PECTOLITES FROM CHISAKA, HIDAKA PROVINCE AND NOZAWA MINE, FURANO, HOKKAIDO

by

Kenzo YAGI, Takeo BAMBA* and Mituo OKEYA**

(with 2 plates)

(Contribution from the Department of Geology and Mineralogy, Faculty of Science, Hokkaido University. No. 1074)

Abstract

Pectolite, a rather rare mineral in Japan, has recently been found in serpentine from Chisaka, Hidaka Province and Nozawa Asbestos Mine, Furano, Hokkaido. Physical properties and chemical composition of the pectolites from the two localities are described. They are almost pure pectolites, nearly free from MnO content. They were formed from the hydrothermal solution, rich in Ca and Na in the later stage of crystallization of serpentines.

Contents

Introduction

Occurrence of pectolite was first described in Japan by HARADA (1934) from several localities in Hokkaido as aggregates cutting through serpentine or diabase. Later Sugi and Kutuna found pectolite as a minor constituent mineral in an aegirine syenite from Iwaki Island, Setouchi Sea (SUGI and KUTUNA, 1944, TANEDA, 1952). Recently we found beautiful aggregates of acicular crystals of pectolite in the ser-

* Hokkaido Branch, Geological Survey of Japan, Sapporo.
** Hokkaido Industrial Research Institute, Sapporo.

pentine along the upstream of the Chiroro River, Chisaka, Hidaka Province, and also in the asbestos-bearing serpentine at Nozawa Mine, Furano, both in central Hokkaido. In the following mineralogical description on these pectolites will be given.

Modes of Occurrence

Along Panke-Yutorashinai River, a small tributary of the Chiroro River, Chisaka, Hidaka Province, snow white aggregates of radiating acicular crystals of pectolite are observed closely associated with nephrite at the contact of rodingite and the surrounding serpentine. Although the main parts of the serpentine are severely decomposed or sheared, those parts intruded by rodingite are very hard and resistant, forming many large blocks scattered along the river, some of which measure more than 5 m in diameter. Pectolite is well-developed in the area where nephrite is formed along the contact of rodingite and serpentine. This mode of occurrence is similar to that described by BLOXAM (1954) from Girvan-Ballantrae complex. At Nozawa Asbestos Mine, Furano, pectolite forms thick platy aggregates within the fissure of asbestos-bearing serpentine in the vicinity of leucocratic dyke rocks, aplitic in composition. Neither rodingite nor nephrite is associated with pectolite in this case.

Physical Properties

The crystals are needle-shaped, elongated parallel to b-axis, and forms a (100) and c (001) are well-developed, whereas form b (010) and other prismatic forms are not developed. Cleavages are well-developed parallel to (001) and (100). Nevertheless the crystals are very tenaceous and their big aggregates are difficult to break with a hammer, and tiny acicular crystals are itchy to the skin. By this characteristic feature this mineral can easily be distinguished from wollastonite, which is easily broken into rather stout prisms. Specific gravity measured by a pycnometer is 2.86 for Chisaka pectolite and 2.87 for Nozawa pectolite. The crystals are colorless in thin section. Elongation is nearly parallel to Z and is positive. Optic plane coincides nearly with (100), and is almost normal to (010). Refractive indices determined by dispersion method are shown in Table 1.

Table 1. Optic Properties of Pectolites.

	Chisaka	Nozawa
α	1.598	1.599
β	1.604	1.605
γ	1.631	1.631

Table 2. X-ray Powder Data of Pectolites.

