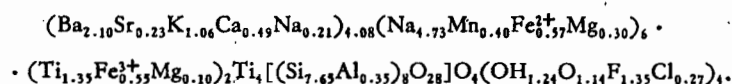*MINERALOGY*

NEW VARIETIES OF LAMPROPHYLLITE — BARYTOLAMPROPHYLLITE AND ORTHORHOMBIC LAMPROPHYLLITE*

Peng Tze-chung (彭志忠) and Chang Chien-hung (張建洪)

(*Peking Geological College*)

Abstract

In our research in the analysis of the crystal structure of lamprophyllite in 1962, we discovered two new varieties existing in the mineral group of lamprophyllite. One is the constituent variety, the barytolamprophyllite, which is the Ba analogue mineral of (strontium) lamprophyllite; its crystallochemical formula is:

$$(Ba_{2.10}Sr_{0.23}K_{1.06}Ca_{0.49}Na_{0.21})_{4.08}(Na_{4.73}Mn_{0.40}Fe^{2+}_{0.57}Mg_{0.30})_6 \cdot$$

$$\cdot (Ti_{1.35}Fe^{3+}_{0.55}Mg_{0.10})_2Ti_4[(Si_{7.65}Al_{0.35})_8O_{28}]O_4(OH_{1.24}O_{1.14}F_{1.35}Cl_{0.27})_4.$$

The other is the structural variety, the orthorhombic lamprophyllite, which is different from the ordinary lamprophyllite of the monoclinic system, and belongs to the orthorhombic system with the following orthorhombic cell parameters:

$$a_0 = 19.32\,\text{Å}, \quad b_0 = 7.05\,\text{Å}, \quad c_0 = 5.43\,\text{Å}.$$

Barytolamprophyllite

The specimen under study was supplied by the Museum of the Peking Institute of Geology. It was taken from the Lovozer intrusive in the Kola Peninsula of the Soviet Union. Barytolamprophyllite is found in the ijolite containing lamprophyllite. The associated minerals are aegirine, nepheline, potash feldspar, cancrinite and apatite, etc. Barytolamprophyllite occurs as a foliated aggregate and its single crystal grain is coarse, being 5 mm in size. The crystal face can not be seen but a set of very perfect cleavage can be observed in the specimen (Fig. 1). It is brittle and can easily be foliated. Its hardness is 2—3. It has a glassy lustre and is dark brown in colour and yellow white in streak. Under reflected light, the surface shows a special golden lustre.

The present authors made optical measurements, chemical analyses, spectrum analyses, determination of specific gravity, X-ray powder analyses, and X-ray single crystal analyses on barytolamprophyllite. Similar research work on the (strontium) lamprophyllite taken from Khibin of the Soviet Union was carried out for comparison (Fig. 4). (The specimen was supplied by Comrade Chen Chao-po). Some of their main data are given in Table 1.

Table 1

Comparison of Barytolamprophyllite with (Strontium) Lamprophyllite

	Barytolamprophyllite	(Strontium) Lamprophyllite
a_0	19.96 Å $\pm$ 0.07	19.44 Å $\pm$ 0.07
b_0	7.07 Å $\pm$ 0.02	7.05 Å $\pm$ 0.02
c_0	5.43 Å $\pm$ 0.01	5.43 Å $\pm$ 0.01
β	96°30′	96°30′
Colour	dark brown	brown-yellow with orange-red
Ng	1.776—1.778	1.769
Nm (calculated)	1.754	1.740
Np	1.742—1.743	1.733
Ng–Np	0.35	0.36
Pleochroism	Ng (brown) > Nm > Np(light yellow)	Ng(brown yellow) > Nm > Np(light brown-yellow)
	Strong pleochroism	slightly weak pleochroism
(+) 2V Na	29°—30° (conoscopic method on universal stage)	32°
C ∧ NgNa	6°—7°	5°—6°
Cleavage	(100) perfect, (011) comparatively developed, (010) not perfect	(100) perfect, (011) not developed, (010) not perfect
Specific gravity	3.62—3.66	3.46—3.54

Under microscope, the fragment of this mineral is of rhombic shape (Fig. 2). The rhomb is a (100) cleavage plane and its edge is parallel to the (011) cleavage plane. The obtuse bisectrix of the rhomb is in the z-axis direction and the acute bisectrix shows the y-axis direction. (The {011} cleavage was not observed in (strontium) lampro-phyllite). The distinct cleavage of (010) was observed on rhombic fragments of (100),

Fig. 1.　Barytolamprophyllite (ЛАМ) in ijolite, white reflection plane is (100) cleavage plane.
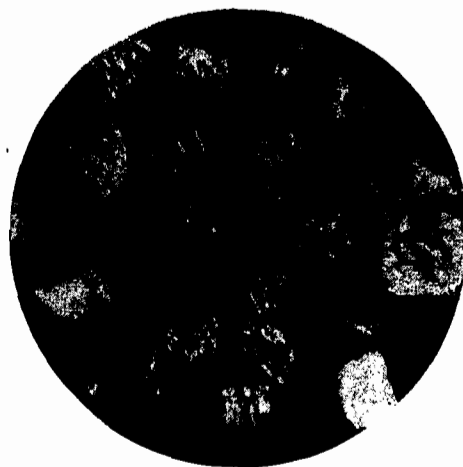

Fig. 2.　Cleavage fragments of barytolam-prophyllite under binocular.

