Mineral Resources of Jodhpur

Abstract

The spots and blotches of varying shape, size and shades, observed in the Jodhpur sandstone in parts of Western Rajasthan, were studied in detail. A few types of such marks were recorded near Jodhpur, Khatu and Ladnu. It seems that these marks have been formed due to the activity of some microorganisms e.g. some species of iron bacteria, during early stages of digenesis of the sandstones. These marks if properly analyzed may prove to be useful in the correlation and the environmental interpretation of these rocks of the Trans Aravali Region.

Introduction

The trans Aravali Vindhyan (Marwar Super Group) sediments are exposed with in the sands of Great Thar Desert on the western flank of the Main Aravali Range. These sediments forming flat-topped hills uncomfortably overlie the Malani rhyolites and their equivalents, the Jalore and Siwana granites and the Aravali metasediments (cf. Awasthi et al. 1977 and Heron 1932) in parts of Pali, Jodhpur, Nagaur, Jaisalmer, Bikaner and Churu districts of Western Rajasthan. The geology of the area has been worked out by a number of workers like Heron (1932, 1953) Misara (1969), Charabarti and Singh (1963), Shrivastave (1971), Shrivastava and Srinivasan (1964), Awasthi et al. (1977), Pareekh and Sinha (1978), Paliwal (1975, 1976, 1977, 1978) and Crawford and Compston (1979).

The present paper deals with the spots of various shape and size within spotted sandstone of the Jodhpur formation (Group) exposed around Jodhpur (26^0 18': 73'), Khatu (27^0 7': 74^0 19') and Ladnu (27^0 38': 74^0 23'). The Jodhpur formation which forms the lower parts of the Trans Aravali Vindhyans, comprises of three distinct sub units, with a locally met with boulder bed at the base (Pareekh and Sinha, 1978) and stromatolitic limestone at the top (Paliwal, 1975). Above the boulder bed lie the alternating layers of maroon shale and less sorted siltstones and sandstone with cross laminations (Paliwal, 1978). Above this is trick red to Maroon coloured fine grained, less sorted sandstones with cross laminations. The top unit is of pale yellow to brown and gray coloured, medium grained sandstones. Sedimentary features and texture of the sandstones, indicate a shallow marine to fluviatile environment of deposition (Paliwal, 1976, 1978).

Description of the Marks

Various spots and blotches like marks recorded in the Jodhpur sandstone could be classified into following types on the basis of their shape size, colour of the structures and the sandstone in which they are found, presence of carbonaceous matter and finally, composition of the cement in and outside the spotted features.

Type I Irregular leucocratic patches of variable shape and size with no trace of ferruginous material in the intergranular spaces with in brick red medium to coarse-grained quartos sandstone.

Type II White or cream coloured spherical marks (3 to 5 cm in diameter) with or without a small (0.5 cm in diameter) centrally placed nucleus of carbonaceous matter, within ferruginous sandstone (fig. 1A. and I). Where the black centrally placed nucleus in present, intergranular spaces of nuclear region, leucocratic zone and surrounded red zone, are filled with carbonaceous matter, traces of carbonaceous matter and ferruginous cement respectively.

Type III White coloured spherical marks (2 to 3 cm in diameter) with a large (1.5 to 2 cm in diameter) black nuclear region, within pink quartos sandstone. Intergranualar spaces of the nuclear region are filled with carbonaceous matter and ferruginous cement whereas the surrounding leucocratic rim is devoid of any such matrix.

Type IV Light coloured siliceous pebbly marks (1 to 2 cm in diameter) in light pink, medium grained quartos sandstone.

Type V Irregular bodies of bentonitic or ferruginous clay with varying shape and size within brick red sandstone.

Type VI Dark coloured discnoidal bodies of ferruginous and carbonaceous matter (0.5 to 1 cm in longest dimension) with a calcareous nuclear region within light coloured quartos sandstone.

Type VII Greenish clayey pellets (1 to 1.5 cm in diameter) which brick red ferruginous sandstone.

Type VIII Black coloured thin non-separable pellets, with a circular plan (0.4 to 0.8 cm in diameter) on the bedding planes of light coloured, fine grained quartos sandstone.

Type IX Black carbonaceous and ferruginous pellets (1 to 1.5 cm in diameter), perfectly circular in plan and elliptical in section, within pink to brick red sandstone or within ferruginous clay balls present in them. The pellets are easily separable, leaving behind a circular cavity with smooth lining.

Mechanism of Formation

All these marks except type IV and V seem to have been formed due to the activity of some microorganisms, during early stages of digenesis of the sandstone. Carbonaceous matter within intergranuler spaces in all these cases appear to be of organic origin, i.e. derived from the cell substances of the microorganisms. These microorganism e.g. Thiobacillus ferroxidants and thiobacillus thiooxidants are capable of building up their cells substances

from pure inorganic compounds. They can also easily synthesize their organic cell carbon by fixation of carbon dioxide, from the air or water (cf. Imhoff 1978). Thiobacillus ferroxidants are capable of oxidizing iron (II) to iron (III) more rapidly than any other physicochemical process.

During sedimentation microorganism also entered the intergranular spaces of the loose sand, along with the succeeding iron solutions. Subsequently, these organisms started precipitating iron oxide, either on their seath as in the case of Ferrobacillus ferrooxidants (cf. Brock 1970) resulting in type III marks or by utilizing oxygen and carbondioxide causing reduction as in case of Gallionella ferruginea (cf. Harder 1950). However the zone of their activity subsequently became free fron iron. Microorganisms of close colonial habitat after their death accumulated in form of a centrally placed carbonaceous nucleus, in the iron free spherical structure (type II and III) or remained scattered giving an irregular shape to the leucocratic zone (type I).

Microorganisms like Leptothrix ochracea and Cladothrix dichotoma which precipitated ferricoxide in presence of lime (cf. Harder 1950) appear to be responsible for the formation of type VI marks by accumulating and precipating iron oxide from the surrounding iron solutions (cf. Harder 1950).

Ferrugineous and carbonaceous disk like structures of type VIII & IX, within clay balls in the brick red sandstone are casually met with. These structures appear to be organic remains and need more attention.

Conclusions

The spots and blotches of various colours and shape recorded in the Jodhpur sandstone of Western Rajasthan are the organochemical structures formed during early stages of diagensis of the sandstone. Biological activities of the microorganism like Thiobacillus ferrooxidants, Thiobacillus thiooxidants, Ferrobacillus ferroxidants, Gallionella ferruginea and Cladothrix dichotoma, etc. have played an important role in the formation of these organo-chemical structures (marks). Besides synthesizing organic cell carbon from the atmosphere carbon dioxide and building up their cell substances from pure inorganic compounds, these microorganism have also governed the oxidation-reduction process of the iron content of the sediments resulting in the formation of the above-mentioned structures.

Occurrence of similar marks at a number of places in the vindhyan sediments of the East Aravalli Region (cf. Heron 1922) and the presence of organic carbonesceous matter in these structures (e.g. nuclear region of Type II structure fir. 1A) may prove their significance in the stratigraphic correlation and the age determination of these rocks.