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Geological Set Up and Mode of Occurrence of Stromatolitic Phosphorites of Gandhra, Panchmahals, Gujarat, India

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Abstract

Phosphorite bearing stromatolites of the Champaner Group of Aravalli Super Group have been reported from Panchmahals district, Gujarat. The phosphatic horizon is confined to the Khandia Formation. The stromatolitic phosphorite is traceable over a distance of 2.7 km within crystalline dolomitic limestone around Ranjitpura i.e north of Gandhra and Chalvad villages with their horizontal width of 10 to 30 meters.

The Precambrian phosphorite deposits of Panchmahals district, Gujarat show a great variation in their mode of occurrences. They occur as discontinuous lenses and bands, found associated with the dolomitic limestone of the area. On the basis of physico-morphological features, the phosphorite deposits of Panchmahals have been classified into the following varieties, viz., Columnar stromatolitic phosphorite, Laminated stromatolitic phosphorite, Pelletal phosphorite, Nodular phosphorite and Bedded phosphorite.

1. Introduction

The phosphorite occurrences have been recorded from Champaner Group of rocks of the Aravalli Super Group around Ranitpura (22°27´50´´:73°43´), Panchmahals district, Gujarat. The stromatolitic phosphorite is traceable over a distance of 2.7 km within crystalline dolomitic limestone and silicified dolomite, extending from Udaipur in the North to Jhabua in the South. The Precambrain phosphorite deposits of the Aravalli Super Group have been discussed in detail by various workers since their discovery in 1968 by personnel of G.S.I.[1] The Geology and structure of Udaipur deposits have been discussed by different authors[2,3,4,5,6] The mineralogical studies of the Udaipur deposits have also been carried out by several authors[7,8,9]. The occurrence of Jhabua phosphorites and detailed work on petrography, stratigraphy and genesis was carried out in (1980).[10] The geology, stratigraphy and structure of Panchmahals phosphorite was carried out[11] but the detailed work on pertomineralogy, mode of occurrences, geochemistry and the genesis of these phosphorites was carried out by the author Ali[12,13 14].

2. Geological Setup

The phosphatic horizon is confined to Khandia Formation of the Champaner Group of the Aravalli Super Group of rocks and occurs in close association with stromatolites within crystalline dolomitic limestone. The rock units encountered in the area include metaconglomerate, quartzite, phyllites, dolomitic limestone, phosphatic limestone, metagraywacke and granitoids occupying the entire southern and western part of the area and are the product of low grade regional metamorphism. The general strike trend of the rocks is NW-SE direction. The rocks around Gandhra form a major anticlinal fold with axial plane trending WNW-ESE to nearly E-W.

The presence of stromatolitic structure in limestone at different stage indicate the shallow nature of the basin supported by the presence of sedimentary structures like current bedding, ripple marks etc. in the area[13]. The phosphatic dolomitic limestone extends for about 1.2 km in Ranjitpura, 0.7 km in Gandhra. 0.4 km in Ambapani and 0.4 km in Chalvad with a horizontal width of 10 to 30 meters

3. Nature and Mode of Occurrences

In order to ascertain the distribution of the phosphorite deposits, the mode of occurrence of these phosphorite deposits has been discussed in detail. Five modes of phosphorite occurrences are recognized viz., Columnar stromatolitic phosphorite laminated stromatolitic phosphorite, pelletal phosphorite, nodular phosphorites and bedded stromatolitic phosphorites . The phosphatic material also occurs as streak, nodules, patches and laminae within the dolomitic limestone[13].

There is wide variation of P_2O_5 concentration in various bands and bodies of phosphorite but the richest portion (about 20% P_2O_5) is confined to the Ranjitpura where it is composed of columnar and laminated algal stromatolitic phosphorite. The dark bluish grey microsphorite possibly carbonate apatite occurs as streak, nodules, patches, laminae within almost phosphate free dolomitic limestone. The phosphatic bodies occur as discontinuous lenses and bands within the dolomitic limestone unit at Ranjitpura, Ambapani, Gandhra and Chalvad villages in the form of i) columnar algal stromatolitic phosphorite (Fig. 1) with main concentration in algal column ii) as pellets and interclasts in a non-phosphatic matrix as in central and north-eastern part of Gandhra iii) as laminated and bedded phosphorite, occurring parallel to dolomitic limestone (Fig. 3) and iv) disseminated and nodular bodies set almost in non-phosphatic dolomitic matrix.