(1)			(2)		(3)	
d(Å)	I	hkl	d(Å)	I	d(Å)	I
7.83	50	100	7.72	vw	7.74	vw
7.03	50	001	6.95	w	6.96	vw
5.50	50	$\bar{1}01$	5.45	w	5.34	w
4.98	10	101				
4.55	10	$\bar{1}11$				
4.00	20	$\bar{1}\bar{1}1$				
3.90	60	200	3.87	m	3.86	m
3.77	20	111, $2\bar{1}0$				
3.52	50	$\bar{2}01$	3.48	m	3.49	m
3.43	40	020				
3.33 }	60B	$\bar{1}02$	3.30	vs	3.30	vs
3.28 }		201	3.26	s	3.26	s
3.16	50	$2\bar{1}1$	3.14	w	3.14	w
3.10	80	210, $\bar{1}21$	3.07	vs	3.07	vs
2.921	100	120, $2\bar{2}0$+	2.90	s	2.90	s
2.739	60		2.72	m	2.73	m
2.600	60		2.58	m	2.58	m
2.430	50					
2.338	50		2.33	w	2.32	w
2.298	60		2.29	m	2.29	m
2.227	20					
2.191 }	60		2.18	vw	2.17	vw
2.166 }			2.16	vw	2.16	vw
2.090	20		2.08	vw	2.08	vw
2.053 }	30		1.99	vw	1.99	vw
2.002 }						
1.945	20		1.95	vw	1.93	vw
1.926	40		1.91	vw	1.91	vw
1.877	40		1.85	vw	1.87	vw
1.831	40		1.82	vw	1.82	vw
1.781	30				1.77	vw
1.752	60		1.74	w	1.75	w
1.716	60		1.71	vw	1.71	w
1.675	20		1.67	vw	1.67	vw
1.661	40		1.65	w	1.65	w
1.603	40		1.61	vw	1.61	vw
1.570	20					
1.554	50					

(1) Pectolite from Bergen Hill, New Jersey (HILDEBRAND, 1953).
(2) Pectolite from Chisaka.
(3) Pectolite from Nozawa Mine.

X-ray powder data obtained on the condition: Cu$K\alpha$ 30 KV, 7 mA, scanning speed 1° per minute, are given in Table 2, as compared with the data obtained by HILDEBRAND (1953) by minimizing the effects of preferred orientation. The correspondence are fairly good, though there are some effects of preferred orientation in the present samples.

Chemical Composition

Pure samples were chemically analysed with the results shown in Table 3. It is noticed that contents of Al_2O_3, Fe_2O_3, MgO, MnO, and K_2O are exceedingly low. Atomic ratios were calculated on the basis of O, OH=18.000, and the chemical formulas are given as follows:

Chisaka pectolite

$$Na_{1.978}(Ca_{4.011}Mn_{0.003})_{4.014}(Si_{5.967}Al_{0.013}Fe_{0.012})_{5.992}O_{15.949}(OH)_{2.051}$$

Table 3. Chemical Composition of Pectolites.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SiO_2	54.05	53.72	53.35	52.73	53.80	54.02	52.04	51.44	48.72
TiO_2	0.00	0.00	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Al_2O_3	0.13	0.10	0.14	0.24	0.00	n.d.	0.92	n.d.	0.29
Fe_2O_3	0.16	0.15	n.d.	n.d.	0.00	n.d.	n.d.	n.d.	0.03
FeO	n.d.	n.d.	0.20	0.10	1.00	n.d.	1.29	2.01	1.33
MnO	0.00	0.03	n.d.	tr.	0.12	1.53	2.31	11.69	28.99
MgO	0.00	0.00	n.d.	tr.	0.00	n.d.	0.05	0.13	0.06
CaO	34.01	33.70	33.90	33.93	33.20	32.20	31.15	20.53	10.42
Na_2O	9.10	9.20	9.20	8.90	9.01	8.88	7.97	9.50	7.38
K_2O	0.00	0.00	0.34	0.37	0.00	0.36	0.90	n.d.	0.26
H_2O+	2.83	2.77	2.96	3.36	2.94	3.00	3.07	2.25	2.67
H_2O-	0.16	0.02	0.18	n.d.	n.d.	n.d.	n.d.	n.d.	0.11
Total	100.44	99.69	100.27	99.63	100.07	99.99	100.21	99.95	100.46

