

certain, but indicates a maximum value, as this was the limit of sensitivity of the method.

The molecular ratios are in good agreement, for sodium, iron, and sulphur, with those of natrojarosite $\text{NaFe}_3(\text{SO}_4)_2(\text{OH})_6$. The determined water content is, with respect to this formula, somewhat high, but it may be supposed that the material responsible for the insoluble slightly affects the water ratio.

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¹ A. Lacroix, *Min. France*, 1910, vol. 4, p. 145.

² R. Van Tassel, *Bull. Inst. roy. Sci. nat. Belgique*, 1956, vol. 32, no. 24, p. 9 [M.A. 13-369].

³ A. A. Moss, *Min. Mag.*, 1957, vol. 31, p. 407.

⁴ S. B. Hendricks, *Amer. Min.*, 1937, vol. 22, p. 773.

⁵ C. M. Warshaw, *ibid.*, 1956, vol. 41, p. 288.

⁶ W. F. Hillebrand and S. L. Penfield, *Amer. Journ. Sci.*, 1902, ser. 4, vol. 14, p. 211.

⁷ M. Hartwig-Bendig, *Zeits. angew. Min.*, 1941, vol. 3, p. 195.

Isokite from Mangualde, Portugal.

D. J. FISHER's discovery of isokite replacing triplite from the old tin mines of Slavkov, Bohemia,¹ an environment quite different from the carbonatite in which isokite was originally found,² aroused the writer's interest in other triplite localities. This has led to the identification as isokite of a mineral described but not named by A. M. de Jesus³ from Mangualde, in the province of Beira, Portugal, which historically would now appear to be the first locality for this mineral. The mineral was described as a fluophosphate of calcium and magnesium, but was not named as the chemical analysis was unsatisfactory, totalling only 90.58 % (after the oxygen-fluorine correction), and it could only be compared with cryphiolite, the one substance then recorded of similar composition, but now a discredited species.⁴

As described by de Jesus, the mineral forms dull white earthy crusts on partially oxidized and hydrated triplite (his *metatriplite*). A specimen recently obtained through the courtesy of Professor de Jesus and J. Lima-de-Faria consists of massive black triplite (enclosing patches of pale brown triplite) thinly encrusted here and there in irregular cavities

with dull white earthy material. Optically this white material, as far as can be determined, resembles isokite, being minutely crystalline in aggregates of fibres or radiating platelets with negative elongation, α near 1.590 and γ near 1.610. These figures are only approximate, and unfortunately the platelets are too small for determination of sign and optic axial angle. An X-ray powder photograph was taken by Dr. J. D. C. McConnell who states that it is identical with his photograph of the type isokite from Rhodesia.

As the main difference between isokite and de Jesús's analysis lies in the phosphate content, the latter was redetermined on a small sample (5 mg.) freed of a little contaminating triplite, quartz, and feldspar by means of the electromagnet and the centrifuge. The determination, made by my colleague R. Pickup, revealed 37.0% P_2O_5 , in place of 26.59% reported by de Jesús. With this correction the analysis may be restated as CaO 31.52, MgO 20.69, P_2O_5 37.0, F 7.75, SiO_2 4.13, FeO 1.81, MnO 0.57, Na_2O 0.37, K_2O 0.25, H_2O —0.16%. The deficiency in the total has been eliminated and, allowing for some impurities, the composition is essentially that of isokite, $CaMgPO_4F$, and the interpretation⁵ as near $Ca_3Mg_3(PO_4)_2O_2F_2$ can no longer stand.

At both Mangualde and Slavkov triplite is replaced by isokite, implying substitution of the cations iron and manganese by calcium and magnesium, whereas at Isoka the isokite developed from dolomite, the cations remaining passive while fluophosphate replaced carbonate. According to de Jesús, but accepting later corrections to his nomenclature, the phosphate sequence at Mangualde comprised a main hydrothermal phase of lithiophilite and triplite, with rare manganapatite, and a later mixed hydrothermal and supergene phase of heterosite, hureaulite, strengite, isokite, and torbernite. The record⁶ of 'a mineral perhaps identical with wagnerite' from Mangualde evidently refers to isokite.

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¹ Min. Mag., 1957, vol. 31, p. 587.

² Ibid., 1955, vol. 30, p. 687.

³ Comun. Serv. Geol. Portugal, 1936, vol. 19, pp. 154–156 [M.A. 6–440 (anal. XIV)].

⁴ Min. Mag., 1956, vol. 31, p. 346.

⁵ M. H. Hey, An Index of Mineral Species, 2nd edn, London, 1955, item 22.1.12, p. 262.

⁶ Dana's System of Mineralogy, 7th edn, vol. 2, 1951, p. 847.