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RESEARCH ARTICLE

GEOMORPHOLOGY & SEDIMENTATION OF THE AREA AROUND HOMINID LOCALITY HATHNORA NARMADA RIFT VALLEY CENTRAL INDIA.

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Abstract

Narmada River originates at Amarkantak at an elevation of about 1057m above m.s.l. It descended from the mountainous tract traversing over a distance of 1280km across the middle of the Indian sub-continent to join the Gulf of Cambay, near Baroda in Gujrat state. The area of study around Homonid locality Hathnora forms the part of central sector of Narmada, it is bound by Vindhychal in the north and Satpura range to the south; the area in between these two upland is found to be ideal locus of sedimentation as witnessed by the presence of Quaternary landscape and multicyclic sequence of Quaternary terraces in the valley. The general elevation of Narmada alluvial plain varies between 00.00 to 65.00 m in lower Narmada and 65.00 to 95.00 m in upper Narmada valley above the sea level. The general gradient of this plain in this stretch is about 1m /km towards west.

The Narmada conspicuously has straight course is controlled by ENE_WSW to E_W lineament, is bounded by Vindhyan in the north and Satpura in the south it is exposed the repeated post erisional and depositional activities and subjected to anisotropic and asymmetric tectonic dislocation which has culminated diversified units and region which further undergone to process of tectonic evolution and chiseling of terrain by dynamic erosional and depositional activity resulting in and reshaping the terrain into various morphogenetic units and land form elements, re-configuration of drainage, topography, physiographic, erosional platform, planation surfaces, denudation ridges, structural units linear valleys, strike hills, valley gapes, escarpments and river terraces. The cumulative dynamics of structural deform, rining and sinking platform of Narmada has also manifested concealed cyclic mechanism of tectonics, seiesmicity, neosiesmic events and in surface manifestation. In addition the valley gapes and valley trenches provided ideal sites and platform for accumulation&sedimentation.

The Narmada Rift valley formed a linear trench in the middle of Indian subcontinent was an ideal locus for accumulation of sediments. The rift trench is intruded by the dolerite and other mafic and siliceous dykes and sills along lineaments in different phases of

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Tectonic deformation. The Quaternary sedimentation incepting from glacial activity, followed by fluvio-glacial, lacustrine and fluvial phase within the rifting and sinking environment, block, faulting, uplifting, isolated domal up-lift, Neogene rifting, Quaternary sedimentation, rift-bound Pliocene–Pleistocene rifting and volcanic activity specifically during glacial and fluvio-glacial phase are major component of the Quaternary period and tectonic processes of the Narmada Rift System which forms the base of quaternary deposits .

The Quaternary events of the Narmada portys three prominent terraces and two sub terraces which are designated NT1 to NT3 and sub terraces NT2-A is NT2-B, NT2 B, besides NT2-C, NT3-A & NT3-B besides NT-0 in the valley. They have been designed NT₀ to NT₃, (280 to 400 m), NT₀ being the low level terrace above the present-day course of the river, NT₁-the younger terrace both of cyclic ad o cyclic nature. The NT₃ terrace occurs as elongated strip and isolated caps and lenses along the margin of valley flanks has divergent relative disposition. These land forms indicate vigorous and abrupt incision of valley floor due to relatively & repaid uplift of watershed area during Upper Pleistocene time. The NT₁to NT₂ are the major depositional terrace and have both convergent & divergent mutual disposition with other terrace. These terraces further downstream have matched equivalents along the valley flanks, whereas in the up stream section the matched equivalents are rare. The conspicuous divergent relation of these terraces the valley reveals successive uplift of catchments area and consequential incision of valley floor and adjustment of base level of Narmada during Upper Pleistocene time.

The sequence of quaternary dposits depicts cyclic transitional environmental of the rift basins are caused by tectonic activities (uplift and subsidence), changes in relief, and climatic variations. The climatic changes in uplift, coupled with block faulting, rifting and sinking platform, created basins unstable platform for the accumulations of thick lacustrine and fluvial sediments sequences with terrestrial and aquatic fossils.The evidence of the effects of tectonics on fauna and flora are distinct and its signatures on dislocation and concealing of fossiliferous horizons are uncontrolled and ill defined in the ecosystem in the valley during the Pliocene–Pleistocene periods. The boulder conglomerate which yielded the skull cap of *Homo erects* in Narmada rift from Hathnora Sonakia (1984) remainedonly discovery of hominid fossil in last two and half decade due inconsistency and concealed nature of fosilifrous horizon due faulting, and subsidence of Quaternary blanket of Narmada rift system as such researcher and scientist failed to add any further knowledge to hominid discovery.in Narmada valley...

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Introduction:-

Narmada River originates at Amarkantak at an elevation of about 1057m above m.s.l. it descended from the mountainous tract traversing over a distance of 1280km across the middle of the Indian sub-continent to join the Gulf of Cambay, near Baroda in Gujarat state. The river course of Narmada is conspicuously straight, controlled by E-W lineament. It descends down the mountaineous tract through deep and steep gorges in straight sinuous to meandering pattern with average sinuosity index of 1.38, which at places exceeds 1.55 for some selected segments of Narmada channel. It almost flows E-W along the Lineament over a length of 1300 Kilometers across the middle of Indian sub-continent to debouch into the Gulf of Cambay in the Arabian Sea. The area of study around Homonid locality Hathnora forms the part of central sector of Narmada, is bound by Vindhyaachal in the north and Satpura range to the south; the area in between these two upland is found to be ideal locus of sedimentation as witnessed by

the presence of multicyclic sequence of Quaternary terraces in the valley on the surface and possess thick sequence of concealed quaternary sediments up to the depth of 320 m as witnessed by bore hole logs and data of state and Fadaral agencies drilled under various projects Khan et.al (2012) Khan et.al (2013)Khan et.al (2014)Khan et.al (2015)Khan et.al (2016)Khan et.al (2016).

Previous Work:-

The Quaternary deposits of Narmada have been studied in detailed in last three decade and lithostratigraphy of Narmada valley has been updated (Khan 1984, Khan & Benarjee 1984, Khan & Rahate 1990-91-90 Khan & Sonakia 1992, Khan & *et al* 1991, Rahate & Khan 1985, Khan *et al.* 1991, Khan 1991, Khan *et al.* 1992, Yadav & Khan 1996. The Narmada valley embodied almost whole of the Quaternary deposits time span from the lower Pleistocene to Holocene (Khan & Sonakia (1992). Khan (1912), Khan (2012), Khan et.al (2013) Khan et.al (2014), Khan (2015), Khan et.al (2015) Khan et.al (2015) .The results of sedimentological studies Khan (2015), quartz grain morphology, Paleosole studyKhan (2014),in recent years detailed aspects of heavy mineral assemblage, sedimentary structures,Quaternary tectonics & sedimentation, geomorphphic evolution have been attemptedof Quaternary column of Hominid locality in central sector of Narmada, revealed the presence of complete sequence of quaternary sediments in Narmada rock basin viz Glacial, fluvio-glacial ad fluvial domain whereas the boulder conglomerate which has yielded human skull which is of fluvio-glacial origin Khan & Sonakia (1991)

Present work:-

The present work is telefocus to study the various aspects of geomorphology and georphphic veolution, Quaternary tectonics and sedimentation of the area around Hominid locality Hathnora in the central sector of Narmada valley.The area studied is about 4000 sq.km, is occupied by thick Quaternary deposits, it is estimated to be about 320 m thick the merits of bore hole data of ETO, CGWB and GSI, represent various domain of sedimentation. It is found to be ideal locus of sediment accumulation and Quaternary sedimentation in central India as witnessed by multi-cyclic sequence of Quaternary terraces in the valley.

The area has been posed to the repeated post erosional & depositional activities and subjected to anisotropic and asymmetric tectonic dislocation which has culminated diversified manifestation, which further undergone to process of tectonic evolution and chiseling of rift valley by dynamic erosional and depositional activity resulting in reshaping of the terrain into various multi morphogenetic illustration and reorganization of units and land form element, sequential and renewed configuration of drainage, topography, physiography,plantation surfaces, denudation ridges, structural linear valleys, strike hills, valley gapes, escarpments and river terraces. The cumulative concealed dynamics and structural deformation of rinsing and sinking platform of Narmada, hidden cyclic mechanism of tectonics, geothermic, seismicity and neotectonics has illustrated various signatures and imprints on landscape in the valley.The landscape and valley architech provided ideal sites and platform for sedimentation has been collectively studied.In addition to the landscape profile of the area, drainage configuration river terrace, basin boundaries Quaternary sedimentation and configuration of land form elements have been studied, and correlated with geomorphic events, erosional cycles neotectonics events, paleosoles, sedimentation, tephra events and occurrencesat different levels in increasing antiquity (Plate No_1 & 2).

Narmada Rift Valley:-

In Central India SONATA LINEAMENT ZONE embodies the two Quaternary basins of tectonic origin on the two margins of Satpura Crustal Block Namada & Tapti. The associated Narmada South (Satpura North) fault and Satpura South Fault marking the two hinges of the Satpura block are fundamental in nature and extend to Moho level. The Narmada Quaternary basin in the north and Tapti-Purna basin in the south are flanking Satpura.The Satpura Range, trending ENE-WSW forms a prominent morph tectonic unit in the area bound by Lat. 20°43'N & 23°30'N and longitudes 73°52'E and 81°30'E, between Rajpipla, (Gujarat) in the West and Maikal Ranges (Madhya Pradesh) in the east. The Satpura block is flanked in the North by Collinear Valleys of Narmada and Son and in the South by Tapti-Purna; Kanhan, Pench and Wainganga rivers flow across the southern slopes in the eastern part.

The area studied tectonically encompasses two crustal provinces of Central India Shield, namely, the Northern Crustal Province (NCP) and the Southern Crustal Province (SCP (Acharyya and Roy, 1998; Roy, 1988). The two provinces are separated by a crustal level shear zone, referred as Central Indian Suture (CIS Jain et al. 1995). The southern part of the NCP, containing the Satpura and son Narmada (SONA) valley geographic domain, is known as Central Indian Tectonic Zone (CITZ; Radhakrishna and the CITZ are marked by Narmada North Fault (NNF) in the north and CIS in the south (Acharyya, 1999).

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The study of tectonic set up of Narmada valley, surface manifestation and geo-physical data shows that the Son-Narmada and Tapti lineament together represent an intraplate rift with a central (Satpura Block) horst bounded on either side by grabens: the Narmada graben on the north and the Tapti graben to the south (Mishra et al, 1999).

The catchment area of the river, bordered by the Satpura and Vindhya Mountain Ranges, stretches over a territory of 98,796 km² (38,145.3 sq mi). It is situated between longitudes 72°32' and 81°45' east and latitudes 21°20' to 23°45' north, on the northern edge of the Deccan Plateau. The catchment area encompasses important regions in Madhya Pradesh, Gujarat, and Maharashtra.

The Quaternary tract of Narmada basin covers an area of about 17950 sq. km starting from west of Jabalpur (23°07' 79°05' 30") to east of Harda (22° 29'; 76° 58'), and Gureshwar and Bharouche section in Gujarat state for a distance of about 1320 km. It is found to be ideal locus of Quaternary sedimentation in Central India as witness by multi-cyclic sequence of Quaternary terraces in the valley. The general elevation of Narmada alluvial plain varies between 265.7 and 274.3 m above the sea level. The general gradient of this plain in this stretch is about 1m /Km towards West.

