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Sheridanite from the V-Ti-Fe deposits of Madangere, North Kanara District, Karnataka

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Abstract

Sheridanite with the formula $(Mg_{7.97}\ Al_{2.64}\ Fe''_{1.38}\ Ti_{0.01}\ Mn_{0.01})\ [(Si_{5.3}\ Al_{2.7})\ O_{20})]\ (OH)_{16}$ occurs as one of the main gangue minerals in the V-Ti-Fe deposits of Madangere. It is found chiefly as late stage pyrogenic mineral and to a very limited extent as secondary mineral after hògbomite.

Introduction

The Madangere area covered in the present study occupies a total of 125 km², stretching between the longitudes 74°21′ - 74°25′E and latitudes 14°32′ - 14°37½′N. It is a Precambrian terrain consisting abundantly of granodiorite-tonalite gneiss which occasionally contain small enclaves of older metabasic/ultramafic rocks and intruded by a large number of amphibolites, V-Ti-Fe bodies, epidiorites and dolerites (in that chronological order). The present account, however, is concerned only with the occurrence of sheridanite, which has been noted only in the V-Ti-Fe deposits of the area.

Although chlorite has been reported from several of the V-Ti-Fe deposits, including those of Bushveld (Schwellnus and Willemse, 1943) and Karnataka (Naganna *et al* 1976; Ramiengar *et al* 1978; and Vasudev and Srinivasan, 1979), it has not been specifically distinguished as sheridanite. As far as the knowledge of the authors goes, this is the first report of the mineral from India.

Mode of occurrence

Sheridanite is noted in all the nine V-Ti-Fe ore bodies of the area, which typically occur as narrow tabular discordant intrusions into the granitic gneisses (see Devaraju *et al* 1981, for a generalised description of the ore bodies). There is, however, no uniformity in the distribution of the mineral; its incidence varies from one body to the other and even within the limits of an individual body. In terms of mode worked-out using thin sections of 3 cm x 2 cm, the content of mineral ranges from a couple of scales, as in the spinel-bearing narrow sill-like body occurring northwest of the Gangavali bridge, to about 12%, as in the bodies located near Madangere, Hiregutte and Kodsani. Within a well exposed individual body a slight to moderate increase in the frequency of the mineral is noticed from centre to borders. The sheridanite enriched portions of the ore look schistose with the mineral plates showing preferred orientation parallel to the borders of the intrusion.

Petrography

In hand specimen, the mineral is seen as elongated lensoidal patches of scales and flakes. When fresh it shows moderate to dark green colour and vitreous lustre. But, when weathered/altered it exhibits light green or pale reddish brown or almost white colour and pearly to dull lustre. When fresh the mineral is soft (1½ to 2½ on the Mohs scale), easily cleavable into small flakes which are flexible, but, on weathering the mineral turns brittle and crumbles into powder.

Sheridanite is the only silicate phase occurring in an otherwise oxide association constituting the V-Ti-Fe intrusions. The main oxide mineral phases of the ore bodies include, magnetite, titanomagnetite, maghemite (and martite), hematite, ilmenite, goethite and högbomite (in the decreasing order of abundance). Spinel is noted only in one intrusion. Sheridanite occurs chiefly occupying the interstices of the ore grains and to a limited extent as a secondary mineral replacing högbomite along its crystal boundaries, cleavages and other weak planes. The former type occurs as aggregation of prisms (<.53 mm × .04 mm), plates (av .53 mm × 45 mm), scales (av .04 mm × .02 mm) and needles (<.02 mm × .12 mm).

Optical characters

In thin section, the mineral is colourless to pale green coloured, with weak to somewhat moderate pleochroism in shades of pale green and straw yellow, commonly shows undulatory extinction, polysynthetic twinning and a typical combination of yellow, green and blue interference colours of the second order. Besides, it is biaxial positive with a small axial angle around 26° and $n_\gamma = 1.606$.

X-ray data

Powder X-ray pattern obtained for Madangere sheridanite, employing Schimedzu X-ray diffractometer type S5, with the settings of 30 Kv/15 MA current, CuKα radiation Ni filter and scanning speed of 10 mm per minute, shows prominent peaks corresponding to the d(Å) value 7.167 (100%), 4.770 (88%), 3.547 (95%) and 2.840 (50%) and is similar to that recorded by Sakamoto and Sudo (1956) for sheridanite from Wanibuchi mines in Japan.

