SHORT COMMUNICATIONS

OCCURRENCE OF CHROMIFEROUS LODESTONE NEAR CHALINGAL, KASARAGOD DISTRICT, KERALA

P.V. SUKUMARAN and A.R. NAMBIAR*

Geological Survey of India, Geodata Division, Nagpur - 440 006

*Geological Survey of India, Op. Karnataka and Goa, Kumaraswamy Layout, Bangalore - 560 078

Abstract: This communication reports the new find of chromiferous lodestone near Chalingal village in Kasaragod District of Kerala. The chemistry and mineralogy of the lodestone suggest that the band may have segregated during the early phase of magmatic differentiation.

Keywords: Lodestone, Magmatic differentiation, Ilmenite, Magnetite, Cumulus texture.

INTRODUCTION

It is well known that magnetite crystallising out of cooling magmas, acquires magnetic polarity. However, natural magnets called lodestones are rare. They usually occur as lenses in layered mafic and ultramafic complexes. In peninsular India, occurrence of titaniferous and vanadiferous magnetite exhibiting natural magnetism has been reported by Ranganathan et al. (1991). The present find of lodestone is from a locality (12°22.5'-75°07') 1.5 km southeast of Chalingal village, which is 6.5 km north of Kanhangad town in Kasaragod District of Kerala (Fig.1). It occurs as a resistant band in laterite duricrust, which forms the midland terrain in the physiography of Kerala. The basement rocks are intensely lateritised here to thickness exceeding 20 m. They are seldom exposed and are available for observation only along dissected valleys and well-cuttings and quarry-faces. Examination of these sections reveals that the basement rocks consist of pyroxene granulite and charnockite intruded by dolerite and gabbro dykes.

The lodestone band under discussion has an E-W strike and sub-vertical dip and extends over a length of 350 m along the strike. The body pinches and swells along the strike and has a maximum width of 15 m. The lodestone displays perceptible, though feeble, magnetism. The weak magnetic polarity is perhaps due to alteration of the primary magnetite to haematite and hydrous iron oxide and the presence of appreciable amount of silicate minerals. A highly silicified and serpentinised ultramafic rock is exposed in a well cutting one kilometre north of the lodestone body, though not in its strike continuity. It is likely that the lodestone is perhaps associated with a mafic-ultramafic complex that is under laterite cover.

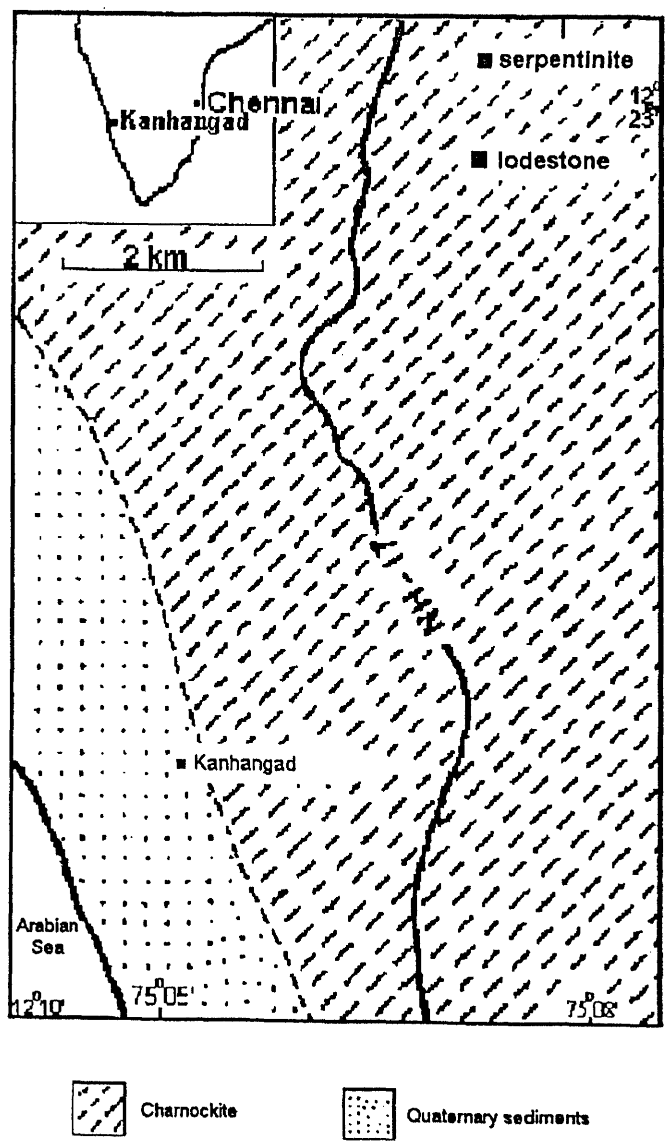

Fig.1. Map showing location of loadstone.

