

ORIENTATION OF CRYSTALLITES IN THE IGNITION  
PRODUCTS OF  $Mg(OH)_2$  AND  $Ca(OH)_2$

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$Mg(OH)_2$ (BRUCITE)

1. Büsser and Köberich<sup>1</sup> showed that when a single crystal plate of  $Mg(OH)_2$  (brucite) is ignited to  $MgO$  (periclase), the crystallites of  $MgO$  are in parallel grouping with a threefold axis  $[111]$  parallel to the previous  $c$ -axis, and with a twofold axis  $[1\bar{1}0]$  parallel to the previous  $a$ -axis. This conclusion followed from the observation that on passing monochromatic  $x$ -rays normally through the ignited plate a pattern of discrete monochromatic spots with the symmetry of  $D_{3d}$  is obtained instead of uniformly blackened Debye circles. I have repeated this experiment and checked the description of these writers in detail. I also observed orientation of  $MgO$  crystallites with respect to the threefold axis on a rotation photograph of the ignited plate about the plate normal.

2. In a preceding note<sup>2</sup> I showed that on igniting a brucite fiber ( $Mg, Fe$ )  $(OH)_2$  the  $MgO$  crystallites here also have their  $[\bar{1}\bar{1}0]$  axis parallel to the previous  $a$ -axis, that is, parallel to the fiber axis.

3. Some extra reflections on the  $x$ -ray photograph of this ignited fiber were attributed to the presence of a second oriented solid phase. Now since the ratio  $Mg:Fe$  is about 4:1 by weight or 13:1 by atoms, it was suspected that this phase is the spinel  $MgFe_2O_4$  (magnesio-ferrite). The accompanying table confirms the presence of the spinel and shows that it likewise has its  $[1\bar{1}0]$  axis in the fiber axis.

4. Since the unignited brucite fibers are highly elastic, the bent fibers were found to give focussed  $x$ -ray reflections.

$Ca(OH)_2$

1.  $Ca(OH)_2$ <sup>3</sup> crystallized by a diffusion process<sup>4</sup> shows hexagonal prisms with the forms 0001 (cleavage plane),  $10\bar{1}0$  and oc-

<sup>1</sup> Büsser, W., Köberich, F., *Z. Physik. Chem.*, vol. 17, p. 310, 1932.

<sup>2</sup> West, C., *Am. Mineral.*, vol. 17, p. 313, 1932.

<sup>3</sup> Natural crystals of  $Ca(OH)_2$  (portlandite) are described by Tilley, C., *Mineral. Mag.*, vol. 23, p. 419, 1933.

<sup>4</sup> Prepared by Crove, C. See Johnston, J., Grove, C., *J. Am. Chem. Soc.*, vol. 53, p. 3976, 1931. The refractive indices of this material agree well with published values.

TABLE I. FIBER DIAGRAM OF IGNITED FE-BRUCITE  
MgO and MgFe<sub>2</sub>O<sub>4</sub> phases present with [110] in the fiber axis

<i>d</i>	<i>hkl</i>	Powder Intensity		Observed Intensity in Layer Line						
		<i>S</i>	<i>P</i>	0	I	II	III	IV	V	
2.96	220	5		vw/a	w					
2.53	311	10		m	m	m				
2.42	222	0	1	(M)		(M)				
2.10	400	5	6	(VST)		(VST)				
1.71	422	3		a	w	vw	w			
1.61	{511 333}	7		m	w	w	m			
1.48	440	9	5	(VST)		(VST)				
1.42	531	0			0	0	0	0		
1.33	620	2			0	0	0	0		
1.28	533	2		0	w		vw	0		
1.26	622	0	4	(W)		(MW)		(M)		
1.21	444	0	5	(ST)				(ST)		
1.12	642	2			0	0	0	0		vw
1.09	{553 731}	4		0	w			w		w
1.05	800	2	4	(M)				(M)		

Note: Column 1 gives the interplanar spacing.

Column 2 gives the indices of the spinel phase reflections.

Columns 3 and 4 give the observed intensities on powder photographs of spinel and periclase respectively; the former are taken from E. Posnjak, *Am. J. Sci.*, vol. 19, p. 67, 1930. The remaining columns indicate the observed intensities on the fiber photograph. The symbol (M) etc., indicates that this observed intensity is due primarily to the periclase phase.

casional narrow imperfect  $10\bar{1}1$  faces, which however leave no doubt as to the trigonal symmetry. The axes are chosen to conform to the accepted structure axes ( $c/a=1.41$ ) and were checked by *x*-ray methods. It is of interest first, that terminal faces other than the base have not previously been observed,<sup>5</sup> and second that the isomorphous Mg(OH)<sub>2</sub> (brucite,  $c/a=1.51$ ) shows only  $11\bar{2}0$  in the prism zone. The measured angle  $0001:10\bar{1}1$  varies from  $57-59^\circ$  with the average of several readings  $58^\circ 18'$  or  $c/a=1.41$ .

