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Note on rock-forming minerals in the Joetsu district, Niigata Prefecture, Japan.
(9) Leucosphenite from the Omi district.

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ABSTRACT

Leucosphenite occurs as small, pale blue, elongated tabular crystals in the cavities of riebekite bearing albitite on the floor of the Kinzan valley, Omi, Niigata Prefecture. The leucosphenite as boron mineral is found from some locations in the world. In the present study, the leucosphenite with very low boron content is reported. Leucosphenite coexists with albite, mica, Mg-riebekite, ohmilite, pectolite and quartz. The coexisting mineral is not boron mineral. The structural formula is $K_{0.01}Na_{4.64}Ba_{1.19}Mn_{0.02}Fe_{0.01}Ti_{2.08}Al_{0.01}B_{0.34}Si_{11.00}O_{30}$. The space group is C2/m, and unit cell paramenters are a=9.8232(12) Å, b=16.839(18) Å, c=7.203(11) Å, β=93° 24(1)′ and v=1189.3(26) Å^3.

KEY WORDS
Albitite, Boron, Leucosphenite, Omi

Introduction

Leucosphenite was first recognized as a distinct mineral in an alkalic pegmatite in the Narsarsuk region in Greenland by Flink (1898). He gave $BaNa_4(Ti_2O_2)(Si_2O_5)_5$ as its ideal formula. Milton et al. (1954) reported that leucosphenite occured in oil shale as well-formed crystals several millimeters in length in the Green river formation in North-eastern Utah and Wyoming. Milton (1957) proposed on the basis of the chemical analyses that structural formula is $CaNaBaTi_3BSi_9O_{29}$. Yefimov and Katayeava (1960) described the occurrence of leucosphenite in the pegmatite veins of the Inaglina ultrabasic-alkali massif, South Yakutia, Russian Feduation. They confirmed boron as an essential component and assigned the mineral a new formula, $Na_4BaTi_2B_2(SiO_3)_{10}$. Shumyatskaya et al. (1968) comfirmed the structure formula of leucosphenite. Chao and Watkinson (1972) reported that leucosphenite occurs in the pegmatites and thermally metamorphosed inclu-

