

recorded, assuming an original molecular water content of 15.7, and the material no longer yielded an X-ray pattern.

Ignition of 0.1089 g of the material in a platinum crucible over a Meker burner gave a residue shown by X-ray examination to consist of several phases of alumina,  $\text{Al}_2\text{O}_3$ , corresponding in weight to 8.01(8) % of aluminium in the mineral, equivalent to 15.70 molecules of water in the formula  $\text{Al}_2\text{C}_{12}\text{O}_{12} \cdot x\text{H}_2\text{O}$ .

Microchemical gravimetric carbon determinations were carried out by heating a few milligrams of the mineral in a closed, evacuated vessel with a chromic-phosphoric acid mixture, the evolved carbon dioxide being absorbed in baryta solution and subsequently weighed as barium carbonate. Three determinations for total carbon (21.3 %, 22.3 %, and 22.0 %) were carried out. One (21.3 %) is in fair agreement with that (21.42 %) calculated from the aluminium figure obtained by ignition; the higher values are probably due to the presence of undetected inclusions of free carbonaceous matter in the mineral.

A series of specimens was examined under long-wave (3650 Å) and short-wave (2537 Å) ultra-violet light. Material from Artern showed a whitish-yellow fluorescence, the intensity varying from very strong to weak under 3650 Å radiation and from moderate to weak under 2537 Å radiation. Specimens from Malevka, Tula, USSR, were not obviously fluorescent. The blue fluorescence described in Dana's 'System of Mineralogy', 7th edition, was not observed.

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### *Calzirtite and associated minerals from Tapira, Brazil*

IN 1961 Zdorik, Sidorenko, and Bykova described a new calcium titanio-zirconate, which they named calzirtite, found in a metasomatic

calcite-forsterite-magnetite rock from an alkalic ultrabasic massif in Eastern Siberia. Vlasov's book 'Mineralogy of the rare elements' (1964 [M.A. 17-14]) presents all essential data on this mineral, and indicates Aldan as the type area, and that it occurs with dysanlyte and apatite. Structurally it proved to be a new derivative of the type  $\text{CaF}_2\text{-CeO}_2$ , and several papers discuss this topic (see Russian references).

Quite recently this rather uncommon mineral has been found in several samples collected from soils, eluvials, and alluvials near the centre of the pyrochlore deposit of Tapira, situated in Sacramento, Minas Gerais, Brazil. It was met in amounts varying from several per cent. to just a trace. Branco (1956) and Alves (1960) have described the geology and mineralogy of the Tapira deposits. The principal minerals of the more niobium-rich areas are magnetite (with martite and ilmenite), limonite, niobian perovskite, baryte, titanium minerals, pyrochlore, and alteration products. Other minerals mentioned, mainly from adjacent areas, are ilmenite, hematite, niobian rutile, apatite, pyrolusite, psilomelane, feldspars, quartz, and biotite (vermiculite). However, there was no reference to the mineral now identified as calzirtite, or to several other minerals mentioned below.

The mineral in question was identified by comparing its X-ray powder diffraction diagram with the diagram of calzirtite published by Zdorik *et al.* (1961). Normally it shows a yellowish-brown to yellowish-green colour, but dark olive-green grains were also observed. It occurs in very irregular grains or aggregates, in sizes on an average of  $0.3 \times 0.14$  mm (up to  $0.74 \times 0.50$  mm and down to  $0.05 \times 0.03$  mm). Occasionally it is intergrown with hematite, gorceixite, and other low reflecting gangue minerals. Sometimes an alteration to leucoxene is observed.

In transmitted light the colour is pale greenish or sometimes brownish (non-pleochroic). The birefringence and refractive indices are very high (Zdorik *et al.* (1961) reported birefringence and refractive indices of respectively 0.07-0.08 and between 2.19 and 2.36). The mineral has a pronounced conchoidal fracture, but no cleavage could be discerned. In polished section the colour is light grey, and the reflectance is practically equal to that of barian pyrochlore (14-16 %). The bireflection in air is weak to distinct. The internal reflections are often strong with yellowish-brown to reddish-brown colours. The polishing hardness is similar to that of zircon. These properties are in rather good agreement with those given by Zdorik *et al.* (1961). Qualitative X-ray fluorescence

analysis indicates Ca, Zr, and Ti as main components and Nb as an accessory constituent.

In addition to calzirtite, about thirty minerals or mineral-varieties were found in the samples. Of these, magnetite (more or less martitized and often with some ilmenite lamellae), hematite, gorceixite, and goethite are often major components. Leucoxene (mostly anatase) is an important minor component, often showing pronounced colloform structures.

Apatite and biotite (mostly altered to hydrobiotite) vary from major components in some samples to trace constituents in others. Quartz, ilmenite, manganese oxides (not further determined), garnet, and locally also diopsidic pyroxene, are minor or sporadic constituents. The garnet most frequently encountered has a cell-size of about 12.46 Å, suggesting melanite or schorlomite; another type with a cell-size 12.27 Å may perhaps be a zirconium-bearing garnet (see Nickel, 1960), and another resembles plazolite.

Barian and common pyrochlore, perovskite, zircon, and very locally rutile, pyrrhotine, chalcopyrite, fluorite, pyrite, amphibole (probably richterite), epidote, and feldspar (e.g. microcline) also occur as accessories or rare constituents. The barian pyrochlore (probably pandaite) and common pyrochlore have cell-sizes of about 10.55 and 10.44 Å respectively. Pyrochlores with cell-sizes ranging from 10.47 to 10.56 Å also occur, corresponding presumably to varieties transitional between common pyrochlore and pandaite. Many pyrochlore crystals are zoned.

The perovskite has a cell-size of about 3.82 Å, and the fluorescent-bead test indicates that it contains niobium. Alteration of perovskite to leucoxene (mostly anatase) has been frequently observed, as well as an occasional replacement by sphene.

The minerals fersmite, marcasite, and chlorite were indicated only in single cases. For the identification of mineral grains the X-ray powder diffraction preparation method of Hiemstra (1956) was used, and this also yielded powder diagrams very similar to those of fergusonite and moissanite, but these lack confirmation.

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*Instability of the garnet  $Ca_3Mn^{III}Si_3O_{12}$ , and the substitution  $Mn^{III} \rightleftharpoons Al$*

OF the first six elements (Sc, Ti, V, Cr, Mn, Fe) of the first transition series, Sc is heavily enriched in garnet relative to host rock (Oliver, 1956, 1961 records 40 ppm in host rock, and up to 2000 ppm in garnet), indicating that a scandium garnet is probably stable. Titanium (III) garnets are not definitely known to exist, but they would form only at very low  $P_{O_2}$ . Vanadium, chromium, and iron (III) garnets of the type  $Ca_3M^{III}Si_3O_{12}$  are stable, but no garnet has yet been described in which  $Mn^{III}$  definitely replaces Al in the (a) sites of space group  $Ia\bar{3}d$ . Since higher manganese oxides and minerals such as viridine and piemontite (the latter often associated with garnet containing little or no 'Mn<sub>2</sub>O<sub>3</sub>') are moderately common in metamorphic rocks, the absence of Mn (III) garnets cannot be explained by postulating that  $P_{O_2}$  was outside the stability field of  $Mn^{III}$ . Since the ionic radius of  $Mn^{III}$  is close to that of