Chapter III

NATURE AND MODE OF OCCURRENCE OF PHOSPHORITE

The phosphorite deposits of the Matoon and Dakan Kotra of Udaipur district, Rajasthan, show a great variation in their mode of occurrence. They are found associated with the cherty brecciated quartzitic rocks and bluish-grey dolomite.

Nature of phosphorites

The phosphorite deposits have been classified into the following varieties based on their physico-morphological features:

1. Columnar stromatolitic phosphorite.
2. Laminar stromatolitic phosphorite.
3. Silicified fragmental phosphorite.
5. Nodular phosphorite.
6. Pelletal phosphorite.

1. Columnar stromatolitic phosphorite

The columnar stromatolites are typically bluish-grey in colour and occur as ill-defined tabular columns with the convex laminae in dolomitic ground mass and show concentration of $P_2O_5$ only in the algal columns. Phosphorites associated with the
columnar algal structures are very common in the central portion of the western limb of the western anticline in the western and northern parts of the Dakan Kotra (Pl. III, Fig. 1). The concentric rings of algal structure are composed of collophane lining their outer margins while calcite, dolomite and quartz occur alternately at the inner margins. The algal stromatolites occur more or less at right angles to the bedding planes of dolomite. They stand prominently on the weathered surface of the dolomite due to their greater resistance to weathering.

2. Laminar stromatolitic phosphorite

The laminar stromatolites occur south of the western part of Dakan Kotra as thin lamina alternating with the bedding plains of dolomite (Pl. III, Fig. 2). The thickness of the individual lamina varies from one mm to one cm. Under microscope they show lamina of collophane alternating with calcareous matter with quartz. Due to later deformation, the phosphorites were broken and boudinage like structures developed. This variety generally shows higher $P_2O_5$ content as compared to other varieties of Dakan Kotra.

3. Silicified fragmental phosphorite

The fragmental phosphorite is brecciated as well as silicified. It is composed of sub-rounded to sub-angular fragments of algal stromatolites which are embedded in a cherty and quartzose matrix (Pl. III, Fig. 3). This variety could be
seen in the central and south-eastern part of Matoon and the southern boundary of the western part and on northern tip of Dakan Kotra. In some cases the fragmentary phosphorite shows the presence of rounded to sub-rounded grains of collophane (Pl.IV, Fig. 1), which are partly replaced by calcite. Sub-rounded to sub-angular grains of quartz and feldspar were also recorded from Dakan Kotra.

4. **Massive bedded phosphorite**

   The massive bedded variety of phosphorite is found in the southern part of Matoon ridge as well as in an isolated hillock in the south-eastern part near Dakan Kotra. The bedded phosphorite occurs associated with fine-grained dolomitic marble and have thin alternating lamina composed of quartz and collophane or calcite and collophane. The bands vary in thickness from one to 10 cm.

5. **Nodular phosphorite**

   The nodular phosphorite is not common in the study area. It was identified only from the central portion of the phosphorite horizon of Matoon (Pl. IV, Figs. 2 and 3). The nodules are composed of fine-grained phosphatic materials and embedded in brecciated quartzite. They vary in size from 1 to 4 cm in length and 0.2 to one cm in width and show higher concentration of \( P_2O_5 \).
6. **Pelletal phosphorite**

The phosphorite pellets are elongated in shape and composed of collophane and calcareous matter and/or collophane only. They are embedded in a dolomitic groundmass. Individual lenses and pellets vary from 2 to 60 mm in length and one to 6 mm in breadth. They are found to occur parallel or sub-parallel to the bedding plane of dolomite. This variety could be seen in the southern boundary of western part and northern tip of northern part of Dakan Kotra as well as at some places in Matoon (Pl.V, Fig. 1).

**Mode of occurrence of phosphorite deposits**

The important phosphorite occurrences have been surveyed, and mapped in order to ascertain the distribution of the deposits. The mode of occurrence of the phosphorites in Matoon and Dakan Kotra areas has been discussed in detail. The geological set-up, structure and distribution of phosphorite deposits are presented in figures 2 and 3.

The phosphorite band at Matoon (Fig. 2) occurs as a single horizon, extending for about 3 km along its strike. Its thickness varies from 0.5 to 20 m and the horizon pinches and swells along strike of the band. There is a wide variation of P₂O₅ concentration and the richest portion of the deposit (>30 per cent P₂O₅) is confined to the central portion of an arcuate hill. It is composed of brecciated, fragmental and
pelletal phosphorite which gradually becomes fine-grained and stromatolitic towards both the northern and the southern extremities. Current-bedded orthoquartzite underlies the phosphorite which is laterally replaced by dolomite in southern part and dolomitic marble in the northern part, and overlain by brecciated quartzite and sandy phyllites in the west. The Kharbaria phosphorite deposit appears to be the folded extension of Matoon deposits. The columnar and layered variety of stromatolitic phosphorite occurs at the northern and southern parts while reworked brecciated phosphorite containing angular to subangular and rounded fragments of algal stromatolite are confined to central portion of the deposit. The regional structural trend of the rocks containing phosphatic horizon is NNE - SSW with dips varying from 50° to 80° due west.

In Dakan Kotra only one horizon of phosphorite was encountered (Fig. 3). It follows the bedding as well as structural trends of the associated host rock. The contact of the phosphorite horizon is found to be sharp on the hanging wall side, while on the foot wall side it grades to phosphatic limestone-marble. This phosphorite band is traceable over a strike length of about 750 m in western part. The thickness of the phosphorite horizon varies from place to place. Thickening and thinning of the phosphorite horizon is a common feature. In the western part the phosphorite band is found associated with dolomitic marble and in the south-western part with cherty jespery quartzite. A thin quartzite band occurs discontinuously below the phosphorite
horizon towards the west, and the phyllites occurring above the phosphorite, grade in to graywackes. The outcrop pattern of phosphorite is arcuate in the northern part and curvi-linear in the southern parts of the area. However, in the northern and eastern parts the outcrop is not continuous and occasionally intervened by dolomitic limestone. The deposit forms a refolded anticline plunging almost north. The strike of the country rocks of the phosphorite runs more or less N-S to NW-SE in the southern portion and more or less E-W in the northern portion of the area. They dip at 45°- 75° west to WNW and 50° north in the two portions respectively.

The $P_2O_5$ content varies from west to east. The richest portion of the deposit (> 20 per cent $P_2O_5$) is confined to the central portion of western part where it is composed of columnar and laminated algal phosphorite. At times the individual algae attains a length upto 10 cm and commonly occurs more or less at right angles to the bedding plane of dolomite. The branching type of algae is also common. The reworked or recemented variety occurs at the southern end of western part while at the northern tip the fragments and pellets of different sizes of algal stromatolites are found embedded in the dolomitic ground mass. Angular to sub-angular fragments of algal stromatolites associated with brecciated cherty quartzite and calcareous matter can be seen on the isolated hill tops in the SE and SW parts of the area. At places the larger phosphorite fragments show complete algal structures.