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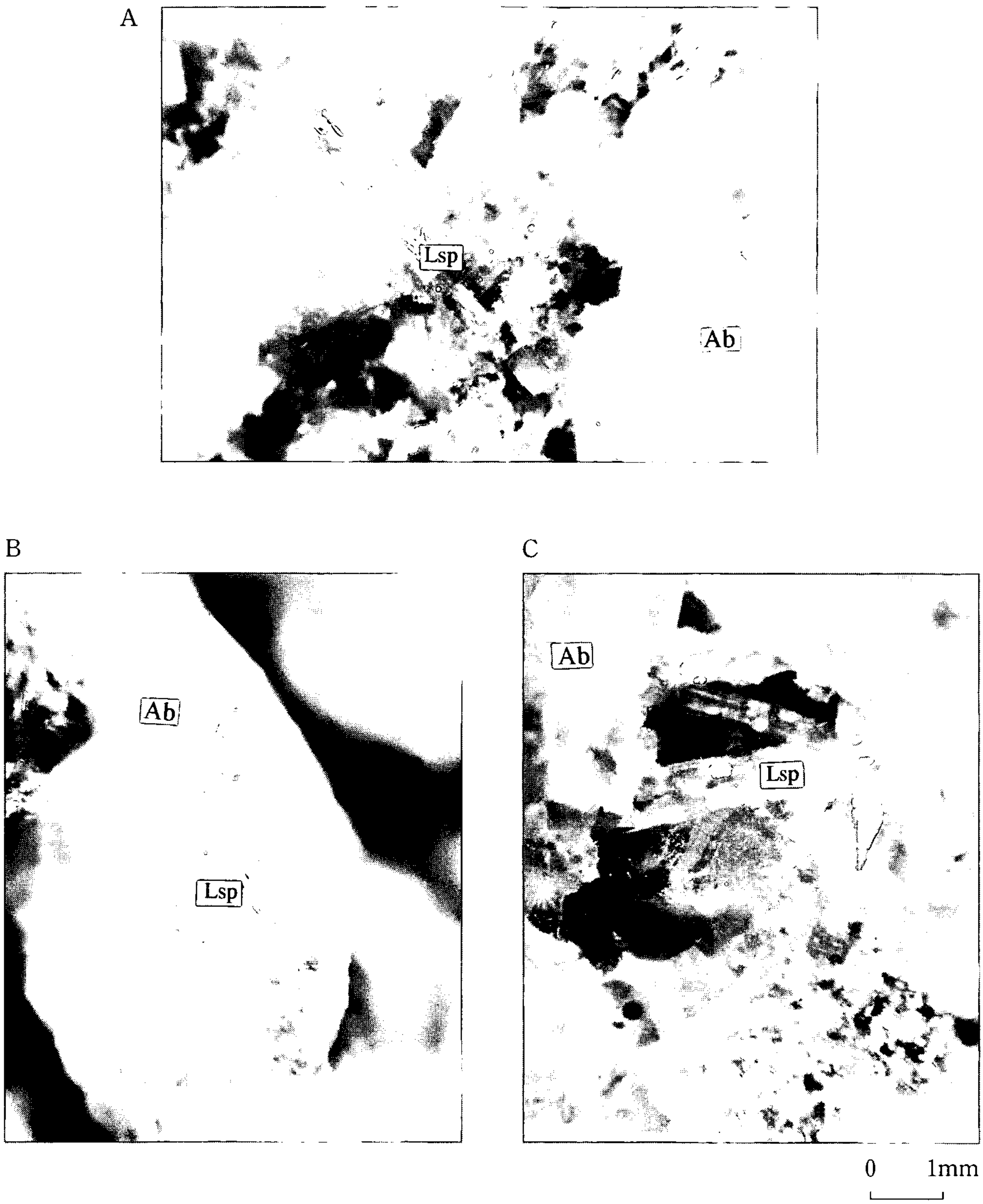

Figure 1. A, B and C. Photograph of leucosphenite coexisted with albite in the cavities of albitite. Lsp: leucosphenite, Ab: albite.

sions in the nepheline syenite, Mont St. Hilaire, Quebec. Chao and Watkinson (1972), and Pabst and Milton (1972) reconfirmed boron as an essential component. Chihara et al. (1978) described leucosphnite in Mg-riebekite bearing albitite from the Omi district, Niigata Prefecture, Japan. However, they discussed the chemical compositions and the physical properties of only two new minerals of nunakite and ohmilite. They described leucosphenite as the coexisting mineral. Grew et al. (1993) reported leucosphenite coexisted with reedmergnerite as boron bearing in pegmatites associated with a Jurassic subalkaline granitic complex in north Tajikista. Unfortunately, the did not give the chemical composition of leucosphenite. The majority of leucosphenites occur in alkalic rocks as syenite and pegmatite except for sedimentary rocks. Albitite is new occurrence. Chihara (1987) already gave the part of anayses as SiO_2, TiO_2, Na_2O and BaO, and the physical properties of leucosphenite from the Omi. However, they are not enough data. In the present study, I give chemical composition included boron and the description on the occurence and the physical properties of leucosphenite.

Occurrence

The small leucosphenite bearing albitite ($1 \times 1 \times 0.5 m^3$) occurs on the lower part of the