The principal tributaries of Narmada River are Sher Sakkar Dudhi in Tawa and Ganjal in, Hiran & Gaur. The Man, Karjan, Madhumati, Heran and Orsang, Amravati Narmada valley originate from the Satpura and Vidhyan hills from south and north of the trunk channel the most of these tributaries have short and precipitous course after they debouch from the hills. The area of sub basin of these tributaries is occupied by thick Quaternary sediments reclassified as older and younger alluvium on the basis of lithology sedimentological characters environments of sedimentation geological breaks. The blanket of quaternary sediments of Sher Sakkar Dudhi in Tawa and Ganjal, Hiran & Gaur in Narmada valley is chiseled in to two terraces besides present day flood plain. These terraces are designated as ST1 to ST2; SHT1 to SHT2, TT1 to TT2, and DT1 to DT2 respectively. The landscape is entrenched and cut across deep in quaternary blanket in to stepped sequence of terraces. These terraces are time equivalent to each other and have developed simultaneously during the same events. The incised blanket exposes lateral sequence of quaternary sediment which depict hidden strata, unseen relict exposures of older deposits and signatures and imprints of neotectonism.

The Narmada Rift valley formed a linear trench in the middle of Indian subcontinent was an ideal locus for accumulation of sediments. The rift trench is intruded by the dolerite and other mafic and siliceous dykes and sills along lineaments in different phases of tectonic deformation. The Quaternary sedimentation inception from glacial activity, followed by fluvio-glacial, lacustrine and fluvial phase within the rising and sinking environment, block faulting and segmental and linear displacement and dislocation, uplifting and isolated domal up-lift, Neogene rifting and Quaternary sedimentation and rift-bound Pliocene–Pleistocene rifting and volcanic activity specifically during glacial and fluvio-glacial phase are major component of the Quaternary period and tectonic processes of the Narmada Rift System which form the base of quaternary deposits.

The Quaternary events of the Narmada porty three prominent terraces and two sub terraces which are designated NT1 to NT3 and sub terraces NT2-A is NT2-B, NT2 B, besides NT2-C, NT3-A & NT3-B besides NT-0 in increasing order of antiquity. The terraces are described in detail separately. These are both erosional and depositional terraces and confined at an elevation of, between 280m to 310-315. The NT1 is being the youngest terrace and NT3- B it is being the oldest terrace identified in the valley. The relative disposition of these terraces is shown in the (Table No _2 to _7).

The Narmada has in the area under study has sculptured the alluvial tract into stepped sequence forming four alluvial terraces along its course. These are designated as NT0 to NT3 NT0 being the youngest terrace and NT-3 the oldest terrace. These terraces are separated by the scarp both curvilinear and linear in nature facing towards river side. These are abandoned flood plains represent the level of former valley floor in the area, and were formed by

cumulative climato-tectonic changes in the watershed of Narmada in the Quaternary times. In Narmada NT0 and NT1 area depositional terraces whereas NT2 & NT3 are erosional terraces. These are both depositional and erosional terraces which are cyclic and non cyclic in nature and paired equivalent on both side of river. The Narmada exhibits swelling and pinching nature along its course of 1300 kms, between Amarkantak and Bharouch the channel course of Narmada is mainly controlled by ENE-WSW lineament and its sympathetic fractures. The Narmada in Jabalpur _ Harda and Gurdeshwar _ Bharouch section embodies prominent blanket of Quaternary deposits which display steeped sequence of river

terraces. These terraces are separated by linear and curvilinear scarp facing river. In Jabalpur _Harda section Hiran Dudhi, Shakker, Sher and tawa are the prominent tributaries.

The Quaternary plain of Narmada display fluvial terraces of the stepped topographic benches, which from the prominent Quaternary landscape flanking Narmada Valley, indicate the former levels of flood-plain or valley floor. These land forms have been formed by combined action of erosion and depositional process of stream, the up warping in the hard ward ends and consequent climatic change in the post-Pleistocene time.

The Narmada basin is bounded by Narmada north and Narmada south faults, located in the apex zone of northward convexity in the Narmada south fault. At places (e.g. around Hoshangabad), the northern limit of the basin transcends Narmada north faults. The Quaternary lithic fill rests over Gondwana sediments, Mahakoshals, Deccan Trap, Granites and Bijawars.

The Narmada plain is studded with ENE-WSW elongated ridges bearing imprints of polyphase folding in the Sihora Sleemanabad area. Denudational ridge in the Deccan Traps of Barela-Mandla region, show imprints of dominant ENE fabric.

The area studied evolved in response to topography and landscape profile in tectonic zone and reactivated superimposition of drainage on pre existing topography, lithology and structure. The Narmada Son lineament zones represent an interaction of lithology, structure and climate, illustrating time dependent reactivation history West, (1962;) Choubey (1971). The central part of the earthquake affected area is characterized by units of recent fluvial origin – Narmada-alluvium, whereas the area towards north exhibits units of Vindhyan syncline, with valley and montane topography comprising hogbacks and cuestas. Further north, the syncline has wide plateau with prominent scarp overlooking the Indo-Gangetic plains. Towards south in the Satpura block geomorphic units of extrusive origin with different levels of plateau, units of structural origin on the Mesozoic sediments and units of denudational origin culminate into high hill ranges with steep slope

In the northern flank of Narmada on southern margin of Vindhyan, dominant geomorphic forms are hogbacks and cuestas, while towards north, plateau, mesa and butte are prominent geomorphic feature. This geomorphic pattern indicates post Vindhyan and pre-Gondwana reactivation of NNF (North Narmada Fault). Con-spicious level-differences in the Gondwana-Deccan Trap contact surfaces reflect the nature of the main ENE fault and cross fault in the Satpura ranges. Elongated plateau, mesa and butte in Deccan Traps of Seoni-Mandla-Balaghat-Jabalpur district the dominant structural control over the evolution of landforms. Southwestern regional gradient of laterite capping in the Amarkantak region indicates adjustment of plantation surfaces during Tertiary period (Roy Chowdhury et al., 1964).

A chain of detached/isolated slices of Mahakoshal volcano-sedimentary rocks are noted on southern fault bound margin. Tiwari and Bhai, (1997), The detailed sedimentological analysis of quaternary sediments of surface, both paleo and present domain of Narmada, bore hole sediments from surface up to the depth of 350 m below the surface, analysis of paleo-sole horizon, quartz grain morphology of both the quaternary sediments and tephra soil and tephra stratigraphy, lithological assemblage, biostratigraphy and magnetostratigraphy have identified seven lithostratigraphic units of the surface of fluvial domain of Narmada, where the boulder bed represent the glacial phase at the base of Narmada trench boulder conglomerate glacial- fluvial and River terraces fluvial phase in increasing antiquity. The sediments of boulder bed and boulder conglomerate are concealed under younger deposits, are not fully exposed in the valley, however the detailed sedimentological, heavy minerals, quartz grain morphology and paleo soles Khan et.al (1991). Khan et.al (2012) Khan et.al (2012) Khan et.al (2013) Khan (2014), Khan (2014), Khan et.al (2016), Khan et.al (2015) Khan et.al (2016), Khan et.al (2016), Khan et.al (2016), Khan et.al (2016) Khan et.al (in press), Khan et.al (in press) has established a record of Quaternary deposits from Lower Pleistocene to Holocene.

The Narmada valley in eastern and central segment exhibits a combination a mixed topography and quaternary plain with inselbergs, highlands and trapean plateau. The area in north and south of Jabalpur-Narsighpur-Hosangabad are occupied by plateau. The central part is a valley gape occupied by Quaternary sediments which have been accumulated in linear trench. This alluvial plain is drained by Narmada, Gaur, Hiran, Sher, Shakker, Dudhi, Tawa and Ganjal rivers and their tributaries. On the basis of altitudinal variation, five prominent geomorphic surfaces between 310 m and 585 m above MSL have been identified. The average elevation in the plain is around 390m MSL with the gradient from east to west. The plain is dotted with low inselbergs and mesas. The plateau in the southern sector attains an elevation of 585m MSL near Bamhni and in the northern area, the elevation is around 501m MSL near Bichhua village. In the eastern sector, Barela and Sihora area attain an elevation of 526m and 508m MSL, respectively. The southern plateau has a general ENE-WSW trend, while the northern plateau extends E-W. The highland and plateau show evidences of several cycles of erosion during the geological time. The plain of Gaur, Hiran and Narmada are accretional in nature.

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Quaternary Sedimentation:-

The Narmada Rift System consists of symmetrical basins that have been evolved in different stages of tectonism. The 100 -120 km-wide and 1300 km long rift bounded by Satpura in south and Vindhyan in north constitutes conspicuous ENE-WSW to E-W rift basin zone is filled with Pliocene–Pleistocene sediments, whereas some of them contain Miocene sedimentary deposits. Most of the sedimentary sequences contain faunal and floral remains including hominid species.

The Narmada Rift valley formed a linear trench in the middle of Indian subcontinent was an ideal locus for accumulation of sediments. The rift trench is intruded by the dolerite and other mafic and siliceous dykes and sills along lineaments in different phases of tectonic deformation. The Quaternary sedimentation incepting from glacial activity, followed by fluvio-glacial, lacustrine and fluvial phase within the rising and sinking environment, block faulting and segmental and linear displacement and dislocation, uplifting and isolated domal up-lift, Neogene rifting and Quaternary sedimentation and rift-bound Pliocene–Pleistocene rifting and volcanic activity specifically during glacial and fluvio-glacial phase are major component of the Quaternary period and tectonic processes of the Narmada Rift System and form the base of quaternary deposits. The Quaternary sedimentation was triggered by tectonic activities / up lift and climatic changes. The provenance for these sediments is the weathering products of eroding pre- Cambrian, meta-sediments, sedimentary and volcanic rocks along the watershed upland, rift escarpments and shoulders; faulted and uplifted blocks, volcanic fissure zones, and plateaus within and outside the rift. The Narmada Rift System, bounded by adjacent plateaus rising 300–700 m above the rift floor, consists of number symmetrical and asymmetrical faulted blocks, escarpment, rock cut terraces, rock floors and segments of micro half grabben. Although rift-related basins started to form during the late Oligocene to early Miocene times, the Narmada Rifts were fully defined by middle to late Miocene time.

The Miocene -Pliocene–Pleistocene lake deposit of Katni on the eastern rift shoulder was created by faulting, topographic control, or isostatic depression similar to that of other Rift system.

The sequence of quaternary deposits depicts cyclic environmental transitions of the rift basins are caused by tectonic activities (uplift and subsidence), changes in relief, and climatic variations. The climatic changes in uplift, topographic and landscape features, coupled with block faulting, rising and sinking platform, created basins for the accumulations of thick lacustrine and fluvial sediments sequences with terrestrial and aquatic fossils. The sequential change in the sediment facies from finely bedded lacustrine deposits to fluvial sediments are commonly noted in

the sedimentary sequences and reflect environmental and tectonic changes that can be temporally determined. Moreover, regional correlation based on the chemistry and geochronology of interbedded tephra has made it possible to establish accurate stratigraphic relations that are useful for pale- environment reconstruction and evolutionary studies of fossil remains in the Narmada rift valley Khan et.al. (2012). The regional tephra correlation is being used increasingly to link sites together, and has already established that similar tephra layers are known from other parts of rift valley, as well as from other basin and peninsular India Achariya,(1993), Khan (1992) Khan et.al. (2012) Tiwari (1996).

