



# Quaternary Fluvial Sedimentations of Sindphana River in Maharashtra, India

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## ABSTRACT

The Pleistocene formations in the Sindphana River, a tributary of Godavari River in Beed and Parbhani district of Maharashtra are represented by the fluvial deposits having a maximum thickness of about 15 m as revealed from data collected for foundation studies at the dam site on river Sindphana near Majalgaon. The surface of the alluvium, generally about 10 to 15 m above the modern bed level of the Sindphana river, forms a conspicuous terrace surfaces in the valley. This alluvial flat, covered by black soil, merges gradually into valley flat pediments. The slope deposits formed at foot of major divide ranges are 6-8 m thick and rarely merge into the Sindphana alluvium. The three main types of fluvial formations in the upper Sindphana basin are as follows: 1. Sandy Silt – weakly calcified, 2. Silty Sand – moderately to strongly calcified and 3. Pebbly gravels sediments. Sandy Silt (weakly calcified) Quaternary sedimentary deposit is represented mainly by less calcareous, faintly laminated brownish silt or sandy silt with thin (~ 2m) intercalated with patches of pebbly gravels, has developed a distinct terrace (4 to 4 m above modern bed level) cut into the older terrace surface developed on the calcareous alluvial fill at an average elevation of about 8 to 10 m above modern bed level. Silty Sand (moderately to strongly calcified) deposits are generally 8 to 10 m thick and are the most prominent Quaternary formations in the valley. However, only the upper 8 m section is generally available for examination on the banks of the Sindphana river and along its tributaries. It is observed that these deposits are laid down in channels, near channel and floodplain environments. Pebbly gravels sediments are bouldery-pebbly, sub-rounded, crudely stratified, well-consolidated gravels with a maximum thickness of about 5 m. They occur on an eroded valley flat surface of basalt at an elevation of about 20 m above the modern bed level of the Sindphana.

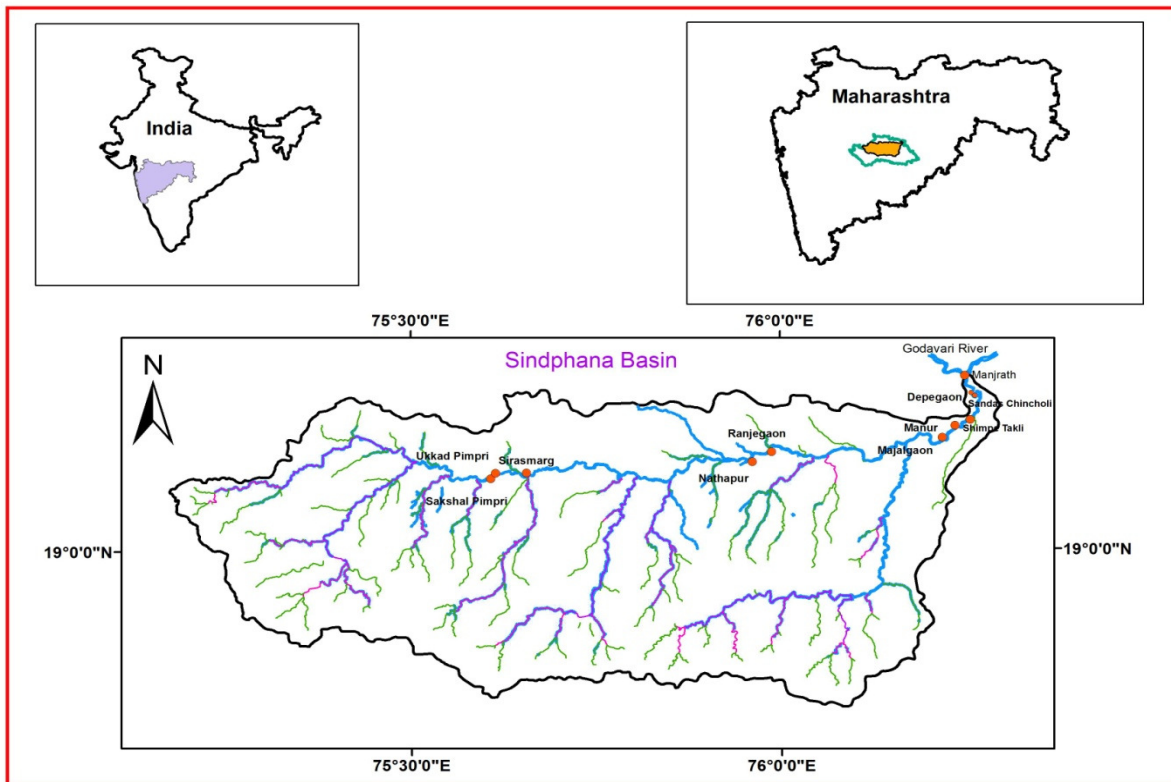
**Keywords:** Sindphana River, Pediments, Sedimentary deposit, Basalt