Fig. 3. Developed cleavage (100) of bary-tolamprophyllite under polaring microscope.
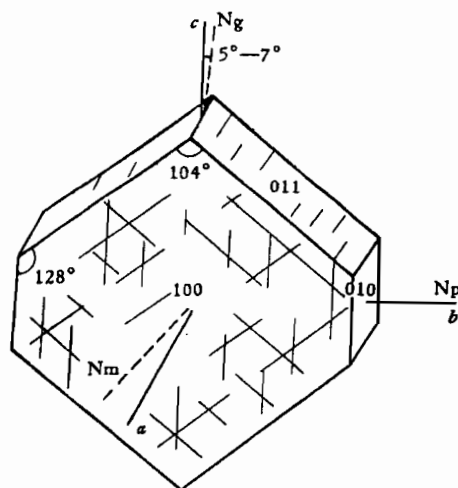
Fig. 4. (Strontium) lamprophyllite crystal.

Fig. 5. Cleavage fragment and optical orientation of barytolamprophyllite.

hexagonal in shape with 128° and 104° angles (Fig. 5). The data obtained may be compared with those given by W. T. Pecora[1]. The corresponding angles of lamprophyllite measured by him are 125° and 110° respectively. The most developed cleavage is (100) as observed in thin sections (Fig. 3). In fragments and in the thin section parallel to (010), polysynthetic twin might be observed along (100). Biaxial positive. Under the sodium light ($\lambda\,Na = 580\,m\mu$), the optical data of barytolamprophyllite are as follows: $(+)2V = 29$—$30°$ (conoscopic method on universal stage). $Ng = 1.776$—1.778. $Nm = 1.754$ (calculated); $Np = 1.742$—1.743; $Ng - Np = 0.035$. The optic plane is perpendicular to (010). $Ng \wedge C = 6°$—$7°$. Nm nearly perpendicular to (100). $Np = b$. Pleochroism distinct. Ng—deep brown-yellow. Nm—brown-yellow. Np—light yellow. Absorption formula: $Ng > Nm > Np$. Dispersion very distinct; $r > v$[2,3,4].

As seen from Table 1, barytolamprophyllite is different from (strontium) lamprophyllite in optical properties. No big change in optical orientation and 2 V is observed; refractive index increases while birefringence does not change ($Ng - Np = 0.035$—0.036).

The pleochorism of barytolamprophyllite is further distinguished from that of (strontium) lamprophyllite: barytolamprophyllite occurs in dark brown under parallel polarized light, while (strontium) lamprophyllite often occurs in brown-yellow with orange-red (the more the Sr content, the deeper the orange-red colour).

The specific gravity of barytolamprophyllite is between 3.62 to 3.66. However, according to theoretical calculation from cell parameters and chemical analysis, the specific gravity is 3.61. The specific gravity of (strontium) lamprophyllite is 3.46—3.54, while the theoretical specific gravity is 3.45. Though the cell parameter of barytolamprophyllite is bigger than that of (strontium) lamprophyllite, yet the specific gravity of barytolamprophyllite increases remarkably because of the big increase of BaO contained.

Table 2

Chemical Analysis of Barytolamprophyllite

Constituent	Barytolamprophyllite	Barium (Strontium) Lamprophyllite	(Strontium) Lamprophyllite
SiO_2	28.53	30.95	29.85
Al_2O_3	1.12	0.22	0.63
TiO_2	26.60	28.15	30.12
Fe_2O_3	2.72	0.89	0.82
FeO	2.63	4.15	2.82
MnO	1.75	1.05	2.32
MgO	1.00	0.86	0.23
CaO	1.70	1.64	1.61
Na_2O	9.52	9.80	11.96
K_2O	3.10	1.82	1.01
BaO	17.24	10.51	1.45
SrO	1.47	7.99	14.01
P_2O_5	0.06	—	—
$(Nb, Ta)_2O_5$	—	—	0.62
F	1.60	1.45	1.55
Cl	0.51	0.04	—
H_2O^+	0.70	0.99	0.51
H_2O^-	—	0.32	0.20
	100.12	100.79	99.69
$-O=F_2+Cl_2$	−0.78	−0.62	−0.65
Total	99.34	100.17	99.04
Data source	this thesis (1962)	О. Б. Дудкин[6] (1959)	Chen Chao-po

Kung Po-huei and Chen Tsao-wu of the Chemical Analysis Laboratory of Peking Institute of Geology made complete chemical analysis of barytolamprophyllite (specimen weighed 2.5 g). The results of the analysis are given in Table 2. For the purpose of comparison, the results of chemical analysis of (strontium) lamprophyllite and barium (strontium) lamprophyllite[6] are also listed in the same table.

As seen in Table 2 the BaO contained in barytolamprophyllite is particularly high in percentage (17.74%), and on the contrary, the percentage of SrO contained is very low

(1.47%). Table 3 gives for comparison the quantity of BaO and SrO contained in various lamprophyllites and the number of atoms of Ba and Sr.