Moreover, because of tephra layers in sedimentary basins of different geologic periods, processes such as faulting, rifting, sedimentation and diagenesis, impact of climatic changes, age of fossils, nature and acquisition of archeological implements, and the origin, distribution, and functional significance of early hominid artifact assemblages can be deciphered. However, evidence of the effects of tectonics on fauna and flora are distinct and their signatures on concealed fossiliferous horizons are uncontrolled and ill defined in the ecosystem in the valley during the Pliocene–Pleistocene periods. The boulder conglomerate which yielded the skull cap of *Homo erectus* in Narmada rift from Hathnora Sonakia (1984) remained only discovery of hominid fossil in last two and half decade due inconsistency concealed nature of fossiliferous horizon due faulting, and subsidence of Quaternary blanket of Narmada rift system as such researcher and scientist failed to add any further knowledge to hominid discovery any further.

In the Narmada valley the River terraces (NT-1 NT-3) represent sediments of Sohagpur, Shahganj and Hoshangabad formations, and date back to the Late Pleistocene. The sedimentation commenced with a break in sedimentation after deposition of sediments of boulder form the base of rock basin. The break is represented by boulder conglomerate which is the persistent horizon and represents a specific phase of sedimentation in the rift valley. The sediments of paleo fluvial domain of Narmada were deposited in to two phases of sedimentation with a sharp break marked by tectonic and related climatic changes. The sediment of first phase of paleo domain of Narmada represented by Sohagpur formation overlies the boulder conglomerate followed by the fluvial flood plain deposit of Shahganj formation. The sequence of these to formation is exposed in the cliff section which represents different sediment facies typical of fluvial environments .The sequence of sediments display imprints of compressive tectonic regimes of sedimentation. The southern margin of lower Narmada is marked by Narmada–Son Fault the transformation of this geofracture. The other evidences evidence for prevalence of compressive stress regime in the central sector of Narmada basin is provided by numerous reverse faults in the Neogene sediments exposed immediately to the south of Narmada–Son Fault (Agarwal, 1986). These evidences suggest that the sediments of both the formation were formed in a compressive tectonic environment. There are evidences of subsidence of basin which has been documented on landscape of basin which are authenticated by other studies exist from adjacent area of synsedimentary subsidence on alluvial plain sedimentation. The entrenched meander and cut off meander on the southern bank around Tamcharand Balkar South of Hathnora, channel braiding in Narmada and Tawa in south west of Hathnora is due to sudden loss of bed slope are positive evidences of subsidence of southern block. It may also be inferred a low sinuosity in Narmada channel and sudden entrenchment between Dehri and Shahganj of about 12 m further revealed that area is under slow subsidence unstable and relatively fixed river system in a slowly subsiding basin for the deposition of these sediments in a thrusting environment along the NSF which is consistent with the subsurface studies. The disposition of terraces, entrenched meander, entrenched scar, configuration of stream net work highly braided nature of Tawa river suggest that area is under compressive stress along the NSF. The disposition divergence and convergence of drainage net in conformity of quaternary landscape is anomalous, further imprints and neoseismic signatures on landscape profile revealed persistent instability of basin during sedimentation.

The tectonic uplift of the Narmada valley during the Early and Late Holocene suggests inversion of an earlier subsiding basin. Such inversions of the basin have been common in the Tertiary times and are well recorded in the sediments of that age (Roy, 1990). A symmetric convergence of the NT-1, NT-2 terraces , diagonal disposition of paired equivalent of terraces across the channel , divergent and linear disposition of cliff of NT-3 terrace in conformity of NSF constant subsidence of basin and in response to frequent movement and geotectonic activity along the NSF. In Narmada river section dislocation in the litho units deformation in muddy layer bulding in clayey strata and sediments across NSF, NNW tilting of the NT-1, NT-2 sediments litho units consisting of the Late Pleistocene sequence, the anomalous topographic slope in the same direction and the incised cliffs up to 12 -16 m in the streams in the area, indicate pulsational unsynchronized neoseismic movements of Narmada graben along the NSF during the Early Holocene.

The 5–8-m incised cliffs of the streams also suggest that this block escaped the uplift induced large scale incision going on simultaneously in other areas of the Narmada valley. The occurrence of ravines and association of deep gullies north of Hatnora is morph tectonic manifestation caused by the sudden vertical movement and block adjustment due subsidence resulting to sudden collapse of sedimentation platform.

In the Lower Narmada valley the Mid–Late Holocene Quaternary valley deposits is the product of a Holocene high sea-level-induced deposition in a deeply incised valley trench trough highly influenced by NSF. The Mid–Late which resulted in both estuarine and fluvial sedimentation in the lower reaches. A significant slowing down of tectonic uplift facilitated the encroachment of the sea into the valley and the creation of a depositional wedge, which extended up to the deep in land foothills. The 5–10-m exposed thickness of the valley-fill sediments reveals tide dominated estuarine deposition in the lower reaches and fluvial deposition upstream of the tide reach.

In the middle Narmada valley pre-existing quaternary platform of NT2 & NT-3 of middle Pleistocene prior to induced sedimentation of tidal transgression was strongly induced by tectonic impulses of NSF. The relative disposition of Narmada and resulting terraces NT-2 NT-3, cliff alluvial bluff and scarp, reveals, the reactivation of Narmada due to sudden uplift and of the area and related eustatic changes in the sea level. The relative disposition of terraces, pairing of terraces, imprints of neotectonism relict and hanging drainage, isolated occurrences of alluvial fan on the southern bank associated digonestic geomorphic elements and over all morphogenetic expression of Narmada Rift valley in the area of study indicate that area is under stress and evolved under tectonically compressive during the Mid–Late Holocene.

The incursion and transgression of tides, present estuarine reach contains several islands, which are coeval with the terrace surface above the present tidal range. Hence, they are the products of estuarine processes of the Mid–Late Holocene and not those of the present day. Funnel shaped morphology and increasing tidal energy landward are characteristics of tide-dominated estuaries (Wright et al., 1973). Existing data suggest that the Mid–Late Holocene sea level has remained at the same level up to the present with minor fluctuations. The Mid–Late Holocene sediments show tilting of 10–20° which is more pronounced in the vicinity of the NSF suggesting that the incision and uplift of the valley-fill terraces well above the present day tidal limits is related to the continued differential uplift along NSF.

The Narmada currently, the river occupies the northern margin of the Early Holocene channel belt and is clearly more sinuous. It exhibits a narrow channel with wide meanders inside wide belts of Mid–Late Holocene terraces. In the Narmada valley the River terraces (NT-3) has occupied large area on the both bank of Narmada. It extends from Sohagpur to Shivpur in the west on southern bank and on the north bank it is restricted in the north western corner in between Makalbard and Semrikhojre. The average elevation of this surface is about 75 m above m.s.l, separated by both linear and curvilinear scarp from NT-2. The average height of cliff is about 325 m above the m.s.l. The sediments comprised of this terrace are exposed in the cliff section. The oldest deposit of the exposed sediment successions a highly pedogenised mottled clay horizon showing vertisolic characters like extensive fracturing giving rise to blocky aggregates, pseudo anticlines and hydro plastic slickenside along the fracture surfaces. The basal unit consisting of rock pebbles with clays is overlain by thick fluvial sediments, which comprise alluvial plain facies. The fluvial sediments indicate deposition in single phase of fluvial sedimentation with a sharp break marked by tectonic changes and related climatic changes. The sequence of this formation is exposed in the cliff section, is marked by the major break in sedimentation as witnessed by the occurrence of persistent pebble horizon at the base. This formation represent different sediment facies typical of fluvial environments. The sequence of sediments display imprints of compressive tectonic regimes on sedimentation.

Quaternary Geology:-

Boulder Bed:-

(Glacial/Fluvial-glacial deposits)

The glacial and fluvio-glacial deposits of Narmada unconformable overly the Vindhyan and the basaltic Deccan Trap rocks. The sediments consist of a Hetero-heterogeneous assemblage of sub-angular to angular, sub-rounded, unsorted, stratified rock fragments ranging from boulders to small pebbles, predominantly of quartzite, gneiss, sandstone, basalt, jasper, chert, gneiss, sandstone, basalt, chert, altered feldspar, ferruginous nodules, in a matrix of very coarse to very fine-sand, silt and clay. These clastics are highly angular, generally poorly sorted and isotropically imprecated. Fine sediments comprise of reddish grayish and greenish sand with appreciable amount of mica flakes, altered feldspar, brick-red and buff silt, greenish-brown silt and clay, and greenish, reddish and dark

maroon hard and plastic clay. These fine sediments contain fairly good amount of ferruginous material, quartz, mica flakes and altered feldspar grain. Through these sediments are similar in composition to the other deposits of Narmada Valley, exhibit entirely different sedimentary pattern, sediment characters and mineral composition. These rock clastics are largely angular, very poorly sorted and demonstrate isotropic imbrications pattern in the valley. The sediments of glacial domain of Narmada occur between and average depth of about 320-265 below the surface and were deposited in glacial environments during Pleistocene time. These deposits are concealed under boulder conglomerate in the valley.

(Boulder Conglomerate)

(Fluvio-glacial deposits)

The Vindhyan Group of rocks and Deccan Trap in the Central sector of the Narmada Valley form the basement for the Quaternary deposits. The conglomerate bed that constituted the fossiliferous horizon of Narmada is sandwiched between older Alluvium and the glacio-fluvial boulder bed. This conglomerate bed is a very persistent marked horizon indicating a distance phase of sedimentation in the Narmada Valley. It is exposed in the bluff/scrap of Narmada around SardarNager, Hathnora, Surajgarh, Budhni, Hoshangabad, Khoksa, Tigharia, Demawar and Bhariya-Ghat at the base of terraces NT₂ (Khan, 1984). The measured thickness of the exposed boulder conglomerate varies from 1.5 to 6.5m but average 5m.

The boulder conglomerate predominantly consists of sub-rounded to well-rounded boulder, cobble and pebble of quartzite, gneiss, sandstone, basalt, agate, jasper, chert, chalcedony tightly cemented in a matrix of sand and silt. The finer sediments include different grade of sand and silt, brown and maroon in color often laminated and cross laminated. The boulder conglomerate has yielded fossil skull cap of early man *Homo erectus* (Sonakia, 1984)

The boulder conglomerate consists of three sub-litho units; each sub-unit characterized by distinct rock fragment shape, size, lithological abundance and allied sediment characters. The sub-units are composed of variable assemblage of quartzite, gneiss, basalt, sandstone, agate, jasper, chalcedony, chart, sand and silt (Khan 1992) These sub-litho units display facies variation in the valley and upper units grades into gritty sandstone upstream of Hathnora

These deposits identified between an average elevations of 245 to 300 m above m.s.l. the basal unit of boulder conglomerate identified is marked at an elevation of about 268 m above m.s.l, exposed on the northern bank of Narmada around Hathnora (22° 52" N - 77° 52" E) skull cap of early man *Homo erectus* (Sonakia, 1984) is recovered from boulder conglomerate located at the depth of about 83 m in stratigraphic column of Quaternary sediments of Narmada.