2. As with Mg(OH)<sub>2</sub> the ignition product of Ca(OH)<sub>2</sub>, or CaO, is a pseudomorph. On passing monochromatic *x*-rays through the base of the pseudomorph the Debye circles on the photograph are almost uniformly blackened; the conclusion is that there is little

<sup>5</sup> Ashton, F., Wilson, R., *Am. J. Sci.*, vol. 13, p. 209, 1927.

orientation of the CaO crystallites in any direction normal to the previous *c*-axis. On the contrary a rotation photograph of the pseudomorph about the previous *c*-axis is exactly that expected for a [111] rotation photograph of CaO. Thus while the MgO crystallites were shown to be oriented in two directions the CaO crystallites are oriented only along one threefold axis.

EXPLANATION

The orientation of RO (or RFe<sub>2</sub>O<sub>4</sub>) crystallites with respect to the axes of the R(OH<sub>2</sub>) from which it was formed will doubtless find its explanation in the similarity in structure of the three crystals. In all three structures six anions form an octahedron about each R atom; in all three structures the anions are in close packing, which is hexagonal in the hydroxide and cubic in the oxides. The simple relation between these two modes of packing is well known. The oxygen-oxygen distances (octahedron edges) and the anion-cation distances are as follows if the variable parameter of R(OH)<sub>2</sub> is *u* = .25.

	Mg(OH) <sub>2</sub>	MgO	MgFe <sub>2</sub> O <sub>4</sub>	Ca(OH) <sub>2</sub>	CaO
0-0	3.13, 2.98	2.98	2.96	3.58.3.26	3.39
R-6 0	2.16	2.10	2.09	2.42	2.40

From a structural point of view the pair R(OH)<sub>2</sub>-RO is the analog of the pair MgBr<sub>2</sub>-LiBr. The similarity in structures of LiBr and MgBr<sub>2</sub> expresses itself in the miscibility of these substances in the solid state.<sup>6</sup>

A new edition of United States Geological Survey Bulletin 679, "The microscopic determination of the nonopaque minerals," has just been published as Bulletin 848 and may be obtained from the Superintendent of Documents, Washington, D. C., for 20 cents. The new edition of 254 pages has been completely rewritten and the tables brought up to date by the introduction of about 500 new entries and 100 changes in old entries. About 250 new mineral species not given in the old edition are included, and tables have

<sup>6</sup> Ferrari, A., Colla, C., *Atti. Accad. Lincei*, vol. 13, p. 78, 1931. International Critical Tables, IV, p. 63.

been added in which the data on the important mineral groups have been assembled. The new edition will therefore entirely supersede the earlier one and will be a necessary reference work for all those who have occasion to identify minerals.

## PROCEEDINGS OF SOCIETIES

### MINERALOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

MINERALOGICAL SOCIETY, *March 15*, MR. ARTHUR RUSSELL, Vice-President, in the chair.

MR. ARTHUR RUSSELL: *Baryte crystals from the Manvers Main Colliery, Wath upon Dearne, near Rotherham, Yorkshire.* A cavity containing exceedingly beautiful colourless crystals of baryte was discovered in the roof of the Parkgate Seam of this colliery in 1930, and the occurrence was briefly described by Mr. C. P. Finn in the same year. Two distinct habits of crystals occurred, prismatic and tabular. The crystals are attached to small coloured rhombohedra of dolomite which form a coating on the grey sandstone, both baryte and dolomite being for the most part more or less thickly sprinkled with small bright twinned crystals of chalcopyrite. The crystal forms present are listed and drawings of the crystals are given.

DR. W. Q. KENNEDY: *The conditions for the crystallization of hornblende in igneous rocks.* By means of a statistical study of the MgO-CaO-FeO ratios of igneous hornblendes it is shown that the latter occupy an intermediate position between the diopsidic pyroxenes and the magnesia-rich, lime-poor monoclinic and orthorhombic pyroxenes. It is concluded, therefore, that (1) pressure and the concentration of the volatile constituents are not the sole determining factors in the crystallization of pyroxene and hornblende from a magma but that the original proportions of the constituent oxides play an equally important part; (2) a magma which, under physical conditions tending towards the retention of the volatile constituents, will produce hornblende as its ferromagnesian constituent will, under effusive conditions, produce diopsidic pyroxene plus hypersthene or enstatite-augite. Thus hornblende = diopsidic pyroxene + orthorhombic pyroxene or enstatite-augite (pigeonite).

MR. ARTHUR RUSSELL: *An account of British mineral collectors and dealers in the 17th, 18th, and 19th centuries (continued).* John Williams of Scorrier House, Cornwall, mine agent and adventurer, copper and tin smelter and banker, born September 23, 1753, died April 17, 1841. The collection of Cornish minerals which he had formed at Scorrier in conjunction with his son John, born August 3, 1777, died August 11, 1849, was greatly added to by the latter. The collection which contained about 10,000 specimens was one of the three finest in Cornwall. In 1893 Mr. John Charles Williams disposed of the collection by presentation between the British Museum, The Royal Institution of Cornwall, Truro Museum and the Robert Hunt Memorial Museum, Redruth. In addition to a memoir of both the Williams, a general account of the collection and its outstanding specimens is given.