## INTRODUCTION

Fluvial systems in Western India are highly affected by the highly seasonal monsoonal climate. Peak discharges in most of the rivers are about ten times greater than the average flows, but occur only for some period of hours to days (Mishra, 1970). During the Quaternary period rapid and frequent changes in climate are well documented (Mishra et al., 2003). In the present study the river originates and flows in semi-arid climate with bed rock being the Deccan trap basalt. In spite of the limited extent and volume of the alluvium, some localities have preserved Early Pleistocene sequences (Mishra et al.,

1999) and even remnants of Pre-Quaternary sediments have been identified (Mishra, 1995; Mishra et al., 2003).

Quaternary sediments are concentrated as narrow fringe along the River valleys e.g. Godavari, Pravara, Sindphana, Purna and Manjra River valleys. The Godavari valley sediments in the western Upland Maharashtra are 2-3 meter thick consisting of entirely coarse grained unconformably rest on the rocky bench 3-20 meter above the present bed of the River. These sequences consist of rounded to sub-rounded pebbles and cobbles of basalt, chalcedony, jasper, agate, chert



**Fig1.** Location map and location of sediments from Sindphana river basin.

and quartz set in a matrix of granular sand and silt showing cross bedding and local inverse grading (Dole *et al.*, 2002).

The Quaternary deposits are complex in nature and might have resulted from the vertical stacking and amalgamation of low sinuosity channels dominated by massive bedded gravels. This suggests the Rivers of low sinuosity channels of braided streams (Kale 1989 and Rajguru *et al.*, 1993). The high proportion of cobbles indicates high energy river, with wide shallow channel and prevalent bed load transport. Atkinson *et al.*, (1990) obtained an age of about 145000 years BP for the sandstone facies from gravel bed of Godavari River near Paithan by using a U/Th series date of the cementing material.

### Study Area

Sindphana River, a tributary of Godavari River in Beed district of Maharashtra, India (Fig.1) is represented by the fluvial deposits having a maximum thickness of about 15 m at river Sindphana near Majalgaon dam site.

### METHODOLOGY

The data presented are based on the field observation on several outcrops, where a representative section has

been discussed in detail. The thickness of the alluvial cover was measured using measuring tapes at the outcrop. The relative abundances of the constituent lithology of the bed load of the presently active river bed (Terrace T0) are derived after the field observations.

### RESULTS AND DISCUSSION

The fluvial systems in the semi arid areas are subject to wide fluctuation in discharge. The fluvial forms and processes are closely associated with the morphogenetic regions. Although river channels can be classified as meandering or non meandering or bed load or wash load dominant, the nature of the semi arid rivers is complex because the rivers are subject to marked fluctuation in water and sediment discharge. In spite of this it is the fact that development of sediments depends on several factors such as sediment supply, climate, tectonic stability etc.

The general predominance of coarse sediment in semi arid rivers is responsible for less stability and more mobility of sediments. Such channels are therefore, unstable and dynamic and are characterized by constant channel migration. Further the semi arid rivers respond fast to the changes in the hydraulic regime because of the higher average rate of motion of coarse sediments. In the present study the depositional environment have



**Fig2.** Photograph of Sandy Silt – non Calcified on right bank of Sindphana river at Nathapur. The photo facing east.

been deduced on the basis of the sedimentological characters of the fluvial deposits of the Sindphana river. The deposits of sediments in the upper reaches of Sindphana river comprises rounded to sub rounded pebbles and cobbles of basalt, chalcedony, agate, chert, zeolites and quartz set in a matrix of granular sand and silt, whereas in lower reaches (i.e. in Sakshalpimpri, Majalgaon etc.) the sediments are medium to fine grained sandy silt and silty clay). The deposits are complex in nature and might have resulted from vertical stacking and amalgamation of number of low sinuosity (non-meandering) channels (Babar, 2008; Babar and Kaplay, 1999 and Babar et al., 2010).