The boulder conglomerate is of middle Pleistocene age equivalent to Siwalik boulder conglomerate (India), Trinil bed of Java (Indonesia) and boulder conglomerate of Tapti (Khan. These deposits have yielded skull cap of early man, *Homo erectus* Narmadensis along with other mammalian fossils (Sonakia, 1984). The Ash bed of Quaternary age is recorded associated with these deposits around Timrawan upstream of Hathnora is of aeolian nature and perhaps indicates volcanic activity during middle Pleistocene time.

Flood plain deposit of paleo domain of Narmada:-

(Fluvial deposit)

The sediments of paleo-domain of Narmada conformably overlie the boulder conglomerate and represent the flood-plain fluvial facies of the Narmada. The sediments of the facies predominantly consist of clay silt and sand, discontinuous nodules and plates. The beds are horizontal, exhibit upward fining sequence typical of fluvial deposits. This domain may be divided into three formations based on lithology, sediment assemblage, shape and size of rock clastics, relative disposition and diagnostic sedimentary characteristics. These formations are, viz. (i) Shohagpur, (ii) Shahganj, and (iii) Hoshangabad Formations respectively. These formations represent the sediments the complete sequence of Narmada deposited in channel and flood plain environments during Upper Pleistocene times. The lowest Shohagpur Formation is named after Shohagpur town. The unit occurs along the outer flanks of Narmada Valley bounded by Vindhya range to the north and Satpura to the south. It consists of sediments of paleo-domain of Narmada. It is represented by a thick sequence of clay, silt-sand and rock gravels. The unit is divisible into three sub litho unit. The basal sub-unit is chiefly red and brownish sand, silt, clay containing appreciable amount of cal matrix. The average measured thickness of this sub-unit is about 6.25m. The middle sub-unit consists of yellow and brownish silt, clay with subordinate sand and occasional rock gravel lenses. The average

measured thickness of this sub-unit is about 5.50m. The upper sub-units predominantly consist of compact yellow clay, silt and calcareous concretion. The average measured thickness of this sub-unit is about 3.25m.

The Sohagpur formation is often associated with discontinuities and persistent pebbly horizons containing well sorted polymodal gravel of quartzite, gneiss, basalt, agate, jasper and chert in the matrix of coarse to fine-sand. The gravel is generally discoidal, spherical and exhibits higher indices of sphericity and roundness indicating their derivation from distance and mixed provenance during sedimentation.

The Shahganj formation is a litho-stratigraphic unit overlying boulder conglomerate and occupies a large area in the central part of the valley. It is exposed in the bluff section of Narmada around Narayanpur, Sardarnagar, Hathnora, Shahganj and Hoshangabad. This formation is equivalent to the Shivpur formation described by Khan (1984) from the downstream of Hoshangabad. It consists of sediments of palaeo-domain of Narmada. It is represented by clay, silt, sand accompanied by inconsistent pebbly beds containing quartzite, gneiss, basalt, chert, agate. The average measured thickness of this formation is about 15m. These sediments constitute three units each characterized by distinct lithology, rock classes and diagnostic sediment characters.

The Hoshangabad is the younger formation of the Narmada and is represented by the flood plain facies. It forms a distinct morphostratigraphic unit; above the present day flood plain of Narmada. It is crescent-shaped and is confined within the meander loop of the Narmada. This formation comprises three units. The basal unit predominantly consists of rock gravels of quartzite, gneiss, basalt and agate imbricated in the grayish sand and silt. The middle unit is represented by unconsolidated imbricated matrix of sand and silt supported by bimodal sorted gravel of quartzite, basalt, agate and chert. The upper unit contains yellowish and brownish silt and clay with occasional calcium concretion. It is capped by black soil. The measured thickness of the units is 6.5m, 5.00m and 3.5m respectively. The sediments of fluvial domain of Narmada identified between elevations of 268 to 350 m above m.s.l. and were deposited in channel and flood plain environments during upper Pleistocene time. The sequence of Quaternary events and the history of sedimentation of Narmada indicate that the upper 70m to 90m of the Narmada alluvium was deposited in a single aggradation episode with minor pauses when dissection of the alluvium produced two terraces (NT₃-NT₂). The sediments of this aggradation episode constitute three lithostratigraphic units viz. Boulder conglomerate, Sohagpur and Shahganj formation. The sediments of the alluvial phase are underlain by a boulder bed of glacio-fluvial origin. Thus, the fossiliferous boulder conglomerate, the basal unit of alluvium marks a disconformity between the lower glacial-boulder layer and upper fluvial sediments. The fossiliferous basal boulder conglomerate is being of middle Pleistocene age (Khan 1992)

The sediments of present domain of Narmada are represented by sediments of active flood plain, point bar and sand bar facies of present domain and consist of unconsolidated imbricated, stratified, polygonal sorted rock-gravel supported by very coarse to very fine-sand and is named as Janwasa formation, after the village Janwasa where it is best developed. The measured thickness in the valley is about 5m. (Plate No _1, 2, 3, &5)

Geomorphology:-

The Narmada in Central sector along its tributaries has chiseled a trigger shaped basin between the Vindhya range in north and the Satpura in the south. The gape between these two physiographic highs is filled by thick pile of Quaternary sediments which constitute complete quaternary sequence of Narmada and represents the oldest Quaternary deposit of peninsular India.

The Quaternary blanket forms a conspicuous landscape of river terraces in central segment of valley between representing the former level of valley floor of Narmada controlled by ENE –WSW to E-W lineament. The Narmada has formed three regional terraces besides its flood plain (NT). These are polycyclic depositional terraces and are designated as NT1, NT2 and NT3 in increasing order of antiquity from the present course of river. These terraces display convergence and divergences in their relative disposition and are separated by linear or curvilinear scarp facing the river.

The NT1 is the youngest lowest terrace forming present flood plain of the Narmada and is marked by a scarp. It is restricted within the meandering loop of Narmada; is a depositional terrace and has convergent relation with older terraces and is of cyclic nature. The NT2 is a regional terrace occupying the central part of valley, separated by conspicuous scarps from NT3 and NT1. It is an erosional terrace and forms the main alluvial plains of the Narmada, is a cyclic terrace and has paired equivalents across the valley. It exhibits divergent relationship, with NT3 and

present day course of Narmada along the outer flanks of the valley, resting either on the Vindhayan or Deccan basaltic rocks. The relative disposition of older terraces NT2 and NT3, their cyclic nature, and divergent relationship amongst each other and with the present course of river in the valley indicate high energy condition of Narmada during the formation of these terraces. The non-cyclic nature of NT1 and its convergent relation with NT2 and NT3 and present day course of Narmada indicates climatic changes towards the later history of sedimentation. The overall disposition of these terraces in the valley, their relative convergent and divergent relation and their relation to the present day course of river, indicates constant decrease in the rate of uplift in watershed region and consequent decrease in energy condition of Narmada towards later Quaternary time.

Table No 1:- Morphostratigraphy of the Narmada Alluvium.

Terrace Elevation above MSL	Nature of its Origin	Morphostratigraphy
NT ₀ 260-280 m	Depositional	Light grey to dark grey sand and silt
NT ₁ 280-300- m	Erosional / Depositional	Light grey to dark grey sand and silt with rock pebble sand and silt
NT _{2A} 300-320 m	Depositional	Grey & brown sand and silt.
NT _{2B} 320-340m	Depositional	Yellow brownish clay with silt
NT _{2C} 340-360 m	Erosional / Depositional	Yellow brownish clay with silt with
	Dark brown oxidized clay silt	
NT _{3A} 360-380 m	Depositional	Dark brown, dark yellow clay silt Brownish red clay and silt with Calc-matrix.
NT _{3B} 400 m	Erosional/ Depositional	Dark brown, dark yellow clay silt Brownish red clay and silt with Calc-matrix

Janwasa Surface :- (NT0)

It is the youngest surface of the Narmada in the area. It is noticed above the present day flood plain of Narmada at an average elevation of about 280 m above the m.s.l. This surface is characterized by lack of drainage, gentle slope and scanty vegetation. The geomorphic features associated with this surface are strand lines, meander scroll, and active flood plain. It is observed around Hoshangabad, Shahganj, Hathnora and Upstream of Sardarnagar.

Hoshangabad:- (NT1)

It is older than Narmada surface and named after Hoshangabad (22 15 – 77 43) town where it is best developed. The surface forms the morpho-stratigraphic unit and is identified at an average elevation of about 295 m, above m.s.l. around Hoshangabad, Sahaganj, Hathnora, Narayanpur, Dheri and Ramnagar. It is crescent shaped and is characteristically restricted within the meander of Narmada exhibiting diagonally disposed paired equivalents in the valley. It represents the sediments of palaeo-domain of Narmada predominantly consisting of sand, silt and rock gravel. The top soil mostly comprised of light yellow and grey clay silt of about 1.20 m. The depth of weathering varies from 0.35 to 1.50 m. and average depth is 1.15 m. The streams which drain this surface are mostly impersistent and partly of internal nature. These streams are generally sub-parallel to parallel and sub-dendritic in nature and appear to have been controlled by concealed fracture planes. The various erosional pattern identified in this surface are rill erosion and gully erosion.

The Sahaganj surface (NT2):-

It is older than Hoshangabad surface, is identified at an average elevation of 310 m. above m.s.l. named after Sahaganj (22 51-77 47) the prominent village situated on this surface. It is a vast Quaternary surface and forms the central Narmada plain. It is separated from Hoshangabad surface (NT1) by conspicuous scarp along Narmada exposing thick sequence of Quaternary sediments in the bluff section. The bluff scarp of Narmada which persistently extends from Jabalpur to Harda along Narmada indicates sharp incision of valley floor by river which appears to be related with the reactivation of E-W trending lineament suggesting significant tectonic event in the Narmada valley in Quaternary time Khan et.al (2016). The heights of sharp edge scarp vary from 11 to 20 m., the average height is about 16 m. which increases upstream.

The Sahaganj surface is separated from Sohagpur surface by a curvilinear scarp rising to the average height of about 18 m. Though the scarp is quite prominent and forms the stepped sequence of terraces in the valley, at places it is distorted by erosional processes, creep and mass wasting activities along the scarp faces. The development of linear convex slopes along the scarp due to accumulation of mass wasting debris is the prominent feature.

This surface is deeply incised by network of small gullies and has developed small linear tracts of ravines north of Narayanpur, north east of Sardarnagar on the northern bank, around Dhansi and north of Balgaon on the southern bank of Narmada. It displays typical undulating bad land topography with micro scarps of average height of 3.25 m. The prominent topographic breaks and undulations on this surface are noticed along subsequent and insequent stream rising from Vindhyachal in north and Satpura in south and draining in the valley. The extensive land dissection and intensive gullying on this surface is noticed along Narmada in Narayanpur, Hoshangabad, section around Sardarnagar, Hathnora, Sukkawara, east and south east of Sahaganj.

This surface forms the conspicuous landscape (NT2) of Narmada and represents the former level of valley floor. It consists of sediments of palaeo-domains of Narmada predominantly comprising of yellow, grey and reddish brown silt, clay sand and rock gravel. These sediments are capped by black cotton soil. The soil thickness varies from 1.35 m to 2.90 m. and average thickness is about 2.25 m. The weathered zone mostly follows the profile and an average depth of this zone is about 2.80 m. This surface is drained by sup-parallel to parallel streams which appears to have been controlled by concealed fractures and lineaments. The prominent streams draining this surface are Chandani Nadi, Dobi Nadi, Katkasari Nadi, Nanawara Nadi and Palkamti Nadi. The various erosional patterns in this surface are soil erosion, deep gully erosion and accelerated headward erosion.

