

## POSSIBLE NEOTECTONIC ACTIVITIES IN THE LUNI-JAWAI PLAINS, RAJASTHAN

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### Abstract

The present disorganised state of many streams in the Luni-Jawai plains of western Rajasthan has been attributed to a shift to an arid climate. The satellite images of the area, however, indicate a number of lineaments across the plains. Most cases of drainage disappearance appear related to these lineaments, as also the formation of river terraces and development of gullies. The findings tend to confirm at least two episodes of Quaternary tectonic movement in the area, resulting in channel changes/obliterations and other drainage anomalies. The pattern of drainage disorganisation suggests that change of climate could at best be an associated factor, and not the primary one.

### Introduction

The Luni and its major tributaries originating in the Aravalli hill ranges form the only major integrated drainage system within the desert of Rajasthan. A close look at many topographical sheets covering the Luni basin, however, reveals numerous evidences of drainage disorganisation and partial obliteration of many drainage lines. Ghose (1964, 1965), on the basis of his interpretation of aerial photographs and detailed field traverses, first reconstructed the otherwise disorganised and buried drainage channels in a part of the basin, roughly covered by the Survey of India topographical sheet No. 45C (scale 1 : 250,000). The area was mentioned by him as the 'Central Luni basin' (Ghose, 1964, 1965). Reconstruction of these dead stream channels revealed that previously this region had a well-integrated drainage system' (Ghose, 1964, p. 81). He also noted that 'there are many other tributaries like the Sukri, Bandi, the streams of Golia, Bhailan and Kundal-Ramania which became disorganised since the dry climate set in' (Ghose, 1965).

The author, while working in the upper Luni basin, especially in the Aravalli foothills region, came across enough evidence to suggest that neotectonism along a number of NE-SW running faults were responsible for many drainage anomalies (Kar, 1984). New information collected recently forms the subject matter of the present communication.

### Results

*The nature of the 'basin'* ; The area named as the central or the middle Luni basin in literature, does not fulfil the requirements of a basin or a catchment.

The 'Central Luni Basin' appears as an amalgamation of certain contiguous parts of the upper, middle and lower Luni basins. The more appropriate term for the area would be the Luni-Jawai plains. Excepting the western and southwestern parts, which are covered with sand dunes, the rest of the area investigated forms a vast alluvial plain interspersed with hills of granite and rhyolite.

*Lineaments* : A number of lineaments with sharp linear breaks in tonal appearance of features can be made out in all the scenes of the area (Fig. 1). Many of these run in a roughly NE-SW direction, but there are others with different orientations. The best results were obtained from the false colour composites of the

