TECTONIC FRAMEWORK OF GANGETIC ALLUVIUM, WITH SPECIAL REFERENCE TO GANGA RIVER IN UTTAR PRADESH

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ABSTRACT

Gangetic alluvial plain can be regarded as a rapidly sinking basin where active fluvial sedimentation is taking place. Pattern of sedimentation is being controlled by some E–W and WNW–ESE running weak zones, along the courses of major rivers. One such weak zone is marked by the course of Ganga River. Rapid sinking and fluvial sedimentation is prominent on the northern side of Ganga River. Southern side represents a relatively elevated block. This framework of sedimentary tectonics corresponds well with the sedimentary tectonics of Himalayas.

INTRODUCTION

INDO-GANGETIC alluvium is an elongated basin of fluvial sedimentation developed in front of an orogenic mountain chain, with a stable peninsula on the southern side. Its configuration is controlled by the tectonic strike of Himalayas. Important discussions on the structure of gangetic basin are by Wadia (1959)[1], Krishnan (1961)[2], Poddar (1962)[3], Mathur and Kohli (1963)[4], Sengupta (1964)[5], Moolchand *et al.* (1964)[6] and Fuloria (1969)[7]. There are various hypotheses to its origin: the 'fore-deep' hypothesis of Suess, 'Rift-Valley' hypothesis of Burrard, and the presently accepted view that it is a 'sag' formed between the northward drifting Indian continent and the Tethyan basin.

GEOMORPHIC FEATURES OF THE GANGETIC ALLUVIAL PLAIN

The great alluvial tract of Ganga, Brahmaputra, and Indus covering an area of about 8,50,000 sq km is the largest alluvial tract of the world and constitutes one of the three main physiographic divisions of the Indian subcontinent. The thickness of Pleistocene to Recent formations has been revealed by a few boreholes sunk and seismic surveys conducted in connection with exploration for oil. It varies between 500–1,000 metres near the foot hill zone decreasing southwards.

The tract lying in the Uttar Pradesh is drained by the Ganga River system. Among the major tributaries to the Ganga River is the Yamuna, the only major tributary lying to the west and south of the Ganga River. Besides, Ramganga, Gomti, Sharda, Śaryu, Rapti Rivers are located north of the Ganga River.

Yamuna River is an important tributary flowing subparallel to the Ganga River. The Yamuna River shows distinct differences in its geomorphological characters from those of the Ganga River. It has most of its tributaries originating in the south and draining northwards, along with a rather well-developed northern drainage system originating in the area lying between the Yamuna and Ganga Rivers. All the tributaries have entrenched meandering channels with well-developed escarpments (terraces) on their either banks. Hence they do not show development of extensive flood plains.

On the contrary, the Ganga River has most of its tributaries originating in the Himalayas and draining southwards from the north, and a poorly developed northerly flowing tributary system originating in the tract lying south of the Ganga River. Further Ganga River shows well-developed escarpments mostly along its southern bank. On this side there is lack of development of flood plains. The escarpments on the southern bank are best developed wherever the course of river trends E-W or NW–SE, while they are not so prominent when the river course is otherwise. In the area near Kanpur the escarpments on the southern bank are exceptionally well developed. The northern bank, on the other hand, shows extensive flood plains. This tract shows various geomorphological features like ox-bow lakes, abandoned channels, etc. Similar features have been also described along the Gomti River (Misra *et al.*, 1972)[8].

Figure 1 shows the pattern of flow of the important rivers, the Gangetic alluvium, and its relationship to tectonic setup in the peninsula and the Himalayas.

Discussion

There are sharp geomorphological dissimilarities between the area lying to the north of Ganga River from that of the southern area. The entrenched channels of all the rivers located south of the Ganga River including the Yamuna River with its tributaries joining it from the south as well as from he north points to block uplift of this area during he Sub-recent to Recent times. The lack of ıortherly flowing drainage and development of 'scarpments (terraces) points that the southern bank ıcts as a drainage divide along the southern bank of the Ganga River. The development of extensive lood plains in the area north of the course of the Ganga River suggests subsidence along with sedimentation. The boundary between these two blocks thus, lies along the course of the Ganga River.