The geomorphic features associated with this surface is a cut off meander identified around Tamcharu (22 47 30-77 53 10) on the southern bank of Narmada. The linear length of cut off meander is about 11 kilometers, width varies from 250 m to 750 m and average width is 575 m. It is marked by a scarp which rises to the height of about 10 m. The slope is 2-5 towards north. It represents the paleo-course of Narmada and is locally known as “Budhi Narmada”. The relative disposition of this cut off meander, slope elements and its relation to present course of Narmada indicates subsidence of southern block of Narmada and consequential sudden shift of Narmada towards north due to tectonic dislocation and reactivation in the energy system of channel under compressive environment in recent past.

Sohagpur Surface (NT3):-

It is oldest Quaternary surface (NT3) of the Narmada identified at an elevation of about 325 m. above m.s.l. and named after Sohagpur (22 15 – 77 59) the main town situated on this surface. It occupies large area in the south and south eastern corner of the area. It extends from Sohagpur in the east to the Rajpura in the west on the south bank and from Makalbara in the east to Kewalajhir in the west on northern bank of Narmada. It occurs at about 40 m. above the present day channel of Narmada and has gentle slope towards the west.

It represents the sediments of flood plain facies of paleo-domains of Narmada consisting of yellow red and brownish silt, clay containing fairly good amount of calcareous concretion and ferruginous matrix. It is capped by black cotton soil measuring about 3.25 m. The depth of weathering follows the soil profile with an average depth of about 3.50 m. It is drained by Rain Nadi, Tangas Nadi and Palakmati Nadi which are sub-parallel to parallel and are influenced by concealed fracture and lineament. The various erosion pattern noted on this surface are rill erosion, gully erosion and headword erosion.(Plate No 1,2 4,&5). The diagnostic features and elements of terraces are incorporated in the Table No 1 to 7

Salient features of fluvial terraces in type area of jabalpur in nrmada valley:-

TABLE NO_2	GEOMORPHOLOGY AND DIGONESTIC ELEMENTS NRMADA VALLEY							Peniplain Pediplain	Pediplain
Locality SOHAGPUR	Rive r bad	NT0	NT1	NT2-A	NT2-B	NT2- C	NT3-B NT3-C	PP	PD
Age -----								HOLOCENE-----	
Elavation above MSL (m)	300	310	320	328	340	345	355	358	362
Geomorphic	0.00	10.0	10.00	8.00	12.00	5.00	10.00	13.00	17.00

break (m)		0	Aluvial section	Aluvial section with sediment well bedded	Composit Rock cut terrace with recent sediments layer	Rock cut terrac e with recent	Composi t Rock cut terrace with recent sediment s layer	Gradual	Distinct
Elavation above RB (m)	0.00	10.00	20.00	28.00	4000	45.00	55.00	58.00	62.00
Slope	- NS-SW---Towards west			NS-SW -- Towards west	Towards west & NS-SW, NE-SW		S-SSW	S-SSW	
Nature of surface	Erosional / Depositional --				Erosional / Depositional. Erosional		Erosional & partly deposition al	Erorosional	
Cycle Sedimentation	Section depicts up ward cyclic sequence with incomplete cycle NTo , NT1.Polycyclic with breaks NT2-A NT2-B NT2-C						Cliff section not exposed NT3-B NT3-C		
Orientation of W-Axes	ENE-WSW to E-W, NW-SE		ENE-WSW to, E-W	ENE-W NW- SW	ENE-WSW, NW-SE	E-W & NW-SE	ENE-WSW, NW-SE E-W		
Plunge of L-Axes	-----Towards west-----			-----Towards NE-----		-----To wards NE-----			
Relative disposition	Convergent		Divergent		Divergent		Divergent		Divergent
Paired/Unpaired	Unpaired Isolated Patches		Unpaired		Paired section not exposed		Paired		Paired /
Nature of scarp	-----Curvilinear-----		Curvilinear		-----Linear-----		Linear-----		Linear--
Sedimentary feature	Graded bedding , Cross bedding, Lamination, cross lamination			Graded bedding , Cross bedding, Lamination, cross lamination & Cut and Fill features					
Terrace shape	----- Cresent / Cuspate-----		----- Rectangular-----						
Land use pattern	-----Inhabitation and cultivation-----						Forest cover area ----- In habitation & Cultivation-----		
Composition/Litho constituents arranged in probable order of abundance /The rock gravel of river terraces range in size from boulder to small pebble. The finer clastics comprise of very coarse to very fine sand, silt and clay. These rock febrics are	River bad : Quartzite, gneiss, granite, basalt, sandstone, limestone , Augate, Jaspar, schist, , slate, sand and silt. NTo : Quartzite, gneiss,, basalt, ,granite, limestone, sandstone, phyllite, slate, shale, sand and silt NT1 : Quartzite, gneiss, meta basic , basalt, granite sandstone, phyllite, , schist shale sand and silt. NT1-A : Quartzite, granite, gneiss, meta basic sand stone, lime stone schistphyllite, slate, shale, sand silt and clay. NT2-B : Quartzite gneiss, granite, sandstone, limestone, schist, meta basic, slate, sand, silt and clay. NT2-C : Quartzite gneiss, granite, sandstone, limestone, basic schist, slate, phyllite, sand, silt and clay NT3-A : Quartzite gneiss, granite, meta basic basalt limestone, sand stone slate schist, , sand, silt and clay. NT3-B : Quartzite limestone sanstone, gneiss, granite, basalt schist, phyllite, slate, meta basic basic sand, silt and clay. Boulder Conglomerate : Sub angular to sub rounded boulder cobble pebble of Quartzite, gneiss, basic, schist, granite sandstone, Phyllite , slate, shale sand and silt. The fine matrix of sand ,clay								

generally surrounded to well rounded and mostly spherical, oblate, prolate and bladed in shape.	and silt is cross bedded, laminated with cut and features Boulder Bed: sub angular to angular, sub round hybrid and heterogeneous assorted rock fabric of Quartzite limestone, gneiss, granite, schist, , slate, sand, silt and clay.
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Salient features of fluvial terraces in type area of jabalpur in nrmada valley:-

TABLE NO_3	GEOMORPHOLOGY AND DIGONESTIC ELEMENTS							Peniplain	Pediplain	
	NRMADA VALLEY									
Locality: UDAIPUR-BARI BARELLI SECTION	Rive r bad	NT0	NT1	NT2- A	NT2-B	NT2-C	NT3-B NT3-C	PP	PD	
HOLOCENE										
Elavation above MSL (m)	290	300	310	322	332	340	350	354	360	
Geomorphic break (m)	0.00	10.0 0	10.00 Alluvial section of composit sediment s	12.0 0	10.00 Alluvial section o n rock cut base	8.00 Alluvia l section o n rock cut base	10.00 Rock cut surfac e	14.00 Gradual	20.00 Distinct breaks with rock relicts	
Elavation above RB (m)	0.00	10.0 0	20.00	32.0 0	42.00	50.00	60.00	64.00	70.00	
Slope	- NS-SW, S-E--- Towards west		NS-SW -- Towards west		Towards west & NS-SW, NE-SW		S-SSW	S-SSW		
Nature of surface	Erosional / Depositional / Relict				Erosional / Depositional. Erosional		Erosiona l	Erosiona l		
Cycle Sedimentation	Section depicts up ward cyclic sequence with incomplete cycle NT0 , NT1 NT2-A, Polycyclic with breaks NT2-B NT2-C						Cliff section partly exposed of NT3-B NT3-C which depicts upwards fining sequence of sediments			
Orientation of W- Axes	ENE-WSW to E-W,		ENE-WSW to, E-W, NW-SE		ENE-W NW- NE-SW	ENE- WSW, E-W	E-W & NW-SE	ENE-WSW, NW-SE E-W		
Plunge of L-Axes	-----Towards west-----				-----Towards NE-SE		-----Towards west-----			
Relative disposition	Convergent		Divergent		Divergent		Divergent		Divergent	
Paired/Unpaired	Unpaired		Unpaired		Paired		Paired		Paired / Isolated Patches	
Nature of scarp	-----Curvilinear-----		Curvilinear -----		-----Linear-----		-----Linear-----			
Sedimentary feature	Graded bedding , Cross bedding, Lamination, cross lamination				Graded bedding , Cross bedding, Lamination, cross lamination & Cut and Fill features					
Terrace shape	----- Cresent / Cuspate-----				----- Rectangular----- ----- Isolated cap					

Land use pattern	-----Inhabitation and cultivation----- Forest cover area----- In habitation & Cultivation-----
Composition/Litho constituents arranged in probable order of abundance /The rock gravel of river terraces range in size from boulder to small pebble. The finer clastics comprise of very coarse to very fine sand, silt and clay. These rock febrics are generally surrounded to well rounded and mostly spherical, oblate, prolate and bladed in shape.	<p>River bad : Quartzite, gneiss, granite, basalt, meta basic , sandstone, limestone , Augate, Jaspas, schist, , slate, sand and silt.</p> <p>NT0 : Quartzite, gneiss,, basalt, ,granite, limestone, sandstone, phyllite, slate, shale, sand and silt</p> <p>NT1 : Quartzite, gneiss, meta basic , basalt, granite sandstone, phyllite, , schist shale Augate, sand and silt.</p> <p>NT1-A : Quartzite, granite, gneiss, meta basic sand stone, lime stone schist,phyllite, slate, shale, sand silt and clay.</p> <p>NT2-B : Quartzite gneiss, granite, limestone, sandstone, schist, meta basic, slate, sand, silt and clay.</p> <p>NT2-C : Quartzite gneiss, granite, sandstone, limestone, basalt and meta basic schist, slate, phyllite Jaspas, sand, silt and clay</p> <p>NT3-A : Quartzite gneiss, granite, meta basic basalt limestone, sand stone slate schist, , sand, silt and clay.</p> <p>NT3-B : Quartzite limestone sanstone, gneiss, granite, basalt schist, phyllite, slate,sand,silt and clay.</p> <p>Boulder Conglomerate : Sub angular to sub rounded boulder cobble pebble of Quartzite, gneiss, basic, schist, granite sandstone, Phyllite , slate, shale sand and silt. The fine matrix of sand ,clay and silt is cross bedded, laminated with cut and features</p> <p>Boulder Bed: sub angular to angular, sub round hybrid and heterogeneous assorted rock febric of Quartzite limestone, gneiss, granite, schist, , slate, sand, silt and clay.</p>

Salient features of fluvial terraces in type area of jabalpur in nrmada valley valley:-