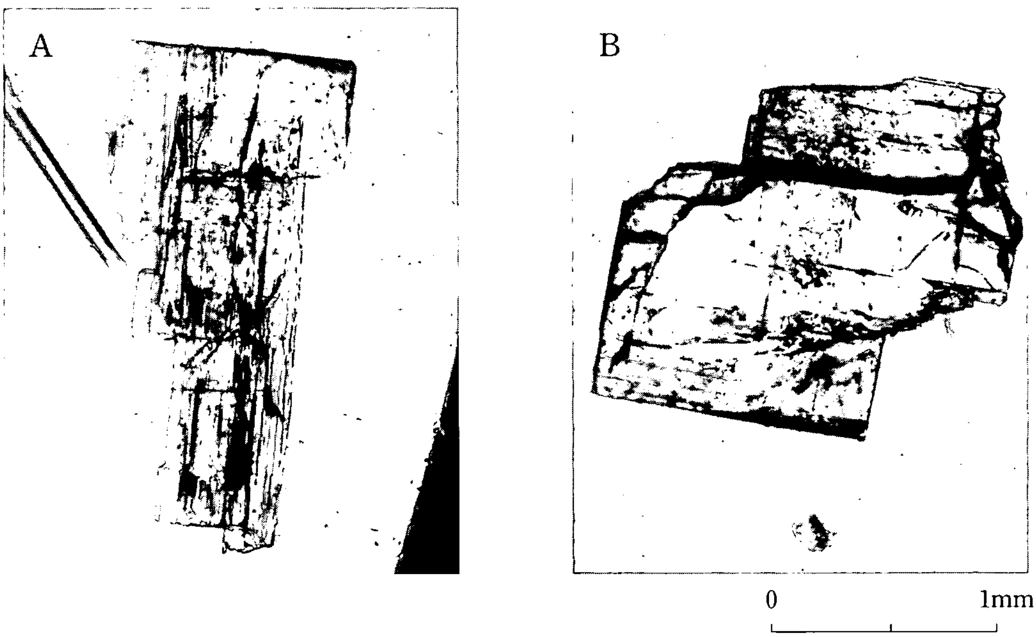

Figure 2. Photomicrographs of the leucosphenites. Each isolated crystal A and B in each cavity for chemical analysis.

river for a distance of about 20 m from the ohmilite and riebekite bearing albitite reported by Chihara et al. (1974). Leucosphenite occurs as pale blue elongated tabular crystals in the cavity of albitite (Fig. 1). It is observed on the surface of albitite and not in albitite. The coexisting minerals are albite, mica, ohmilite, pectolite and quartz at the felsic part. Fig. 2 shows photographs of leucosphenite with needle shaped radiating clusters. Pleochroism is strong: X=pale blue, Z=slightly greenish yellow. The defractive indeces are $\alpha=1.644$ and $\beta=1.682$.

Mineralogical data and discussion

Chemical composition: Electron microprobe analysis of the leucosphenite was performed using JEOL JXA-8060 Superprob at Niigata University. B_2O_3 was determined by EPMA(Hitachi EDS) at Inst. Phys. Chem. Res.. Analyses of the leucosphenite crystals are given in Table 1 together with their structural formulae, calculated on the basis of 30 oxygen atoms after Shumyatskaya et al. (1968).

Na and Ba contents of the leucosphenite from the Kinzan valley are higher than those of the leucosphenites from other localities. Chihara (1987) reported 8.2% boron content as

