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An occurrence of hydrothermal fayalite in the epicrustal rocks of the Bushveld Igneous Complex

FAYALITE ($Fa_{97}Fo_3$) is associated with hydrothermal fluorite and siderite in tension-fractures in the Rooiberg felsite on Zwartkloof 707 KR, 15 km west of Warmbaths, Northern Transvaal. The fluorite mineralization is genetically related to the Bushveld Granite.

The fayalite occurs in veins up to 2 m. thick; in hand specimens it is dark grey to black in colour and shows a very conspicuous sparkling appearance due to the coarse grain size, which is generally about 1 inch in diameter. It has perfect cleavage with fine-grained magnetite present along the cleavage planes. The optical orientation is normal, with α 1·82, $\parallel$ [010], pale yellow; β 1·86, $\parallel$ [001], reddish brown; γ 1·88, pale yellow; $2V_\alpha = 51°$. X-ray powder data (Cu-$K\alpha$ radiation, 114·6 mm diameter camera) agrees well with published data for nearly pure fayalite (Yoder and Sahama, 1957): d_{130} 2·83 Å and d_{174} 1·041 Å.

A microprobe analysis by E. A. Viljoen of the National Institute for Metallurgy, Johannesburg, gave: SiO_2 29·83 %; TiO_2 0·04 %; FeO (including Fe_2O_3 as FeO) 69·79 %; MgO 0·74 %; MgO 0·74 %; MnO 0·71 %; total 101·11 %, Calculation of the structural formula, based on four oxygen atoms, shows that the Fe_2O_3 content is neglible. Raw data were corrected for dead time, drift, absorption, fluorescence, and atomic number effects using the computer programme of N. H. Beeson (U.S. Geol. Survey open file report, 1967). Acceleration potential 15 kV, sample current 0·025μA on brass. Standard, analysed fayalite with SiO_2 30·5 %; TiO_2 0·1 %; FeO 64·9 % MnO 1·1 %; MgO 3·7 %; CaO 0·3 %; total 100·6 %.

The 'purest natural fayalite' from Rockport, Massachusetts, contains small 'magnetic' inclusions and possibly grunerite (Bowen and Schairer, 1932) and is related to a fayalite-bearing 'nordmarkite granite', older than, and intruded by the dominant Rockport Granite (Palache, 1950). On Zwartkloof, siderite, fluorite, and an iron-rich chlorite with magnetite are generally present, while sphalerite, pyrite, chalcopyrite, galena, ilmenite, and molybdenite occur less frequently.

That the fayalite occurrence is hydrothermal is conclusive by association. However, the origin remains somewhat elusive.

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Manganoan ilmenite from the Leinster Granite, Ireland

AN electron-microprobe study of the ferromagnesian silicate and oxide minerals of the Leinster Granite (Brindley, 1969), south of Dublin, has revealed accessory ilmenite that is unusually rich in MnO (Table I).

Analysis 1 is of a single grain from a quartz–biotite–diorite (specimen no. 43); in this rock other ilmenite crystals are somewhat poorer in MnO, but the mean MnO-content of three analyses is 8·61 wt. %. Analysis 2 is the mean of two grains from an adamellite (specimen no. 7411), in which a third ilmenite contained 9·17 wt. % MnO.

The data were obtained using a Japan Electron Optics Laboratory JXA–3A electronprobe microanalyser with a 1 μm beam at 25 kV. Metal standards were used for Fe, Mn, Ti, V, Cr, Co, and Ni; orthoclase was used for Al, wollastonite for Si, and enstatite for Mg. Total iron was calculated as FeO; no V, Cr, or Mg were detected, although these elements are present in ilmenites from other rocks of the intrusion. SiO_2 is uniformly high in all the grains analysed; it is considered unlikely to be due to inclusions since coexisting magnetite is generally low in SiO_2 (unpublished data) and, secondly, high-magnification absorbed-electron images of the grains show them to be homogeneous.

Calculated unit-cell contents are presented in Table I, where ferric iron has been calculated on the basis of stoichiometric hematite–ilmenite–pyrophanite solid solutions. The ilmenite from the quartz-biotite-diorite contains 6 mol. % hematite while that from the adamellite is a binary ilmenite–pyrophanite solid solution. In each case there is 28 mol. % pyrophanite. No attempt has been made to determine directly the valence states of Fe and Mn using the intensity ratios of the $L\alpha$ and $L\beta$ lines (Snetsinger, 1969); some workers consider that the ratios depend also on coordination (Czamanske and Mihalik, 1972).

Various analyses of manganoan ilmenite have been published, notably from the Finnmarka Complex, Norway, where ilmenites contain up to 63 mol. % pyrophanite in solid solution (Czamanske and Mihalik, 1972). Several other workers have presented analyses containing up to 15·15 wt. % MnO (Snetsinger, 1969; Klement, 1887; Simpson, 1929; Omori and Hasegawa, 1955).