TABLE NO_4	GEOMORPHOLOGY AND DIGONESTIC ELEMENTS NRMADA VALLEY							Peniplai n	Pediplai n
Locality: SARDARPUR	Rive r bad	NT0	NT1	NT2-A	NT2-B	NT2-C	NT3-B NT3-C	PP	PD
Age	HOLOCENE								
Elavation above MSL (m)	285	295	300	310	325	335	340	343	348
Geomorphic break (m)	0.00	10.00 Bank scar	5.00 Alluvia l section	10.00 Alluvia l section	15.00 Alluvia l section	10.00 Alluvia l section o n rock cut base	10.00 Rock cut surfac e	13.00 Breaks grdual with rock relicts and soil cover	18.00 Distinct breaks with rock relicts
Elavation above RB (m)	0.00	10.00	15.00	25.00	40.00	50.00	60.00	63.00	68.00
Slope	- NS-SW, S-E--- Towards west		NS-SW --Towards west		Towards west & NS-SW, NE-SW		S-SSW	-SSW	
Nature of surface	Erosional Rock cut surface / Depositional / Relict			Erosional / Depositional. And valley fill Erosional			Erosiona l	Erosiona l	
Cycle Sedimentation	Section depicts up ward cyclic sequence with incomplete cycle NT0 , NT1 NT2-A, Polycyclic with breaks / with upward fining NT2-B NT2-C						Cliff section partly exposed of NT3-B NT3-C which depicts upwards fining sequence of sediments		
Orientation of L -		ENE-	ENE-	ENE-W	ENE-	E-W & NW-	ENE-WSW,		

Axis		WS W to E-W, NW- SE	WSW E-W, to,	NW- NE- SW	WSW, E- W	SE	NW-SE E-W	
Plunge of L-Axis		-----Towards west-----		-----Towards NE-SE		-----Towards East-----		
Relative disposition		Convergent	Divergent	Divergent	Divergent	Divergent	Divergent	
Paired/Unpaired		Unpaired		Unpaired	Paired	Paired	Paired / Paired /	
Nature of scarp		-----Curvilinear----		Curvilinear	-----	-----Linear-----	-----	
Sedimentary feature		Graded bedding , Cross bedding, Lamination, cross lamination			Graded bedding , Cross bedding, Lamination, cross lamination & Cut and Fill features			
Terrace shape		----- Crescent / Cuscate-----			----- Rectangular-----			
Land use pattern		-----Inhabitation and cultivation-----					Forest cover area -----	
Composition/Litho constituents arranged in probable order of abundance /The rock gravel of river terraces range in size from boulder to small pebble. The finer clastics comprise of very coarse to very fine sand, silt and clay. These rock febrics are generally surrounded to well rounded and mostly spherical, oblate, prolate and bladed in shape.		River bad : Quartzite, gneiss, granite, meta basic , sandstone , basalt limestone , Augate, Jasper , , slate , , schist sand and silt. NTo : Quartzite, gneiss, , basalt , granite, meta basic , limestone, sandstone, phyllite, slate, shale, sand and silt NT1 : Quartzite, gneiss, meta basic , basalt, granite sandstone, lime stone, phyllite , schist shale Augate, sand and silt. NT1-A : Quartzite, granite, gneiss, meta basic sand stone, lime stone slate schist, phyllite , , shale, sand silt and clay. NT2-B : Quartzite gneiss, granite, limestone, sandstone, schist, slate meta basic, sand, silt and clay. NT2-C : Quartzite gneiss, granite, sandstone, limestone, basalt and meta basic schist , phyllite slate Jasper, sand, silt and clay NT3-A : Quartzite gneiss, granite, meta basic basalt limestone, sand stone slate schist , sand, silt and clay. NT3-B : Quartzite, gneiss, granite, basalt limestone sandstone ,schist, phyllite, slate,sand, silt and clay. Boulder Conglomerate : Sub angular to sub rounded boulder cobble pebble of Quartzite, gneiss, basic, schist, granite sandstone, Phyllite , slate, shale sand and silt. The fine matrix of sand ,clay and silt is cross bedded, laminated with cut and features Boulder Bed: sub angular to angular, sub round hybrid and heterogeneous assorted rock febric of Quartzite limestone, gneiss, granite, schist , , slate, sand, silt and clay.						

Table no_5:-	geomorphology and digonestic elements nrmada valley.							Peniplain Pediplain	Pediplain
Locality :HATHNORA	River bad	NTo	NT1	NT2-A	NT2-B	NT2-C	NT3-B NT3-C	PP	PD
Age	HOLOCENE								
Elavation above MSL (m)	280	290	300	305	315	325	330	333	338
Geomorphic break (m)	0.00	10.00	10.00	5.00	10.00	10.00	5.00	8.00	13.00
Elavation above RB (m)	0.00	10.00	20.00	25.00	35.00	45.00	50.00	55.00	60.00
Slope	- ---Towards west & NS		Towards west		Towards west & NS-SW,		S-SSW	S-SSW	

Nature of surface	Erosional Rock cut surface / Depositional			Erosional / Depositional and valley fill		Erosional /	Erosional /
Cycle Sedimentation	Section depicts up ward cyclic sequence with incomplete cycle NTo , NT1 Polycyclic with breaks / with upward fining NT2-A, NT2-B NT2-C					section covered by forest	
Orientation of L - Axis	Braided	ENE-WSW to E-W,	ENE-WSW to, E-W,	ENE-W NW-NE-SW	ENE-WSW, E-W	E-W & NW-SE	ENE-WSW, E-W NW-SE
Plunge of L-Axis		-----Towards East & NE	-----Towards East & NE	To wards East & NE			
Relative disposition	Convergent	Divergent	Divergent	Divergent	Divergent	Divergent	Divergent
Paired/Unpaired	Unpaired		Unpaired	Paired	Paired	Paired	Paired /
Nature of scarp	-----Curvilinear-----		Curvilinear	-----Linear-----	-----Linear-----		
Sedimentary feature	Graded bedding , Cross bedding, Lamination, cross lamination			Graded bedding , Cross bedding, Lamination, cross lamination & Cut and Fill features			
Terrace shape	----- Cresent / Cuspate-----		----- Rectangular-----				
Land use pattern	-----Inhabitation / cultivation-/ Forest cover area-----						
Composition/Litho constituents arranged in probable order of abundance /The rock gravel of river terraces range in size from boulder to small pebble. The finer clastics comprise of very coarse to very fine sand, silt and clay. These rock febrics are generally surrounded to well rounded and mostly spherical, oblate, prolate and bladed in shape.	River bad : Quartzite, gneiss, granite, meta basic , , basalt sandstone, limestone , Augate, Jaspasr, , slate, , schist sand and silt. NTo : Quartzite, gneiss,, basalt, ,granite, meta basic , limestone, sandstone, phyllite, slate, shale, sand and silt NT1 : Quartzite, gneiss, meta basic , basalt, granite sandstone, lime stone, schist phyllite, , shale Augate, sand and silt. NT1-A : Quartzite, granite, gneiss, meta basic sand stone, lime stone slate schist,phyllite, , shale, sand silt and clay. NT2-B : Quartzite gneiss, granite, limestone, sandstone, schist, slate meta basic, sand, silt and clay. NT2-C : Quartzite gneiss, granite, sandstone, limestone, basalt and meta basic schist, , phyllite slate Jaspasr, sand, silt and clay NT3-A : Quartzite gneiss, granite, meta basic basalt limestone, sand stone slate schist, , sand, silt and clay. NT3-B : Quartzite, gneiss, granite, basalt limestone sandstone, schist, phyllite, slate,sand, silt and clay. Boulder Conglomerate : Sub angular to sub rounded boulder cobble pebble of Quartzite, gneiss, basic, schist, granite sandstone, Phyllite , slate, shale sand and silt. The fine matrix of sand ,clay and silt is cross bedded, laminated with cut and features Boulder Bed: sub angular to angular, sub round hybrid and heterogeneous assorted rock febric of Quartzite limestone, gneiss, granite, schist, , slate, sand, silt and clay.						

Salient features of fluvial terraces in type area of jabalpur in nrmada valley valley:-

TABLE NO_6	GEOMORPHOLOGY AND DIGONESTIC ELEMENTS NRMADA VALLEY							Pediplain	Pediplain	
Locality : HOSHANGABAD	River bad	NT0	NT1	NT2-A	NT2-B	NT2-C	NT3-B NT3-C	PP	PD	
Age HOLOCENE										
Elavation above MSL (m)	260	270	280	285	295	310	315	318	322.00	
Geomorphic break (m)	0.00	10.00 Alluvi al section	10.00 Alluvia l section	5.00 Alluvia l section	10.00 Alluvia l section o n rock cut base	15.00 Alluvi al section o n rock cut base	5.00 Rock cut surface with thin layer of recent sedimen ts	5.00 Breaks gradual with and soil cover	4.00 Distinct breaks with rock relicts and imprints of erosiona l activity.	
Elavation above RB (m)	0.00	10.00	20.00	25.00	35.00	50.00	55.00	58.00	59.00	
Slope	- ---Towards west & SW		Towards west & SW		Towards west & SW					
Nature of surface	Channel braiding / Depositional			Erosional		Erosional / valley fill / Relict & isolated caps o rock cut benches		Erosion al /	Erosion al /	
Cycle Sedimentation	River bed with channel braids , poit bar, sand bars , braided channel. NT0 , NT1 section depicts up ward cyclic sequence with incomplete cycle. NT2-A, NT2-B NT2-C display Polycyclic with breaks / with upward fining					section not exposed and covered by forest and colluvium /scree deposit				
Orientation of L -Axis	Braide d / Grade d	ENE- WSW to E- W,	ENE- WSW to, E- W,	ENE- W NW- to N-E-	ENE- WSW, E-W NW- SE	E-W & NW- SE	ENE-WSW, E-W			
Plunge of L-Axis		-----Towards East-----		-----Towards NE-SE &E-W		To wards East and NE				
Relative disposition	Convergent		Divergent		Divergent		Divergent		Divergent	
Paired/Unpaired	Unpaired		Unpaired		Paired		Paired		Paired /	
Nature of scarp	-----Curvilinear----		Curvilinear		-----Linear-----		-----Linear-----			
Sedimentary feature	Graded bedding , Cross bedding, Lamination, cross lamination				Graded bedding , Cross bedding, Lamination, cross lamination & Cut and Fill features					
Terrace shape	----- Cresent / Cuspate-----							----- Rectangular-----		
Land use	----- Isolated cap -----Inhabitation / cultivation-/ Forest cover area-----									

pattern	-----
Composition/Litho constituents arranged in probable order of abundance /The rock gravel of river terraces range in size from boulder to small pebble. The finer clastics comprise of very coarse to very fine sand, silt and clay. These rock febrics are generally surrounded to well rounded and mostly spherical, oblate, prolate and bladed in shape.	<p>River bad : Quartzite, gneiss, granite, meta basic , , basalt , sandstone, limestone Augate, Jaspas, , slate, , schist sand and silt.</p> <p>NTo : Quartzite, gneiss,, basalt, ,granite, meta basic , limestone, sandstone, phyllite, slate, shale, sand and silt</p> <p>NT1 : Quartzite, gneiss, meta basic, basalt, granite sandstone, lime stone, phyllite, schist shale Augate, sand and silt.</p> <p>NT1-A : Quartzite, granite, gneiss basalt , meta basic sand stone, lime stone slate schist,phyllite, , shale, sand silt and clay.</p> <p>NT2-B : Quartzite gneiss, granite, limestone, sandstone, schist, slate meta basic, sand, silt and clay.</p> <p>NT2-C : Quartzite gneiss, granite, sandstone, limestone, basalt and meta basic schist, , phyllite slate Jaspas, sand, silt and clay</p> <p>NT3-A : Quartzite gneiss, granite, meta basic basalt limestone, sand stone slate schist, , sand, silt and clay.</p> <p>NT3-B : Quartzite, gneiss, granite, basalt limestone sandstone ,schist, phyllite, slate,sand, silt and clay.</p> <p>Boulder Conglomerate : Sub angular to sub rounded boulder cobble pebble of Quartzite, gneiss, basic, schist, granite sandstone, Phyllite , slate, shale sand and silt. The fine matrix of sand ,clay and silt is cross bedded, laminated with cut and features</p> <p>Boulder Bed: sub angular to angular, sub round hybrid and heterogeneous assorted rock febric of Quartzite limestone, gneiss, granite, schist, , slate, sand, silt and clay.</p>