As seen from Table 3, the number of atoms of Ba is less than that of Sr in the lamprophyllites studied hitherto, but the number of atoms of Ba greatly surpasses that of Sr in barytolamprophyllite. The quantity of other elements contained undergoes no remarkable change. Therefore it can be concluded that barytolamprophyllite is the Ba analogue mineral of (strontium) lamprophyllite.

Table 3

Comparison of Ba and Sr in Barytolamprophyllite and (Strontium) Lamprophyllite Series

No.	Percentage in Weight of BaO and SrO		Atom Number of Ba and Sr in Cell		Ratio of Atom Number between Ba and Sr (Ba+Sr=100)		Analyst and Data Source
	Bao	SrO	Ba	Sr	Ba	Sr	
1	17.74	1.47	2.10	0.23	90.01	9.9	this thesis
2	10.51	7.99	1.08	1.20	47.4	52.6	А. В. Мокрецова и З. И. Горощеко (1954)[6]
3	9.23	7.22	0.94	1.08	46.5	53.5	Е. А. Кульчицкая (1959)[6]
4	6.75	8.40	0.72	1.34	34.9	65.1	К. Белоглазов (1924)[7]
5	3.49	14.12	0.36	2.14	14.4	85.6	М. Е. Казакова (1949—1951)[5]
6	1.44	7.46	0.15	1.12	11.8	88.2	К. Белоглазов (1924)[5]
7	2.31	14.07	0.23	2.04	9.7	90.3	В. Ф. Барабанов (1958)[7]
8	1.80	14.4	0.18	2.14	7.8	92.2	H. C. G. Vincent (1938)[1]
9	1.96	15.90	0.21	2.51	7.7	92.3	B. Gossner, K. Drexler (1935)[7]
10	1.47	13.43	0.15	2.03	6.9	93.1	М. Е. Казакова (1949—1951)[5]
11	1.45	14.01	0.14	2.08	6.3	93.7	Chen Chao-po (This thesis)
12	1.25	14.58	0.13	2.18	5.6	94.4	И. Борнеман (1929)[7]
13	1.12	14.66	0.11	2.08	5.0	95.0	F. A. Gonyer (1942)[1]
14	1.09	14.49	0.11	2.14	4.9	95.1	Н. Влодавещ (1929)[5]
15	0.56	16.76	0.06	2.56	2.3	97.7	И. Борнеман (1929)[5]

In order to ascertain the constituent difference of barytolamprophyllite and (strontium) lamprophyllite as well as the distribution of microelements, the spectrum analysis was also made. Table 4 lists the analytical results of some elements, which differ distinctly in the two minerals.
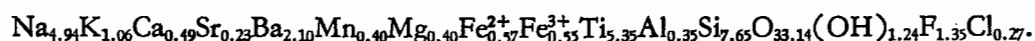
Table 4

Spectrum Analysis of Barytolamprophyllite and (Strontium) Lamprophyllite

Elements / Minerals	Ba	Sr	K	B	Be	Ga	Sn	V	Zr	Nb
Barytolamprophyllite	10.20%	≈3—5%	≈3%	—	—	—	≈0.005%	≈0.003%	≈0.003%	—
(Strontium) Lamprophyllite	≈3%	10—20%	≈1%	≈0.001%	≈0.003%	≈0.003%	≈0.03%	—	≈0.01%	≈0.03%

In Table 4, the sign "$-$" indicates that the sensitivity is lower than that of spectrum analysis. As seen from Table 4, the microelements contained in (strontium) lamprophyllite are more complicated than in barytolamprophyllite and the quantity contained in the former is higher.
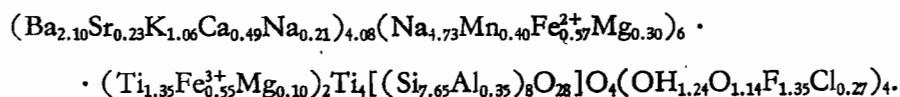
In calculating the crystallochemical formula of barytolamprophyllite, the following crystallochemical formula in general as proposed by H. B. Белов[8] for lamprophyllites has been adopted: $Na_3Sr_2Ti_3\{[Si_2O_7]O(O \cdot OH_1F)\}_2$; the preliminary analytical results recently made by J. Woodrow[9] for the crystal structure of lamprophyllites have been adopted as well. Assuming that the number of anions in the crystallochemical formula of lamprophyllite is 36 (O,OH,F), the proportional numbers of atoms in barytolamprophyllite should be:

$$Na_{4.94}K_{1.06}Ca_{0.49}Sr_{0.23}Ba_{2.10}Mn_{0.40}Mg_{0.40}Fe^{2+}_{0.57}Fe^{3+}_{0.55}Ti_{5.35}Al_{0.35}Si_{7.65}O_{33.14}(OH)_{1.24}F_{1.35}Cl_{0.27}.$$