(1) Pectolite from Nozawa Mine, Furano: Analyst; M. Okeya.
(2) Pectolite from Chisaka, Hidaka Prov.: Analyst; M. Okeya.
(3) Pectolite from Shimekappu, Hidaka Prov.: Analyst; A. Kannari (HARADA, 1934).
(4) Pectolite from Utonai, Teshio Prov.: Analyst; A. Kannari (HARADA, 1934).
(5) Pectolite from Paterson, New Jersey, U.S.A.: Analyst; F. A. Gonyer (PEACOCK, 1935).
(6) Pectolite from Juksporlak, Chibina, U.S.S.R.: Analyst; W. P. Iwanowa (BELJANKIN and IWANOWA, 1933).
(7) Pectolite from Parker Shaft, Franklin, New Jersey, U.S.A.: Analyst; R. B. Gage (PALACHE, 1937). ZnO 0.26, BaO 0.13, SrO 0.12.
(8) Schizolite from Julianehaab, Greenland: Analyst; C. Christensen (WINTHER, 1901). Y_2O_3 2.40.
(9) Serandite from Rouma, Archipel de Los, Guinée française: Analyst; M. Raoult (LACROIX, 1931). Total is given as 100.46, but actually it is 100.26.

Table 3. Continued.

	(1-a)		(2-a)	
Si	5.962	5.992	5.967	5.992
Al	0.017		0.013	
Fe^{3+}	0.013		0.012	
Mn	—	4.019	0.003	4.014
Ca	4.019		4.011	
Na	1.943	1.943	1.978	1.978
OH	2.081	18.000	2.051	18.000
O	15.919		15.949	

(1-a) Atomic ratios of pectolite from Nozawa Mine on the basis of O, OH=18.000.
(2-a) Atomic ratios of pectolite from Chisaka on the basis of O, OH=18.000.

Nozawa pectolite

$$Na_{1.943}Ca_{4.019}(Si_{5.962}Al_{0.017}Fe_{0.013})_{5.992}O_{15.919}(OH)_{2.081}$$

These two formulas are in close agreement with the ideal formula of pectolite $Na_2Ca_4Si_6O_{16}(OH)_2$.

It has been noticed that soda content is fairly constant in pectolites, whereas contents of manganese and lime are variable. The mineral analogous to pectolite and very high in MnO was named " serandite " by LACROIX (1931), and an intermediate member between them " schizolite " (WINTHER, 1901). MACHATSCHKI (1932) and SCHALLER (1955) have shown that pectolite, schizolite and serandite form a continuous series of isostructural solid solutions, between pectolite $Na_2Ca_4Si_6O_{16}(OH)_2$ and serandite $Na_2Mn_4Si_6O_{16}(OH)_2$, with Mn proxying for Ca. In Table 3, some pectolites, schizolite and serandite from various localities in the world are given in the order of increasing content of MnO. It is evident that all the pectolites from Japan belong to pure end members of pectolite almost completely free from MnO.

The D.T.A. curves determined for the pectolites from Chisaka and Nozawa Mine demonstrate the presence of endothermic peaks at about 100° and at about 750°C. The first one is very vague, indicating loss of hygroscopic water, whereas the second gives a very sharp peak beginning at 740° and finishing at 825°, with a maximum at 765°C. X-ray powder data indicate that the decomposed products consist of a mixture of wollastonite and some unknown phases, which may be some sodium silicates. This behavior is similar to the pectolite described by BELJANKIN and IWANOWA (1933). The powdered sample of pectolite heated at 1000°C for 16 hrs in Pt-envelope and then quenched, was found under the microscope to consist of wollastonite, unknown crystalline phase or phases, and small amount of glass. The results of thermal experiments on the pectolites will be discussed in another occasion.

Genetic Significance

HARADA (1934) described that the pectolites were formed within serpentines or diabases in Hokkaido. In the present cases, the pectolites are confined to serpentines, especially where the serpentines are intruded by rodingite or by leucocratic dyke rocks. This suggests that the mineral was formed from the hydrothermal solutions, rich in both calcium and sodium in the later stage of the crystallization of serpentines. The genetic relation between pectolite and nephrite or other associated minerals will be discussed elsewhere.

