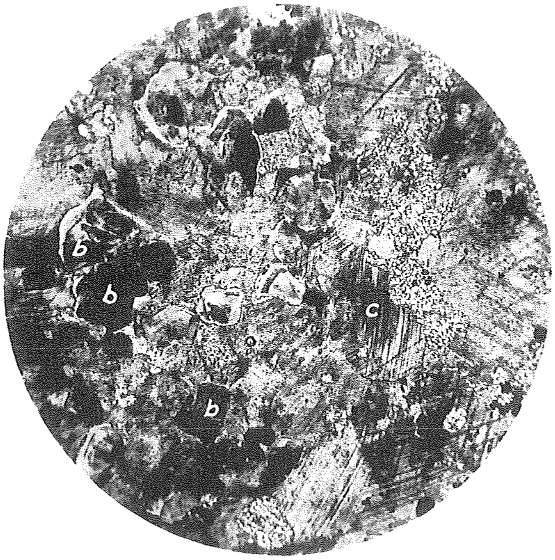


Fig. 5.

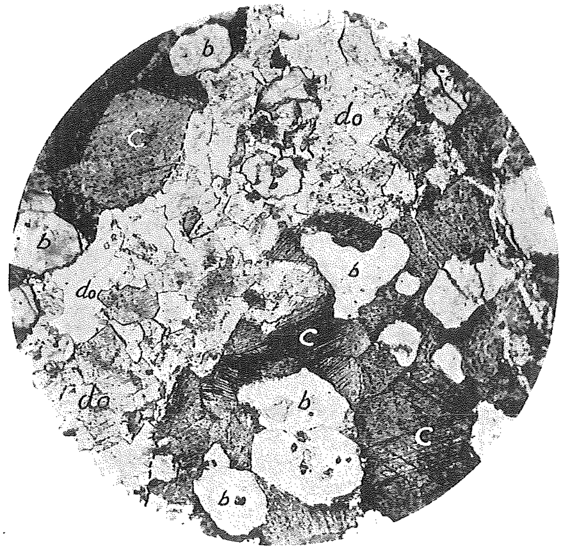


Fig. 6.

T. Watanabe: On the Brucite-Marble (Predazzite) from the Nantei Mine.

PLATE II

PLATE II

Fig. 1. Brucite after periclase. Brucite-fibres are always bent due to the strain-effect in their formation.
Between crossed nicols Magnified 65 diameters.

Fig. 2. Glinding-lamellae in biaxial calcite.
Ordinary light. Magnified 65 diameters.
b=brucite c=calcite

Fig. 3. Veinlet of skarn cutting magnetite-bearing brucite-marble. The Skarn vein consisting of tremolite and diopside are separated from the brucite-marble by a narrow zone of olivine which is almost completely altered to serpentine (black zone).
SK=skarn s=serpentine after olivine
BrM=Spotted brucite-marble with magnetite.

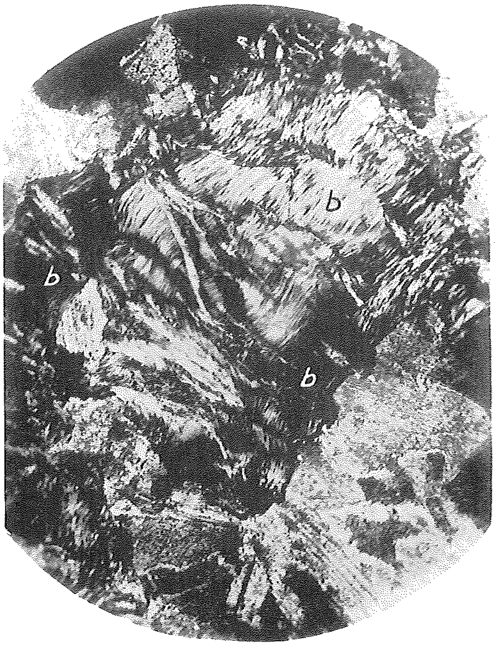


Fig. 1.

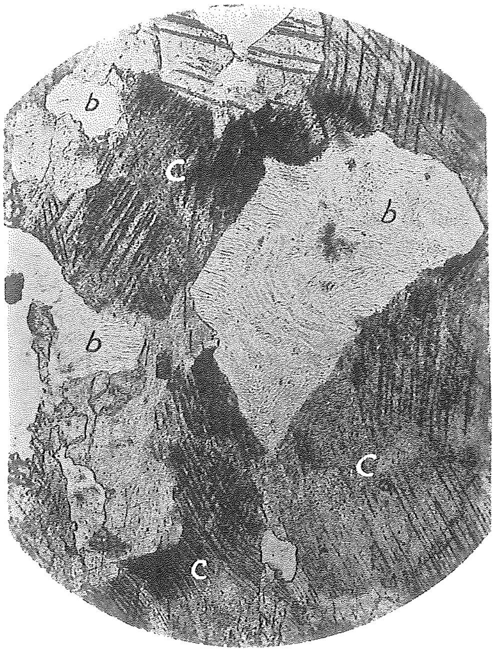


Fig 2.

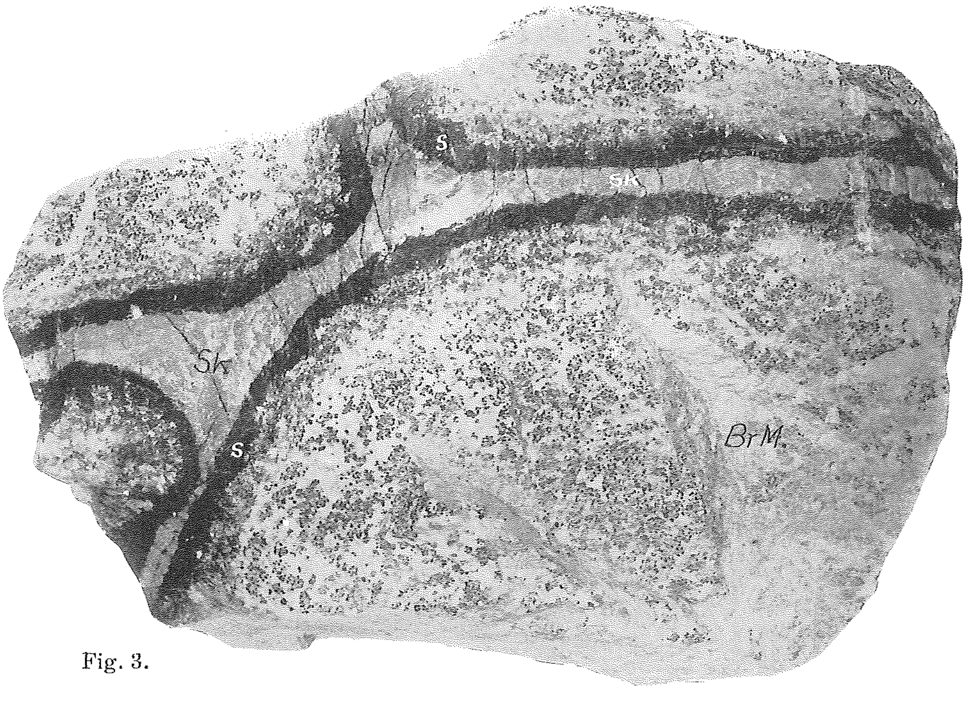
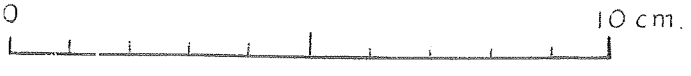


Fig. 3.



T. Watanabe: On the Brucite-Marble (Predazzite) from the Nantei Mine.