Chapter V: Channel Bank deposits

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CHAPTER V

CHANNEL BANK DEPOSITS

Introduction

The channel bank deposits or perimeter sediments provide a good historical record of sedimentation along the river channel. Sand, silt, clay and even gravel and pebble banks help in the reconstruction of paleofloods in the channel. The study of perimeter sedimentology is therefore of utmost importance in any fluvial system. The riparian vegetation (vegetation along the river bank) usually protects the thick sections of these bank deposits.

The outward characteristics of a river channel whether large or small are usually not diagnostic of whether a channel is in the process of aggrading or degrading (Leopold et al 1964). Channel bank deposits certainly give some idea of these tendencies.

The channel size and configuration depends on perimeter sedimentology and the maximum monsoon discharge through these rivers. Bedrock channels are usually narrow, deep and less sinuous. The control of perimeter sedimentology is evident all along Dhul river channel. Bedrock control is stronger in upstream reach. High floods are indicated in form ratio (w/d).

The observations in the field suggest that most of the river channel is very stable and does not show any lateral migration. This is however not true for the channel in the upstream stretch. The river channel west of Titeghar bridge shows a distinct northward shift. (Fig 6.8) There are no evidences of Paleo channels anywhere along the stream course.

Due to inadequate gauging records, perimeter sedimentological sequence can be used to evaluate the discharge and flood tendencies of the channel. Sandy pebbly deposits at higher levels are indicative of strong paleofloods (Miall 1990) in the channel. Texturally the bank deposits represent sediments laid down by floods of high intensity as well as low intensity. Such deposits in Dhul river occur upto 4 m height from bed level.
The fluvio sedimentary response of this small monsoon fed river can be inferred from perimeter sedimentology observed at many places along the channel. Downstream variation in the bank deposits can be recognized from the field photographs (Fig 5.1 to 5.18). Exposed channel banks revealing sequence of sedimentary deposits could be observed only at few places. Samples were collected and measurements were taken from such places only. Sand samples were sieved mechanically to determine their various statistical parameters.

Field observations showed that bank sediments in upper reaches comprise mainly of fine to coarse sand especially in the upper 3 to 4m layer from bed. Layers near the bed are gravelly along the channel with some exception such as one at the right bank 4.8 km distance downstream gravel layer is at 0.4 m height above bed level and the layer is 0.3 m thick. (Fig 5.10). Near the confluence no gravel material is observed near the bed. In the upper reaches gravel is common but in lower reaches it is occasionally observed. Pebbles can be seen at 3 to 4 m height from bed only at 1.5 km distance downstream. Occurrence of pebbles in bank deposition is occasionally seen. At the downstream distance 8.9 km on the right bank pebbles are observed upto 3.6 m height (Fig 5.11). On the right bank at the distance of 11.8 km frequent pebbles are observed upto 1 m. In lower reaches at the downstream distance 15.7 km pebbles are observed upto 0.4m from bed (Fig 5.18).

It is observed that bank sediment in the channel is mainly coarse sand. In most places it is moderately sorted. Exceptionally at the distance of 1.5 km, 3.6 m layer of poorly sorted coarse sand is observed. On the right bank at the distance of 3.4 km, 1.7m layer of poorly sorted sand is observed. At the distance of 14.6 km, a layer of 0.5m comprising of poorly sorted coarse sand is observed.

In the lower reaches fine sand is more common in bank deposits. After distance of 5 km fine sand is observed continuously. At the distance of 5 km on the right bank a layer of 1.9m height comprising fine sand is observed. At the distance of 4.8 km a layer of 0.2 m is observed. But at the distance of 15.6 km both banks comprises of coarse sand. At the distance of 15.7 km left bank comprises fine sand layer of 1.3m thickness.
Left bank deposits

L1
1.3 km downstream

S1
Moderately sorted fine sand
Median: 1.245
Mean: 1.382
SI: 1.110

S2
Moderately sorted coarse sand with gravel
Median: 0.201
Mean: 0.021
SI: 1.110

Fig. S.1

L2
5 km downstream

S1
Moderately sorted fine sand
Median: 2.075
Mean: 1.714
SI: 1.113

S2
Moderately sorted coarse sand with frequent gravel
Median: 1.025
Mean: 0.775
SI: 1.112

Fig. S.2
Left Bank Deposits

L3 15.4 km downstream

S1 Moderately Sorted Fine Sand
Median - 1.713
Mean - 2.075
SI - 1.111

L4 15.5 km downstream

S1 Moderately sorted fine Sand with grass roots
Median - 2.044
Mean - 2.160
SI - 0.839
R7
15 km downstream

