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The Existence of Oxyhornblende Built up from Two Different Lattices

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Abstract

With oxyhornblende from Ikebukuro, Nagano Pref., Japan rotation and Weissenberg photographs were taken and it was found that the mineral was built up from two different lattices, one being the monoclinic amphibole lattice ($I2/m$), the other the monoclinic pyroxene lattice ($C2/c$). The proportion of these two lattices in the mineral is likely to vary from specimen to specimen.

Introduction

T. UEDA and K. TOMITA (1963) studied on kaersutite from Korea and reported that the mineral was built up from two different lattices. Thereafter the author examined oxyhornblende from Ikebukuro (Shinanozakai), Fujimi, Suwa Prov., Nagano Pref., Japan and obtained the same result. In the following the details will be given.

Experimental

The oxyhornblende is found abundantly as phenocrysts in hornblende andesite which is bitterly fragile. The crystals are usually elongated along the c-axis with well developed (110) and (010) faces. The surface of the crystals is always coated with a very thin, black or brown layer. The interior is reddish brown in colour and homogeneous under the microscope. The chemical composition was reported by K. TOMITA (1962) and the optical properties by S. KOZU and B. YOSHIKI (1927). They are as follows:

SiO_2	39.58 %	CaO	12.30 %
Al_2O_3	19.42	Na_2O	2.58
Fe_2O_3	7.54	K_2O	0.20
TiO_2	3.04	$H_2O^{(+)}$	0.00
MgO	14.92	$H_2O^{(-)}$	0.06
MnO	0.11	Total	100.32

Refractive indices:

$n_\alpha = 1.672$
$n_\beta = 1.695$
$n_\gamma = 1.719$

Pleochroism:

X = light greenish brown
Y = greenish brown
Z = reddish brown

Optic axial angle:

$2V_\gamma = 92° 24'$

Optical character:

(−)

The chemical formula may run as follows:

$$(K,\ Na)_{0.5}(Ca,\ Na,\ K)_2(Mg,\ Fe'')_3(Fe''',\ Al,\ Ti)_2Al_2Si_6O_{24}$$

Rotation and Weissenberg photographs about *c*-axis were taken using $Cu\text{-}K_\alpha$ radiations. On the rotation photograph all the spots are arranged perfectly on the layer lines (Fig. 1). On the zero level Weissenberg phtograph (Fig. 2), however, there are a number of extra spots as compared with the corresponding photograph taken with tremolite. The same is the case with the 1st and 2nd level equi-inclination Weissenberg photographs.

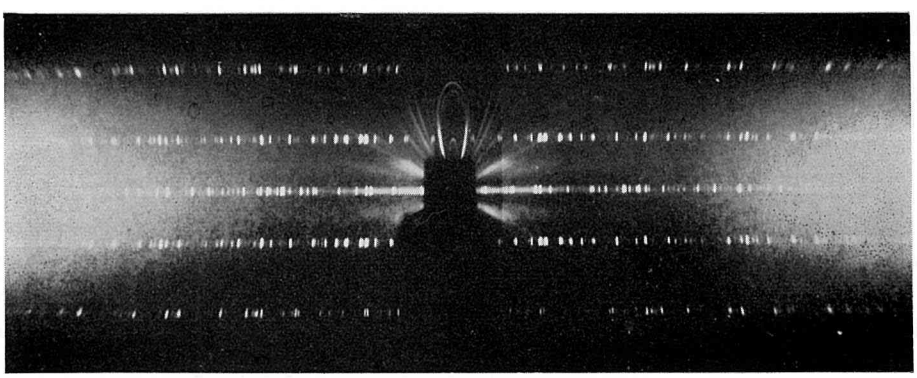

Fig. 1 Rotation photograph about *c*-axis.

The facts are not accountable on the basis of ordinary lattice. Tracing and scrutinizing the lattice rows on them, it is found that there are indeed two, instead of one, sets of spots, of which one is relatively more abundant than the other. Fig. 3 illustrates the zero level Weissenberg diagram in which the solid circles denote the former set and the open circles the latter set.

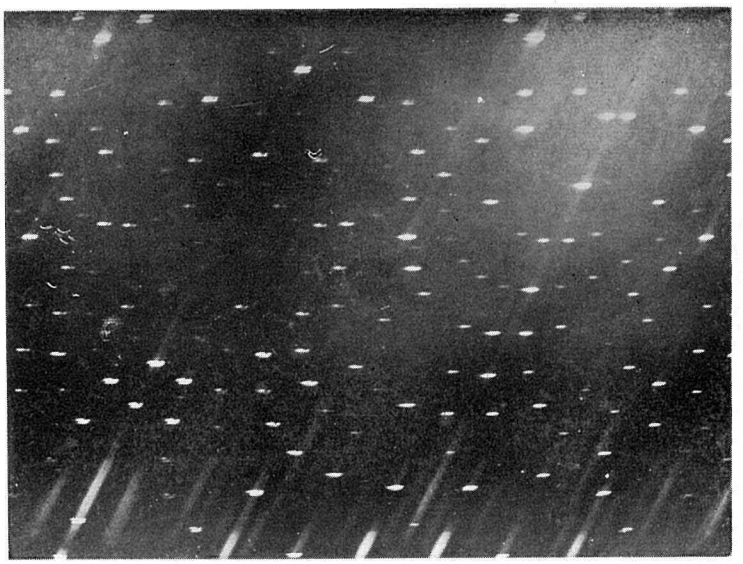

Fig. 2 Weissenberg photograph about *c*-axis (zero level).