3.1 Columnar Stromatolitic Phosphorite

The columnar stromatolitic phosphorites are dark grey and greyish to whitish grey in colour and are composed of

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alternating convex laminae of phosphate and carbonate, enveloped in a sheath of phosphate. This laminated arrangement however is not regularly developed throughout the area. The algal columns dominantly composed of carbonate with thin phosphate laminae. The phosphatic component of the stromatolite is composed mainly of collophone and carbonate (calcite and dolomite). The boundary between collophane and calcite is often gradational suggesting replacement of the latter by the former. The algal stromatolites stand prominently on the weathered surface of the dolomitic limestone due to their greater resistance to weathering. The columnar stromatolites are most common in the area and mainly confined to the northern and north-western part of Gandhra block (Fig. 1) and northern part of Ranjitpura block. Dolomitic Limestone is showing three sets of joints in the north of Gandhra area (Fig. 2).

3.2 Laminated Stromatolitic Phosphorite

The laminated stromatolitic phosphorites are recorded only from Gandhra and Ranjitpura deposits. They are composed mainly of laminations of phosphate and carbonate. The thickness of individual lamina varies from one mm to one cm. The laminae of phosphate are parallel to the bedding of the dolomitic limestone. The laminated stromatolitic phosphorite can be seen in northwestern part of the Gandhra (Fig. 3) and central part of Ranjitpura. These laminated stromatolitic phosphorite are of limited extend both laterally as well as vertically. Microscopic study of the laminated phosphorite shows that the phosphate laminae of the stromatolites are composed of cellophane, which is dark brown to light greyish brown and crypto-crystalline to micro-crystalline in nature. The carbonate laminae are composed of medium to fine grained calcite and dolomite. A careful examination of the collophane-calcite boundary indicates that the fine collophone grains are interspersed with calcite grains suggesting grain to grain replacement of calcite by cellophane. Often the cellophane mass contains cluster of calcite grains which indicate that they are the relicts of carbonate laminae.

3.3 Pelletal Phosphorite

The phosphorite pellets are mainly embedded in dolomitic groundmass. The pellets are elongated in shape varying in length from 2 to 60 mm and 1 to 6 mm in breadth in the study area. These pellets are found to occur parallel to the bedding plane of dolomitic limestone. This variety of phosphorite can be seen in the central part of Gandhra and north-eastern part of Ranjitpura.

3.4 Nodular Phosphorite

The phosphatic nodules, ellipsoidal in shape are composed mainly of fine grained phosphatic material and embedded in dolomitic limestone. These nodules vary in size from 1 to 3 cm in length and 0.5 to 1 cm in width. The nodular phosphorite is mainly confined to the southern part of Gandhra and in the southwestern part of Ranjitpura.

3.5 Bedded Phosphorite

Massive bedded phosphorite, in true sense, is hardly seen in any of the phosphorite deposits of the area. However, bedded looking phosphorites are found in parts of the Ranjitpura block whereas in rest of the deposits it is not traceable. The bedded phosphorite occurs parallel to dolomitic limestone. They have their laminae composed of phosphate and carbonate. The thickness of bands varies from 1 cm to 2 cm. This phosphorite variety has probably been developed due to the intense deformation of columnar stromatolites in the area.

Fig.1

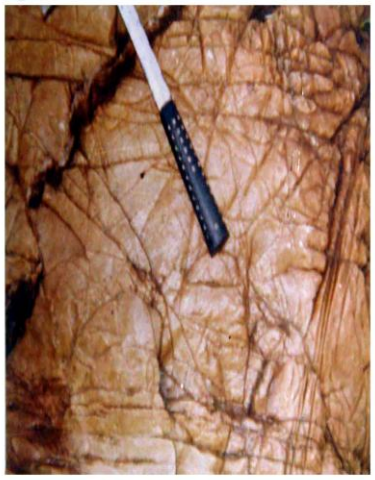

Fig.2

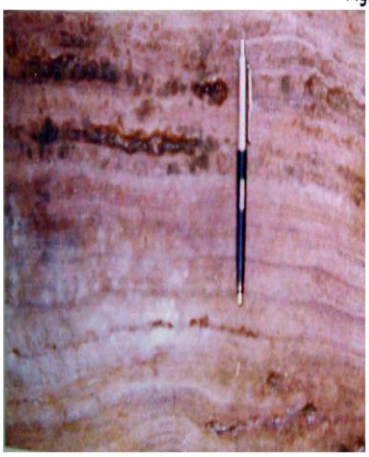

Fig.3

It seems possible that the development of such variety is due to the rolling of the columns parallel to the bedding. This might have been caused by gravity tectonics at the time when the phosphate horizon was not fully lithified. Due to this the columnar stromatolites were laid down and got flattened along the bedding plane due to parallel shearing of layers. These bedded phosphorites are very similar to the bedded phosphorite of Udaipur district, Rajasthan.

4. Results and Discussions

The phosphatic horizon is confined to Khandia Formation of the Champaner Group of Aravalli Super Group. And it is found that in the area of interest the following five varieties of phosphorites were recognized viz., columnar algal stromatolitic phosphorite, laminated algal stromatolitic phosphorites, pelletal phosphorite, nodular phosphorite and bedded phosphorite. Out of these the columnar one are richer in phosphate content.

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