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# X-ray powder data of rhomboclase

RHOMBOCLASE has no entry in X-ray powder data files or tables (JCRDS, 1972; Mikheev *et al.*, 1957 and 1965), but a chemical compound with similar composition $HFe(SO_4)_2.4H_2O$ is recorded (ASTM card 8–63) according to Taylor and Bassett (1952). Data on an artificial product have also been provided by Amiel, Gourdonneau, and Vauthier (1945). For the natural substance, Bolshakov and Ptushko (1967) have indicated fourteen spacings with intensities from 5 to 10, but the data do not agree with the present values.

The unit cell of rhomboclase has been determined, on artificial crystals, by Becherer (1970), who found *a* $9{\cdot}78_5$ Å, *b* $18{\cdot}36_3$, and *c* $5{\cdot}43_1$ and confirmed the orthorhombic symmetry.

The material now examined is rhomboclase from Cerro de Pasco, Peru, kindly provided by the National Museum of Natural History, Smithsonian Institution, Washington (no. 94539–1). The specimen presents micaceous, radiated flakes, mostly devoid of impurities and weathering products. The identification of the species is supported by chemical and optical check. Chemical analysis gave: loss at 110 °C 16·7 %, further at 130 °C 5·0, further at 150 °C 4·9, $Fe_2O_3$ 25·72, $SO_3$ 48·00, sum 100·3, against $H_2O$ 25·25 %, $Fe_2O_3$ 24·87, and $SO_3$ 49·88 calculated for $HFe(SO_4)_2.4H_2O$. The substance examined shows perfect basal cleavage and two good cleavages yielding rhombic sections in the basal plate. The diagonals of the rhombs coincide with extinction directions and hence crystallographic axes. Refractive indices are $\alpha$ (vibration direction along the *c* axis) $< 1{\cdot}55$, $\beta$ (short diagonal of rhombic section) 1·555 and $\gamma$ (long diagonal) 1·634.

X-ray single crystal data were not obtained on terminated crystals, no suitable material being available, but on tiny, colourless cleavage flakes easily oriented according to cleavages and optical directions. Referring to the cell orientation of Becherer (1970), the parameters observed with rotation photographs taken for the three axes are *a* 9·9 Å, *b* 18·4, and *c* 5·44, in good agreement with Becherer's more accurate data and with the morphologically established axial ratio by Bandy (1938), considering a double value for the old *c* axis.

Miss Eva E. Fejer, British Museum (Natural History), kindly prepared cream coloured rhomb-shaped plates of rhomboclase by an adaptation of M. P. Appleby and S. H. Wilkes's (1922) method and provided X-ray powder data. Analysis gave: $Fe_2O_3$ 25·8 %, $SO_3$ 49·2, and $H_2O$ (by difference) 25·0. The parameters calculated from the X-ray powder pattern are *a* 9·73 Å, *b* 18·29, and *c* 5·43. Miss E. E. Fejer also stated that the X-ray powder pattern for the synthetic material agrees with that for rhomboclase from La Alcaparossa, Argentina.

The X-ray data for natural and synthetic rhomboclase are given in Table I. The spacings are indexed and calculated on the basis of Becherer's data (1970). On the