Having studied the chemical analysis results of 16 lamprophyllites, the present authors are of the opinion that the ideal crystallochemical formula put forward by H. B. Белов for lamprophyllite should be extended into:

$$(Ba, Sr, K, Na)_4 (Na, Mn, Fe^{2+}, Mg)_6 (Ti, Fe^{3+}, Mg)_2 Ti_4 [(Si, Al)_2O_7]_4 O_4 (OH, O, F, Cl)_4.$$
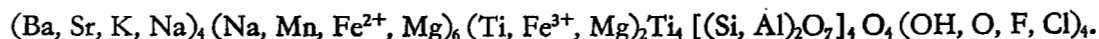
The concrete crystallochemical formula of barytolamprophyllite calculated according to this ideal crystallochemical formula is as follows:

$$(Ba_{2.10}Sr_{0.23}K_{1.06}Ca_{0.49}Na_{0.21})_{4.08}(Na_{4.73}Mn_{0.40}Fe^{2+}_{0.57}Mg_{0.30})_6 \cdot$$
$$\cdot (Ti_{1.35}Fe^{3+}_{0.55}Mg_{0.10})_2Ti_4[(Si_{7.65}Al_{0.35})_8O_{28}]O_4(OH_{1.24}O_{1.14}F_{1.35}Cl_{0.27})_4.$$

The total number of the cations in this formula is 24.08 with only a difference of 0.08 from the theoretical value. This is an allowable error in chemical analysis.

As seen from Table 3, various transitional minerals may be found between barytolamprophyllite and (strontium) lamprophyllite; it means that a continuous isomorphic series might be formed between them. Lamprophyllites in general are minerals of the Sr-end-member. The barium (strontium) lamprophyllite discovered by О. Б. Дудкин[6] is the lamprophyllite of intermediate composition, while the barytolamprophyllite here studied is mineral of the Ba-end-member. Hitherto, the representatives of the barium-strontium series in the lamprophyllite group have all been found.

However, as seen from the crystallochemical formula of barytolamprophyllite, there is still a great part of Ba replaced by K, Ca, and Na. Therefore it may be expected that the barytolamprophyllite containing still more Ba will be discovered in future.

Powder and single crystal X-ray analyses of barytolamprophyllite and (strontium) lamprophyllite show that although the powder pattern of these two lamprophyllites are quite similar, yet their difference is still distinct. The powder pattern of barytolamprophyllite (a) and (strontium) lamprophyllite (b) were taken by Co-target, Fe-filter, and 57.3 mm diameter camera (Fig. 6). Table 5 shows their diffraction data. The powder data of barium (strontium) lamprophyllite have been given by О. Б. Дудкин et al.[10]

It can be easily seen from Fig. 6 and Table 5 that the intensity of the corresponding diffraction lines of barytolamprophyllite and (strontium) lamprophyllite is quite different.
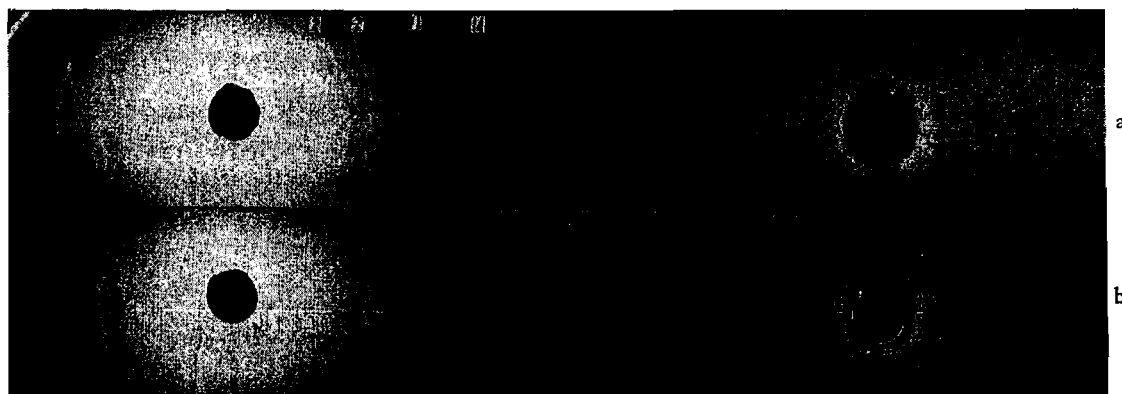
Fig. 6.   Powder pattern of barytolamprophyllite (a) and (strontium) lamprophyllite (b).
Condition of exposure: Co–target, Fe–filter, 30 kv, 10 mA, 10 hours.

Table 5

X–Ray Powder Crystal Data of Barytolamprophyllite

Ray Number	Barytolamprophyllite		(Strontium) Lamprophyllite	
	I	d	I	d
1	3	3.737	3	3.753
*2	7	3.440	5	3.424
*3	5	3.287	7	3.217
4	2	3.055	2	3.024
5	1	2.914	1	2.904
6	10	2.795	10	2.796
*7	5	2.685	1	2.685
*8	5	2.628	1	2.598
9	1	2.48	—	—
10	9	2.149	8	2.137
*11	5	2.047	1	2.041
12	1	1.984	—	—
13	7	1.786	5	1.778
*14	8	1.598	3	1.606
*15	—	—	2	1.563
*16	9	1.479	3	1.480 1.498
*17	0.5	1.453	3	1.446
18	1	1.417	—	—
19	2	1.331	1	1.321
20	1	1.144	2	1.138 1.149
21	3	1.024	2	1.018

Condition of exposure: X–ray—Co (CoK_a = 1.7853 kX); Filter–Fe; Camera diameter: 57.3 mm; 10 mA; 30 kv; 10 hours.

