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NEOTECTONIC ACTIVITIES AND QUATERNARY SEDIMENTATION IN PARTS OF JAIPUR UPLAND

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ABSTRACT

The northern part of Jaipur upland comprising the catchment of the Mendha, Bandi, Kantli and Rupangarh river bears testimony to neotectonic activities. The basement induced post-Neogene tectonic adjustments are evidenced by a variety of morphotectonic and geological features. Study of the drainage net work along with terrace patterns of the river, disposition of erosional plains of Quaternary sedimentation etc. coupled with the neotectonic evidences recorded, signify that the post-Neogene tectonic adjustments have largely controlled the Quaternary sedimentation in this area.

INTRODUCTION

The post-Neogene reactivation of the major faults like Great Boundary fault and Sardar Shahar fault occurring along the eastern and western margins of the Aravalli range respectively, have recently been highlighted by Sen and Sen (1983), Ahmed and Ahmed (1980), Sinha Roy (1986) and Dassarma (1986). They have described a variety of morphotectonic features like knick-point lineaments, fault generated scraps, multitiered hanging valleys, sag ponds, subsequent nature of drainage with strong preferred orientation along fractures, summit level diffrence in earlier erosional surfaces in the contiguous blocks etc. This paper presents the records of some such evidences along with their control over the pattern of a Quaternary sedimentation in the Jaipur upland.

MATERIAL AND METHODS

The present study was carried out over an area of 10,000 sq km in the north-eastern part of the Aravalli hills around the Kantli, Mendha, Rupangarh, Sobawati internal ephemeral rivers and the Bandi ephemeral river which is the tributary of the Yamuna perennial river. The area is bounded by N longitude 74°45' ; 75°45' and E latitude 26°45' ; 27°50'30" (Fig. 1). The studies included Quaternary geological and geomorphological mapping with the help of aerial photography (1 : 50,000 scale), periodic aerial photostudy (1 : 25,000 scale) around the critical patches of sand accretion, soil erosion, and large scale repeat surveying around these patches, dunes and rivers.

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General Geology and Geomorphology

The Delhi Supergroup of the rocks are overlain by fluvial aeolian and playa deposits of Quaternary period. These on the basis of field relationship and laboratory studies have been classified as fluvial and aeolian coeval playa deposits of three different phases (Raghav 1986).

The topography of the area is generally undulating which exhibits a number of different geomorphic units like NNE-SSW trending discontinuous denudational hills, isolated hill rocks, sand dunes, sand sheet, lakes and playas.

The Kantli is a major internal river in the northern part of the study area. It originate from the Khandela hills in the north Jaipur upland and disappears in sand. Sobawati is a small ephemeral river in the western part of the study area. It meets with zeen mata lake. The eastern part of area is drained by Bandi ephemeral river which is having an outlet to Bay of Beangal through chambal-yamuna system. The central part of the area is drained by Mendha ephemeral river. It meets in the northwestern periphery of the Sambhar salt lake. Southern part of the study area is drained by Rupangarh river which meets with Sambhar salt lake in the south-western periphery of the lake (Fig. 1).

RESULTS AND DISCUSSION

A number of features attributable to neotectonic activity were observed in the areas which are described as follows :

(i) Tectonic sag

The development of Quaternary depositional basin at the top of Precambrian rocks indicates that the region might have experienced tectonic movement at the beginning of Quaternary sedimentation. It is further evidenced by variation in thickness of Quaternary sediment from 2.5 m to 40 m in the Rupangarh and Kantli river basin and from 30 m to 70 m in the Mendha river basin. This also indicate existence of graben in between the Rupangarh and Kantli river basins (Sural and Dassarma 1987).

The occurrence of 100 m to 130 m thick Quaternary alluvium was also reported in the adjoining north west of the Sambhar salt lake. This indicates existence of subsiding basin attributed to tectonism, which is further supported by the shifting attitude of Mendha and Rupangarh rivers which show a lateral shift towards north west in the Sambhar Salt lake area, leaving behind many channels (Fig. 2).

