

Interpretation. The primary assemblage in the Fe-Mg silicate-rich mesoband is andradite-diopside-magnetite. This assemblage must have formed under very oxidizing conditions as nearly all Fe is in the Fe^{3+} state. A later fluid phase was introduced into the iron formation by way of a network of veins and, on a microscopic scale, by diffusion along grain boundaries. Reaction with the fluid phase resulted in replacement of andradite and diopside by mineral assemblages that progressively contain more and more Fe^{2+} . The interpreted sequence of minerals is: (andradite-diopside-magnetite) \rightarrow (andradite-ferrosahlite) \rightarrow (Sodic hedenbergite-babingtonite-Al andradite \pm cronstedtite \pm stilpnomelane \pm epidote) \rightarrow (hedenbergite and marcasite). The minerals that are last in the paragenetic sequence represent the most reduced state. These mineralogical changes indicate that the fluid was reducing and that its f_{O_2} was controlled by an external reservoir. Na, Al, and minor amounts of S were introduced into the iron formation by the fluid.

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Barian wölsendorfite from East Greenland

WITHIN the Devonian acid volcanic rocks of Randbøldal, northern East Greenland (Bütler, 1954), uranium has been found in concentrations of up to 1500 ppm (Secher *et al.*, 1975), two orders of magnitude above the average encountered in rhyolitic rock types (cf. Rogers and Adams 1969). Secher *et al.* (1975) have shown that the uranium is mainly concentrated in globular grains and veinlets of hydrocarbon, which are associated with sulphides, most commonly pyrite. The carburan (uraniferous hydrocarbon) mineralization is thought to be epigenetic whereby magmatic uranium was fixed by the hydrocarbons (Steenfelt, in press). Primary uranium minerals such as uraninite have not been observed, but oxidation during weathering has led to the development of limonite and yellowish secondary uranium minerals of which wölsendorfite appears to be the most prolific (Secher *et al.*, 1975). Wölsendorfite commonly forms coatings or dense aggregates in cavities

of the weathered rock but can also be associated with carburan. Optical data are impossible to obtain from the present material due to the fine-grained and turbid nature of the wölsendorfite (samples: GGU nos. 132627 and 202851).

Electron microprobe analyses have been made of an area of wölsendorfite associated with a 1×2 mm bleb of carburan in a quartz-phyric rhyolite. The wölsendorfite is yellow-orange in colour and forms a fine, platy aggregate. It is also partly intergrown with micaceous alteration products of the silicic rhyolite groundmass. The analyses show the wölsendorfite to be homogeneous with an average composition as given in Table I. The detection of Si, Al, Fe, and K may be due to impurities, such as micas, included in the probe beam, which was defocused to prevent volatile loss and specimen damage. Atomic proportions in Table I have been calculated using the basic formula $\text{PbU}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$. Compared with the few

TABLE I. Analytical data for wölsendorfite

Chemical data					
Wt. %	A	B	Atomic	A	B
CaO	0.09	1.24	Ca	0.014	0.181
BaO	3.27		Ba	0.172	
PbO	22.50	23.14	Pb	0.813	1.043
FeO*	0.39		Fe	0.044	0.851
K ₂ O	0.10		K	0.017	
UO ₃	69.05	69.80	U	1.947	2.003
SiO ₂	0.32		Si	0.043	2.005
Al ₂ O ₃	0.10		Al	0.015	
H ₂ O		4.30	H		3.918
Total	95.82	98.48	O‡	7.000	9.000

X-ray diffraction data					
A		B			
<i>d</i> (Å)	<i>I</i> §	<i>d</i> (Å)	<i>I</i>	<i>hkl</i>	
7.01	100	6.93	60	020	<i>Notes.</i> A. Barian wölsendorfite (GGU no. 202851). B. From Protas (1957). * All Fe expressed as FeO. ‡ Assumed oxygen content. § No account taken of preferred orientation due to limited amount of material available.
6.03	20	6.02	30		
3.50	80	3.51	40		
3.47	50	3.47	80		
3.13	50	3.13	60		
3.10	60	3.09	100	321	
2.75	20	2.75	30		
2.47	30	2.45	30		
2.27	15	2.25	30	412	
2.01	25	2.01	30		

previous chemical analyses of wölsendorfite, which is usually associated with vein-type pitchblende and fluorite (Protas, 1957; Deliens, 1977; Belova and Fedorov, 1974), the Greenland material is notable in containing only minor CaO but significant (3.3 wt. %) BaO. This corresponds to about 17% occupancy of the Pb-site, which is a similar value to that attributable to Ca in the type material (Table I, analysis B), and which represents approximately 1 atom in a unit cell of six formula units.