The line with $d = 3.440$ is stronger than that of $d = 3.287$ in barytolamprophyllite, while the corresponding line $d = 3.424$ is weaker than $d = 3.217$ in (strontium) lamprophyllite. The lines with $d = 2.685$ and $d = 2.628$ following the strongest line ($d=2.796$) in barytolamprophyllite are stronger than the two corresponding lines ($d = 2.685$ and $d=2.598$) in (strontium) lamprophyllite. The line with $d=2.047$ of barytolamprophyllite

is also stronger than the corresponding line $(d = 2.041)$ of (strontium) lamprophyllite. Furthermore what is most outstanding is that the lines with $d = 1.598$ and $d = 1.479$ are very strong in barytolamprophyllite, while the two corresponding lines $(d = 1.606$ and $d = 1.480)$ are much weaker in (strontium) lamprophyllite. On the contrary, the lines with $d = 1.563$ and $d = 1.446$ which are distinctly seen in (strontium) lamprophyllite are almost not observed in barytolamprophyllite (a very weak line $d = 1.453$ can be indistinctly observed). Therefore by way of X-ray powder method, it is possible to distinguish barytolamprophyllite from (strontium) lamprophyllite. (The "*" marks in Table 5 represent some lines which show bigger difference between these two lamprophyllites; the numbers in Fig. 6 are the line numbers in Table 5.)

The equi-inclination Weissenberg photographs of $hk0$, $hk1$, $hk2$, $h0l$, $h1l$, $h2l$, $h3l$, etc. of barytolamprophyllite were taken by the Weissenberg camera with Fe_{K_a} and Mn filter. It is shown that barytolamprophyllite belongs to the monoclinic system and its cell parameters are as follows:

$$a_0 = 19.96 \text{ Å} \pm 0.06,$$

$$b_0 = 7.07 \text{ Å} \pm 0.02,$$

$$c_0 = 5.43 \text{ Å} \pm 0.01,$$

$$\beta = 96°30', \quad Z = 1.$$

For comparison, the equi-inclination Weissenberg photographs of $h0l$, $hk0$, $hk1$, $hk2$, etc. of (strontium) lamprophyllite were also taken under the same conditions. The parameters of the monoclinic cell of (strontium) lamprophyllite measured are as follows:

$$a_0 = 19.44 \text{ Å} \pm 0.07,$$

$$b_0 = 7.05 \text{ Å} \pm 0.02,$$

$$c_0 = 5.43 \text{ Å} \pm 0.01,$$

$$\beta = 96°30', \quad Z = 1.$$

Cell parameters b_0 and c_0 of barytolamprophyllite are the same as those of (strontium) lamprophyllite, while a_0 is remarkably higher. There is a clear difference in the Weissenberg photographs (Fig. 7 & 8) of these two minerals. If the $hk0$ (or $h0l$) Weissenberg photographs of these two minerals are superposed one over the other, it can be discovered that all diffraction spots on the $0k0$ line (b^*-axis) and $00l$ line (c^*-axis) completely coincide, while those on the $h00$ line are separate (a^*-axis). The more they go towards high Bragg-angles (spots of bigger diffraction index), the farther they separate. Meanwhile, what is the most distinct is that the relative intensity of the $h00$ diffraction spot of these two minerals is very different. On the Weissenberg photograph of barytolamprophyllite, diffraction spots of 800 and 1200 in $h00$ diffraction are very weak and can not be recorded on the film, while on the Weissenberg photograph of (strontium) lamprophyllite, these spots are distinctly observed.

After indexing the Weissenberg photograph of barytolamprophyllite, the following

diffraction conditions have been discovered:

