CHAPTER - II

LITERATURE REVIEW

Only little published work on sandstones occurring in the vicinity of Himatnagar town is available in the literature, the major contribution is from the officers of Geological Survey of India. Except one or two of the workers, no one has carried out the indepth studies of the Himatnagar sandstones wherein the distribution, mode of occurrence and tectonism is only briefly discussed. The author, in the following text, has attempted to outline the salient features of whatsoever published literature available to him.

FOOTE R.B.

Foote (1898) worked in the NW of Himatnagar town in the river bed of Sabarmati and came across the exposures of laterites associated with grits and sandstones that were resting

over granites and overlain by the alluvium. According to him, the sandstones show variegated colours, predominantly white, grey, pink, purple, lavender and red. They are fine to medium grained, occasionally gritty and showing ripple marks. The dips are gentle (2°-3°) due west. The good exposures are met in the river bed of Sabarmati in the vicinity of Vadnagar, Jawanpur, Arsoria, Pudhera and Pedhamali. No fossils were encountered in these exposures. In Tapti and Kim river exposures of South Gujarat, the lateritic rocks similar to those found in Sabarmati river beds are seen associated with rocks abounding in Nummulites and other Eocene rocks, on the basis of which Eocene age was assigned to the sandstones of the Sabarmati river, NW of Himatnagar.

IYER SAMBASIVA

Iyer (1910) visited the sandstone exposures underlying laterites in the river beds of Sabarmati showing current bedding and gentle dips (upto 8°) due west at Pudhera and Pedhamali. He fully agreed with the observations made by Foote (1898) and considered them of Eocene age.

MIDDLEMISS C.S.

The contribution made by Middlemiss (1921) is worth-while. He worked in detail on the various exposures of sandstones, freestones, quartzitic sandstones, grits, shales etc. occurring

in the vicinity of Himatnagar town and grouped them into a formation as "Ahmednagar (Himatnagar) sandstones". According to him the Ahmednagar sandstones mainly comprise horizontal isolated sandstone exposures with minor shale and conglomerate and occur in the river beds of Hathmati and Sabarmati at Himatnagar and near Eklara respectively. They also occur as low hillocks near Himatnagar and in a series of fairly elevated plateaus with well marked unconformity on Idar (Erinpura) granites at Ghorwada, Berna and Wantra also on Delhi quartzites (Now considered as Aravallis, Heron & Ghosh 1938) at Pedhmala and on Aravallis at Bodi. They mainly consist of 30-60 m thick white, pinkish, brick red, chocolate, brown, dark brown coloured sandstones. They are fine grained rather loose with coarser variety and contain occasional ferruginous concretions; the lower part near the base being conglomeratic. Freestones are mainly pale coloured with siliceous and ferruginous cementing material and show cross and current bedding. The siliceous cement has given rise to a glassy quartzite or quartzitic sandstones. Additionally there are some intercalations of shales. Pink, white calcareous clay or lithomarge layers of kaolin are encountered in the area around Himatnagar. Discussing the various characteristic features Middlemiss writes..... "A relatively young formation, no fossils, it will readily be seen that the presence of ordinary conglomerate, freestone in large quantity and simple shales in the composition of this series, together with their almost undisturbed horizontal lie, point to the series being a relatively young in the geological history of this part of India. That it also comes very high up among the historical rocks

generally, is also to be inferred from several surrounding facts that will presently be mentioned. Unfortunately, no determinable fossil remains have been preserved within the comparatively small thickness exposed, so that we are unable to rely on palaeontological evidence in support of this. Whatever its exact age, it is significant that it constitutes the sole representative in the state of any of the stratigraphic system from Cambrian to Recent with exception of the Deccan trap and laterite, which however, are only found marginally in the state". Regarding the age of Himatnagar sandstones Middlemiss writes..... "As expressed in R.B.Foote's "Geology of Baroda" and in Sambasiva Iyer's "Sketch of the mineral resources of the Baroda State", the presence of lateritic layers associated with the sandstone series of the Sabarmati river has led these two observers to regard this Ahmednagar sandstone series as being of Eocene age. I am unable to accept this conclusion, partly because I think the lateritic layers (as seen chiefly in the river section) are purely surface phenomena, and are not seen in any good massive quarry section and partly because the whole series, and especially the valuable freestone runs, seem very faithfully to those of Dhrangadhra freestone of NE Kathiawad (Fedden, 1884) the Songir sandstones (Sambasiva Iyer, 1910) and possibly also the Barmer sandstones of Western Rajputana (Blanford, 1869). The horizon of the first is accepted as Umia e.g. Jurassic-Cretaceous (or Cretaceous, according to the most recent views), while that of Songir is considered to be marine Cretaceous and to such horizon, I am constrained to refer the

Ahmednagar sandstone with but little reservation on account of the absence of fossils". Thus, according to Middlemiss the age of Himatnagar sandstones could be Cretaceous.