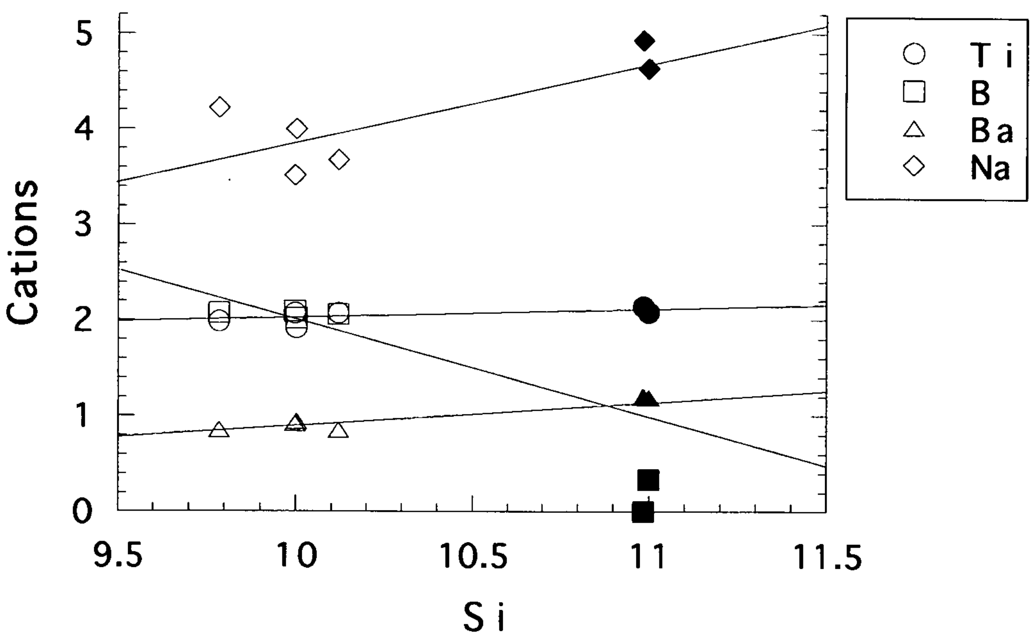

Figure 3. Diagram showing Si against Ti, B, Ba and Na on the basis of 30 oxygens for leucosphenites. Solid simboles indicate leucosphenites from the present study, while open simboles from literatures (Chao and Watkinson, 1972; Pabst and Milton, 1972).

Table 1. Chemical compositions of leucosphenites.

	1	2	3	4	5	6	7	8
SiO_2	56.30	55.85	55.9	54.30	53.66	55.9	55.0	56.94
TiO_2	14.08	14.48	13.8	13.92	14.52	15.5	15.2	13.20
Al_2O_3	0.03	0.05		0	0.11	—	—	
Cr_2O_3	0	0.07		—	—	—	—	
B_2O_3	1.0	tr.	(8.2)	6.36	6.60	6.7	6.7	
FeO	0.08	0.18		0.25	0.04	—	—	
MnO	0.10	0.08		tr.	0	tr.	—	
MgO	0	0		0.13	0	—	—	
CaO	0	0.01		0	0.06	0.1	0.1	
BaO	15.54	15.56	12.8	13.00	11.98	12.7	13.0	13.75
Na_2O	12.25	12.94	9.2	10.70	11.61	10.7	10.0	11.14
K_2O	0.04	0.03		0.79	0.51	—	—	0.56
Total	99.42	99.24	100.0	99.45	99.09	101.6	100.0	
structural formulae on the basis of 30 oxygens								
Si	10.998	10.984	9.999	10.002	9.785	10.120	9.990	
Ti	2.081	2.142	1.856	1.925	1.990	2.080	2.075	
Al	0.007	0.011						
Cr	0	0.011						
B	0.337		(2.532)	2.019	2.075	2.060	2.095	
Fe	0.013	0.030						
Mn	0.017	0.014						
Mg	0	0		0.040	—	—	—	
Ca	0	0.002		0.010				
Ba	1.189	1.199	0.897	0.940	0.855	0.885	0.925	
Na	4.640	4.935	3.191	3.820	4.105	3.680	3.520	
K	0.010	0.007	0	0.185	0.120			
Total	19.292	19.335	18.475	18.931	18.940	18.825	18.605	

1,2 : Kinzan valley, the Omi district, Niigata Prefecture

3 : Kinzan valley, the Omi district, Niigata Prefecture (Chihara, 1987)

4 : Pegmatite veins in an ultrabasic alkaline massif, South Yakutia, Russia (Yefimov and Katayeava, 1960).

5 : Nepheline syenite of Mont St. Hilaire, Quebec, Canada (Chao and Watkinson, 1972).

6 : Green river formation in the Bridge basin, Wyoming, USA (Pabst and Milton, 1972).

7 : Green river formation in the Uinta basin, Utah, USA (Pabst and Milton, 1972).