Further, the course of the Ganga River follows clearly the tectonic lineaments subparallel to those seen in the Himalayas and in the Peninsula. This shear zone delimits the area lying to its north where rapid subsidence takes place along with sedimentation from that lying to the south which shows evidences of uplift. The northern rivers, *e.g.*, Gomti River, which also show development of escarpments and terraces on its southern bank may also be considered to be following a similar weak zone, along which similar movements might have taken place.

Thus, it seems that the general slope of the Gangetic basin towards the Himalayas may be affected by E–W running step faults as indicated above.

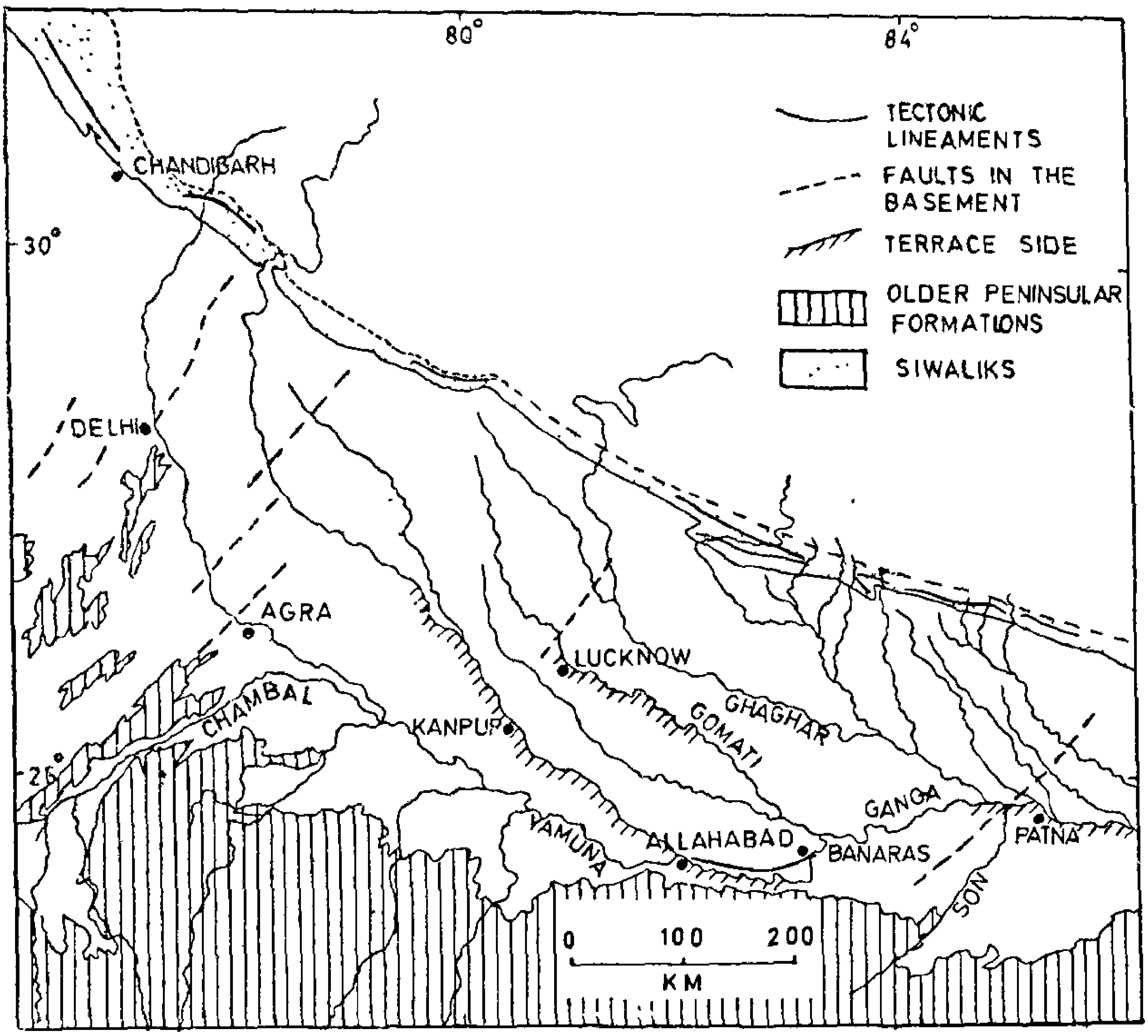

FIG 1. Sketch map of a part of the Gangetic alluvium and adjoining areas showing major rivers. Areas with well-developed terraces along Ganga River are marked with thick line. Note that major rivers run subparallel to the tectonic lineament in the Siwaliks.

Geological Implications

In a basin of sedimentation the process of sedimentary tectonics is of utmost importance, as only this controls the pattern of sedimentation and preservation of various deposits.

Siwalik rocks were deposited in fore-deeps similar to the present-day Gangetic alluvium, where sedimentation was conrolled by fluvial processes. Similar to the shear zones as found in the Gangetic basin certain shear zones might have been active during the sedimentation of the Siwaliks. Gansser (1964 ; Fig. 1)[9] has shown certain E–W tending lineaments in the Siwaliks. These might correspond to the shear zones active during sedimentation of the Siwaliks. Krishnan (1961, 1969)[2,10] also mentions certain longitudinal faults as well, basides the transverse faults, of which some are loci of the earthquakes, occasionally felt in the region. The Bihar earthquake of 1934 with iso seismals (Mercalli scale) trending WNW–ESE, subparallel to the course of Ganga River between Allahabad and Benares suggests presence of zones of disturbance, evidently faults, in the basement below the alluvium, parallel to the trend of the Himalayas.

These weak zones affecting the sedimentation pattern in the Gangetic alluvium would also determine the groundwater pattern in the alluvium. The groundwater development and its potentiality might be different on the two sides of these weak zones, *e.g.*, in the northern and southern blocks of Ganga River.