SAHNI B.

Sahni (1938) made floral studies of the samples collected by Heron & Mukherjee from the shaly layers within Himatnagar sandstones. He recognised for the first time in India two widespread genera of Xerophytic fern Matonidium indicum and Weichselia reticulata from Himatnagar sandstones. Matonidium, the Indian species, is very closely allied to, though not identical with M.Goepperti; the chief difference from the latter being the much greater development of a funnel at the base of the pinnae. The species M.goepperti, schenk is known from the inferior oolite of Yorkshire, from Kimmeridgrian (Upper Jurassic) of Sutherland and from Wealden (Lower Cretaceous) of Germany, Belgium, and England. The genus Matonidium is said to range from the Middle Jurassic to the Cretaceous.

Weichselia reticulata is a better index fossil than the matonidium. The species ranges from Neocomian to the Cenomanian (Edwards, 1933). However this is regarded a leading species of Wealden and has been recorded from Lower Cretaceous strata from England, Belgium, France, Germany, Austria, Sweden, Japan, N.America, Peru etc and some other countries. The small fragment also does not seem to be inconsistent with Lower Cretaceous age. Considering these points, the age of the rocks has been assigned

as Lower Cretaceous corresponding most probably to Wealden.

GUPTA B.C. & MUKHERJEE P.N.

Gupta & Mukherjee (1938) have given a comprehensive account on the work carried out by Middlemiss (1921) & Sahni (1936) on Ahmednagar (Himatnagar) sandstones.

HERON A.M. AND GHOSH P.K.

Heron & Ghosh (1938) have lucidly synthesized the account given by Heron (1917) and Middlemiss (1921). About the deposition of Himatnagar sandstones they write..... "The peneplane which has been recognised throughout the length of the Aravalli range by Middlemiss and Heron was suggested by them (Middlemiss, 1921, p.90; Heron, 1917, p.8) to represent the old land-surface at the time of deposition of the Eocene or the Jurassic beds of Kutch, Bikaner and Jaisalmer and was thought to be traceable down to the floor on which the almost horizontal Ahmednagar sandstone was deposited. ..... But the summits of the flat topped ridges of quartzite, representing the level of the peneplane, are much more, heights given to the east and north being 974, 923, 948, 1040, 1058, 902, 954, 1144, 1156, 961, 969, or say, about 400 feet higher than the base of the Ahmednagar sandstone. It must have been accumulated on a level granite plain, above which the quartzite ridge rose some 400 feet, as they do now. The peneplane is thus older than the Lower Cretaceous Ahmednagar

sandstone by a space of time during which 400 feet of quartzite were eroded, but would still probably be Mesozoic in age. We do not require to suppose a marine transgression for the deposition of the Ahmednagar sandstones as they are probably fluviatile to lacustrine". Thus, these authors have assigned Mesozoic age for the planation which brought about the truncation of Aravallis and Delhi ridges in Himatnagar area.

The Bagh beds occurring to the south and east of Himatnagar sandstone, according to these authors are marine, formed due to trangression of sea, and their supposedly freshwater environments, the Lametas and the Deccan traps were deposited/poured out.

PASCOE E.H.

Pascoe (1949) has given a summary of work carried out by Middlemiss (1921) and agrees for Cretaceous age assigned by Dr.B.Sahni (1936) to the Himatnagar sandstones. However while discussing about the stratigraphic position of Himatnagar sandstones he writes..... "The exact stratigraphic position of the Ahmednagar sandstones of Idar State, the Songir sandstone of Baroda, the Wadhwan freestone of Dhrangadhra in kathiawar and Nimar & Katkat sandstone of Narmada Valley is not certain but the beds most likely belong to early horizon of the Cretaceous Gondwana".

KRISHNAN M.S.

According to Krishnan (1968) Ahmednagar sandstones are of Lower Cretaceous (Wealden) age, Older than Bagh beds and could be contemporaneous with Nimar sandstones underlying Bagh beds. He further considered Himatnagar sandstones as homotaxial with Dhrangadhra sandstones of Saurashtra, Songir sandstones of Baroda, Barmer sandstones of western Rajputana and Nimar sandstones of S.Gujarat indicating a regressive estuarine facies. According to him, the Bagh beds of Lower Narmada Valley, Wadhwan sandstones of Saurashtra, Ukra beds of Kutch and Abur beds of Rajasthan represent the marine transgression of the same (Cretaceous) sea.