8 : Narsarsuk region, Greenland (Flink, 1901).

the remainder, which was subtracted total amounts of SiO_2, TiO_2, Na_2O and BaO from 100%. However it is not exact value. The analtical data by EPMA indicate that the boron content is 1.0wt%. Grew et al. (1993) reported the the negative correlation between Si and B+Na in reedmergnerute from Dara-i-Pioz, Tien Shan. They suggested that it is a possible systematic error from an overlooked interference between B and Si on the electron microprobe. For wet chemical analysis, it is difficult to separate the pure leucosphenite with fine-grained inclusions from other minerals. Some problems still remain for boron analysis.

Fig. 3 is constructed using analyses taken from the literatures (Chao and Watkinson, 1972; Pabst and Milton, 1972) and the present study. Ba and Na contents increase, and Ti content slightly increases with increasing Si content. Though B content is very few in the present study, B contents of four leucoshenites from the literatures are constant with increasing Si content. Two analytical data in the present study shift to low side from a line representing the substitution: Si + B=12 in Fig. 3. B + Ba contents decrease with increasing Si + Na contents (Fig. 4). The sum of Si, B, Ba and Na contents of leucosphenite is about 17, they were plotted on the line except for two samples.

X-ray powder study: The X-ray powder data for leucosphenites are given in Table 2 together with data reported by Chao and Watkinson (1972). The powder patterns of leucosphenite in the present study are agreement with those of the St. Hilaire leucosphenite by them. The unit-cell paramenters obtained from the 17 sharp reflections with asterisk by

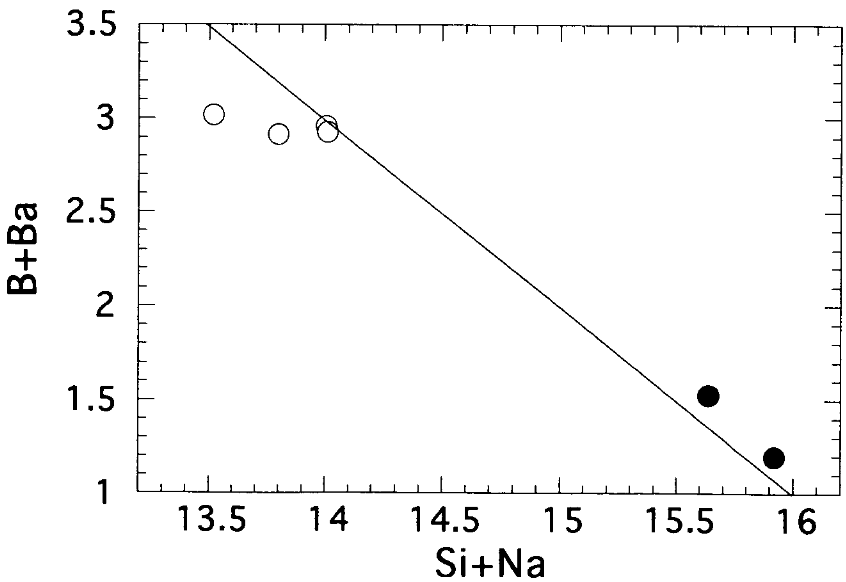

Figure 4. B + Ba contents in leucosphenite against Si + Na contents. Solid circles indicate leucosphenites from the present study, while open circles from the literatures (Chao and Watkinson, 1972; Pabst and Milton, 1972).

Table 2. X-ray powder data of leucisphenites from the Omi district.

			1			2	
H	K	L	dÅ(obs)	dÅ(cal)	I/Io	dÅ(obs)	I/Io
1	1	0	8.46*	8.45	14	8.45	90
2	0	0	4.86	4.89	7	4.87	20
2	2	0	4.23	4.23	16	4.22	100
$\bar{1}$	3	1	4.09*	4.09	9	4.09	20
1	3	1	3.98*	3.98	9	3.98	10
2	0	1	3.93*	3.93	8	3.94	10
$\bar{2}$	2	1	3.74*	3.73	8	3.73	20
2	2	1	3.57*	3.56	11	3.57	30
$\bar{1}$	1	2	3.37*	3.37	15	3.37	70
0	2	2	3.31	3.31	12	3.31	50
1	1	2	3.25*	3.25	10	3.25	30
2	4	0	3.19*	3.19	100	3.19	30
$\bar{2}$	0	2	2.984*	2.983	10	2.982	30
1	5	1	2.893*	2.892	11	2.930	10
3	3	0	2.813*	2.817	8	2.813	40
0	4	2	2.735*	2.735	8	2.732	40
0	6	1	2.615*	2.616	5	2.616	10
$\bar{3}$	1	2	2.464*	2.462	5	2.460	10
2	6	0	2.433	2.434	9	2.434	30
2	6	1	2.287*	2.285	18	2.327	5
0	8	0	2.105*	2.106	5	2.105	20
4	0	2	2.079	2.079	5	2.077	5

