are present of complex composition which might be in part altered aenigmatite, but the low Ti of the silicate grains does not support this, even accepting the loss of Na during hydration. The original composition of these grains remains unknown and analyses 5 and 6 of Table I record typical compositions.

Conclusions. Remarkably iron-rich amphibole and pyroxene corresponding to arfvedsonite and aegirine have been identified.

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REFERENCES

Geikie, A. (1903) *Mem. Geol. Surv. Scotland* (N. Arran etc.).

Howie, R. A., and Walsh, J. N. (1981) *Scot. J. Geol.* **17**, 123–8.

Leake, B. E. (1978) *Mineral. Mag.* **42**, 533–63.

Richey, J. E., Anderson, E. M., and MacGregor, A. G. (1930) *Mem. Geol. Surv. Scotland* (N. Ayrshire).

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Babingtonite in an early Archaean metabasalt from the Pilbara Block, Western Australia

THE rare mineral babingtonite has been found in a sequence of early Archaean metavolcanics in the Kelly Greenstone Belt (Long. 119° 49′ 30″ E., Lat. 21° 40′ 25″ S.) approximately 30 km west of Nullagine in the eastern Pilbara, Western Australia. Babingtonite typically occurs in skarns, veins, and in basaltic rocks which have been altered during low-grade burial metamorphism (Burt, 1971). It has been reported from only two other locations in Australia (Gole, 1981, 1982) and has not previously been reported from metabasalts in Archaean granitoid–greenstone terrain.

The Pilbara Block is the smaller of the two Archaean crustal blocks within the Western Australian Shield. It consists of 56 000 km^2 of granitoid–greenstone terrain in which sequences of metamorphosed volcanics and sediments (greenstone belts) occur between large batholiths of granitoid and gneiss. The major sequence of Archaean metavolcanics in the Pilbara, the Warrawoona Group is between 3500 and 3300 Ma old (Hickman, in press). In the Kelly Greenstone Belt, Warrawoona Group volcanics have been extensively altered and largely recrystallized to prehnite–pumpellyite and greenschist-facies mineral assemblages. However, primary volcanic structures and textures are still very well preserved.

The babingtonite occurrence is in a 30 m thick basalt flow with a mineral assemblage typical of the lower greenschist facies. The upper 15 to 20 m of the flow has a mottled appearance due to irregular yellow-green epidote-rich patches (metadomains) up to 20 cm across surrounded by grey albite-rich basalt. The lower portion of the flow is composed of grey-green relatively unaltered basalt with minor epidote-rich metadomains. Veins containing quartz–albite–chlorite–calcite and epidote–quartz, with or without calcite, occur throughout the flow. Relatively unaltered basalt consists of plates of tabular relict clinopyroxene (0.5 to 2.0 mm long) which wholly or partly enclose laths of albite dusted with fine chlorite and epidote, replacing original calcic plagioclase crystals, with interstitial devitrified basaltic glass (replaced by chlorite, epidote, and sphene) and Fe–Ti oxide. Relict clinopyroxene crystals are commonly mantled by epitaxial overgrowths of pale green fibrous actinolite. The epidote-rich metadomains consist of

TABLE I. *Probe analyses of babingtonite and epidote*

	Babingtonite		
	A	*B*	Epidote
SiO_2	53.22	53.00	38.30
TiO_2	0.01	0.02	0.08
Al_2O_3	1.33	0.50	22.05
FeO*	20.98	22.83	14.39
MnO	2.21	1.56	0.04
MgO	0.56	0.59	0.01
CaO	20.05	19.82	23.76
Na_2O	0.04	0.10	0.04
Total	98.40	98.42	98.70

A. Babingtonite in quartz vein.
B. Babingtonite in epidote-quartz vein.
* All Fe as FeO.

Analyses were carried out at the University of Western Australia using the correction procedure of Bence and Albee (1978). Sample 86480 of the Geology Department, University of Western Australia.

aggregates of lemon yellow epidote (average grain size 0.2 to 0.5 mm) with quartz, carbonate, little or no albite, and minor relict clinopyroxene. Babingtonite has been found in one epidote-rich metadomain. It exhibits characteristic pleochroism (α emerald green, β claret, γ pale brown) and occurs as ragged grains intergrown with epidote and quartz, subhedral grains in epidote-quartz-calcite veins and also as a partial replacement of clinopyroxene. Electron probe microanalyses of babingtonite and epidote are presented in Table I.

REFERENCES

Bence, A. E., and Albee, A. L. (1968) *J. Geol.* **76**, 382–403.
Burt, D. M. (1971) *Spec. Issue Soc. Mining Geol. Japan*, **3**, 375–80.
Gole, M. J. (1981) *Can. Mineral.* **19**, 269–77.
——(1982) *Mineral. Mag.* **46**, 127–30.
Hickman, A. H. (in press). *Spec. Pub. Geol. Soc. Aust.* 7.

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Churchite from Wheal Pendarves, Camborne, Cornwall

CHURCHITE, the rare hydrous yttrium phosphate, has recently been discovered at Wheal Pendarves, an operating tin mine near Camborne, Cornwall. It occurs in the Tryphena lode, drive no. 204 east, on the no. 2 level. Here, the lode is heavily oxidized and consists of hematite and quartz, with lenses of cellular gossany quartz and limonite, the footwall being strongly hematized granite with limonite-coated joints. Decomposing iron pyrites occurs as small patches, and cavities in the quartz are lined with botryoidal and stalactitic iron oxides.

Churchite was found rarely as radiating tufts of silky white crystals attaining 6 mm in length, lining cavities and scattered on joints in gossany veinstuff composed of quartz and light to dark brown limonite, with occasional fragments of hematized granite wallrock. One specimen shows a small spray of churchite needles stained brownish-red by iron oxides. Small clear crystals of baryte occur underlying some of the tufts of churchite, and this mineral was also noticed scattered in cavities in spongy limonite and quartz in adjacent parts of the lode. The lode is in granite close to a major fault and elvan (quartz porphyry) dyke, and is very disordered and split at this point. Other minerals encountered in oxidized parts of the Tryphena lode on no. 2 level include native copper, cuprite, and its variety chalcotrichite, scorodite, pharmacosiderite, olivenite, connellite, and malachite. Apatite (var. francolite) has also been found as