ASPECTS OF RELIEF ON RECONSTRUCTION OF PALAEO ENVIRONMENT AND PALAEOHYDROLOGY IN THE DRAINAGE BASIN OF HASDEO RIVER OF CHHATTISGARH STATE OF INDIA

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ABSTRACT

Alluvial records are terrestrial repository of information on environmental changes that occurred in the geological past in a region. The soil profile properties are seen to be dependent on climatic and vegetation inputs as well as on parent material and in all ill-defined way on relief. However precisely what aspects of the relief are important has never been adequately established. This has been investigated in this paper.

Environmental conditions are inferred generally from surface and buried soils of such bodies of sediment which have been deposited pen-contemporaneous with and subsequent to each environmental change.

Based on pedagogical aspects of alluvial soils particularly soil layering (verves) texture profile features along palaeoslopes, detailed analysis of relief features reconstruction of palaeohydrology of Hasdeo river basin has been worked out. The stratigraphy, morphology and Sub – fossils of colluvialdeposited in the area of study have adequately revealed palaeohydrological conditions of the Hasdeo drainage basin.

Keywords – Terrestrial, Pene-contemporeneouns, Palaeohydrology.

Introducing the Area -Hasdo Basin location map (Plate No.1)depicts the physical and natural setting on a regional scale. Hasdo drainage basin with its geographical area of 10,489 squares kilometer is spread between the latitudes of $21^0$41'N to 23^0 3'N and longitudes of 82^0 05'E, to 83^0 03’ E, The river takes its origin from a place which is about 10 km north of village Sonhat (Sarguja District). The origin point is (23^0'30 N and 82°30' E) located at an elevation of 915 AMSL. The Plate No2 depicts and describes the physiographic Division in the drainage basin. After flowing over distance or about 333 Km HasdoRiver joins Mahanadi in south which runs from west to east.

Hasdo river finds a unique place in the Indian Peninsular. Great water shed divide that separated Son valley in the; north and Mahanadi valley in the south marks the present northern water shed boundary ofHasdo drainage basin. In the east lies Sarguja basin, the drainagetiter shed divide separates north (owing Rinhand river as per the; master slope of

Sarguja basin from southflowing Hasdo river against the master slope of Mahanadi valley (refer plate No.)

The Southern part of Hasdo Basin particularly below latitude of $22^0 15'$ was submerged under Vindhyan sea, which later on emerged due to upheaval the whole sequence of Cuddapah formation overlying unconformable on Precambrian Dhawarian plate form.

Gondwana sedimentation in this basin heralded by wide spread alterations as inferred from the wide spread glace gene Talcher formation in the central south to north central part of the basin The made of ice advancement in the heart land of the basin is inferred from the characteristic distributional pattern in the low lying area of thebasin.

(2) Quaternary Deposits- Alluvial record of;the basin is a terrestrialrepository of environment changes the basin had undergone in thevarious periods of geological epochs. Pedological aspects of flood plains offer some clues to palaeohydrology and those aspects of alluvial soils of greatest interest are found in soil layering, texture, profile features etc, Much important palace environmental information's are deciphered from flood plains and terraces surface and burried soils of such bodies of sediment to infer environmental Conditions pen contemporaneous with, and subsequent to deposition. These aspects will be discussed sub sequently but before it is first necessary to examine the relationship between soil formation and the hydrology.

(3)Models Of Hydrology And Soil Formation— Most or the soil profile properties are seen to be dependent on climatic and vegetation inputs as well as on the parent material and also on relief. The classic models of soil formation (Jenny **1941)** consider soil as a static entity in relation to the flow of water and sediment through the drainage basin.

In this investigation such aspects of relief which imparts crucial and critical effect on slope hydrology has been studied. Now water movements through drainage basin both as surface and sub-surfaceflow are responsible and related to transfers of soil and sediment which modify the land-scape and to the hydrological regime, consequently they help initiate renewed and often very different soil formation. Toaccommodate such realities it is desirable to consider Nine-unit land surface model (fig) prepared by, Coacher and Darrymple (1977).Their assumption that the critical consideration's are the lateral movements of surface materials and the lateral andvertical translocation of soil constituents offers a real chance of understanding the relation between soils and hydrology. These units and pathogenic process in relation to slope are described in figure as below :- (see figure)

