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FRACTURE FILLS OR 'SEDIMENTARY DYKES' IN THE LAKE SEDIMENTS OF JALALA, N.W.F.P.: A PRELIMINARY REPORT

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ABSTRACT

Quaternary lake sediments of Jalala in Mardan District are intersected by discordant structures which have been described as clastic dykes by Allen (1964). These sediments consist of horizontal, alternate beds of clay, silt and sand with local pockets of erratics. Poor sorting, angular to subangular shapes of the grains, and varied mineralogy indicate short distance of transport. Metasediments, amphibolite and granitoids are among the possible source rocks. Field evidences indicate that episodic tectonic activity produced fractures in the sediments which were filled by the plastic flow of clayey material from the overlying beds.

INTRODUCTION

Quaternary sediments composed of horizontal beds of clay, silt and sand occur near Jalala in Mardan District of N.W.F.P. Jalala lies 80 km north of Peshawar along Peshawar–Swat highway. The extent of these deposits is not known precisely but they might cover several tens of square kilometers. Excellent outcrops are exposed along the banks of Jalala Khwar as well as in road cuts, where the thickness of the sediments varies between 20 and 40 meters. The sediments were briefly described by Allen (1964), who referred to them as Shergarh lake beds. He thought that they may have been deposited between 3000 to 15000 years ago in warm and moist climate. Allen also reported clastic dykes but did not propose a mode of origin for them. The present study briefly describes the lithology of the deposits near Jalala and comments on the genesis of "dyke-like" features.

A detailed study of sedimentary facies, fracture orientation, and comparative mineralogy of the fracture fills and their host sediments is in progress and the results will be presented subsequently.

LITHOLOGICAL DESCRIPTION

The sedimentary sequence consists of alternating beds of clay, silt and sand (Fig. 1A). In one of the gullies west of the Jalala bridge, the lower part of the sequence, measuring 12 meters, is represented in Fig. 1B. The upper part at this locality does not display a distinct bedding due to a cover of alluvium and vegetation. The Jalala sediments are thought to be of lake origin, which is evident from parallel lamination, graded bedding, vertical burrows, and horizontal (thin to medium) bedding (see Picard and High, 1972, and Collinson, 1978, for generalized criteria for the recognition of lake sediments). There are lenses of coarse sand within the lake sequence, 1 to 2.5 meters across, forming abandoned channel structures. These, presumably, resulted from the incoming sediment-laden streams discharging into the lake.

The colour of the beds varies from yellow grey (5y 7/2) to light grey (N7) to light olive grey (5y 6/1). The sediments are loosely packed and do not show any indication of cementation. The compaction of clays, however, has resulted in irregular, wavy bedding surfaces. On the basis of grain size the sediments can be classified into clay, silt, fine sand, medium sand and very coarse sand using Udden-Wentworth grain size scale.

Preliminary petrography of sandy and silty beds shows that the sediments are immature with varied mineralogical composition, poor sorting and angular to subangular grain shapes. The textural and mineralogical parameters thus reflect short distance and duration of transport of the sediments.

The dominant mineral constituents include quartz, feldspar (plagioclase > K-feldspar), lithic fragments, biotite and hornblende. Epidote, opaque oxides, garnet, sphene, calcite, rutile, chlorite, tourmaline, apatite, muscovite and rare grains of (?) clinopyroxene, (?) olivine and sillimanite constitute the accessories.

The mineralogy clearly points out to the fact that the source rocks were of different petrological associations. The persistance of amphibole and plagioclase suggests that part of the sediments were derived from the amphibolite belt of Kohistan (Jan, 1979). Biotite, quartz, K-feldspar and lithic fragments indicate metasediments and granitoid also as source rocks.

