Chapter-VIII

Summary

and

Conclusions
SUMMARY AND CONCLUSIONS

The different stages of evolution of the Indian plate during the Mesozoic times led to the development of a number of rift basins along the western margin of the Indian Craton, which included the Late Cretaceous Narmada basin.

A number of rock exposures of Late Cretaceous Lameta Formation (Maastrichtian) are found throughout the Narmada Valley in patches and in the Jabalpur area as isolated hills as well as along the course of the Narmada River. They are made up of sandstones, limestones and sandy limestones.

The present study aims at reconstructing the provenance, plate-tectonic setting and depositional environment of the Lameta Formation in and around Jabalpur. The study is based mainly on the field and petrofacies analysis. A critical appraisal of the factors of climate and transport that influence detrital mineralogy of the sandstones provide help in the interpretation of the provenance. Microfacies analysis of the carbonate rocks was also carried out in order to interpret their depositional environment.

During the course of fieldwork several outcrops of Lameta Formation were examined in and around Jabalpur and samples of sandstones and carbonates were collected. Seventy thin sections of sandstones and thirty seven thin sections of limestones were prepared for petrographic study.
The textual attributes of the sandstones of Lameta Formation such as grain size, roundness and sphericity and textural maturity were studied with a view to interpret their provenance and also estimating the influence of texture on detrital modes and petrofacies. Bivariant plots were used to find out interrelationships of various textural attributes. Statistical parameters of grain-size were computed with the help of cumulative frequency curves and formulae according to the method of Folk (1980).

The sandstones are mostly fine (63%) to medium grained (31%), moderately sorted (51%) to moderately well sorted (21%) and near symmetrical (37%) to coarse skewed (36%).

The roundness of the grains is generally subangular to subrounded. The detrital particles are mainly of low sphericity.

The sandstones were classified according to their textural maturity and are immature to submature.

Bivariant plots of various textural parameters reveal a decrease in size accompanied by increase in sorting, roundness and sphericity. Moreover, decrease in sorting is attended by decrease in both roundness and sphericity. Thus the interrelationship between various textural parameters appears to be normal thereby indicating that the original texture of the sediments is largely preserved and has not been affected by diagenetic processes. It
further implies that since the original texture is preserved, original detrital composition of the sandstones is also not affected by later changes.

The detrital composition of the sandstones of Lameta Formation was evaluated both qualitatively and quantitatively for the purpose of classifying sandstones and for interpreting their provenance. Detrital quartz is the predominant constituent of all the sandstones, which on closer examination are found to be quartz arenite. The average composition of the sandstones is quartz, 98.23%; feldspar, 1.15%, mica, 0.34 and rock fragments, 0.28%.

Among detrital quartz, those of igneous origin predominate in the sandstones, the remaining belong to recrystallised metamorphic and stretched metamorphic source. Rock fragments include chert, schist and shale. The feldspars are scarce in sandstones, and when present are mainly microcline. The grains of mica belong to both muscovite and biotite. The heavy minerals contain the opaques, epidote, tourmaline, zircon, garnet, rutile, staurolite, tremolite-actinolite and biotite.

The factors of paleoclimate and distance of transport influence the detrital mineralogy of the sandstones. The latter are related to provenance and petrofacies.

The paleogeographic reconstruction of the Narmada basin suggests that the provenance of the Lameta Formation was located
towards the northeast or east, a few hundred kilometers from the
study area. The Precambrian metasedimentary rocks and granite-
gneisses of Mahakoshal Group probably acted as the provenance
for the Lameta Formation.

The sand size sediments of the Lameta Formation, probably,
have undergone transportation to a distance of a few hundred
kilometers. One of the causes of feldspar deficiency may be its
destruction by abrasion during transportation. Insufficient sorting
and roundness of the sediments suggests that transportation
process was not effective and is not solely responsible for the high
compositional maturity of the sandstones of Lameta Formation.

Warm and humid climate prevailed during the Late
Cretaceous period in the area. Therefore, the Precambrian
basement rocks which provided sediments to the Narmada basin
might have undergone vigorous weathering under humid tropical
conditions resulting in destruction of much of the feldspars and
labile constituents. Therefore, paleoclimate was a leading factor in
the modification of highly quartzose sandstones of the Lameta
Formation.

The plate-tectonic setting and provenance of the sandstones
were interpreted with the help of Dickinson’s (1985) method of
recognizing the detrital modes and plotting them on standard Qt-F-
L, Qm-F-Lt Qp-Lv-Ls and Qm-P-K triangular diagrams. The
average percentages of detrital modes in the Lameta Formation are Qm, 96.76; Qp, 1.81; F, 1.15 and Ls, 0.28. The petrofacies analysis of the Lameta Formation suggests a continental block provenance with source on stable craton that supplied detritus to the Narmada rift. The detritus was deeply weathered because of their long residence time in soil. The fault bounded basement uplift along incipient rift belts within the continental block, generally, sheds arkosic sands into the adjacent basin. But deposition of quartz-rich detritus into the Narmada rift, most probably, was influenced by warm and humid climate, low relief and long residence time in soil.

The data were also plotted on the provenance discrimination diagram (Basu et al., 1975) which indicates a plutonic source for these sandstones.

The chemically precipitated cements include carbonate, silica and iron-oxide in order of abundance. The calcite cement occurs in the form of coatings around detrital grains as well as fracture and pore fillings. The silica cement occurs in the form of overgrowth on detrital quartz grains as well as pore fillings in the form of microcrystalline chert. The iron-oxide cement occurs in the form of coating around detrital grains and show replacement and corrosion of detrital grains. In general, cementing materials
are clearly distinguishable from detrital components and the former have not modified the latter except in some patches.

In order to evaluate the degree of compaction in sandstones, their grain to grain contacts were recognized and counted. However, the floating grain and point and long contacts are dominant in sandstones indicating more or less uncompacted fabric causing the original texture and packing to be largely preserved.

For estimating the depth of burial of the sandstones, the average minus cement porosity was plotted on standard burial depth against minus-cement porosity by several workers. The depth of burial determined for the Lameta Formation is 1000m to 1600m.

Microfacies analysis of the limestones of Lameta Formation was carried out in order to interpret their depositional environment. The study points out that both the limestone units represent algal boundstones.

On the basis of above it could be inferred that these limestones were formed under varying hydrodynamic conditions of shallow marine environment, represented by inter-tidal and subtidal conditions.