(ii) Drainage inversion and sedimentation

Three generation of drainage net work have been identified in the area. Thc first generation palaeodrainage that is oldest appears to record a well developed

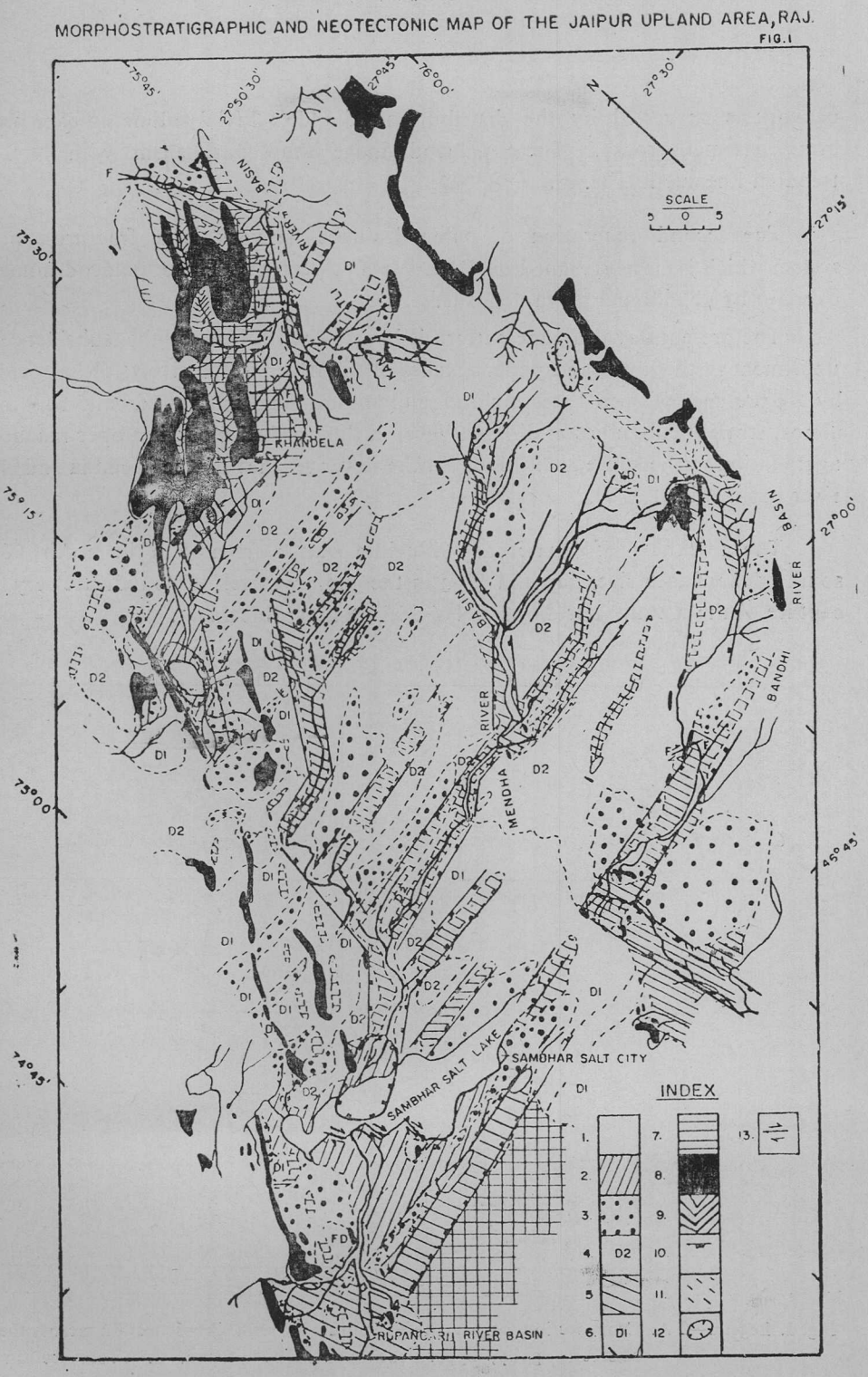

Fig. 1. Legend—1. Lake, playa, river and local depressions. 2. Younger flood plain, 3. Younger and active dunes/sand sheet. 4. Older dunes/sand sheet, 5. Older palaeo-channel, 6. Fossil dunes/sand sheet, 7. Oldest palaeo-channel, 8. Denudation hills, 9. Broad flat valley, 10. Late quaternary faulting with bar and ball on down thrown side, 11. Abandoned playa, 12. Sag pond. 13. Possible direction of lateral movement

network as suggested by the distribution of oldest fluvial sediments over precambrian basement rocks. These palaeodrainage show parallelism with NNE-SSW trendign lineament (Fig. 1).