PETROCHEMISTRY

Petrography

Study of polished sections of the lodestone shows presence of magnetite and ilmenite as discrete major oxide minerals forming 90-95% of the rock (Fig.2). The rock is equigranular with the mineral grain boundaries often meeting at triple junctions giving rise to adcumulus texture. Quite often the intergranular material is formed of mafic minerals now in various stages of alteration. Magnetite forms two-thirds, while ilmenite occupies one-third of the rock in polished sections. Magnetite shows alteration to haematite along cracks, fracture planes and crystal boundaries. Ilmenite does not show pronounced alteration, though incipient alteration to leucoxene is observed. Ilmenite is distinguishable from magnetite by the pale pink colour and reflection pleochroism.

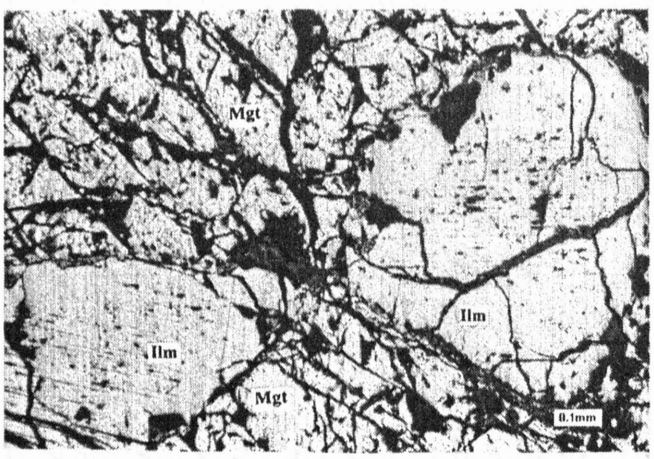

Fig.2. Photomicrograph of lodestone. Ilm - Ilmenite, Mgt - Magnetite. Length of bar: 0.1 mm.

Besides oxide minerals, silicate minerals are also present in the rock and they constitute about 5-10%. Serpentine is the most common of these minerals and occurs as a light bluish mineral in the interstices between oxide minerals. Serpentine in this type of occurrence does not leave any relict primary mineral but occasionally retains the shape of olivine. Serpentine also occurs as a marginal alteration product of pyroxene. Pyroxene is dominated by orthopyroxene (hypersthene), but clinopyroxene (augite) is also present. Amphibole in the rock is represented by tremolite that is an alteration product of clinopyroxene. In addition to these silicates, crystalline quartz formed by the alteration of primary silicate minerals occurs as vug fillings and veinlets. Rare flakes of deep red mica were observed which is probably phlogopite.

Geochemistry

In order to understand the composition of minerals of the lodestone, one representative sample was analysed by AAS and ICP. Further, ilmenite and magnetite phases in the lodestone were analysed by EPMA on polished surfaces. Purified samples of ilmenite and magnetite from the loadstone (~99% purity achieved by repeated separation techniques employing hand magnet, bromoform and isodynamic separator) were also analysed by AAS. The analytical results are given in Table 1. Also given for comparison are the chemical data of Kurihundi titanomagnetite from the Sargur terrain.