1 : This Study
2 : Chao and Watkinson (1972)

using silicon as an external standard. They were refined by a least-squares method (Sakurai, 1968). The results were given in Table 3, together with other data for comparison. The cell dimensions b, c and β of leucosphenite in the present study are similar to those of the leucosphenites reported by Chao and Watkinson (1972) and Pabst and Milton (1972), the cell volume and cell dimension a of leucosphenite in the present study are larger than those of the leucosphenites reported by them. These differences depend on boron content.

In conclusion, the results in the present study supported that boron is not essential component for leucosphenite.

Table 3. Unit-cell paramenters of leucosphenite.

	aÅ	bÅ	cÅ	β°	vÅ³
Omi (this Study)	9.823(1)	16.9839(18)	7.203(11)	93.24(1)	1189.3(26)
Quebec, Canada*	9.781(1)	16.854(2)	7.208(1)	93.16(1)	1186.31
Yakutia, USSR**	9.799(4)	16.840(6)	7.199(3)	93.22(6)	1185.89
Utah, USA***	9.796	16.843	7.199	93.23	1185.73

*Chao and Watkinson (1972) **Shumyatskaya et al. (1971) ***Pabst and Milton (1972)

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References

Chao, G. Y. and Watkinson, D. H. (1972) Leucosphenite from Mont St. Hilaire, Quebec. Canadian Mineralogist, 11, 851~860.

Chihara, K. (1987) Ohmilite, nunakawaite, as new minerals leucosphenite and benitoite from the Omi district. 96~108. Professor Kazuya Chihara Commemorial Volume, "Science of jadeite". Dept. Geol. Mineral., Niigata Univ., 6.243p. (in Japanese)

Chihara, K., Komatsu, M. and Mizota, T. (1978) Mineralogy and paragenesis of new minerals, ohmilite and nunakawaite, in the riebeckite-albitite associated with serpentinites from the Ohmi area, central Japan. Intnal. Mineral. Assoc. 11, 75 (abstract).

Flink, G (1901) On the minerals from Narsarsuk on the Firth of Tunugdliarfik in southern Grrenland. Meed. Grønl., 24, 7~213.

Grew, E. S., Belakovskiy D. I., Fleet, M. E., Yates, M. G., McGee, J. J. and Marquez, N. (1993) Reedmergnerite and associated minerals from peralkaline pegmatite, Dara-i-Pioz, southern Tien Shan, Tajikistan. European Jour. Mineral., 5, 971~984.

Milton, C., Joseph, M. A. and Sherwood, A. M. (1954) New occurrence of leucosphenite, in oil shale from Utah. Am. Mineral., 39, 337.

Pabst, A. and Milton, C. (1972) Leucosphenite, and its occurrence in the Green river formation of Utah and Wyoming. Am. Mineral., 57, 1801~1822.

Sakurai, T. (1968) Universal crystallographic computation program system (in Japanese). Crystallogr. Soc. J. Publ.

Shumyatskaya, N. G., Voronkov, A. A. and Pyatenko, Yu. A. (1968) The atomic structure of leucosphenite $Na_8Ba_2Ti_4O_4(B_4Si_{20}O_{56})$. Sov. Phys. Crystallogr., 13, 130~131.

Yefimov, A. V. and Katayeava, Z. T. (1960) The first discovery of leucoshenite in the USSR. Earth Sci. Sec. Dokl., 129, 1169~1171.