The ambient environment of the Gangetic sediments of chalcolithic period

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Abstract. There is considerable controversy regarding the mode of deposition of the OCP culture-associated sediments in the Gangetic valley and their ecological implications. SEM and sedimentologic studies show a fluvial mode of deposition of sediments originally derived from a glacial environment.

Keywords. SEM; OCP cultures; Gangetic sediments; environment.

1. Introduction

The sediments associated with the Ochre Coloured Pottery (OCP), which is datable to c. 1800 B.C., (Huxtable *et al* 1972) in the Gangetic valley look very different from the regular habitational deposit and are bereft of all human artifacts except for a few occasional OCP sherds. Since the OCP culture is the oldest Chalcolithic culture of Uttar Pradesh with reported contacts with the Indus Civilization (c. 2400-1700 B.C.) and association with the Copper Hoards (a culture marked by distinctive copper tools found in caches), the depositional environment of the associated sediments assumes importance.

It is significant to find an explanation for such a large scale distribution of a detrital-looking sediment and a near total absence of regular habitational deposits. Was it due to an intense aeolian activity indicating severe arid conditions, amounting to desertic conditions, in an area where today there is 100-200 cm annual rain fall? Or was there a great deluge? Was there a vast lake caused by tectonic uplift of the Gangetic alluvium? Answers to these questions are crucial to an understanding of the environmental conditions in which the OCP man was living, but unfortunately there is still considerable controversy about the origin of these sediments (Agrawal 1971, Lal 1968, 1971-72, Sharma 1977).

We, therefore, took up the problem afresh. Samples were collected from the two typical sites of District Saharanpur, U. P., viz. Nasirpur and Ambakheri. Both the sites are known for their OCP associations. The sediment samples were subjected to sedimentologic, mineralogic and scanning electronic microscopic (SEM) analyses to reconstruct their depositional environment. Our results are briefly reported below.

2. Sedimentologic analyses

The OCP associated sediments are of a uniform texture and their thickness varies from 1 to 2 m. The top shows a humic horizon and the bottom layer is full of kankar nodules. Table 1 gives the sedimentological and mineralogical characteristics of the sediments obtained from Nasirpur 1 and 2 and Ambakheri in western U. P. The samples are silty sand to sandy silt in nature but poorly sorted (table 1). The poor sorting is mainly because of the bimodal nature of deposition indicated by the presence of coarse sand as well as silt. Coarse sand ranges from 15.9% to 41.9% whereas clay varies from 9.1% to 21.6% (table 1). These sediments, therefore, seem to have been transported during floods under intermittent suspension (indicated by the presence of coarse and fine sand) and also under continuous suspension (indicated by the presence of silt and clay fraction) (Blatt *et al* 1972). The samples analysed by Lal (1971-72) have been assigned by him to an aeolian activity. But the presence of a significant percentage of coarse sand clearly indicates a bimodal deposition.

Mineralogical analyses show (table 1) a major presence of micaceous minerals (muscovite, biotite and chlorite) in the coarser fraction. Any long range wind transport should have abraded the fragile mica component into clay sized fractions (Glennie 1970). The presence of coarse mica goes against an aeolian mode of transport.

Thus both the bi-modal nature of its deposition and its mineralogic composition indicate that the deposit is fluvial and not aeolian.

Table 1. Sedimentologic and mineralogic analyses of OCP sediments. A bimodal deposition showing both coarse sand and silt as also the presence of coarse mica rules out aeolian deposition.
(Munsell Colour No. 7.5 YR 5/4)

Sample No.	Site	Texture classification	Mid value (mm)	Trask sorting coeff.	Coarse sand % (2.0-2 mm)	Silt and fine sand % (0.2-0.002 mm)	Clay (<0.002 mm)	Minerals
SEM-12	Nasirpur-1 (U.P.)	Silt	0.03	3.6	32.7	58.2	9.1	Major: Muscovite, chlorite, quartz. Minor: Sodic feldspar, apatite, magnetite, garnet.
SEM-13	Ambakheri (U.P.)	Silty sand	0.09	5.0	41.9	41.5	16.6	Major: Quartz & muscovite Minor: Biotite, epidote, orthoclase, magnetite
SEM-14	Nasirpur-2 (U.P.)	Sandy silt	0.035	4.7	15.9	62.5	21.6	Major: Muscovite, chlorite, quartz Minor: Sodic feldspar, apatite, magnetite, garnet.

Figure 1. SEM micrograph of quartz grain from the OCP associated sediments at Nasirpur, showing stepped fracture formations and conchoidal fracture indicative of glacial action.

Figure 2. SEM micrograph of quartz grain from the OCP associated sediments at Nasirpur showing V-shaped indentations indicative of fluvial transport.

Figure 3. SEM micrograph of quartz grain showing a sub-angular shape and marks of conchoidal fracture indicative of glacio-fluvial transport.

3. SEM Studies

Quartz grains (total 28; size > 0.25 mm) were examined under the SEM, following the standard techniques of sample preparation (Kransley and Doornkamp 1973). These techniques are fairly well established now and have been successfully applied to other Indian sediments, [Agrawal and Roy 1977; Pant *et al.*, in press].

The grains showed distinct conchoidal fractures, parallel stepped structures, etc. indicating a glacial origin (figure 1). At higher magnifications one could see V-shaped pits indicating transportation through sub-aqueous environment (figure 2). No aeolian features like upturned cleavage plates, etc. could be detected. The grains, also were sub-angular (figure 3); none of them showing forsted and rounded shapes typical of aeolian transport.

The fluvial activity and the glacial features on the grains as also the presence of micaceous minerals, can be explained by the fact that the Gangetic river system originates in the Himalayan region. Aeolian activity is neither indicated by the sedimentologic and SEM analysis nor can it explain the source of micaceous material. The multiple evidences cited here thus show that the sediments were probably deposited during the waning stages of a flood in a near channel or levee environment.

4. Discussion

Even today, intense floods can leave 1-2 m of silt behind. During such floods, the OCP settlements must have been washed away. Some sherds must have got mixed up with the slush deposited in the silt left behind by the flood. The rolled and ochreous nature of the OCP sherds is also explained by flood water action. Since most of the sites are on the flood plain of the R. Ganges and its tributaries, no major lake created by tectonic uplifts (Lal 1968) need be invoked. Nor can one infer any aridity and aeolian activity (Lal 1971-72) from such sediments. In fact, the widespread OCP sediments indicate an intense flood activity which, if anything, could denote a heavier rainfall.

5. Conclusions

We thus see that the sedimentological, mineralogical and SEM analyses of the OCP associated sediments indicate intense and extensive flood activity which washed away the OCP settlements and left behind the silt which at places got mixed up with the OCP sherds and other artifacts. This devastation may also partly explain the considerable delay in the urbanization of the *doab*. Urbanization came to *doab* only in the first millennium B.C., whereas the first urban centres were thrown up by the Indus Civilization in Punjab and Rajasthan as early as the third millennium B.C.

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