The lodestone has 4.67% Cr; it is also enriched in Cu, Ni, and Co. The magnetite has considerable Cr, V, Ni, Co, Zn and Cu compared to ilmenite. These elements are known to substitute for Fe in magnetite/ilmenite structure (Deer et al. 1966), but Cr in magnetite is in substantial amount, though no discrete chromite phase could be identified in polished sections. The high Cr content of the lodestone and magnetite, and the absence of chromite suggest that much of Cr occurs in magnetite. When magnetite and ilmenite coexist Cr is known to enter preferentially into magnetite structure (Carmichael, 1967). Unlike the titanomagnetite lodestone of Kurihundi, the present lodestone is relatively low in Cu,

Table 1. Partial chemical analysis of lodestone, magnetite and ilmenite

Sample	Cu	Zn	Ni	Co	Cr	Fe	Mn	TiO_2	V
	in ppm				in wt.%				
Lodestone*	116	520	800	120	4.67	45.70	0.12	2.60	na
Magnetite*	130	380	650	100	6.00	47.30	0.13	2.70	1.20
Ilmenite*	86	240	40	50	0.14	25.12	0.45	30.40	0.12
Lodestone**	56	283	788	132	>1.50	54.63	0.08	8.10	0.63
Magnetite+	na	na	na	na	na	84.40	0.07	0.11	na
Ilmenite+	na	na	na	na	na	42.63	0.48	52.83	na
Titanomagnetite@	600	70	500	100	nd	51.11	0.07	15.00	0.32

*AAS data; **ICP data; + EPMA data; na - not analysed; @ Kurihundi lodestone (Ranganathan et al.1991); nd - no data

Fe and Ti and high in Cr, V, Zn, Ni, Co and Mn. The V content in Chalingal lodestone exceeds that reported for titaniferous magnetite bands from southern parts of the Dharwar craton (Vasudev and Srinivasan, 1979).

ORIGIN

The cumulus texture shown by the lodestone confirms that the primary minerals in the rock are formed by gravitational settling from a crystallising basic magma. The fairly high concentration of trace elements like Cr, V, Mn, Ni and Co in magnetite and ilmenite of the lodestone indicates incorporation of these elements during the early phase of magmatic crystallisation. Further, occurrence of a serpentinised body in the vicinity and the presence of serpentine and pyroxenes in the lodestone imply its possible association with a layered complex in which the lodestone may be a rhythmic layer. Obviously the area calls for detailed exploration not only for its scientific interest but also for its economic potential.

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ARSENIC RICH PHASES IN AQUIFER SEDIMENTS FROM SOUTHERN WEST BENGAL

P.K. Mukherjee, Taraknath Pal*, S. Sengupta and S. Shome
Central Petrological Laboratory, Geological Survey of India, 15, Kyd Street, Kolkata 700016
*Corresponding Author; **Email:** tnpal@hotmail.com

INTRODUCTION

Arsenic pollution in groundwater of southern West Bengal, India and adjoining Bangladesh is an alarming environmental problem. Many alternatives have been suggested, dealing with the likely minerals contributing arsenic and also the likely processes responsible for release of the element in groundwater (Nickson et al. 1998, 2000; Acharyya et al. 1999, 2000; McArthur et al. 2001). We present here the identity of the phases with high arsenic content recovered from the aquifer material.

Arsenic concentration greater than 0.05mg/l in groundwater is found to be confined in the Ganga-Padma delta region. Hooghly river, a tributary of the Ganga-Padma river system, marks the western limit of the incidence of such high values. It is also observed that such high values are restricted to the shallow aquifers (20-100m) of the region. Two areas Chakdah in Nadia District and Baruipur in 24-Paraganas(S) District of West Bengal (Fig. 1), with reported incidence of greater than 0.05mg/l arsenic in groundwater, have been selected mainly for studies of the shallow aquifer material and to identify the arsenic bearing phases in it. In the two areas of Nadia and 24-Parghanas (S) Districts, the greater than 0.05mg/L values in groundwater (arsenous zone)

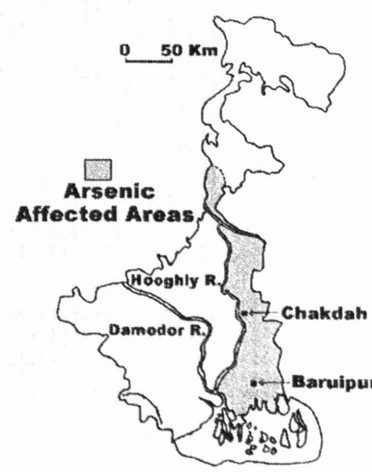

Fig.1. Arsenic affected areas of West Bengal with the locations of Chakdah and Baruipur areas.