FRACTURE FILLS

The horizontal sedimentary beds are intersected by vertical as well as inclined (30–70°) fracture fills generally extending to a depth of more than three

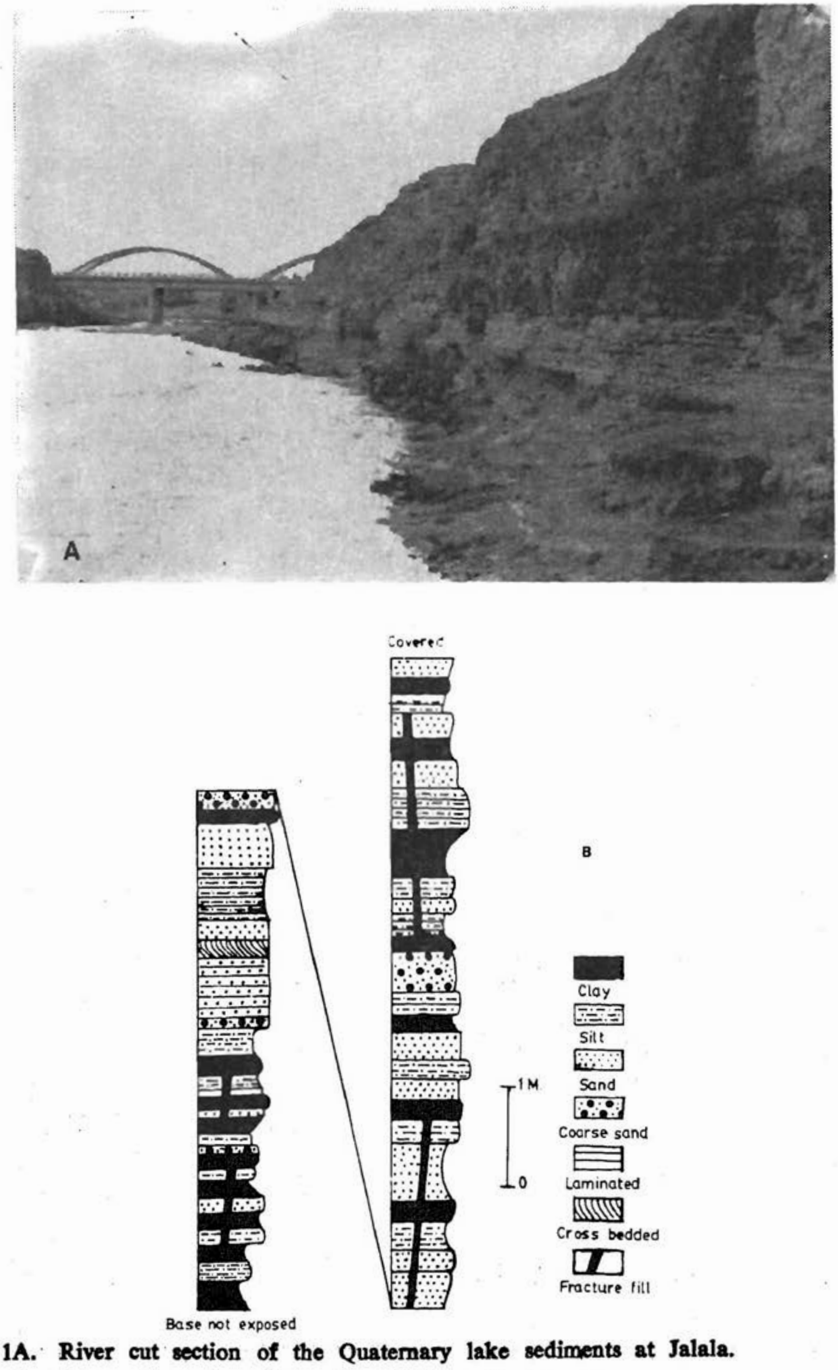

Fig. **1A. River cut section of the Quaternary lake sediments at Jalala.**

1B. Measured stratigraphic section of the sediments exposed about ½ Km W of the bridge.

meters. They are tabular and range from 3 to 35 cm in width; however, most of them are wider in the uppermost parts (i.e., the point of origin). Field observations in the case of a few prominent fracture fills suggest that they may extend laterally for several tens of meters.