Three main types of fluvial formations in the Sindphana basin are as follows:

1. Sandy Silt – weakly calcified
2. Silty Sand – moderately to strongly calcified
3. Pebbly gravels sediments

#### **Sandy Silt – Poorly Calcified**

This Quaternary sedimentary deposit is represented mainly by less calcareous, faintly laminated brownish silt or sandy silt with thin (~ 2m) intercalated with patches of pebbly gravels, has developed a distinct terrace (6 to 8 m above modern bed level) cut into the older terrace surface developed on the calcareous alluvial fill at an average elevation of about 15 to 20 m above modern bed level.

These deposits are found younger floodplain areas of Sindphana River at Nathapur (Fig. 2), Shimpe Takli,

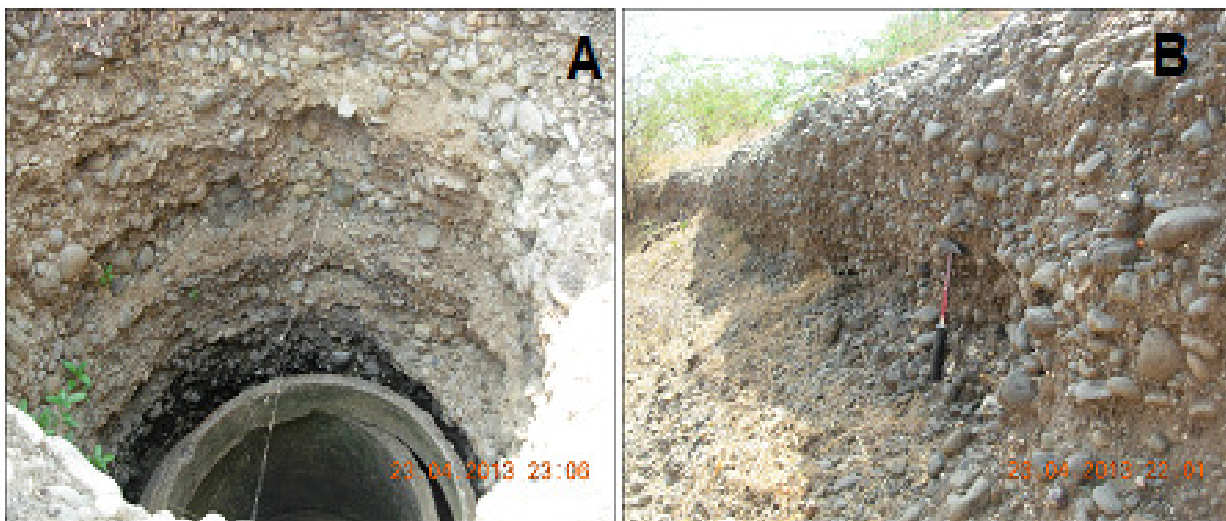
Majalgaon, Manur, Sandas Chincholi, Dipegaon and Ranjegaon (right bank) areas. These are younger sediments compared to the moderately to strongly calcified deposits.

#### **Silty Sand – Moderately to Strongly Calcified**

These deposits are generally 5 to 10 m thick and are the most prominent Quaternary formations in the valley. However, only the upper 15 m section is generally available for examination on the banks of the Sindphana river and along its tributaries. It is observed that these deposits are laid down in channels, near channel and floodplain environments. The silty sand deposits occur either as inter-fingering layers with gravels and sands or as uniform, more or less massive or faintly laminated sedimentary units in the upper part of deposits are brownish in colour and are traversed by calcareous bands i.e. calcretes (Fig. 3) and concretions. Sorting is poor and lamination is poorly preserved probably due to post diagenetic changes. Dissection cracks in the sediments indicate the periodic drying after the deposition in the channel to overbank environment, were also observed in the sections at Sakshalpimpri, Shirasmarg, Ukkad Pimpri, Rajegaon (Left bank) and along the Sindphana River at Manjrath (Fig. 3). The presence of clay deposit below the sandy pebbly gravel in some of the sections suggests the existence of local back swamp conditions in the abandoned floodplain of the Sindphana. These deposits yield the faint inclined bedding and some cross bedding structures. The deposits suggest their



**Fig 3.** Photograph of silty sand showing the development of calcrete. Photo facing east on right bank of Sindphana river at Manjrath.