X-ray diffractometry of the material analysed agrees well with published data on wölsendorfite (Deliens, 1977). The most significant lines measured are included in Table I with comparative data for the calcic wölsendorfite of Protas (1957). In all, thirty-two lines were measured for this sample, a listing of which is obtainable from the authors. However, due to the *P*-lattice, the large cell-size and the fact that the *b* cell edge is close to twice *c* in wölsendorfite (Touissant, 1961), unambiguous indexing of most of these lines is not possible. Only the few lines indicated in Table I are deemed unambiguously indexed by Protas (1957). Consequently, the calculation of refined cell parameters

by least squares cannot be attempted. In general, however, the *d*-spacings of barian wölsendorfite are equal to or slightly larger than those in the corresponding calcic variety (Table I), suggesting that the incorporation of the larger Ba cation has led to an expansion of the lattice.

It is concluded from these data that wölsendorfite is chemically more variable than hitherto thought and that Ca is not an essential constituent as implied by some compendia of mineral formulae (e.g. Fleischer, 1980). It is hoped that further work will quantify more completely the degree of, and causes of, Ca-Ba-Pb variability in this mineral species.

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A dendritic-type arrangement of pyrite from the Kangiara deposit, SE Australia

THE Kangiara deposit in SE Australia (fig. 1) is a Cu-Pb-Zn deposit of approximately 50 000 tonnes which occurs in acid volcanic rocks of Silurian age. It closely resembles the deposits of Woodlawn (Malone *et al.*, 1975) and Captains Flat (Davis, 1975) with respect to its mineralogy, ore textures and sulphur isotope composition.

Pyrite is one of the main sulphide minerals present in the Kangiara mineralization, and typically occurs as euhedral grains, both isolated and in clusters, set in sphalerite, galena, chalcocopyrite or quartz. However, within pyrite-rich portions of the mineralization a dendritic-type arrangement of pyrite grains (fig. 2) also occurs. This unusual arrangement of pyrite grains varies in width from 0.05 mm to 0.5 mm (averaging 0.1 mm), and is up to 5 mm long. The dendritic structures are only seen in certain planes in the ore. Etching the dendritic-type arrangement with HF showed that central portions of the pyrite grains are more susceptible to the acid. These etched central portions are normally aligned with one another, and form distinct orientations in the mineralized samples, independent of the orientation of the actual pyrite grains. In addition to the isolated, clusters and dendritic forms of pyrite, radiating patterns and delicate networks are present, and may be variations of the dendritic pyrite form.

Electron microprobe analyses of both the isolated euhedral pyrite and the dendritic pyrite forms (Table I) gave approximately stoichiometric values

for pyrite. The minor differences which do occur may be due to instrumental variations, the presence of submicroscopic inclusions, or slight variations in elemental substitution of iron in the pyrite

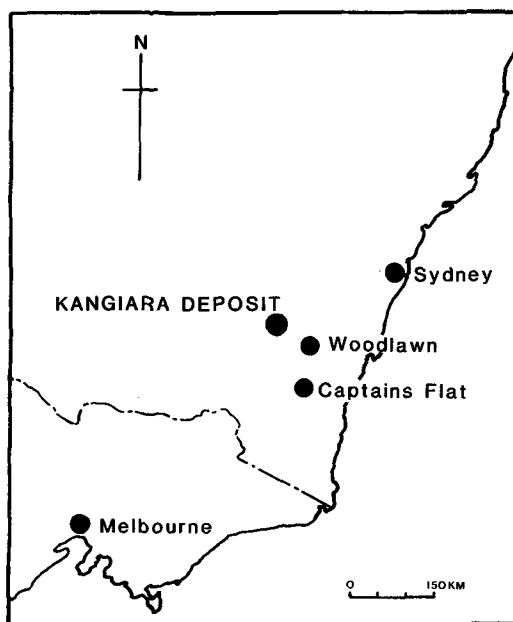


FIG. 1. Location of the Kangiara deposit, south-eastern Australia.