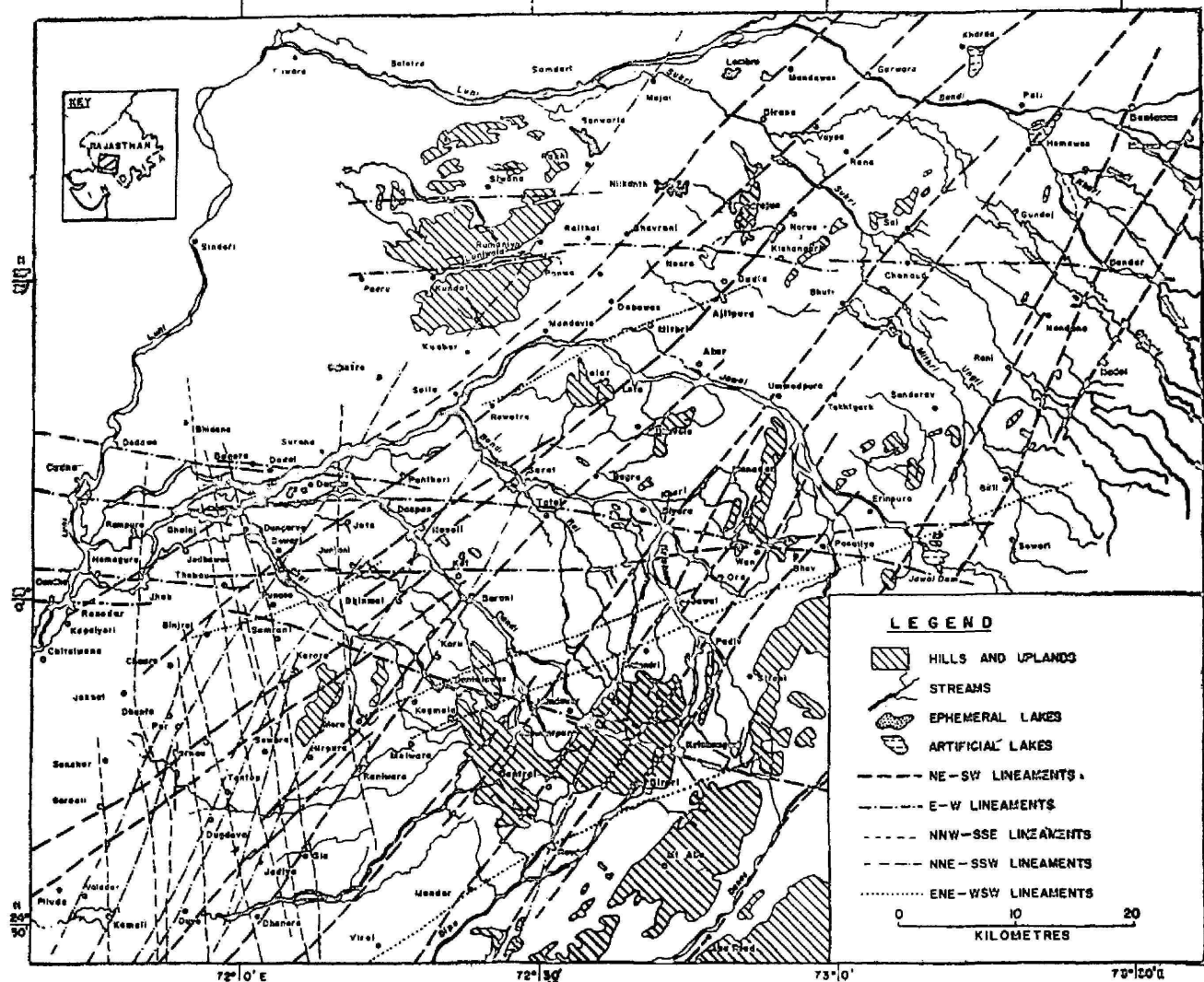


Figure 1. Lineaments and drainage anomalies in the Luni-Jawai Plains and adjoining areas.

LANDSAT TM products at 1 : 250,000 scale, but the black and white LANDSAT MSS products provided better information on the NE-SW lineaments. Since a zone of sand streaks produced over the desert plain by the prevailing SW wind does also provide similar tonal breaks, the aerial photographs, field information and TM products were scrutinized more carefully for delineating the NE-SW lineaments. The lineaments were found to cut across the almost similar trend of the sandy features. A total of thirteen major NE-SW lineaments were identified. Some of these could also be partly identified from the available aerial photographs of 1959. A number of lineaments with similar trend occur to the east of these lineaments also, even within the Aravalli, along which neotectonic movements have taken place (Kar, 1984, 1987).

Among the other lineaments, the E-W ones extend for considerable distance through the scenes and some even extend from the west of the Luni valley to the Aravalli foothills. At least seven such could be recognised.

*Neotectonic movements* : Evidence of neotectonism is difficult to trace in the desert region of Rajasthan, because of the thickness and mobility of sand. The superimposition of the present drainage map of the Luni-Jawai plains on the lineament map shows, however, striking relationship between the two, especially between the NE-SW lineaments and the drainage features like sudden branching and widening of the bed (e.g., the Somesar, the Sukri, the Jawai and the Sagi), disappearance and reappearance of the courses (e.g., the Mithri), or stream bends (e.g., the Sukri, the Ungti, the Khari, the Bandi, the Jawai and some of their tributaries).

Moreover, in the case of the NE-SW lineaments, aerial photographs and field observations reveal sudden incision of the stream beds or terracing along many of the streams and formation of tributary gullies upstream of a number of lineaments, while downstream of the lineaments the streams show signs of braiding and channel shifting. Unless the next lineament downstream favours downcutting and terracing, the effects are carried to the base of the earlier lineament. A set of two alluvial terraces has been identified along many of the streams in the area, especially along the Somesar, the Chhali, the Sukri, the Jawai, the Bandi and the Sagi. While the fall from the upper terrace to the lower terrace is generally between 1.5 and 2.0 m, that between the lower terrace and the river bed is between 1.0 and 1.5 m. In many cases the upper terrace is followed at its distal end by an alluvial scarp of about 1 m height, which separates the terrace sequence from the 'original surface' where aeolian sandy hummocks and sand sheets prevail. The maximum terrace relief of 10 to 12 m was noticed along the banks of the Jawai, especially between Saila and Daman. In the case of the Bandi (Khari), the terraces and stream incisions alternate with braided courses on the successive lineament controlled blocks, along with zones of tributary gully formation fringing the incised segments (Fig. 2). Such sequences were also noticed along the Jawai, the Sukri and the Somesar in the area suggesting neotectonism. In the case of the Sukri, the incision is conspicuous upstream of the two lineaments through Rani and Sai and also downstream of those through Vayad and Majal, while braiding and channel obliteration dominate on the adjacent lineament-controlled blocks. Similar alternate sequences of the fluvial features along the lineaments in the Aravalli foothills provided clues to two episodes of neotectonic movement (Kar, 1984, 1987).

