ABSTRACT

The area under investigation lies in the central part of the western margin of Son-Mahanadi Gondwana belt and extends from Korba to Korbi in the State of Madhya Pradesh, occupying about 4028 square kilometers.

The Talchir sediments of Korba and Hasdo-Arand coalfields are the subject matter of the present study and have been investigated in respect of their lithofacies, petrography, paleodrainage patterns, provenance, basin geomorphology and depositional environments.

Detailed field work by the author during the winter months of 1981, 1982 and 1983 has revealed that the Talchir sediments of the area comprise of seven basic types of lithofacies, namely, massive (basal) diamictite, laminated mudstone with or without dropstone, inter-bedded shale-siltstone/sandstone, massive sandstone, splintery shale, stratified (upper) diamictite and cross-stratified sandstone. Study of the vertical and lateral variations in lithofacies reveals that the nature and pattern of variation is directly related to the geomorphic position of measured section in relation to the basin margin. Sequences developed at or near the basin edge are thin and give evidence of having been deposited in shallow, isolated bodies of standing water while those
representing the more distal parts of the basin, are much thicker, more diversified and appear to have been deposited in deeper and bigger lakes.

The petrographic study of the diamictite units and sandstones of Talchir Formation provides valuable information regarding their mode of formation. The massive diamictite which invariably occurs at the base of the Talchir sequence, is poorly sorted and comprises of clasts of pebble-, cobble-, and boulder-grades set in an abundant green coloured, predominantly clayey, matrix. Studies made on 1593 clasts of this diamictite unit reveals that they have a coarse skewed unimodal size frequency distribution. On an average the clasts are subangular to subrounded (average roundness 0.306) although about 14% of them are rounded to well rounded. The most commonly occurring shape of clasts is compact bladed (32%). The average sphericity of clasts is 0.72. Quartzite (33% to 46%), granite and gneiss (27% to 34%) and sandstone (17% to 23%) constitute the most abundant lithologies occurring as clasts in the massive diamictite. Other lithologies occurring in minor amounts are greenstone and basalt, limestone and chert and low grade metamorphic rocks. The matrix of the diamictite is moderately sorted, generally fine skewed, mesokurtic and shows a bimodal size frequency distribution. In composition it varies from sublith-wacke to subarkosic-wacke.
The upper diamictite unit is stratified but resembles the massive diamictite in its textural and compositional characteristics. However, it differs from the massive variety in some important respects. Thus, the clasts of this diamictite unit are smaller in size, more fine skewed and about 23% of them are rounded to well rounded (average roundness 0.328). The matrix of the stratified diamictite is sandy, shows unimodal size frequency distribution and its composition varies from sub-litharenite to sub-arkose. Further, it contains more quartz and feldspar and lesser amount of labile rock fragments as compared to the massive (basal) diamictite.

The sandstone of the Talchir Formation are sub-litharenite and sub-arkose and show close resemblance to the matrix of the diamictites inasmuch as the chief modal constituents are concerned. However, they show remarkable uniformity of texture and composition. On the basis of their mode of occurrence and sedimentary characters, the sandstones have been grouped into three facies, namely, massive, cross-stratified and inter-bedded. All sandstone types are fine to very fine grained but whereas the massive sandstone shows variable size frequency distribution from unimodal to trimodal, the other two types are unimodal. By and large, the cross-stratified sandstones are better sorted than the other types. Grains constituting the sandstones are, on an average, subrounded.
It is interesting to note that the heavy mineral assemblages contained in the sandstones and in the matrix of the diamictites are almost identical both in respect of quality and quantity. Indeed from the point of view of mineral composition, the sandstones and the matrix of the diamictite units show very close similarity suggesting a common source of supply of detritus through time and, therefore, suggesting tectonic stability during Talchir sedimentation.

The paleocurrent systems existing during the Talchir times have been reconstructed on the basis of orientation of long axes of clasts in the two diamictite units as well as on cross-stratification foreset dip azimuths and alignment of channel axes in sandstones. During the deposition of massive (basal) diamictite, the depositing agency moved in a general easterly and northeasterly direction at or near the margin of the basin. Further basinwards, the direction changed to northerly and northwesterly. In most outcrops studied the degree of preferred orientation is significant. Two mutually perpendicular modes are seen and their pattern resembles those observed in glacial tills.