Almost all the fractures are filled with clay, which has been hardened due to compaction and by losing its moisture to the adjacent sandy beds on both sides. This clay is exposed in resistant forms on the surface, or in weathered vertical sections. In rare cases, however, the fracture fills also contain some granitic boulders and sand.

Three modes of origin can be suggested for the development of such structures :

i) Sedimentary injection of material from below. This phenomenon has been reported by various workers (e.g. Shrock, 1948; Oomkens, 1966) and is mainly due to the squeezing up of loose sandy material containing gas or water under high pressure. The injection of the material can occur either during or after the deposition of the sediments.

ii) Development of mudcracks or shrinkage cracks in fine-grained plastic sediments due to tensional forces and subsequent filling up of the cracks by the material derived from overlying younger sediments. Such features are polygonal and display V-shape cross-sections (see Reineck and Singh, 1975, p. 50).

iii) Syn/or post-depositional fractures formed due to tectonic activity in the area and subsequent filling up of the fractures and cracks by the flow/washing in of the more plastic clayey material.

Analysis of the above-mentioned possibilities shows that the first two machanisms cannot account for the origin of fracture fills at Jalala. There is no indication of injection of material from below. If there was any, the fractures would instead be broader at the base and would taper upwards. Similarly, the abundance of clay and absence of sand in the fracture fills suggest that these are not sedimentary dykes. Mudcracks, are generally in centimeters and typically V-shaped in cross-section (Pettijohn, 1975). The Jalala lake sediments, on the other hand, contain fractures which are too wide and long for mudcracks (Fig. 2A).

The third possibility, as said earlier, seems more plausible and is supported by the evidence that flow of material from upper beds into the fractures can be observed in the field (Fig. 2B). Moreover, presence of erratic boulders also rules out the possibility of any kind of injection mechanism for their formation. The fractures seem to be of different generations as (1) they are not confined to any particular horizon of the sequence, (2) the older fractures are covered by younger sediments with subsequent deevlopment of new fractures (Fig. 2C). It appears that Jalala lake beds have undergone episodic tectonic activity.