TABLE NO_7	GEOMORPHOLOGY AND DIGONESTIC ELEMENTS NRMADA VALLEY							Pediplain	Pediplain /pediment	
Locality: NASRULLAHGUNJ	River bad	NTo	NT1	NT2-A	NT2-B	NT2-C	NT3-B NT3-C	PP	PD	
Age	HOLOCENE									
Elavation above MSL (m)	255	265	270	280	290	300	310	313	318	
Geomorphic break (m)	0.00	10.00	10.00	10.00	10	10.00	10.00	3.00	5.00	
Elavation above RB (m)	0.00	10.00	20.00	30.00	40.00	50.00	60.00	63.00	68.00	
Slope	- ---Towards west & SW		Towards west & SW		Towards west & SW					
Nature of surface	Channel braiding / Depositional			Erosional		Erosional / Depositional. valley fill			Erosional / Relict & isolated caps on rock cut benches / barren rock cut benches of basaltic rocks	
Cycle Sedimentation	River bed with rock cut benches , channel braids braided channel. NTo, NT1 section depicts thin veneer of quaternary sediments incomplete cycle. NT2-A, NT2-B NT2-C display upward fining sequence with incomplete cycle.						Rock cut benches and platform.			
Orientation of L -	Braided	ENE-	ENE-	ENE-	ENE-	E-W	ENE-WSW, E-W			

Axis	/ Graded	WSW to E-W,	WSW to, E-W,	W NW-to N-E-	WSW, E-W NW-SE	& NW-SE	
Plunge of L-Axis		-----Towards East-----		----- Towards NE-SE &E-W	To wards East and NE		
Relative disposition	Convergent		Divergent		Divergent		Divergent
Paired/Unpaired	Unpaired		Unpaired	Paired	Paired	Paired	Paired
Nature of scarp	-----Curvilinear----		-----Linear-----		-----Linear-----		
Sedimentary feature	Graded bedding , Cross bedding, Lamination, cross lamination			Graded bedding , Cross bedding, Lamination, cross lamination & Cut and Fill features			
Terrace shape	----- Cusate----- Rectangular-----						
Land use pattern	-----Inhabitation / cultivation-/ Forest cover area-----						
Composition/Litho constituents arranged in probable order of abundance /The rock gravel of river terraces range in size from boulder to small pebble. The finer clastics comprise of very coarse to very fine sand, silt and clay. These rock febrics are generally surrounded to well rounded and mostly spherical, oblate, prolate and bladed in shape.	<p>River bad : Quartzite, gneiss, granite, meta basic , , basalt , sandstone, limestone Augate, Jasper, , slate, , schist sand and silt.</p> <p>NT0 : Quartzite, gneiss,, basalt, ,granite, meta basic , limestone, sandstone, phyllite, slate, shale, sand and silt</p> <p>NT1 : Quartzite, gneiss, meta basic, basalt, granite sandstone, lime stone, phyllite, schist shale Augate, sand and silt.</p> <p>NT1-A : Quartzite, granite, gneiss basalt , meta basic sand stone, lime stone slate schist,phyllite, , shale, sand silt and clay.</p> <p>NT2-B : Quartzite gneiss, granite, limestone, sandstone, schist, slate meta basic, sand, silt and clay.</p> <p>NT2-C : Quartzite gneiss, granite, sandstone, limestone, basalt and meta basic schist, , phyllite slate Jasper, sand, silt and clay</p> <p>NT3-A : Quartzite gneiss, granite, meta basic basalt limestone, sand stone slate schist, , sand, silt and clay.</p> <p>NT3-B : Quartzite, gneiss, granite, basalt limestone sandstone, schist, phyllite, slate, sand, silt and clay.</p> <p>Boulder Conglomerate : Sub angular to sub rounded boulder cobble pebble of Quartzite, gneiss, basic, schist, granite sandstone, Phyllite , slate, shale sand and silt. The fine matrix of sand ,clay and silt is cross bedded, laminated with cut and features</p> <p>Boulder Bed: sub angular to angular, sub round hybrid and heterogeneous assorted rock febric of Quartzite limestone, gneiss, granite, schist, , slate, sand, silt and clay.</p>						

Plate No.GH_ 1:-

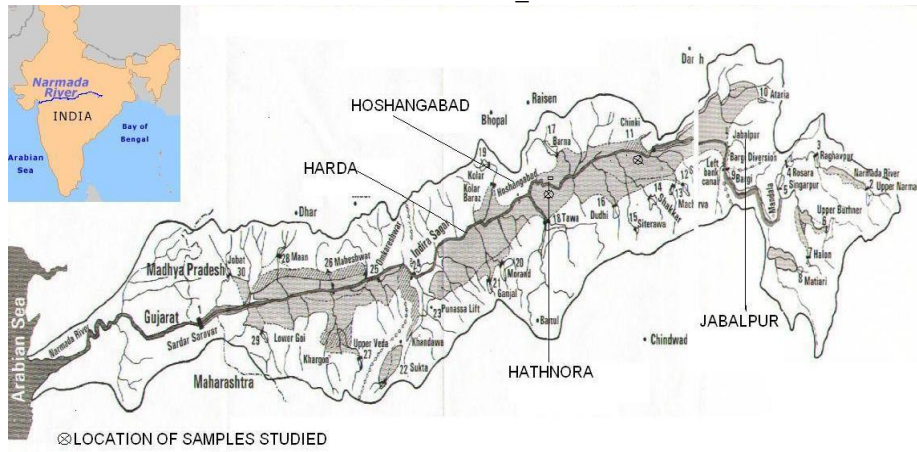


Plate NoGH_ 2:-

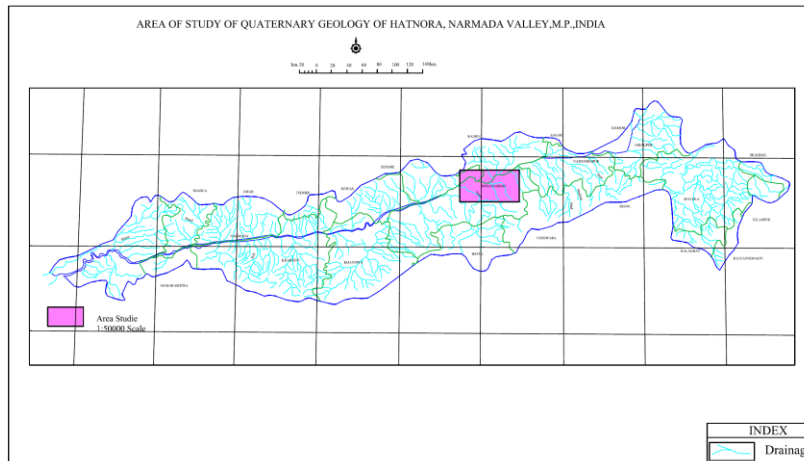


Plate NoGH_ 3:-

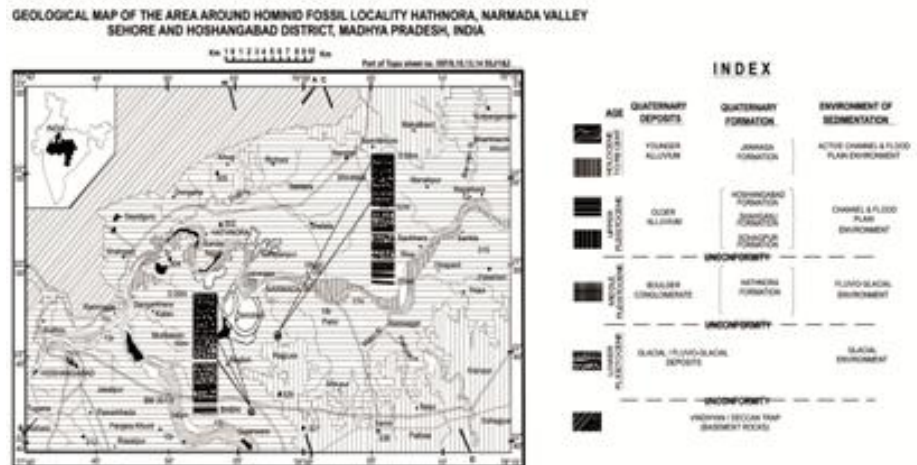


Plate No GH_4:-

GEO MORPHOLOGICAL MAP OF THE AREA AROUND HOMINID FOSSIL LOCALITY HATHNORA, NARMADA VALLEY SEHORE AND HOSHANGABAD DISTRICT, MADHYA PRADESH, INDIA

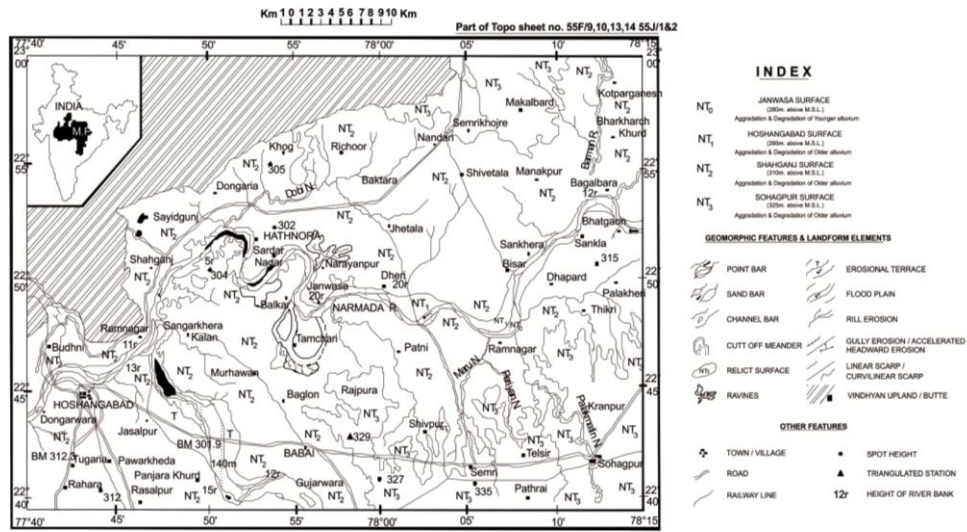


Plate No GH_5:-

CROSS SECTIONS OF QUATERNARY DEPOSITS OF NARMADA VALLEY, SEHORE & HOSHANGABAD DISTRICTS, MADHYA PRADESH, INDIA

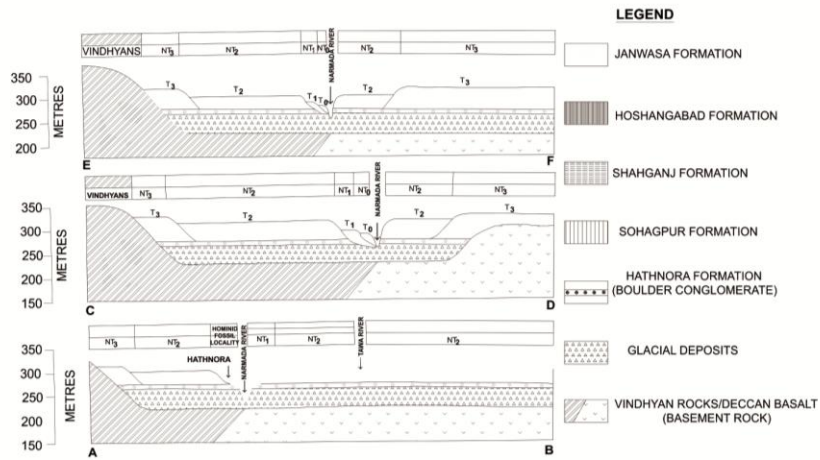


Plate No GH_ 6:-
LITHOSTRATIGRAPHIC SECTION OF QUATERNARY DEPOSITS OF HOMONID FOSSIL LOCALITY HATHNORA
NARMADA VALLEY, SEHORE & HOSHANGABAD DISTRICTS, MADHYA PRADESH, INDIA