Acknowledgements

We were indebted to Mr. A. MURAKAMI of Furenai, Hiratori Town, Hidaka, and to Mr. K. NOGUCHI, Director of the Nozawa Asbestos Mine, for their kind help during the field survey. We were much benefited by stimulating discussion on pectolite with Prof. Z. HARADA, now the Principal of Asahikawa Technical College. Dr. E. NARITA of Hokkaido Branch of Geological Survey of Japan helped us in X-ray investigation. Our cordial thanks are due to all of them. Part of the cost for the present study was defrayed by the Grant for Scientific Research by the Ministry of Education of Japan.

References Cited

BELJANKIN, D. S. and IWANOWA, W. P. (1933): Untersuchung der chemischen Konstitution des Pektoliths. Centralbl. Min. A. 327–339.

BLOXAM, T. W. (1954): Rodingite from Girvan-Ballantrae complex, Ayrshire. Min. Mag. **30**, 525–528.

HARADA, Z. (1934): Über einen neuen Pektolithfund in Japan. J. Fac. Sci. Hokkaido Imp. Univ. Ser. IV, **4**, 355–359.

HILDEBRAND, F. A. (1953): Minimizing the effects of preferred orientation in X-ray powder diffraction patterns. Am. Min. **38**, 1051–1056.

LACROIX, A. (1931): Les pegmatites de la syenite sodalitique de l'ile Rouma, Archipel de Los, Guinée française. Description d'un nouveau mineral (serandite) qu'elles renferment. Compt. Rend. Acad. Sci. Paris **192**, 189–194.

MACHATSCHKI, F. (1932): Serandit-Pektolith-Wollastonit. Centralbl. Min. A. 69–73.

PALACHE, C. (1937): The minerals of Franklin and Sterling Hill, Sussex County, New Jersey. U.S.G.S. Prof. Paper **180**, pp. 135.

PEACOCK, M. A. (1935): On pectolite. Zeit. Krist. **90**, 97–111.

SCHALLER, W. T. (1955): The pectolite-schizolite-serandite series. Am. Min. **40**, 1022–1031.

SUGI, K. and KUTUNA, M. (1944): Aegirine syenite from Iwaki Island, Ehime Prefecture. J. Jap. Assoc. Min. Petr. Econ. Geol. **31**, 259–274.

TANEDA, S. (1952): Pectolite- and eudialite-like mineral-bearing aegirine syenite from Iwaki Islet, Setouti (Inland Sea), Japan. Jap. J. Geol. Geogr. **22**, 235–240.

WINTHER, C. (1901): Schizolite, a new mineral. Meddel. om Grønland **24**, 196–203.

(Manuscript received August 28, 1967)

PLATE 21 AND EXPLANATION

Explanation of Plate 21

Fig. 1 Aggregate of pectolite crystals (white), associated intimately with nephrite (grey) and serpentine (grey), from Chisaka, Hidaka Province. × 1/2 Natural size.

Fig. 2 Aggregates of acicular crystals of pectolite (white) grown on nephrite (grey). Same locality. × 1/2 natural size.

Fig. 3 ditto. Same locality. × 2/3 natural size.

Fig. 4 Aggregates of acicular crystals of pectolite from Nozawa Mine. × 2/3 natural size.