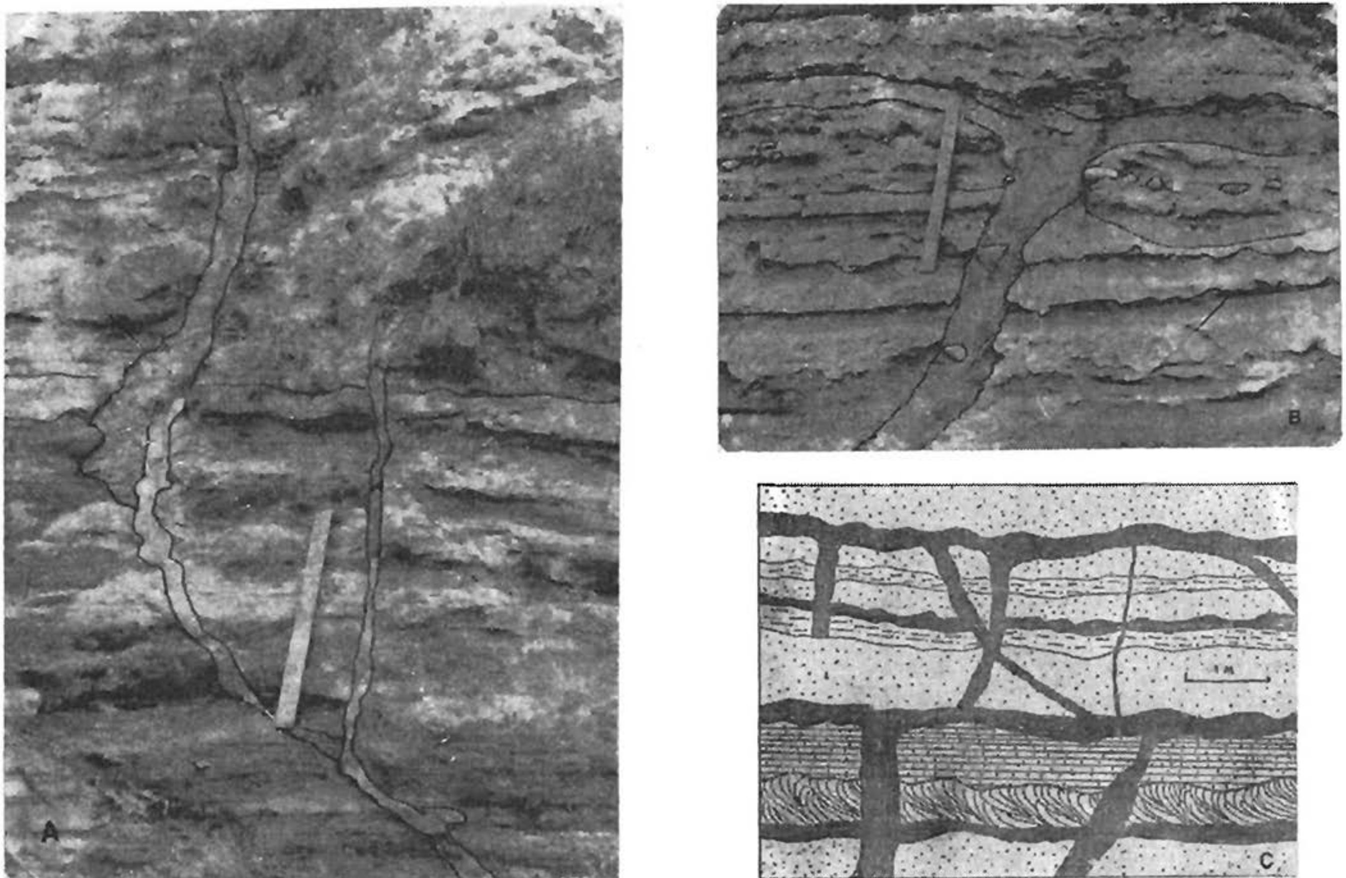

Fig. 2A. Clay filled fractures in the sediments.
2B. Fracture fills within lake beds in road cut just N of bridge. Note flowage of clay and granite erratics from the overlying beds into the fracture.
2C. Diagrammatic vertical section showing various sets of fracture fills (for symbols compare Fig. 1B).

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REFERENCES

Allen, J.E., 1964. Quaternary stratigraphic sequence in the Potwar Basin and adjacent Northwest Pakistan. Geol. Bull. Univ. Peshawar 1, 2—5.

Collinson, J.D., 1978. Lakes. In: Sedimentary Environments and Facies (H.R. Reading editor). Elsevier, N.Y., 61—79.

Jan, M.Q., 1979. Petrography of the amphibolites of Swat and Kohistan. Geol. Bull. Univ. Peshawar (special issue) 11, 51—64.

Oomkens, E., 1966. Environmental significance of sand dykes. Sedimentology 7, 145—148.

Pettijohn, F.J., 1975. Sedimentary Rocks. Harper & Row, N.Y.

Picard, M.D. & High, L.R., Jr., 1972. Criteria for recognizng lacustrine rocks. In: Recognition of Ancient Sedimentary Environments (J.K. Rigby & W.K. Hamblin editors). S.E.P.M. Special Publ. 16, 108—145.

Reineck, H.E. & Singh, I.B., 1975. Depositional Sedimentary Environments. Springer-Verlag. N.Y.

Shrock, R.R., 1948. Sequence in Layered Rocks. McGraw-Hill, N.Y.