

SHORT COMMUNICATIONS

MINERALOGICAL MAGAZINE, MARCH 1986, VOL. 50, PP. 173-175

Winchite re-discovered from the type locality in India

WINCHITE, a violet sodic-calcic amphibole, was discovered by a Mr H. J. Winch in the manganese ore mine at Kajlidongri (22° 57' N., 37° 31' E.) MP, India, and was named by Sir Lewis Fermor (1904, 1906, 1909). It is from the original sample analysed by Fermor that the International Mineralogical Association's amphibole nomenclature names the theoretical compositions $\text{CaNaMg}_4\text{Fe}^{3+}\text{Si}_8\text{O}_{22}(\text{OH})_2$ and $\text{CaNaMg}_4\text{AlSi}_8\text{O}_{22}(\text{OH})_2$ ferri-winchite

and aluminowinchite (Leake, 1978; Rock and Leake, 1984). The original analysis is still classified as winchite without a prefix as Fe^{3+} is less than 1.00. However, despite intensive searching (Nayak and Leake, 1975; Leake *et al.*, 1981) among the violet and other amphiboles at the type locality at Kajlidongri, involving both wet and microprobe analyses, no crystal even approaching the composition of the original winchite could be identified.

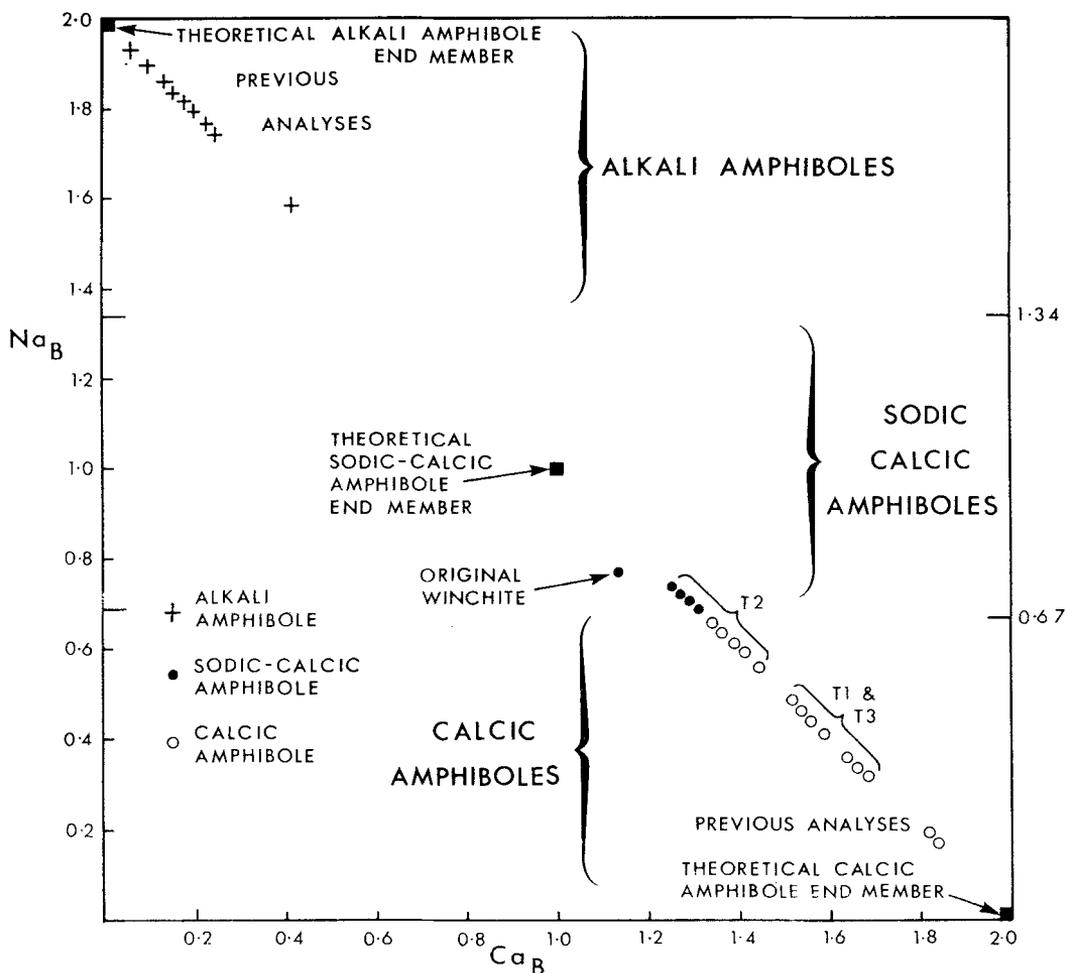


FIG. 1. Plot of Na_B against Ca_B for amphiboles from Kajlidongri referred to the standard amphibole formula of $\text{A}_{0-1}\text{B}_2\text{C}_3\text{VI}_T\text{VII}_8\text{O}_{22}(\text{OH},\text{F},\text{Cl})_2$. Previous analyses are listed in Nayak and Leake (1975) and Leake *et al.*, 1981.