In the Hasdo basined area 8 (eight) dominant units dealing with slope and hydrology have been identified.(1) Crest (waxing slope) (1) The free face (Scarp) (3) Rectilinear slope (4) Concave slope (5)alluvial foot slope (6) alluvial toe slope.(7) channel wall (8) channel bed. Convexity of slope and development of convex slope profile on the crest is caused due to sheet-erosion which starts with the downsplash of rain water on the summits convexity of slope has beenobserved on all the ridges in the Hasdo basin. The free surface or scarpoccurs in range and starts from the source area of Hasdo River to itsmiddle reach and all of them trend in North West to south-east direction with angle of slope more than 42^0 The rectilinear slope profiles are formed by the accumulation of debris at the base of; the free face or beneath the crests of the summits, the slope angle is between $25\text{-}30^0$

(4) SOIL-SLOPE RELATIONSHIP :- Stability of soil profiledeveloped on landscape depends upon the overall effect of geomorphologic factor and so the stability depends and closely related to the soils position in a landscape- notably its relationship toslope and to the processes operating on slopes. Slope controls the hydrological characteristics of the site, the drainage relationship and the position of the water table. The control exercised by slope has longbeen recognised in the literature. In the **CATENACONCEPT**. Milne(1947) followedby Fitzpatrick (1971) and Glenworth& Dion (1949) have described the concept which is illustrated below in the figure which is selfexplanatory. (Figure)

(5) Field Investigations: Quaternary deposits uncomfortably over the lower Gondwana group of rocks and are confined along the bank of Hasdo river and its tributaries Hasdo valley is main occupied by Talcher rock. Quaternary sediments deposited by the Hasdo River and most of its 7th and 8th order tributaries can be classified as:

(a) Stabdised Hill Wash Sediment
(b) Older Alluvium
(c) Younger Alluvium

Overlying the Talchir rock extensive and thick pile of semi consolidated COLLUVIAL deposit in the vicinity of hill. The colluvial deposit forms hillocks, knolls, mounds and have been subjected to erosion by recent erosion cycle and gives rise to quite a few areas of deep cutting and dissection. The outcrops exposures are observed to possess reddish brown semi consolidated ferruginous saltyclay (perhaps derived from the erosion transportation and deposition of Talcher shale lying in the upper reaches in the geological past the collegial deposit hill near a place south and south east of Donger Paharshow the effect of lateralisation. About 50 mounds of stabilised colluvial deposit lying over the Talcher sandstone (south and south east of village kunkuna). The composition of these hill wash consists of material (Quartz feeds par mainly) derived from adjacent granite-gneisshills.

The older alluvium is formed bythe earlier flood plain deposits of Hasdo River and its tributaries like GejAhiran, Tan etc. Older alluvium exposed mainly on the bank section of Hasdo River and does not form a continuous morphostratigraphic unit. Away from the banks the older alluvium merges with pediment zone. It rests over the bed rock of either Talcher or over the stabilised hill washsedimentsconformably. The older alluvium is homogenous mixture of silt and clay and possesses layering and banding to narrate its sedimentolmical history.

The flood plain deposit of recent times constitutes younger alluvium. It is yellowish grey coloured semi consolidated to unconsolidated silt and fine sand deposited in the vicinity of river bank after scooping out either Talcher rocks or even the stabilised-hills of colluvail deposit.

Younger alluvium occurs in the channel sediments constituting pointbar, natural levees from channel bars. The channel sediments contain angular to sub rounded elongated gravels, pebbles and cobbles ranging in size from few centimetres to 30 cm.

The residual soil colluviums and loos boulders of Talcher rocks lying in the pediment zone speaks out its erosion history. This pediplain surface represents the lowest level of erosion.

(6)Relief Analyses-In order to analyse the geometry of landformmorphometry and with different slopes corresponding to differentperiods of penpeneplanation if is necessary to study first the Thalweg profile which outlines the valley. Basin from its source area to the area of mouth so as to understand the river valley along the winding line of valley floor and the effects of uplift, warping, subsidence phenomena could be deciphered. The profile drawn; is enclosed (Plate No-)

The profile shows that HasdoRiver in its upper reach has concave- upward and flows downward with steep gradient up to 400m Amsl at a confluence point of its tributary Geg there after achieving concavity that further flattens. The various breaks in its slope gradient at various elevation levels in its upper reach. Which indicates occurrences of water fall and youthful stage of erosion? In the middle reach plain surface are discernible which indicates late mature stage.