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ASHING PROCEDURES FOR VOLATILE ELEMENTS IN BIOMATERIALS

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ORGANIC content of biomaterial is destroyed either by ashing in a muffle furnace at different temperatures or wet ashing by the action of various oxidising liquids[1-5].

It has been suggested that for a proper study of the behaviour of the elements in biomaterials in different ashing techniques, the tracer must be in the same chemical form as that of the stable element, as then only the tracer indicates the proper losses of the corresponding elements. The tracer should therefore be incorporated into the structure of organometallic complexes in the same way as the stable counterpart. To achieve therefore proper exchange of tracer with stable counterparts, the tracer was injected into the pedal sinus of a bivalve *Anadara granosa*, and the losses of iron, strontium, cobalt, zinc, cerium, manganese and cesium, were determined following various ashing procedures and reported in an earlier communication[5]. These studies were further extended to understand the losses of volatile elements like mercury, selenium, arsenic, antimony, chromium, ruthenium and tungsten following dry and wet ashing techniques and are reported here.

The soft tissues of the experimental animals were dissected after 48–96 hours following tracer injection and transferred into a plastic counting vial and the radioactivity was measured following gamma-ray spectroscopy. For dry ashing, the tissue was transferred into a silica crucible, dehydrated under an infrared lamp and further ashed in a muffle furnace either at 400° C or 700° C for about 24 hours. The ash samples were dissolved in dilute hydrochloric acid, transferred to counting vials and gamma activity measured once again maintaining the geometry. In wet ashing, the samples were transferred into a glass beaker and brought into solution by using oxidising mixtures[5]. The tissues were digested with aliquots of 25 ml of oxidising liquids till the sample was free of carbon. The digested samples were then transferred to counting vials and counted maintaining the geometry.