Plate 21

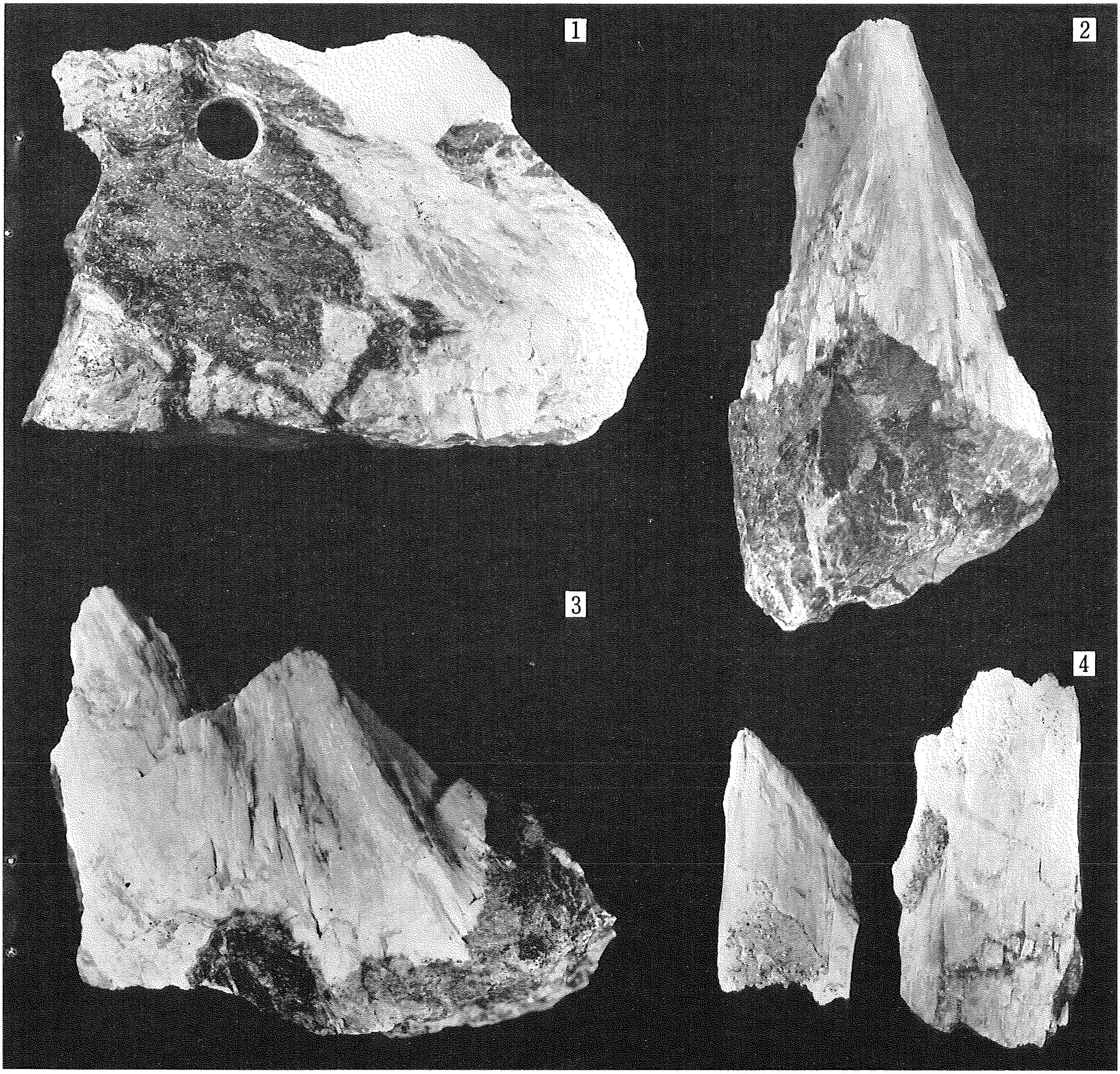

PLATE 22 AND EXPLANATION

Explanation of plate 22

Fig. 1 Pectolite (P) associated with nephrite (N) and serpentine (S). Pectolite from Chisaka, Hidaka Province. Parallel nicols, × 20.

Fig. 2 ditto. Crossed nicols, × 20.

Fig. 3 Closer view of the relation between pectolite (P), nephrite (N) and serpentine (S) in the same section as Fig. 1. Parallel nicols, × 50.

Fig. 4 ditto. Crossed nicols, × 50.

Plate 22