**Fig4.** Photograph of Pebbly gravel beds A) right bank of Sindphana river at Manur B) right bank of Sindphana river at Manjrath Photo facing east.

settling under low current velocities and overbank accretion. These deposits perhaps developed under

waning bed load and suspension sedimentation processes on overbank floodplains. The vertical

uniformity and regularity of grain size in the silty sand unit suggest that the stream flow responsible for the aggradational sequence was much less flashy.

### **Pebbly Gravels Sediments**

These are bouldery-pebbly, sub-rounded, crudely stratified, well-consolidated gravels with a maximum thickness of about 5 m. They occur on an eroded valley flat surface of basalt at an elevation of about 10 m above the modern bed level of the Sindphana. Exposures of these gravels (Fig. 4) are found at the right bank (e.g. at Manjrath near confluence of river Sindphana with the river Godavari). The surface of this gravel forms a distinct high ground at an elevation of about 384 m above sea level. Lithologically, the pebbly gravel comprises fragments of compact basalt and multi-coloured cherts. The matrix is of silt and fine sand and the cement is calcareous and argillaceous. The pebbly gravel is moderately sorted but poorly graded and is inter-layered with well laminated granular gravel. The sediment thickness ranges in size from 2 to 8m.

The pebbly gravels capped plateau has been dissected and the alluvial fills are found to be resting against the eroded slopes of the gullies. It is therefore, apparent that there is a clear cut erosional disconformity between the pebbly gravel beds (Fig. 4) and the alluvial fills of the Sindphana River. The pebbly gravels are lenticular, discontinuous bodies and are cemented by secondary calcite. Pebble lithology is represented by compact, porphyritic basalts, cherts, chalcedony, secondary silica and zeolites. The gravels are sub-rounded, moderate to well sorted but generally poorly graded suggesting their deposition as channel bars in a seasonal flooding stream. All these field characters suggest that the lower gravels were deposited in the high energy upper flow regime of channel environment by a stream having a peak discharge for a short duration only. Similar types of pebbly gravel beds have been observed in the same stratigraphical relationship with the alluvial fill further upstream at Nevasa in the Pravara valley (Ansari and Pappu, 1975) and downstream at various localities such as Nandur Madhmeshwar, Hiradpuri, Dharangaon, Apegaon along the Godavari River (Babar, 2011).

The pebbly gravels are grey to dark grey, yellowish and reddish brown, poorly sorted and matrix-supported. In most cases, the matrix comprises medium to coarse grained sands, argillaceous and carbonaceous materials. They are polymictic, texturally immature and crudely stratified or massive. The pebbly gravel units were deposited most probably as small lenticular bodies of channel lag or low sinuous streams (Reineck and Singh, 1980). They might have been deposited as debris flow deposits. Some of the siliceous pebbles display surface cracks due to weathering. Signs of weathering and iron staining are seen along micro joints. In the sediments the

imbrications, grading and stratification are not seen conspicuously. These sediments have yielded faunal remains of *Bos* sp., *elephus* sp. and wood (Corvinus, 1981). Stratigraphically and geomorphologically they have tentatively dated to the late-middle Pleistocene period (Rajaguru and Kale, 1985). The pebbly gravel sediments are correlated with the Godavari formation by Kale (1988). The coarseness of sediments, poor sorting, lack of grading and stratification and general absence of cross bedding are suggestive of deposition by non-meandering, shallow and wide streams.

### **CONCLUSION**

A comparison of the present channel deposits and older sediments of Upper Pleistocene reveals that the former are sandy pebbly in nature and thus are coarser than the later ones. This fact indicates that the rivers during the closing phase of Pleistocene had relatively low competence. The climatic control is quite evident in the basin. The phases of erosion are linked to warm and wet periods while the episodes of deposition are associated with cold and dry phases. Besides this several factors such as sediment supply, nature of transporting sediments, tectonic stability etc also plays an important role in the formation of pedofacies. The present study revealed that Sandy Silt deposits are dominant at localities Nathapur, Shimpe Takli, Majalgaon, Manur, Sandas Chincholi, Dipegaon and Ranjegaonon (right bank), Silty Sand – moderately to strongly calcified sediments are developed at Sakshalpimpri, Shirasmarg, Ukkad Pimpri, Rajegaon (Left bank) and Manjrath and Pebbly gravels sediments are found at Manjrath and Manur.

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