This raised the question as to whether the original analysis might have been carried out on a mixture of calcic and alkali amphiboles, both of which certainly co-exist at this locality, or whether some other error had occurred.

All the alkali amphiboles studied by Leake *et al.* (1981) were violet magnesio-arfvedsonites or magnesio-riebeckites, sometimes with significant contents of Mn, while the co-existing calcic amphibole was usually tremolite. An approximately equal mixture of alkali and calcic amphiboles might resemble the sodic calcic winchite, or an analytical error may have occurred, or inclusions of calcite might have been present in an analysed alkali amphibole. For various reasons it can be shown (Leake *et al.*, 1981) that none of these possibilities is

entirely consistent with the evidence and so we continued to search for winchite at this locality.

Recently Mr F. Chao, working under the supervision of Dr C. M. Farrow, identified a single crystal (T2) the composition of which (Table I) approaches the original winchite sufficiently closely to strongly suggest that the original analysis is probably reliable.

Crystal T2 is 0.3 mm in diameter and is strongly zoned, as are most of the amphiboles at this locality. It varies from a 0.04 mm sodic-calcic centre (fig. 1) to a calcic outside but the centre falls into the winchite field of the IMA classification. The centre differs from the original winchite analysis (Table I) mainly in the much lower content of Fe_2O_3 , being about 5% instead of 7%. Nevertheless, as fig. 1

TABLE I Chemical analysis of some amphiboles from Kajlidongri, India

	1	2	3	4	5	6	7	8
SiO_2	55.64	56.08	55.82	56.09	56.52	56.94	56.60	57.33
Al_2O_3	1.08	1.91	2.02	1.69	1.83	1.54	2.02	0.81
TiO_2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe_2O_3	7.06	5.27	5.15	4.81	4.69	3.69	3.52	2.00
MnO	0.77	0.67	0.55	0.37	0.59	0.43	0.46	0.62
MgO	22.09	20.66	21.17	21.09	21.73	22.07	22.02	22.91
CaO	7.64	8.56	8.64	9.34	9.70	10.00	10.39	11.07
Na_2O	2.89	3.48	3.25	3.22	3.23	3.06	2.46	1.93
K_2O	9.98	0.55	0.86	0.55	0.50	0.47	0.62	0.57
Total	98.15	97.18	97.46	97.16	98.79	98.20	98.09	97.24
Ions per 23(O)								
Si	7.70	7.78	7.73	7.78	7.72	7.79	7.75	7.89
Al ^{IV}	0.17	0.22	0.27	0.22	0.28	0.21	0.25	0.11
Al ^{VI}	0.00	0.09	0.06	0.06	0.02	0.04	0.08	0.02
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe ³	0.73	0.55	0.54	0.50	0.48	0.38	0.36	0.21
Mn	0.09	0.08	0.06	0.04	0.07	0.05	0.05	0.07
Mg	4.55	4.27	4.36	4.36	4.43	4.50	4.50	4.70
Ca	1.13	1.27	1.28	1.39	1.42	1.47	1.53	1.63
Na _B	0.77	0.73	0.72	0.61	0.58	0.53	0.47	0.37
Na _A	0.00	0.21	0.16	0.25	0.28	0.28	0.18	0.15
K	0.17	0.10	0.15	0.10	0.09	0.08	0.11	0.10
T	7.87	8.00	8.00	8.00	8.00	8.00	8.00	8.00
C	5.37	5.00	5.04	4.96	5.00	4.98	4.99	5.00
B	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
A	0.07	0.31	0.31	0.35	0.36	0.36	0.29	0.25

- Original winchite from Fermor (1909). In addition, 3.09% loss on ignition and 0.14% H_2O - giving a total of 101.38, were reported. The state of oxidation of the iron was not given but in view of Lahiri's (1971) determination of 6.00% Fe_2O_3 , 0.13% FeO and Nayak and Leake's (1975) determination of 12.09% Fe_2O_3 , 0.10% FeO on amphiboles from Kajlidongri, all the iron is assumed to be Fe_2O_3 in all the analyses in this table.
- Zoned crystal T2; representative analysis by microprobe. 2 and 3 are winchites from near the core, 4-7 are subcalcic tremolites nearer to the periphery. Nearly colourless-pale puce 0.3 mm crystal with microcline, diopside, plagioclase and apatite in a 3 mm thick layer in Mn ore rock. Amphibole crystals range up to 5 mm in diameter in this sample.
- Crystal T1; representative analysis. Tremolite. 2-5 mm colourless crystals, associated with perthitic K feldspar, apatite and Mn ore (Hollandite) in a 10 cm thick layer with Mn ore and biotite rich layer adjoining.
- Crystal T3; representative analysis. Tremolite 0.5 - 1 mm colourless crystals associated with Mn ore, microcline, phlogopite, diopside and quartz.