S1: Poorly sorted coarse sand
Median: 0.364
Mean: 1.325
S1: 1.638

S2: Moderately sorted coarse sand with frequent gravels
Median: 0.019
Mean: 2.536
S1: 0.764

Right Bank deposits

Fig. 5.10

R8
15.3 km downstream

S1: Poorly sorted fine sand with occasional gravels
Median: 3.074
Mean: 1.981
S1: 1.092

S2: Poorly sorted fine sand with frequent gravels
Median: 1.388
Mean: 1.422
S1: 1.102

S3: Moderately sorted fine sand with mica
Median: 2.071
Mean: 1.304
S1: 0.229

Fig. 5.11
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Sorting index of all the bank sediments ranges between .711 to 1.119 Ф. But it is .468 in the lower layer at right bank 12 in the sample 2. It means that most of the sediments are poorly or moderately sorted with the exception of the sediment near confluence which is well sorted.

The values for mean range from .260 to 2.195 Ф. It is seen from the values that all sediment ranges between medium to coarse sand. Median of the sediment shows highest value of 2.127 Ф at 5.9 km distance and lowest value is 0.144 Ф at the distance of 15.7 km. Skewness of the sediments also shows the variation. It changes asymmetrically. The value varies from -0.424 to 0.876 Ф. At the distance of 3.3 km sediment is very coarse and at the distance of 1.4 km it is very fine. No trend is observed in the change in these values.

Thus in the lower reaches of river proportion of fine sand has increased in bank deposits. Height of layers above bed level with gravels and pebbles decreases in the lower reaches. Grass roots in the bank sediment are observed frequently in the lower reaches.

Mud and fine sand deposits in the matrix of coarse sand probably suggest the settling of fine sediments during low flow (waning) flood stage. Changes in the fluvial regime are reflected in the size variation and a fining upward sequence at every site along the channel. Coarse sediments on the bank are related to high floods and finer sediments to medium discharge regimes. Thus these perimeter deposits reflect the range of processes dominant at different discharge stages. The abrupt change in discharge and competence of the river can also be inferred from change in sediment size from coarser to finer (Karlekar 1990). It was seen that silty sandy sediments are transported as suspended load (40 to 75 mg/l) throughout monsoon and coarser sediments are transported as bed load during very high intensity floods in the channel.
The sand silt sediment all along the left and right banks show some definite trends in their size and distributional characteristics. The river banks are basically controlled by sedimentary deposits or degradational process at the bank site.

**Downstream variations in the properties of left bank deposits**

Sand is the major constituent of perimeter deposits all along the channel. Gravels and pebbles are mainly embedded in the matrix of silt and sand as the bank material.

Mean Phi size of the sediment in the upper 2 to 4 m section all along the channel increases to 2 upto 15.4 km and suddenly decreases near confluence area. Lower bank deposits however show decrease in Phi size upto 5 km from source, then a gradual increase upto 15.5 km which remains stable upto confluence (Fig.5.19) Median size is more sensitive to fluviogeomorphic variations along the channel. Median Phi size of upper layer sediments slowly decreases towards the confluence. The lower sediments however show a tendency of increase in Median Phi size upto 15.5 km. There is hardly any variation in sorting of bank sediments in upper as well as lower layers in the bank deposits. The left bank sediments at a distance of 15 km are negatively skewed showing the predominance of coarser deposits.

On the whole the deposits in the upper 2 to 4 m layers all along the left bank are coarser than those in the lower layer upto 2 m from the bed level. This pattern clearly indicates earlier high flood conditions. The lower layer finer deposits suggest medium discharge conditions.

Thus the processes dominant in the different discharge stages are reflected in the variation of sediment size of perimeter deposits.
Downstream variations in the properties of right bank sand deposits

The right bank deposits along the river channel show more complexities. Median phi size of upper layer sediments is almost constant after a distance of 9 km from the source. The sediments at 2 to 4 m above bed level are fine sediments after 9 km from the source. The upper layer perimeter deposits on right bank upto 9 km from source comprise of coarse to medium sand. (Fig 5.20) The lower layer deposits show significant fluctuations as regards medium Phi size. They are coarse upto 3.5 km from source, remain coarse upto 12 km from where the bank deposits show major part of medium to fine sediments upto near confluence area.

The right bank deposits also do not show any variation in sorting in upper and lower layers in the downstream direction. Lower layer sediments are negatively skewed at a distance of 15.4 km from the source.