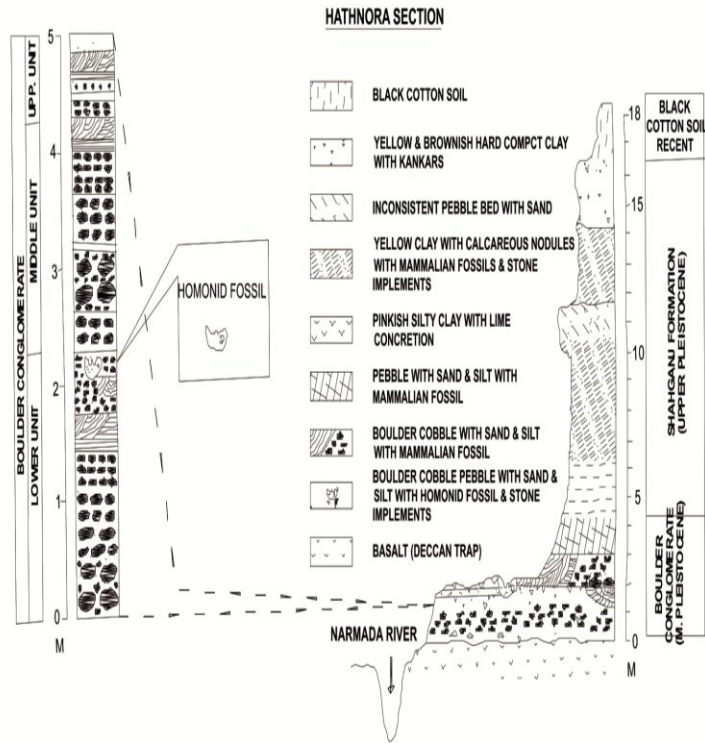
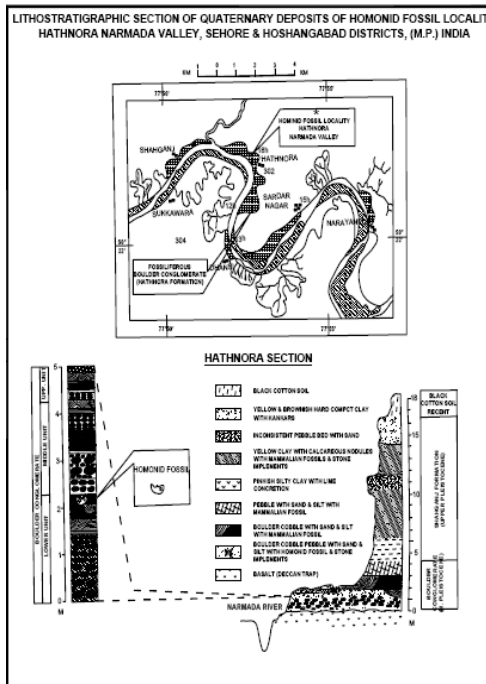


Plate No GH_ 7:-



Summary & Conclusion:-

Narmada River originates at Amarkantak at an elevation of about 1057m above m.s.l. It descended from the mountainous tract traversing over a distance of 1280 km across the middle of the Indian sub-continent to join the Gulf of Cambay, near Baroda in Gujrat state. The area of study around Homonid locality Hathnora forms the part of central sector of Narmada, it is bound by Vindhya in the north and Satpura range to the south; the area in between these two upland is found to be ideal locus of sedimentation as witnessed by the presence of Quaternary landscape and multicyclic sequence of Quaternary terraces in the valley. The general elevation of Narmada alluvial plain varies between 00.00 to 65.00 m in lower Narmada and 65.00 to 95.00 m in upper Narmada valley above the sea level. The general gradient of this plain in this stretch is about 1m /km towards west.

The Narmada conspicuously has straight course is controlled by ENE_WSW to E_W lineament, is bounded by Vindhyan in the north and Satpura in the south it is exposed the repeated post erisional and depositional activities and subjected to anisotropic and asymmetric tectonic dislocation which has culminated diversified units and region which further undergone to process of tectonic evolution and chiseling of terrain by dynamic erosional and depositional activity resulting in and reshaping the terrain into various morphogenetic units and land form elements, re-configuration of drainage, topography, physiographic, erosional platform, planation surfaces, denudation ridges, structural units linear valleys, strike hills, valley gapes, escarpments and river terraces. The cumulative dynamics of structural deform, rinsing and sinking platform of Narmada has also manifested concealed cyclic mechanism of tectonics, seiesmicity, neosiesmic events and in surface manifestation. In addition the valley gapes and valley trenches provided ideal sites and platform for accumulation& sedimentation.

The Narmada Rift valley formed a linear trench in the middle of Indian subcontinent was an ideal locus for accumulation of sediments. The rift trench is intruded by the dolerite and other mafic and siliceous dykes and sills along lineaments in different phases of tectonic deformation. The Quaternary sedimentation incepting from glacial activity, followed by fluvio-glacial, lacustrine and fluvial phase within the rinsing and sinking environment, block, faulting, uplifting, isolated domal up- lift, Neogene rifting, Quaternary sedimentation, rift-bound Pliocene–Pleistocene rifting and volcanic activity specifically during glacial and fluvio-glacial phase are major component of the Quaternary period and tectonic processes of the Narmada Rift System which forms the base of quaternary deposits.

The glacial and fluvio-glacial deposits of Narmada unconformable overly the Vindhyan and the basaltic Deccan Trap rocks. The sediments consist of a Hetero-heterogeneous assemblage of sub-angular to angular, sub-rounded, unsorted, stratified rock fragments ranging from boulders to small pebbles, predominantly of quartzite, gneiss, sandstone, basalt, jasper, chert, gneiss, sandstone, basalt, chert, altered feldspar, ferruginous nodules, in a matrix of very coarse to very fine-sand, silt and clay. The sediments of glacial domain of Narmada occur between an average depth of about 320-265 below the surface and were deposited in glacial environments during Pleistocene time. These deposits are concealed under boulder conglomerate in the valley. The conglomerate bed that constituted the fossiliferous horizon of Narmada is sandwiched between older Alluvium and the glacio-fluvial boulder bed. This conglomerate bed is a very persistent marked horizon indicating a distance phase of sedimentation in the Narmada Valley. It is exposed in the bluff/scrap of Narmada around Sardar Nager, Hathnora, Surajgarh, Budhni, Hoshangabad, Khoksa, Tigharia, Demawar and Bhariya-Ghat at the base of terraces NT₂ (Khan, 1984). The boulder conglomerate predominantly consists of sub-rounded to well-rounded boulder, cobble and pebble of quartzite, gneiss, sandstone, basalt, agate, jasper, chert, chalcedony tightly cemented in a matrix of sand and silt. These deposits identified between an average elevations of 245 to 300 m above m.s.l. the basal unit of boulder conglomerate identified is marked at an elevation of about 268 m above m.s.l, exposed on the northern bank of Narmada around Hathnora (22° 52' N - 77° 52' E) at the depth of about 83 m in stratigraphic column of Quaternary sediments of Narmada.

The sediments of paleo-domain of Narmada conformably overlies the boulder conglomerate and represent the flood-plain fluvial facies of the Narmada. The sediments of the facies predominantly consist of clay silt and sand, discontinuous nodules and plates. The beds are horizontal, exhibit upward fining sequence typical of fluvial deposits. This domain may be divided into three formations based on lithology, sediment assemblage, shape and size of rock clastics, relative disposition and diagnostic sedimentary characteristics. These formations are, viz. (i) Shohagpur, (ii) Shahganj, and (iii) Hoshangabad Formations respectively. These formations represent the sediments the complete sequence of Narmada deposited in channel and flood plain environments during Upper Pleistocene times. The lowest Shohagpur Formation is named after Shohagpur town. The unit occurs along the outer

flanks of Narmada Valley bounded by Vindhya range to the north and Satpura to the south. It consists of sediments of paleo-domain of Narmada. It is represented by a thick sequence of clay, silt-sand and rock gravels.

In Narmada rift valley the quaternary sediments are accumulated in two section viz Jabalpur-Harda section and Guredhwar and Bharouch section where as in other area Harda to Gurudeshwar section of valley rock cut terraces, rock cut platform and benches are notices which at many places over lie by caps and strips quaternary deposits representing the former level of valley floor of Narmada. The rock cut terraces and rock cut benches are time equivalent to NT1 to NT3 which have developed in Jabalpur-Harda and Gurudeshwar –Bharouche sections. Khan et.al (2016). The Quaternary events of the Narmada portys three prominent terraces and two sub terraces in these sections which are designated NT1 to NT3 and sub terraces NT2-A is NT2-B, NT2 B, besides NT2-C, NT3-A & NT3-B besides NT-0 in the valley. They have been designed NT₀ to NT₃, (280 to 400 m), NT₀ being the low level terrace above the present-day course of the river, NT₁-the younger terrace both of cyclic ad o cyclic nature. The NT₃ terrace occurs as elongated strip and isolated caps and lenses along the margin of valley flanks has divergent relative disposition. These land forms indicate vigorous and abrupt incision of valley floor due to relatively & repaid uplift of watershed area during Upper Pleistocene time. The NT₁ to NT₂ are the major depositional terrace and have both convergent & divergent mutual disposition with other terrace. These terraces further downstream have matched equivalents along the valley flanks, whereas in the up stream section the matched equivalents are rare. The conspicuous divergent relation of these terraces the valley reveals successive uplift of catchments area and consequential incision of valley floor and adjustment of base level of Narmada during Upper Pleistocene time.

The sequence of quaternary dposits depicts cyclic transitional environmental of the rift basins are caused by tectonic activities (uplift and subsidence), changes in relief, and climatic variations. The climatic changes in uplift, coupled with block faulting, rinsing and sinking platform, created basins unstable platform for the accumulations of thick lacustrine and fluvial sediments sequences with terrestrial and aquatic fossils. The evidence of the effects of tectonics on fauna and flora are distinct and its signatures on dislocation and concealing of fossiliferous horizons are uncontrolled and ill defined in the ecosystem in the valley during the Pliocene–Pleistocene periods. The boulder conglomerate which yielded the skull cap of *Homo eructs* in Narmada rift from Hathnora Sonakia (1984) remained only discovery of hominid fossil in last two and half decade due inconsistency and concealed nature of fosilifrous horizon due faulting, and subsidence of Quaternary blanket of Narmada rift system as such researcher and scientist failed to add any further knowledge to hominid discovery.in Narmada valley..

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