All analyses by microprobe, Cambridge Instruments Microscan 5. Pure metal and simple mineral standards; 20 kV, 3nA probe current, energy dispersive analysis.

shows, taken with the new discovery of crystals T1 and T3, the gap between the only calcic amphiboles previously known and the original winchite analysis is almost bridged and leads to the reasonable supposition that the crystal studied by Fermor was essentially correctly analysed. This accords with his careful description (Fermor, 1904, 1906, 1909) of the procedures of separation. The original winchite was described as violet in colour but our sample is virtually colourless.

The amphiboles at Kajlidongri are extremely complex, ranging from Ti-rich to Ti-poor, from Mn-rich to Mn-poor, from magnesio-arfvedsonite to magnesio-riebeckite; there is winchite and tremolite. Nevertheless there still appears to be a significant gap in composition between the alkali amphiboles and the calcic to just sodic-calcic specimens of winchite (fig. 1). Even the original winchite was not close to the theoretical end-member formula. All the evidence suggests a miscibility gap in the sodic-calcic amphibole field, so that a complete series of solid solutions from

KEYWORDS: winchite, tremolite, manganese ore, India.

*Department of Geology,
University of Glasgow,
Glasgow G12 8QQ, Scotland*

*Centre of Advanced Study in Geology,
University of Saugar, PO Saugar,
(MP) 470-003, India*

calcic to alkali amphiboles was not stable. The precise control on this gap remains to be elucidated.

Acknowledgements. F. Chao is supported by the Chinese Government; the sample was collected with many others by V. Nayak.

REFERENCES

- Fermor, L. L. (1904) *Rec. Geol. Surv. India*, **31**, 235-6.
 — (1906) *Trans. Min. Geol. Inst. India*, **1**, 69.
 — (1909) *Mem. Geol. Surv. India*, **37**, Part 1, 149.
 Lahiri, D. (1971) *Econ. Geol.* **66**, 1176-85.
 Leake, B. E. (1978) *Mineral. Mag.* **42**, 533-63 and *Am. Mineral.* **62**, 1023-53.
 — Farrow, C. M., and Nayak, V. K. (1981) *Am. Mineral.* **66**, 625-31.
 Nayak, V. K., and Leake, B. E. (1975) *Mineral. Mag.* **40**, 395-9.
 Rock, N. M. S., and Leake, B. E. (1984) *Ibid.* **48**, 211-27.

[Manuscript received 25 May 1985]

© Copyright the Mineralogical Society

B. E. LEAKE
C. M. FARROW
F. CHAO
V. K. NAYAK

MINERALOGICAL MAGAZINE, MARCH 1986, VOL. 50, PP. 175-177

Gahnite in an Archaean iron-formation, West Greenland

THE zinc spinel gahnite has been discovered in an iron-formation in the Archaean Malene supracrustal belt of West Greenland. The supracrustals, which are c.3000 Ma old and form extensive outcrops in the Godthåb area of West Greenland, consist of layered and massive amphibolites together with Mg-rich metasediments and calc-silicate horizons. The supracrustals have suffered several phases of deformation and been metamorphosed under amphibolite facies conditions. The iron-formation forms layers up to 2 m wide which can be traced with intervals for up to a few hundred metres along the strike, interlayered in quartz-cordierite-rich metasediments which are locally tourmaline-bearing. The iron-formation

consists of magnetite-rich layers alternating with layers composed mainly of anthophyllite-gedrite. In the magnetite-rich layers the magnetite is accompanied by grunerite, pyrite, pyrrhotite, chalcopyrite, molybdenite, and gahnite, locally with very small amounts of biotite, hornblende, ilmenite, and rutile. In the anthophyllite-gedrite layers small amounts of pyrite, pyrrhotite, chalcopyrite, molybdenite, ilmenite, and gahnite occur. The Malene metasediments are thought to represent Mg-rich clays comparable with modern deep-sea sediments (Beech and Chadwick, 1980). The iron-formation is interpreted as a chemical precipitate of submarine exhalative origin (Appel, 1983).

The gahnite, which in some thin layers within the