The paleoflow pattern obtained from the fabric study of stratified (upper) diamictite is significantly different from the one just described. The long axes of clasts generally show unimodal frequency distribution and outcrop to outcrop
variation in mean orientation direction is restricted within 79° of arc (in contrast to 89° of arc in basal diamictite). Further, the scatter of variance ($s^2$) values in the upper diamictite is much less as compared to basal diamictite and ranges from 2000 to 3000 in 10 outcrops out of 12 studied. These values, as well as the fabric patterns, are comparable to those associated with stream gravels.

The sediment dispersal pattern obtained from cross-stratification foreset dip azimuth data and orientation of channel axes in sandstones is compatible with the pattern existing at the time of deposition of the stratified (upper) diamictite. It seems that a fluvial system was well established during the closing stages of Talchir sedimentation in the study area.

Based on paleocurrent studies, a southwesterly to westerly source area for the Talchir sediments is indicated. The pre-Gondwana rocks exposed in the indicated area are granite and gneiss of Archaean age, quartzite, quartz schist, mica schist, garnetiferous schist and slate with inter-bedded greenstone and traprock belonging to the Chilpighat "series" (Lower Pre-Cambrian) and red coloured quartzose sandstones shales and limestones of the Chhattisgarh basin (Upper Pre-Cambrian). The clast lithology of the two diamictite units as well as the mineral composition of the Talchir sandstones and matrix
of the diamictites is perfectly compatible with the rocks present in the suggested provenance indicating that the later did indeed serve as the source rocks for the Talchir sediments.

The present day distribution of the Talchir rocks in the study area, the nature of vertical and lateral variation in lithofacies in the proximal and distal parts of the basin and the changing patterns of paleodrainage through time, suggests that Talchir sedimentation in the area under investigation was initiated in small and big sub-basins or lakes on the floor of the basin. In the proximal part of the main basin, sedimentation took place in small, shallow lakes and consequently the thickness of sediments laid down was small. However, in the distal and deeper parts of the basin, the lakes were deeper and more extensive resulting in the accumulation of a thicker and more diversified lithic fill.

Presence of striated pavement in the study area, occurrence of dropstones in fine clastics, varves and associated lithologies in neighbouring areas and presence of shaped clasts in diamictites and roches moutonnees on basement rocks are evidences in the face of which a glacigene origin of the Talchir sediments cannot be disputed. Thus, in the study area a glaciolacustrine environment of deposition is envisaged to explain most of the lithofacies. However, towards the end of Talchir sedimentation, a fluvioglacial environment is visualised on the basis of sandstone facies and paleocurrent patterns.
Sedimentation started in the Talchir basin with the deposition of the massive (basal) diamictite which has been interpreted as a basal till laid down on the edge of proglacial lakes. The fine clastics brought into the lakes was deposited as laminated mudstones while clasts were dropped from floating ice sheets into the fine clastics. In some areas, an inter-bedded sequence of shale and siltstone/fine sandstone was deposited giving evidence of slight shallowing of the basin and consequent reworking by weak currents. The laminated mudstone and inter-bedded sequences pass into massive, fine to very fine grained sandstone indicating rapid sedimentation and further shallowing of the basin.

In the marginal parts of Talchir basin, the massive sandstone passes into cross-stratified sandstone indicating the advent of fluvioglacial conditions. However, in the distal parts of the basin, the massive sandstone gives way to a thick sequence of laminated, splintery shale suggesting that lacustrine conditions still persisted in the deeper parts of the basin. Reworked coarse glacial debris was then deposited in glacial streams which now is represented by the stratified (upper) diamictite. The presence of cross-stratified sandstone capping the Talchir sequence in most of the sections studied, indicates the total disappearance of lacustrine conditions and the establishment of truly fluviatile conditions and marking the end of Talchir sedimentation in the study area.