$$hkl : h + k = 2n,$$

$$h0l : h = 2n,$$

$$0k0 : k = 2n.$$

The diffraction symbol of the crystal is $2/mC$-/-, namely the possible space group is Cm, $C2$ or $C2/m$. The crystal structure analyses of barytolamprophyllite were made by the present authors in 1962 in cooperation with the Institute of Physics of Academia Sinica, and the three-dimensional Patterson function was calculated. The result obtained shows that its space group may be $C2$. Recently, J. Woodrow[9] was of the opinion that
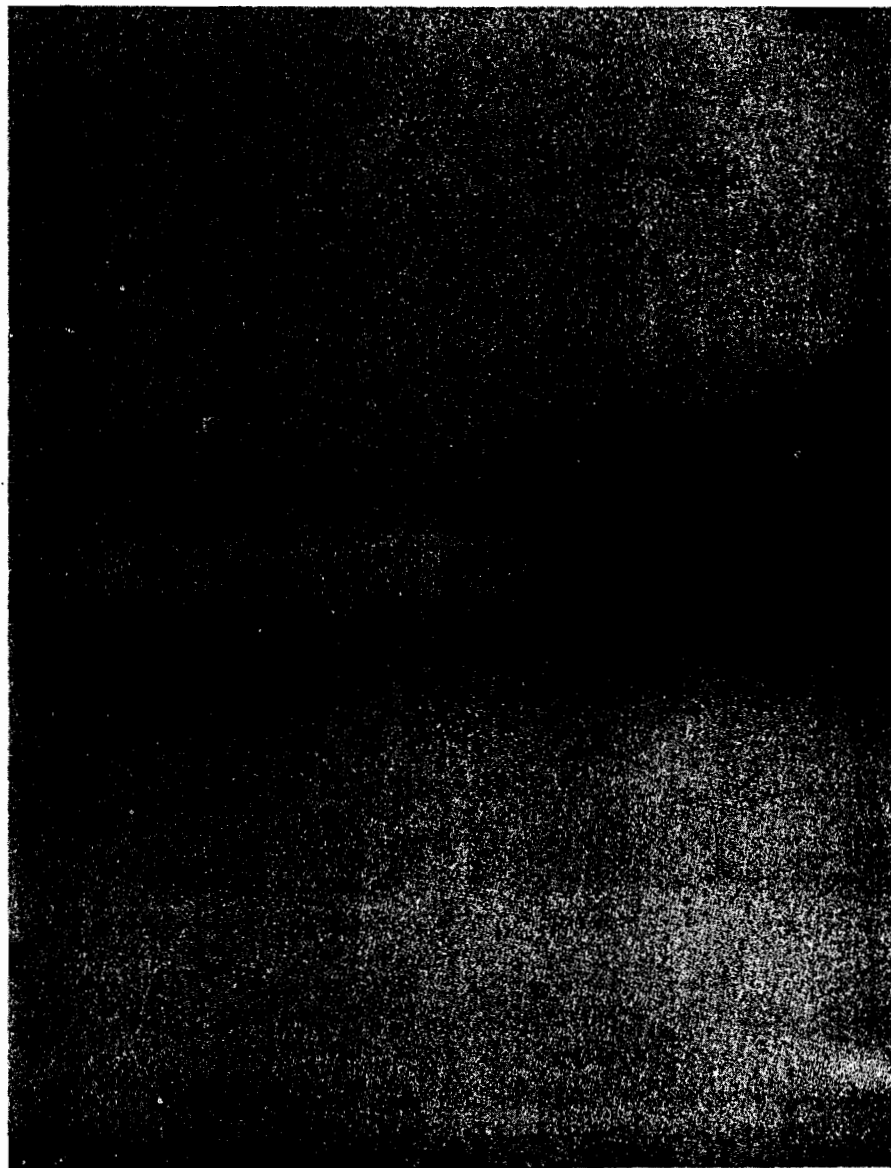

Fig. 7.   Weissenberg photograph $(h0l)$ of barytolamprophyllite.

Condition of exposure: Fe-target, Mn-filter, 35 kv, 10 mA, 36 hours.

the space group of lamprophyllite was $C2/m$.   The present authors, however, holds that the space group of lamprophyllite may be in a transitional position between $C2$ and $C2/m$. The details will be discussed elsewhere.
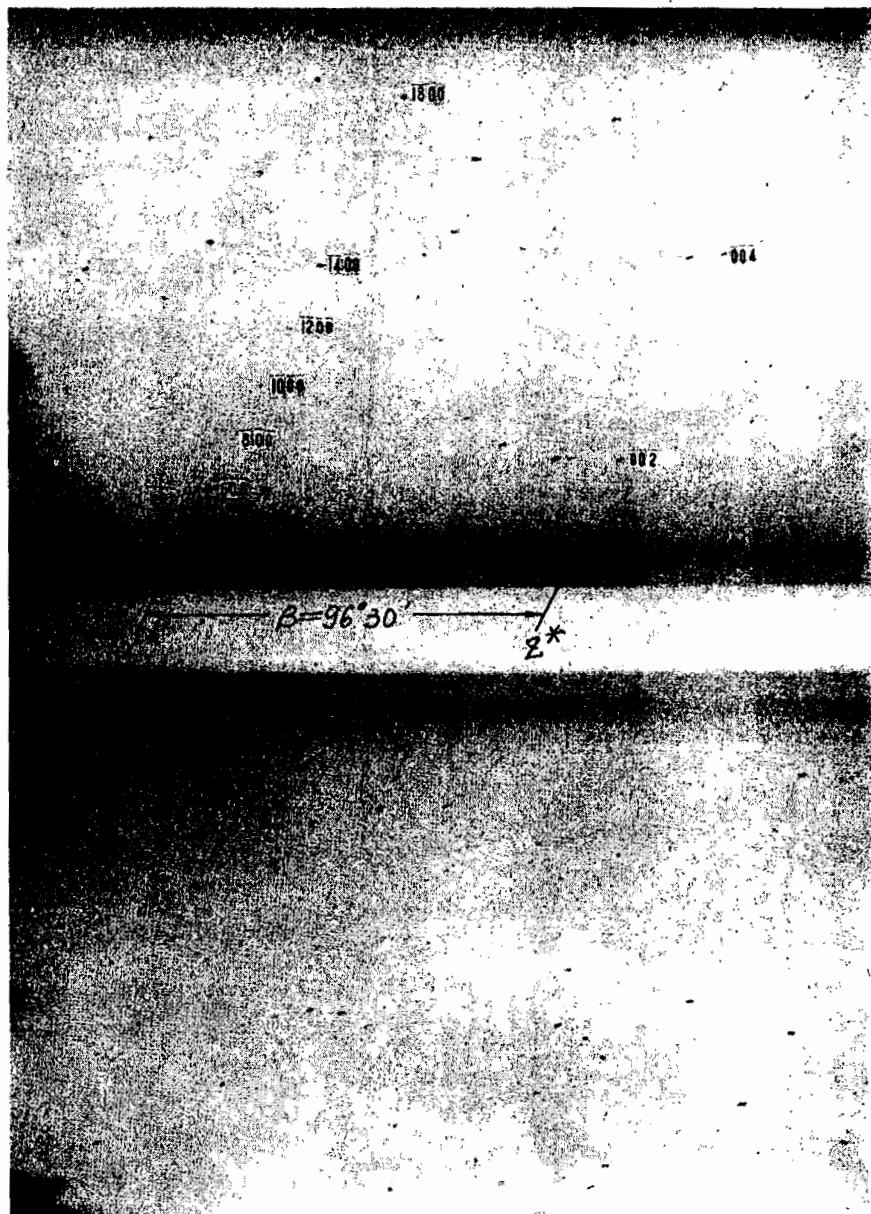