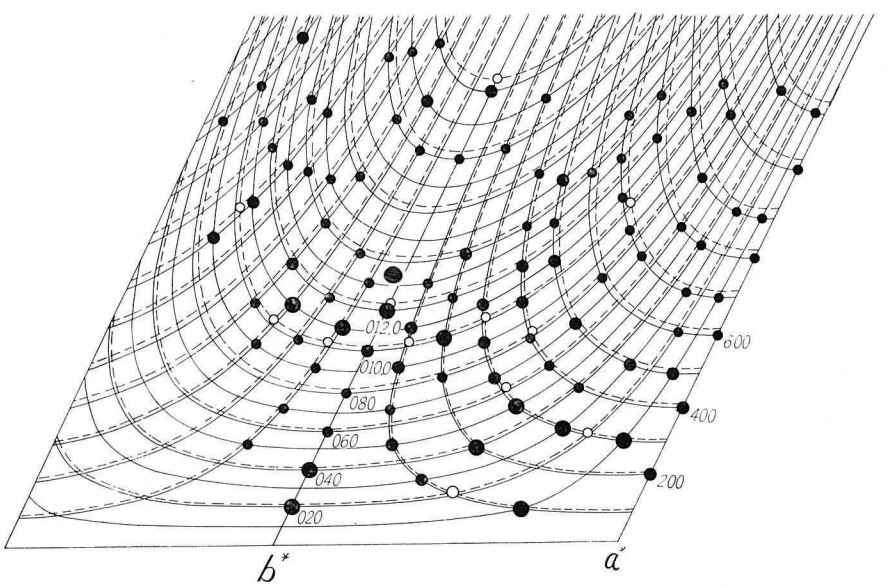

Fig. 3 *hk0* Weissenberg diagram.

The arrangement of the former is the same as that in the case of tremolite and each of the spots is almost the same in intensity as that of tremolite respectively. The arrangement of the latter is the same as that in the case of diopside and each of the spots is almost the same in intensity as that of diopside respectively. It follows immediately from these observations that the mineral is built on two different lattices, b^* c^* reciprocal net planes being overlapped and the direct c-axes being identical in length.

In one set of spots hkl reflexions appear when $h+k+l=2n$, $h0l$ reflexions when $h+l=2n$ and $0k0$ reflexions when $k=2n$; in the other set of spots hkl reflexions appear when $h+k=2n$, $h0l$ reflexions when $h=2n$, $l=2n$ and $0k0$ reflexions when $k=2n$; hence space groups are $I2/m$ and $C2/c$ respectively. The cell dimensions are as follows:

$I2/m$	$C2/c$
$a=$ 9.85±0.01 Å	$a=$9.75±0.01 Å
$b=$18.08±0.01	$b=$8.88±0.01
$c=$ 5.33±0.01	$c=$5.33±0.01
$\beta=$105°43′±0.1°	$\beta=$105°43′±0.1°

Evidently, the former is a monoclinic amphibole lattice, the latter a monoclinic pyroxene littice.

Weissenberg photographs about c-axis were taken with several other specimens. In these photographs the spots brought about by the monoclinic pyroxene are not always in coincidence with one another in number and in intensity. The ratio of the two component minerals, therefore, varies from specimen to specimen. The monoclinic amphibole is, however, always more predominant than the other.

Consideration

The oxyhornblende examined in the present investigation occurs in a single crystal with well developed (110) and (010) faces and is homogeneous under the microscope; nevertheless the X-ray study has revealed that the mineral is built on two component minerals, viz., monoclinic amphibole and monoclinic pyroxene. The two component minerals are in such a relationship that their three axes are parallel. They may, therefore, be arranged side by side. This may be possible if the size and arrangement of the chains, consisting of $Si0_4$ tetrahedra, in each of the two minerals are taken into account.

S. KOZU et al. (1927) reported that common hornblende heated to 750°C showed the same optical properties as those of oxyhornblende and that oxyhornblende was transformed to pyroxene at 1050°~1200°C. N. L. BOWEN and E. POSNJAK (1931) and M. WITTELS (1952) reported that tremolite heated at 900°C for 24 hours gave amphibole pattern together with pyroxene pattern in an X-ray powder photograph. The author has observed that a single crystal of actinolite heated at 900°C for 2 hours gives a number of extra spots on the Weissenberg photographs and the patterns on the

Weissenberg photographs are the same as those of the present oxyhornblende. Details of the observation will appear elsewhere. Taking these observations into consideration oxyhornblende might be an alteration product from other amphibole such as tschermakite-pargasite series heated and oxydized in nature.

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