TABLE I. *X-ray powder data of rhomboclase*

| *hkl* | $d_{calc}$ | Rhomboclase, Cerro de Pasco, Peru | | | | Analysed synthetic material | |
|---|---|---|---|---|---|---|---|
| | | $d_{meas}$* | | $d_{meas}$† | | $d_{meas}$‡ | |
| 020 | 9·182 Å | 9·18 Å | > 100 | 9·10 Å | vs | 9·14 Å | vvs |
| 011 | 5·211 | — | — | 5·21 | vw | 5·20 | mw |
| 200 | 4·890 | 4·86 | ?1 | 4·86 | vvw | 4·87 | w |
| 101 | 4·750 | 4·75 | 7 | 4·73 | m | 4·74 | s |
| 040 | 4·591 | 4·57 | 2 | 4·56 | vvw | 4·55 | vw |
| 220 | 4·316 | — | — | — | — | 4·26 | vw |
| 121 | 4·219 | 4·20 | 2 | 4·20 | vw | 4·20 | mw |
| 031 | 4·063 | 4·05 | 15 | 4·05 | ms | 4·05 | s |
| 131 | 3·753 | 3·73 | ?1 | 3·73 | vw | 3·74 | m |
| 211 | 3·566 | 3·55 | 4 | 3·55 | w | 3·55 | s |
| 240 | 3·348 | 3·33 | 15 | 3·33 | s | 3·325 | s |
| 141 | 3·302 | 3·29 | 18 | 3·28 | s | 3·280 | s |
| 231 | 3·119 | 3·11 | 11 | 3·11 | m | 3·107 | s |
| 051 | 3·043 | 3·05 | 10 | 3·04 | w | 3·040 | mw |
| 250 | 2·936 | — | — | — | — | 2·917 | vvw |
| 241 | 2·850 | — | — | — | — | 2·843 | vvw |
| 311 | 2·765 | — | — | 2·77 | vw | 2·777 | w |
| 321 | 2·676 | 2·66 | 1 | 2·67 | vw | 2·656 | mw |
| 112 | 2·590 | — | — | 2·59 | vw | 2·580 | mwb |
| 123 | 2·516 | — | — | 2·512 | vw | 2·503 | w |
| 410 | 2·425 | — | — | 2·429 | vw | 2·427 | mw |
| 420 | 2·364 | — | — | — | — | 2·350 | vw |
| 042 | 2·338 | 2·33 | 2 | 2·334 | w | 2·337 | mw |
| 222 | 2·298 | 2·28 | 5 | 2·287 | mw | 2·288 | mw+ |
| 232 | 2·214 | — | — | 2·212 | vvw | 2·208 | vw |
| 440 | 2·159 | — | — | 2·152 | vw | 2·143 | w |
| 242 | 2·109 | — | — | 2·108 | w | 2·103 | mwb |
| 361 | 2·064 | — | — | 2·060 | vw | 2·059 | w |
| 062 | 2·026 | — | — | 2·024 | w | 2·025 | mw |
| 441 | 2·007 | — | — | — | — | 1·990 | vvw |
| 281 | 1·941 | — | — | 1·932 | vvw | 1·931 | vvwb |
| 262 | 1·876 | — | — | 1·869 | vvw | 1·870 | vvw |
| 123 | 1·748 | — | — | 1·748 | w | | |
| 323 | 1·560 | — | — | 1·559 | vw | | |
| 413 | 1·451 | — | — | 1·447 | vw | | |
| 363 | 1·407 | — | — | 1·401 | vw | | |

* Diffractometer data from 2 to 40° $\theta$ with Co-$K\alpha$ radiation and 2° $\theta$/min.
† Powder record with 114·6 mm diam. camera and Co-$K\alpha$ radiation.
‡ Powder data provided by Miss E. E. Fejer, 1973. Record with 114·6 mm diam. camera and Co-$K\alpha$ radiation.

one hand, the data of Taylor and Bassett (1952, ASTM card 8–63) are in reasonably good agreement with the values in Table I, assuming that the intense 020 reflection was split by absorption. On the other hand, neither the natural material examined by Bolshakov and Ptushko (1967), nor the artificial product with strongest line 8·60 Å of Amiel *et al.* (1945), can be considered as rhomboclase.

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# Low-pressure re-metamorphism of granulite and orthogneiss complexes in the Křišťanov and Prachatice Massifs (southern Bohemia)

THE pre-Cambrian Moldanubian Křišťanov Massif consists largely of granulite-facies granulites containing kyanite and garnet with or without biotite and sillimanite, and biotite–garnet orthogneisses (Frejvald, 1970, 1974). Similar rocks comprise the Prachatice Massif. Some of the rocks show re-metamorphism in a younger event of probable Variscan age.

This note describes the characteristic features of the later metamorphism:

Slightly altered kyanite–garnet–biotite±sillimanite granulites and biotite±garnet orthogneisses develop cordierite–biotite±sillimanite mineralogy or quartz–biotite symplectite. Cordierite (or sericitized cordierite) grows at the expense of pre-existing biotite, sillimanite, and garnet. New biotite or quartz–biotite symplectite forms by recrystallization of biotite-rich foliae in the granulite gneisses and, in part, at the expense of garnet and cordierite. In some granulite gneisses garnet appears to break down to cordierite and sillimanite. The status of sillimanite in the biotite-rich foliae is uncertain.