Now, if we consider the areas enclosed by the NE-SW lineaments as separate fault blocks, differential movement along them must have uplifted some blocks, segmented the stream valleys and produced local changes in base level which, in

turn, favoured stream rejuvenation, consequent downcutting and terracing, and gullying activities. Some other blocks were relatively downfaulted, on which stream widening and braiding are noticed. Streams like the Ungti and the Mithri could not perhaps maintain their courses over these differentially moving blocks and hence were segmented into parts which are now obliterated or remain truncated, depending upon whether the valley segments rested on an upfaulted or a downfaulted block.

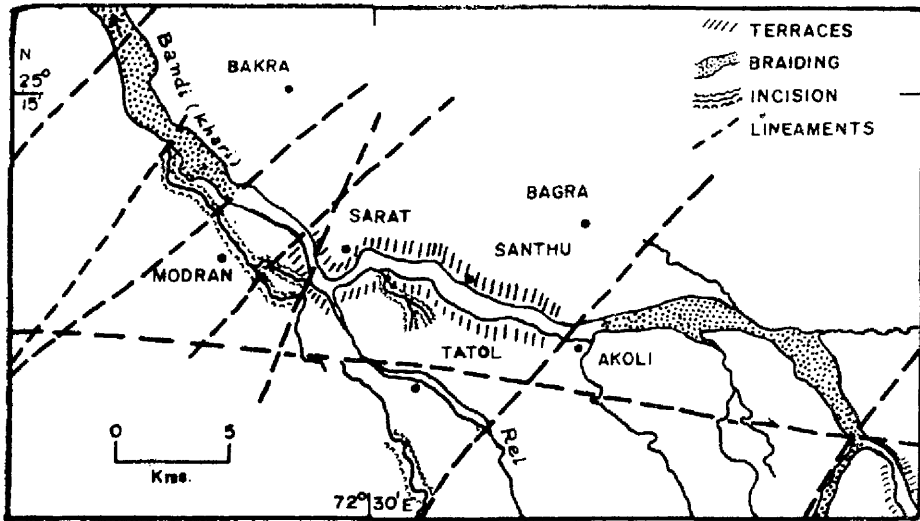


Figure 2. Behaviour of the Bandi (Khari) across the lineaments.

Among the other lineaments the E-W ones have distinct control on drainage characteristics. The numerous distributaries of the Jawai near its confluence with the Luni are controlled by a set of three parallel E-W lineaments, where stream widening is a dominant process. The courses of the Somesar near Bandar, the Rel near Tatol, the Bandi downstream of Daspan, the Khajuriya bala near Junjani and the Sagi near Bhadwi are also affected while crossing the lineaments, producing channel changes and braiding along the lineament, channel shrinkage/obliteration on the downstream side (e.g., Khajuriya bala), and terracing/incision on the upstream side (e.g., the Sukri south of Jayala), suggesting recent movements. A number of such E-W lineaments occur all through the eastern part of the desert and across the Aravalli axis, some of them running for hundreds of kilometres. More studies will be required to ascertain the effects of these lineaments on Quaternary landforms and drainage. Among the others, movement along one ENE-WSW lineament through Sirori Revdar, Mandar and Virol, rejuvenated the south-flowing tributaries of the Sipu from the Jaswantpura hills and uplands with consequent stream incision and rills and gully formation. Most of the NNE-SSW and NNW-SSE lineaments are in the dune area of the southwest, making it difficult to decipher their effects.

### Conclusion

The morphological evidence indicates at least two episodes of tectonic movement in the Luni-Jawai plains during the Quaternary period, resulting in drainage disorganisation. The controlling lineaments could have been produced during the Delhi cycle of orogeny (Dasgupta and Chandra, 1978), when the major E-W structural trends of Kachchha were also set up (Biswas, 1971). Since there are numerous

evidences of neotectonism from the Aravallis, the east Rajasthan plains and the Kachchha (Biswas, 1974; Babu, 1978; Sen, 1982; Dassarma, 1986; Bhargava *et al.* 1986), it is quite possible that periodic movements in those areas activated many lineaments in the desert plains also. The details of the type of movement and nature of displacement need further investigation, but the observations suggest a horst and graben situation and step-faulting. The 1819 earthquake of Kachchh is known to have affected areas as far north as Jaisalmer (Burnes, 1835), while a N-S fault to the west of Sardar Shahr is reported to be mildly active (Ahmad, 1984).

Apart from their influence on drainage changes, the lineaments do also provide clues to groundwater, especially where associated with present or former channels, as evident from the results of chance drilling along lineaments near Soila and east of Sanchor. Most of the saline and non-saline depressions in the area also appear to be related to movements along the lineaments, although lying along the former channel courses. It is not argued that Quaternary climatic changes did not affect the streams of the Luni-Jawai plains, but that the observed drainage anomalies took place due principally to neotectonism. Climatic change, at best, was an associated factor for the anomalies.

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