The second generation of palaeodrainage network is a fracture controlled system which is largely aligned in ENE-WSW direction. These palaeodrainage are overlain by abandoned playa deposits.

The present day drainage pattern is largely controlled by the subsidence and upliftment in the lower and upper reaches of the rivers respectively. It is evidenced by the presence of deep dissection and gullying ranging in depth from 5 to 9 m with almost straight cut gullies at different level in the uplifted block in upper reaches and aggradation in the subsequent block in the lower reaches of the Mendha and Kantli river basin (Fig. 1 & 2).

The thickness of Quaternary alluvium varies from 45 m in north, 60 m in south of the Kantli river gap and 35 m in the gap area itself. This indicate very recent capture of the Kantli river along NNW-SSE trending lineament.

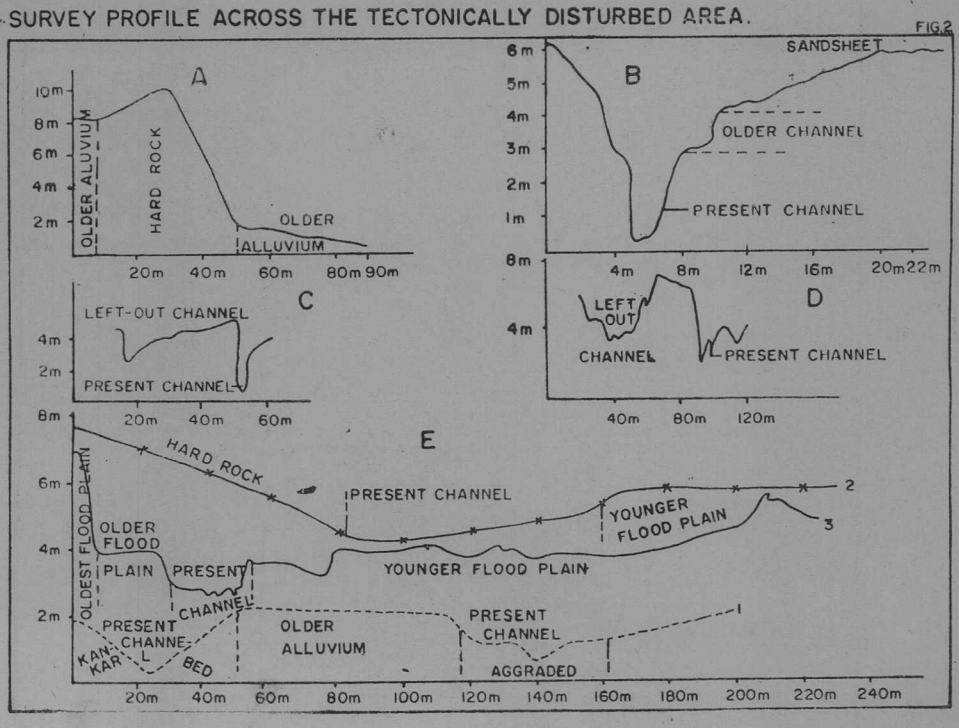

Fig. 2. Legend—2 A. Cross section across the Fatehpur hills. B. Cross section across the deep dissected gully, upper reaches of Mendha river, C. Cross section lower reaches Rupangarh river, D. Cross section lower reaches of Mendha river, E. Survey prsfile across the 1, Mendha, 2. Kantli, 3. Rupangarh river.

(iii) Rejuvenation of fault and river entrenchment

In the lower reaches rivers have a tendency to form point bar deposit on convex side and lateral cutting on concave side which indicates initial stage of entrenchment where the tributaries have not yet attained the equillibrium due to changing base level (Fig. 2). Rejuvenation of fault plain along the valleys and/subsidence in the lake or playa area are suggested for the changing base level (Fig. 2). River entrenchment due to subsidence is also indicated by the formation of gullies in obstacle dune field area on the western side of the hills which is drained by east flowing tributaries against the general slope.

(iv) Tilt and warping

6 to 8° of tilt toward NW and warping were recorded in the sediments of first generation palaeodrainage in the upper reaches of the Kantli river basin in the area NE of Khandela.

(v) Fault and dislocation

Presence of a faulted kankar horizon which shows a vertical dislocation of nearly 1 m was observed within one of the abandoned playa deposits in the central part of the Mendha river basin. Off-setting of first generation of palaeodrainage sediments against the second generation palaeodrainage sediments was also observed NW of Khandela along the section cutting of Sobawati river tributary.