Fig. 8.   Weissenberg photograph $(h0l)$ of (strontium) lamprophyllite.

Condition of exposure: Fe–target, Mn–filter, 35 kv, 10 mA, 27 hours.

ORTHORHOMBIC LAMPROPHYLLITE

Lamprophyllite in general belongs to the monoclinic system.   This was confirmed by Э. М. Бонштедт's goniometric study of lamprophyllite long ago.   He obtained the axial ratio as $a:b:c = 0.923:1:0.605$, $\beta = 102°43'$[5].   It is clear that Э. М. Бонштедт selected the unit plane wrongly; consequently he could only get the axial ratio of pseudocells.

The optical study of T. Pecora also showed that lamprophyllite belongs to the mono-clinic system (or it might belong to the triclinic system) [1].

From a comprehensive study, the present authors are sure that lamprophyllite be-longs to the monoclinic system. This has also been confirmed by J. Woodrow in his recent work [9].

However, lamprophyllite is still believed to belong to the orthorhombic system by some authors [1,3,11] on the basis of the results of X-ray analyses made by Gossner and Drexler [1]. With measurement by the oscillation method, Gossner and Drexler measured the length of the axis of lamprophyllite and confirmed that it belongs to the ortho-rhombic system. It was quite possible that the crystal studied by Gossner and Drexler
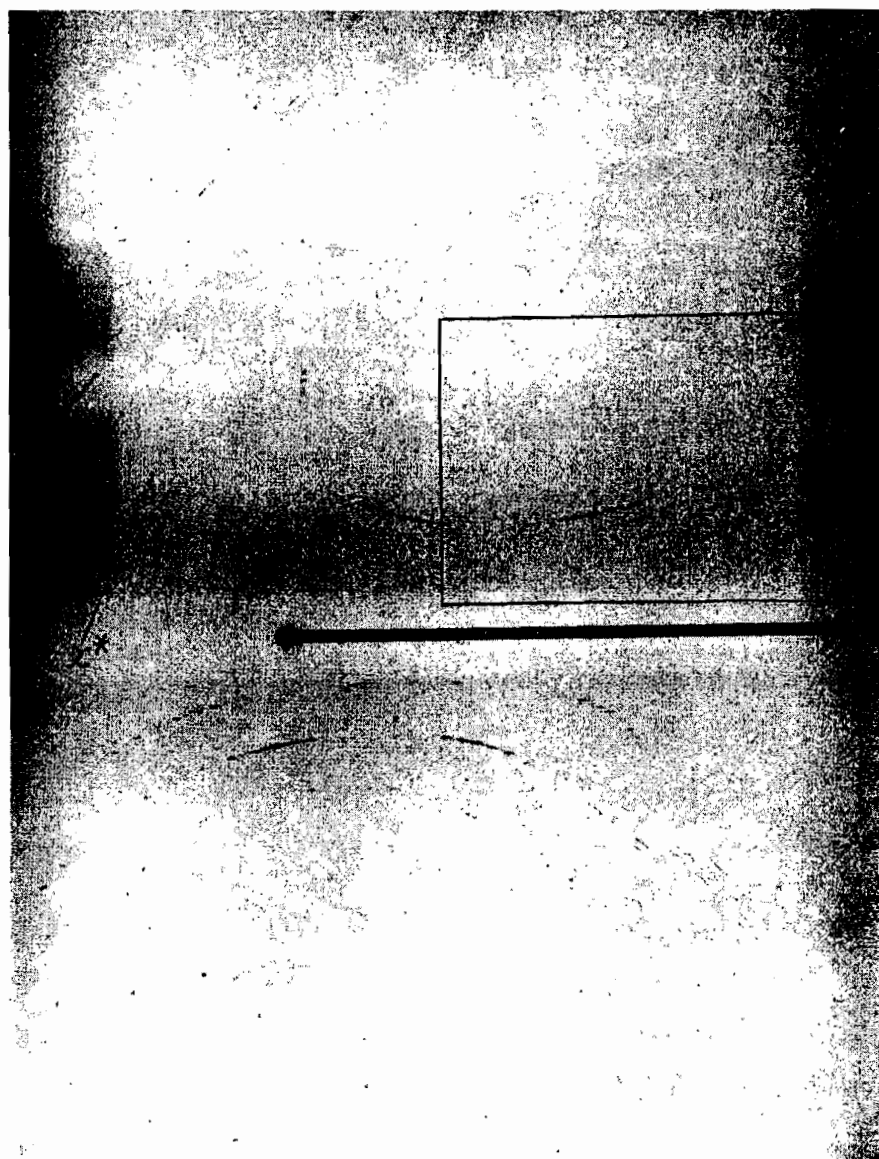