The hypsometric curve drawn for Hasdo basin (main) and its important tributaries indicates three clear breaks. Hypsometric integral which is equivalent to the ratio of the area under hypsometric curve to the entire area of the square. The whole basin area of Hasdo River had been divided in to 433 grids (1km x 1km) from the top sheet. The Hypsometric integrals, emotional integrals and inferred stage of streams of Hasdo river (a total of 23) have been calculated and presented below:-

No.	Name of Basin	Hypsometric Integral	Erosian Integral	Stage of Erosion	Remarks
1.	Ghunghution	37%	63%	Mature	
2.	Bania	45%	55%	Mature	
3.	Dhuneti	41%	59%	Mature	
4.	Halphali	52%	48%	Early Maturity	5.

5.	Hasai	38%	62%	Late Maturity	
6.	Nauwnar	44%	56%	Mature	
7.	Kauria	25%	75%	Old	Monodnock
8.	Paruar	33%	67%	Old	
9.	Ghorghela	39%	61%	Mature	
10.	Bamani	44%	56%	Mature	
11.	Katai	56%	44%	Late Maturity	
12.	Anjan	49%	51%	Mid-Maturity	
13.	Gej	50%	50%	Early Mature	
14.	Manasi	35%	65%	Mature	
15.	Chorni	35%	65%	Mature	
16.	Godgoda	28%	72%	Old	Monodnock
17.	Tan	39%	61%	Late Maturity	
18.	Belgari	29%	71%	Old	Monodnock
19.	Dhengur	42%	58%	Mature	
20.	Ahiran	28%	72%	Old	Monodnock
21.	Dom	34%	66%	Old	Monodnock
22.	Gongdei	14%	76%	Old	Monodnock
23.					

% Erosion Integral means % of andmass eroded Hasdo basin possess all the three stages of erosional cycle.

(7) Reconstructing The Past And PalacoGeography:-A map called Generalised contour map (S.W. Wooldridge) has been prepared by using parameters of dislope across main valleywhich dissect the dispose. Thatlinked up the interfluves. Thus the generalised contours are tangent on the significant interfluves. These contours facilitate the reconstruction of the land surface in the past.

The analyses of the map of generalised contours of Hasdo basin reveal some interesting clues for reconstruction of past landscape configuration.The northern part of Hasdo basinal area was originallycovered with the basaltic lava flows of Deccan-Trap. The new drainage system developed on that landform had dissected the layers of basalt with passage of time. From the study of relative relief and other parameters the remnants of relative relief and other parameters the remnants of erosion surface had been defected. There are nine relief groups ranging in elevation from (below 300m Amsl) to above 900 m Ams1

Generalised contour characterization in Hasdo Basin

Relief Group	**Value of Contours in meters**	**Area in Squ.Km.**	**Area Coverage In Basin In%**	**Rank Characteristic**	**Remark Intensity**
G1	300 M & Below	1040.06	0.099%	4th	Very Low
G2	300-400	1768.06	16.85%	2nd	Low
G3	400-500	2383.93	22.7%	First	Medium
G4	500-600	3752.50	36%	First	Medium
G5	600-700	856.60	0.08%		
G6	700-800	521.27	0.01%		
G7	800-900	145.27	0.01%		
G8	above 900 m	61.24	0.006		

From the above table it is inferred that land mass with in contourrange of 400-600m was most significant and occupied the 58.5% of the basin area of the Hasdo in the past. it ranks first with medium altitude group the second major land form unit ranking second within the relief range of 300-400 m Amsl occupied 16.85% of the basinal area is

characterised by low altitude group. Both these surfaces joined to gather covered 7536% of the basinal area with the characteristics land form showing low to medium altitude.

These relief Groups when reviewed in the light and data graph of altimetry frequency Histogram a proper geomorphologic significance of the earth while basin landforms withwell preserved signatures of erosion cycle havebeen deciphered. The Longitudinal profile, the Superimposed profile besides,geological structural and tectonic history (Worked out by Geological Survey of India) average slope map, cross profiles, percent hypsometric curve analyses enabled to trace out seven erosion surfaces with in the basin area of Hasdo at different elevation ranges.Thus 32% of basinal area fall below the seventh erosion surface400 m Amsl and below. Similarly 31% of basinal area falls below erosion surface (sixth in order) in the elevation range of 500-400m AMSL. Similarly fifth erosion surface covering 27% of basinal area is traced out in the elevation range of 600-500in Amsl.