4 to 10 mm displacement in the soil profile in the sediments of second generation palaeodrainage was observed in the area NE of Khandela along the section cutting of Kantli river tributary.

(vi) Fractures and joints

Development of deep seated wide fractures were observed in the sediments of palaeodrainage of second generation which occur at the top of western extermity of the Samod hills, falling in the upper reaches of Bandi river. Presence of vertical to very steep joints were also observed in the sediments of second generation of palaeodrainage NE of Khandela along the section of Kantli river system. Some of these fractures are filled up by the precipitation of calcium carbonate.

(vii) River terrace

Two sets of fluvial cut and fill terrace and rock cut terrace have been identified in the upper reaches of the Kantli, Rupangarh and Bandi rivers, whereas only one set of fluvial cut terrace were observed in the upper reaches of the Mendha river. These terraces have converging slopes towards the river. A level diffrence of 8 m in the present terrace of second fluvial phase is observed in the upper reaches of Bandi river which is attributed to neotectonic activity (Fig. 2).

(viii) Morphotectonic analysis

Multitiered planation surfaces and broad flat valleys, which occur at different levels were observed in the Khandela hills. Thc western side of these hills is bounded by fault generated scarp where quartzite hills are faulted against Quaternary sediments occuring along the valleys of the north flowing Nahargarh Nala. The eastern side of these hills is bound by dissected broad flat rocky pediment and pediplain which is drained by internal ephemeral Kantli river (Fig. 1).

Presencee of a lineament controlled spring and several abandoned and active sag ponds were also noticed in this sector. The spring water along this lineament shows usually higher temperature which could perhaps be attributed to neotectonic energy released in heat form. (Saxena and Sinha 1991).

Study of present drainage net work with the alignment of channel in preferred orientation suggest that the major control of these courses is structural, although, the overall drainage represent a coarse dendritic pattern modified by structures. Three sets of lineaments identified on space imagery as well as on aerial photographs appear to control the directions along which the stream cours esare aligned (Table 1). These directions are NNW-SSE, ENE-WSW and NNE-SSW (Fig. 1). The influence

Table 1. Characteristics of geomorphic units

Geomorphic unit	Lineament	Characteristic
Kantli river gap	NNW-SSE	Maximum opening in NNE-SSW direction
Sikar gap (Sobawati river gap)	NNW-SSE	—do—
Danta-Ramgarh gap	ENE-WSW	Maximum opening in ENE-WSW
Sambhar Salt lake gap	NNW-SSE	Maximum opening in NNE-SSW
Rupangarh river gap	NNE-SSW	Maximum opening in NNW-SSE
Jin Mata lake	NNE-SSW	Elongated
Sambhar Salt lake	NNW-SSE & NNE-SSW	Elongated along these lineaments
Kantli river	NW-SE & NNE-SSW	All the interaction of these lineament river form rectilinear pattern
Rupangarh river	NNE-SSW & ENE-WSW	River flow northeasterly with zig-zag path along these lineament to meet Sambhar Salt lake
Mendha river	—do—	River flow southwesterly with zig-zag path along these lineament to meet Sambhar Salt lake
Bandi river	—do—	Linear pattern at the interaction of these lineament

of these directions is also noted in the development of hill gaps as well as Sambhar Salt lake and Jin Mata depressions where longer axis parallel these orientation.

The intersection of NNE-SSW and NNW-SSE and ENE-WSW trending lineament where evidence of recent crustal movements can be discerned shows development of sag ponds. The Mendha river appears to be flowing in a younger graben which is bounded on both side by uplifted blocks occupied by Khandela hills and Kantli river basin in the north and Rupangarh river basin in the south. The upliftment has also created a divide along eastern margin of this graben which has diverted the flow of Bandi river toward south paralleling the divide which causes Bandi river to flow into Yamuna system as against the other rivers of the area which are internal in nature. The dominance of salinity, water logging, flooding and sand movements in the Mendha river basins and soil erosion in the Kantli river, Rupangarh and Bandi river basin also indicate tectonic control of these features.

On the basis of disposition of palaeo-drainage as well as present drainage it appears that the NNW-SSE trending lineament is the youngest which has caused off-set in the ENE-WSW and NNE-SSW trending lineament. The ENE-WSW trending lineament shows parallelism with the palaeo-drainage and abandoned playas of second generation indicating a clockwise rotation of the palaeo-drainage from first generation to second generation.

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