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X-ray, DTA and chemical investigation of the so-called bauxite from Shivaganga, Chitradurga District

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Abstract

The 'bauxite' of Shivaganga is actually an aluminous clay deposit containing essentially a mixture of halloysite and kaolinite.

Introduction

Deposit of fine clay earlier described as bauxite (Venkataramaiah, 1918; Ramachandra Rao and Radhakrishna, 1939) occurs about 3 km N 25°W of the Shivaganga village (Long. 76°17'E and Lat. 14°4'23"N) covering the flat tops of the low mound △2570. The deposit is currently being worked for fine clay by a private agency. The observations in the quarry reveal the predominantly earthy yellow colour and the presence of occasional tubular cavities and circular pisolite-like patches showing a concentration of pinkish iron oxide, particularly in the upper levels. The freshly cut material is massive, compact, shows conchoidal fracture and has a hardness of $2\frac{1}{2}$ to 3 on the Mohs scale.

Description

Observation under a transmission electron microscope has revealed that the Shivaganga clay is essentially a mixture of laths of halloysite and hexagons of kaolinite.

Figure A. Powder X-ray diffraction patterns of clay from Shivaganga.

The powder X-ray diffractogram (Fig. A) obtained using CuKα radiation and Ni filter compares very closely with the clay minerals belonging to kaolinite group (Brindley *et al.*, 1963 and Dimanche *et al.*, 1974). The measured 'd' spacings (Table I) are similar to those recorded for kaolinite/hydro-kaolinite/halloysite (Douillet and Nicols, 1969). Peaks and spacings typical of quartz and/or bauxite minerals are not observed.

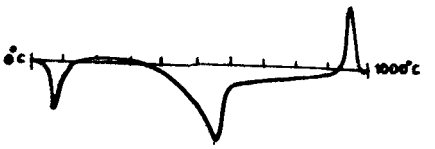

Figure B. Differential thermal curve obtained for clay from Shivaganga.

In the DTA curve (Fig. B) the first marked low temparature endothermic peak at 70°C is related to the liberation of hygroscopic water and conversion of halloysite

to metahalloysite, the second endothermic peak at 565°C to the removal of OH links into the octahedral sheet, and the prominent exothermic peak at 955°C to the re-crystallization of $\alpha - Al_2O_3$ and mullite.

TABLE I. X-ray diffraction data for clay from Shivaganga

I	dA°
100	7.217
60	4.444
28	4.216
28	4.181
5	3.847
75	3.583
35	3.520
5	3.433
15	3.252
30	2.561
25	2.508
25	2.498
23	2.378
35	2.338
10	1.985
12	1.895
5	1.797
13	1.685
15	1.643
23	1.488

TABLE II. Chemical analysis of clay from Shivaganga

SiO_2	38.80	
Al_2O_3	42.10	
Fe_2O_3	2.11	
FeO	1.20	
MgO	0.14	
CaO	0.56	
H_2O^+	12.86	
H_2O^-	2.29	
Total	100.06	
Number of ions on the basis of 18.0,OH		
Si	3.51	4.00
Al	0.49	
Al	4.00	
Fe^{+3}	0.14	
Fe^{+2}	0.09	4.30
Mg	0.02	
Ca	0.05	
OH	7.75	7.75

Chemistry: The chemical analysis (Table II) shows that the Shivaganga material has a little more Al_2O_3 than recorded for kaolinites and halloysites (Douillet and Nicolas, 1969) This peculiarity is attributed to the presennce of a small amount (in amounts below the detection limits of X-ray and DTA) of bauxite minerals mixed with clay. The extra Al may be present in the adsorbed state particularly with the halloysite. The latter interpretation is supported by the fact that 2 to 3% Al_2O_3 in the sample is in the leachable form and could be readily extracted by treating with dilute HCl.

Conclusion

From the foregoing it is concluded that the so-called 'bauxite' or 'siliceous bauxite' of Shivaganga is actually an aluminous clay being essentially a mixture of halloysite and kaolinite.

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A note on the natural arch in the Tirumala Hills, Chittoor District, Andhra Pradesh

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Abstract

A natural arch is carved by the agencies of nature in the Nagari Quartzite, exposed on the Tirumala hills. It is suggested that this may owe its origin to jointing and stream action.

Introduction

A natural arch (Fig. 1) of scenic beauty and geological significance is situated on the Tirumala hills, forming a part of the Palkonda Ranges in the Chittoor district of Andhra Pradesh. It is located about 0.8 km WNW of the well-known shrine of Lord Venkateswara on the Tirumala hills on the road leading to the micro-wave station. A detailed account of the arch has been given in the handbook of the Geology Department of Shri Venkateswara University (Suryanarayana, 1977).

Geological setting

The Tirumala hills, essentially made up of Nagari Quartzite of the Cuddapah Supergroup rise abruptly from the plains to the west and south, where gneisses and granites forming the basement (Precambrian) are extensively exposed. The lowermost bed in the Nagari Quartzite sequence is a conglomerate which is traced in a cutting close to the road leading to the micro-wave station from Tirumala. The conglomerate is polymict and is essentially composed of pebbles of quartzite, quartz and boulders of hornblende granite. It is followed by flesh coloured, medium to coarse grained quartzite. The natural arch is carved out of the quartzite. The regional strike of bedding is NNW-SSE with low dips of 5°-12° towards east. The bedding follows the contours showing variations in strike and dip directions. The rocks are highly jointed