In the upland area of the basin shows many rectilinear elements of slope and the undulating terrain lying below the flat surface at the lower end of upland shows evidences of parallel retreat of slope without the loss of graint. The Kamthi sandstone of Gondwana Super group is exposed on the erosion surface (FIRST) at the elevation above 1000 m Amsl. This residual type of exposure of kamthi must have come into existence of this elevation offer the complete erosion of basaltic layers deposited (during Upper cretaceous) over Mahadeva formations of upper Gondwana (Lower Eocene to upper Triassic). Thiscould have happened only with the upheaval of Gondwana Table land overlain with basaltic layer during post Deccan Trap period. After the upheaval erosion cycle must have started working to denude the Basaltic layer followedby Mahadevasoverlying theKamthi formations. The present day occurrences of deep valleys of young to mature stage in the present day upland area of Hasdo basin (North of23 latitude) up to its source area (Sonhat plateau) must have come into existence through rejuvenated cycle of erosion as a consequence to upheaval of entire Gondwana Table.

The geomorphologic attributes of Gondwana land must have en hurried by the deposition of basaltic lava flows on the eroded surface of Gondwana terrain during late cretaceous to early Eocene period.

The field evidence of the absence of Infra-trappean beds (Lameta) which are present in adjacent Sarguja basin overlain by, basaltic flow give positive clue about reversal of Palace- slope in the Hasdo basinal area. Therefore the palace-slope which was north west and formed during Permian Triassic period, over and along which Gondwana formation were deposited reversed during lower cretaceous period and assumed southeast trend and prevented the deposition of Infra-Trappe anflviatile to Estuarine facies of lower cretaceous period.

(7b)Palaeogeography & Denudational Chronology:- During pre Dharawarian period (Achaean) there existed gigantic geosynclines named Satpuda Geosynclines (M.S.Krishnan 1953) whose geographical stretch from west to East uptoAsam in the central part of the Indian Peninsula. During Satpura mountain building period two master basin namely Son valley in the north (North of Latitude $23^{0}30'$) andMahanadi in the south came into existence and both were separated by east west stretching watershed passing through Amarkantak of Maikal(Satpura Range) in the west to adjoining area of Jashpur through the north central part of Sarguja. This water shed comprising Precambrian rock resulted due to the upheaval of pre Cambrian basement.

Hasdo basin was earlier an extreme upland part of Mahanadi basin which had south east master slope. The Mahanadi master basin was subjected to Subsidence under Vindhyan sea leaving the uppermost northern- western part during Lower Vindhayan period. The region lying below $22^{0}15$ Latitude of the present Hasdo-Basin only got submerged in the Vindhyan sea. This has been proved from the fieldoccurrence of thick(>115 meter) black shale of marine origin near Lalpura village in Hasdo basin and secondly in the entire Mahanadi basin no whereCuddapah formation form the basement of Gondwanasediment The Cuddapah formations were subsequently exhumed on which drainage network caused by erosion cycle came into existence. The master slope then was towards north. The Pre-Cambrian basement in

the present central sector of Hasdo basin has one of the 6th order tributary flows northward from its origin source area supports the view.

The Hasdo drainage basin developed on the Horst block of Indian peninsula on which drainage and erosional cycle started developing between Ordoviciansillurian and Devonian period. There after the Hasdobasinal area lost its dynamic character during early Triassic period. From late carboniferous to lower cretaceous there occurred an extensive system of continental deposit consisting the Gondwana system During Permian to CarboniferousTalcher and Barakardeposits were laid down. Duringthe carboniferous period Gondwana sedimentation was heralded by widespread glaciations. The glace gene Talcher formation had widespread in the central south to central north.

The reversal of change in the environment from glacial outwash to fluvial glacial and lacustrine- fluvial conditions occurred.

While major parts of Son-Mahanadi and Satpuda Basins were the milleu of continental glacial and per glacial sedimentation, the Manendragarh near sonhat registered marine transgression.

After the recession of glaciers deposition of the coal measures commenced in the embryonic Gondwana basin formed in the glacially denuded valley encircled by high topographic relief.

A remarkable palaeogeo graphic break up in the Indian Peninsula occurred during lower cretaceous period, the break-up of Gondwana land and its drift. After the settlement and stability of landmass. fissure eruption during late cretaceous to early Eocene which resulted in large scale extrusion of basaltic lava flows which were deposited on the eroded surface of uppermost Gondwana layer (Kamthi) or eroded surface of Achaean-granite-gneissic rocks. The basaltic lava deposits caused burial of former geomorphologic land forms and drainage system.

The present drainage system of Hasdo basin is the result of Pleistocene up lift and tilt. There had been rejuvenation in the recent past with the express ion of waterfalls rapids on either sides of some of the tributaries.

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