BHANDARI L.L. & SURESHKUMAR

Bhandari & Sureshkumar (1970) during their study on Paleo-currents of Dhrangadhra/Wadhwan sandstones of Saurashtra found that the general current direction of various river systems was from east to west (266°); the source of sediments remained from igneous and metamorphic rocks of Delhis and Aravallis lying to the NE and E of the Saurashtra region. The sedimentation might have taken place in the lower reaches of the river system flowing westward from Aravalli ranges. The presence of pollens belonging to genus cheivolepis (Verma & Rawat, 1964) represents the place of sedimentation indicating a coastal environment. Further according to above authors, the absence of microplanktons and

presence of pteridophytic spores in Dhrangadhra formation suggests large influx of fresh water at the time of deposition of Dhrangadhra sediments, if not, the sedimentation under fluvial condition. The occurrence of Himatnagar sandstones with similar facies along the north eastern fringes of present day Cambay basin and considered to be homotaxial to Dhrangadhra sandstones, supports this view. In addition to this, the similar facies have been met in sub-surface area in Viramgam structural wells in Cambay basin (229 m) and also in Serau East well (350 m) in Sanchor Basin.

SRIVASTAVA P.K.

Shrivastava (1973) has shown the continuity of Mesozoic rocks exposed in Wagad territory of Kutch (Wagad sandstone) with the Dhrangadhra sandstones in Saurashtra. The Dhrangadhra sandstones are considered equivalent to Himatnagar, and on the basis of palynological studies from Dhrangadhra formation a distinct Lower Cretaceous (Neconian-Aptian) age has been assigned (Verma and Rawat 1964). The type Dhrangadhra is a coarse grity current bedded felspathic sandstones with thin bands of sandy shale and clays; the carbonaceous shale contains many plant remains. The sandstones are deposited in lower fluvial to deltaic environment.

RAIVERMAN V.

Raiverman (1975) on the basis of the study on the Hathmati river bed exposures at Himatnagar and Sabarmati river bed exposures at Kadoli grouped the Himatnagar sandstones as thick bedded sandstones & shales and thin bedded sandstones & shales. He considered them as of Nimar group. The sandstones have erosional and sharp contact with shales; the sandstones grade into shales (claystone and silty claystone) through a short transition zone. Sometimes the sandstones are overlain by alternation of sandstones and shales. The large scale cross bedding and ferruginous concretions are seen in these sandstones. He considered the fluvial origin of Himatnagar sandstones. The sandstones are poor in felspar content, though the granitic provenance is nearby. Raiverman (Op.Cit.) considered the paucity of felspar in the sandstone to be due to deep weathering of granitic material which resulted in complete destruction of felspar into Kaolin prior to the onset of sedimentation.

MALKAN V.G. ET AL

The D.T.A. and X-Ray analyses of clay deposits of Eklara, Arsodia and Davad in the Sabarmati river bed is briefly outlined by Malkan et. al. (1976). The predominance of endothermic peaks at 520° C to 630°C and exothermic peaks between 980° C to 1020° C with a small endothermic peak at 70° C,. with the X-ray 'A' values between 4.48° A to 2.58° A, suggests that the clay mineral are mostly kaolinite with little halloysite. The diffraction at

3.04° A in Eklara & Davad also suggests the presence of calcite.

GHEVARIA Z.G.

Ghevaria (1982) divided the Himatnagar sandstones into (i) Sabarmati Formation and (ii) Hathmati Formations. According to him the depositional environment of these lithounits varies from shallow lagoonal to deltaic, with intermittent incursion of bracksih water; the basin was assumed under continuous state of active subsidence during deposition.

MUKHERJEE M.K.

According to Mukherjee (1983), the Himatnagar sandstones with fossiliferous shales and conglomerates have been deposited under a combination of lacustrine and fluviatile environments. He correlated Himatnagar sandstones with Wadhwan Formation of Saurashtra and Lametas of Narmada Valley. On the basis of Mesozoic exposures of Himatnagar, Dhrangadhra-Wadhwan and of Narmada Valley together with the sub-surface sandstones occurrence at Serau (345 m, continental environment), Tharad (40 m, continental environment), Dhadhuka (145 m, shallow water beach environment), Anand (73 m, fresh water fluvial environment) in Cambay basin, he considered the shifting of shoreline in Upper Cretaceous period.

BISWAS S.K. & DESHPANDE S.V.

Biswas & Deshpande (1983), discussing the geology and hydrocarbon prospects of Kutch, Saurashtra and Narmada Basin, considered that the Himatnagar sandstone is equivalent to the Nimar sandstone of Lower Cretaceous age. According to them the Narmada Basin opened up in the western part forming the fringe part around Himatnagar, providing the place for the deposition of Cretaceous sediments under alluvial environments.

AKHTAR K. AND AQUIL M.

Akhtal and Aquil (1984) made an attempt to interpret the depositional environment of Himatnagar sandstone. On the basis of various primary sedimentary structures like planar and trough cross stratification, symmetrical and assymmetrical ripple marks, convolute lamination, gross lithological variation and their vertical variability, they considered fluvial facies such as channel lag, lower point bar, upper point bar, flood plain and deposition of Himatnagar sandstones in overall fluvial environment.