Fig. 9. Weissenberg photograph (*hk*1) of (strontium) lamprophyllite. All spots of monoclinic lamprophyllite twin and orthorhombic lamprophyllite separate on Weissenberg photo-graph (*hk*1).

Condition of Exposure: Fe-target, Mn-filter, 35 kv, 10 mA, 30 hours.

was a polysynthetic twin, because it was rather easy to wrongly take the polysynthetic twin of the monoclinic crystal orthorhombic through the oscillation method.

Through the study of (strontium) lamprophyllite, the present authors have discovered that orthorhombic lamprophyllite does exist, but it exists not independently but in the polysynthetic twin of monoclinic (strontium) lamprophyllite as submicroscopic crystallite.

In taking the Weissenberg photograph of monoclinic (strontium) lamprophyllite, we discovered that it becomes the polysynthetic twin along (100). There was no difference between the Weissenberg photograph of $(hk0)$ of polysynthetic twin and that of single crystal. However, on the Weissenberg photograph of $(hk1)$ and $(hk2)$, the diffraction spots of these two parts of the twin crystal are separate from each other. Figure 9 is the Weissenberg photograph of $(hk1)$ of (strontium) lamprophyllite. It can be seen from this figure that the diffraction spots closely gather together on the curves of $h01$, $h11$, $h21$, $h31 \cdots$. In order to make a further study on this phenomenon, the square part of Fig. 9 has been enlarged and indexed (Fig. 10). Between the diffraction spot of $(hk1)$ of one crystal and that of the other crystal $(\bar{h}k1)$, there appear some continuous diffused lines. This is distinctly due to the structural disorder packing.

Fig. 10. Weissenberg photograph $(hk1)$ of (strontium) lamprophyllite, which is the enlarged square part of Fig. 9. Indices above diffraction spots $\bar{h}k1$ and $hk1$ represent monoclinic lamprophyllite twin; indices below diffraction spot $hk1$ represent orthorhombic lamprophyllite.

Here special attention should be paid upon that in the centre of the continuous diffused lines there is a part of comparatively concentrated black. As a result of analysing these diffraction spots, it is discovered that the crystal producing these spots belongs to the orthorhombic system. (The clearest spots are orthorhombic diffraction spots (221) between two monoclinic crystals $(\bar{2}21)$ and (221) as well as (321) between (221) and

$(\bar{4}21)$). The orthorhombic cell parameters are as follows:

$$a_0 = 19.32 \text{ Å} \pm 0.07,$$
$$b_0 = 7.05 \text{ Å} \pm 0.02,$$
$$c_0 = 5.43 \text{ Å} \pm 0.01.$$

Henceforth it is believed that in the polysynthetic twin of monoclinic (strontium) lamprophyllite studied here, there exist some orthorhombic (strontium) lamprophyllites, which are very small and thin, and intergrow co-axically with monoclinic lamprophyllite. It is quite possible that these orthorhombic lamprophyllites exist near the composition plane of the twin of monoclinic lamprophyllite.

Because orthorhombic lamprophyllite has not yet been observed under microscope, no further research has been done on it.

The following relationship exists between cells of orthorhombic lamprophyllite and those of monoclinic lamprophyllite:

Orthorhombic lamprophyllite	Monoclinic lamprophyllite
a_0	$\approx$	$a \sin \beta$
b_0	$\approx$	b
c_0	$\approx$	c

Therefore the relationship between orthorhombic lamprophyllite and monoclinic lamprophyllite is similar to that between orthorhombic pyroxene and monoclinic pyroxene.

As there is only a very small quantity of orthorhombic lamprophyllite existing in monoclinic lamprophyllite, there are very few diffraction spots of orthorhombic lamprophyllite on the Weissenberg photograph, and its space group can not be determinated. However, according to the ($hk1$) Weissenberg photograph, its space group is believed to belong to the primitive lattice (P). On the basis of the symmetry of monoclinic lamprophyllite, it is suggested that the space group of orthorhombic lamprophyllite may probably be: $D_{2h}^{12} = P_{nmn}$.

CONCLUSIONS

1. There is a complete isomorphic series existing between barytolamprophyllite and (strontium)lamprophyllite. The one commonly seen is strontium lamprophyllite, while barytolamprophyllite is not often found and it is the Ba-end-member of this series.

2. Lamprophyllite contains two modifications of monoclinic and orthorhombic systems. The lamprophyllite in general belongs to the monoclinic system and the orthorhombic lamprophyllite exists as submicroscopic crystallite in the polysynthetic twin of monoclinic lamprophyllite.

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