Chemistry

Mineral analysis has been performed with a Cambridge M-9 microscan instrument using a 20 KV accelerating potential and a sample current of 25 nA. Standards used were the natural minerals diopside for Ca and Si, olivine for Mg, hematite for Fe, rhodonite for Mn, ilmenite for Ti, corundum and almandine for Al, jadeite for Na, orthoclase for K and the oxides Cr_2O_3 for Cr, V_2O_5 for V and ZnO for Zn. The accuracy of the analysis is about 1 to 2% for the major elements and up to 5% for the minor elements.

The chemical analysis of the Madangere sheridanite (Table 1, No. 1) obtained employing the above procedure bears a remarkable similarity with those reported by McMurchy (1934) (No. 2) (Quoted by Deer *et al* 1962) and Wilson (1977) (No. 3). Interestingly, this similarity is observed in spite of the fact that the three sheridanites compared have very different paragenesis. The great similarity of the Madangere sheridanite with particularly the one reported by McMurchy is reflected even in the numbers of ions calculated on the basis of 26 oxygens.

Discussion

The main sheridanite of V-Ti-Fe intrusions of Madangere, which occurs occupying the interstices of ore grains, shows evidence of being a late stage magmatic mineral. There is no indication of its formation either by hydrothermal alteration or metasomatism or metamorphism. The bulk of Fe and Ti of the ore magma was extracted in the early stages of crystallization as magnetite and ilmenite and ther was late stage accumulation of alumina, magnesia and silica in the proportione required for sheridanite formation. The separation of alumina and magnesia, however, appears to have taken place in at least two different stages of crystallization ;

TABLE 1. Chemical composition of Sheridanites

	1 a)	2	3
SiO_2	26.60	26.68	27.45
TiO_2	0.08	tr.	0.10
Al_2O_3	22.84	25.20	23.03
V_2O_3	0.00	-	—
Cr_2O_3	0.00	- -	-
Fe_2O_3	—	- -	1.49
FeO	8.32 b)	8.70	8.38
MnO	0.04	—	0.05
MgO	26.90	26.96	27.87
CaO	0.00	0.28	0.04
Na_2O	0.00	- -	0.06
K_2O	0.00		0.45
ZnO	0.00	—	—
H_2O+	12.19 c)	11.70	11.09
H_2O-	0.59 c)	—	0.15
	97.56	99.52	100.16

Numbers of ions calculated on the basis of 28 oxygen equivalents, ignoring H_2O+.

	1		2		3	
Si	5.290	8.00	5.127	8.00	5.249	8.00
Al^{iv}	2.710		2.873		2.751	
Al^{vi}	2.640	12.01	2.837	12.01	2.440	12.10
Ti	0.012		—		0.015	
Fe'''	–		––		0.214	
Fe''	1.384		1.398		1.340	
Mn	0.007		-		0.008	
Mg	7.972		7.722		7.942	
Ca	-		0.057		0.008	
Na	- -		—		0.023	
K	—		—		0.110	
OH	16.000		16.000		16.000	

1. Sheridanite from Madangere V-Ti-Fe instrusion. Analyst: J. J. M. M. M. Coolen.
   a) Average of two electronprobe micro analyses
   b) Total Fe determined as FeO
   c) Analysed by V. H. Uttangi.
2. Sheridanite (grochauite), Burra Burra. Ducktown, Tennessee (McMurchy 1934). Analyst: E. V. Shannon. (Quoted by Deer *et al* 1962).
3. Sheridanite associated with zincian högbomite in the altered aluminous granulite, Strangways Range, Central Australia (Wilson 1977). Analyst: G. Longthaler.

in the early stages at hight emperatures as spinel and hogbomite (between the two, the former is restricted to only one body, but, the latter is noted in all the ore intrusions and in late stage at low temperature when silica also accumulated, as sheridanite. The absence of free silica in the intrusions suggests that the silica accumulated in the last stages was just enough for sheridanite formation. The restricted late stage reaction of accumulated silica along grain boundaries, cleavage and other weak planes of early formed hogbomite explains the local transformation of hogbomite into sheridanite.

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