

# A New Geoscientific Predictive Model to Trace Saraswati: The Lost Himalayan River of the Saraswati Civilization

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**Abstract:** I, the author of this paper, have proposed a plausible model for the Saraswati River Valley Civilization which involves a "Habitable Trinity": i) a stable landmass that was the rock formation of Upper Proterozoic / Precambrian on one side for the life such as fish, reptiles, mammals and ultimately early humans for their evolution, development, movement, settlements and other things, ii) a deep and wide valley on north side which later was converted into a fertile fluvial plain for agriculture and constructing civil facilities, and iii) a perennial glacier - fed river Saraswati: - the present day Yamuna river that was source of fresh water for drinking and irrigation purposes and also means to transport huge volume of water and sediment load from snow - covered Himalayan mountainous regions right from Upper Pleistocene to Lower Holocene for converting the Saraswati River Valley: - a barren rocky terrain into a fertile/alluvial land. The human communities from Neolithic might have lived and moved in the Hills of Aravali right from 40, 000 yrs BP, when modern man came into existence, and finally settled in about 10, 000 yrs BP, for the first time, at the sites of Bhirrana, Kunal in Haryana within river regime and later at the sites of Kalibangan, Suratgarh, Anupgarh, Kishangarh in Rajasthan; Cholistan: - Ganweriwala, Fort Abbas; and Mohanjodaro in present day Pakistan within the river regime and later at the sites of Mitathal, Kheri Maham, Farmana, Pouli, Dhani, Rakhigarhi, Balu, Siswal in Haryana, Sothi in Rajasthan within Saraswati river basin; Mehrgarh, and Harappa in Pakistan within Indus river basin in the fertile alluvial plains. The early Saraswati River Civilization started migrating to other areas that were environmentally friendly in about 8, 500 yrs BP ago due to departure of the river Saraswati, i. e., Yamuna towards the Ganga river basin. So the archeological sites such as Bhirrana, Kunal, Kalibangan, Ganweriwala, and Fort Abbas and Mohanjodaro are the first oldest sites and the Rakhigarhi in Haryana and Sothi in Rajasthan; and Mehrgarh and Harappa in Pakistan are the first largest but second oldest sites of Saraswati and Indus River Valley Civilizations, respectively. Discovery of recent findings related to largest and oldest territory and habitats of the human communities from Neolithic to Saraswati Civilization at Bhirrana, Kunal, Rakhigarhi in Haryana; Dalewan, Lakhmirawala in Punjab; Kalibangan, Suratgarh, Anupgarh, and Kishangarh in Rajasthan; and Cholistan - Fort Abbas, Marot, Ganweriwala, and Mohanjodaro now in Pakistan in the entire 960 km length of the river Saraswati have an edge over the findings in the contemporary Egypt, Mesopotamia combined and even the Harappan Civilization that includes Mohanjodaro and Harappa, both in Pakistan. So, as per my findings, it is the Saraswati River Valley Civilization, wherein all the oldest as well as the largest sites are contemporary and having similarities in all the man - made creative things, is the largest and the oldest Civilization in the world and not the Indus River Valley Civilization or Harappa Civilization as has been established by earlier workers. Thus, now, the Saraswati River Valley Civilization should be named as the: 'SARASWATI CIVILIZATION'.

**Keywords:** Saraswati River Valley, archeology, geoscientific model, habitable trinity, stable landmass, fertile sites/fluvial plains, perennial glacier - fed and monsoonal rivers, palaeomouth of water flows/rivers, palaeo - channel, climate change, global phenomenon

## 1. Introduction

We know that origin of the Earth and the things in it, like lithosphere, biosphere, hydrosphere, and the origin and nature of life - the emergence of the fourth geosphere, are all facts and therefore not based on theory. All these things can be traced back right up to their origin along with the elements involved. Similarly the existence of the great depressions / basins such as Sirmaur basin and Siwalik basin, the world's largest basin, aligned almost in NW - SE and minor depressions / basins perpendicular to these basins, like Indus basin and Saraswati basin aligned almost in N 65° E - S 65° W and other minor depressions / basins that were first created and later filled by sediments and / or organic material can be solved based on model - dependent reality.

### 1) The views / model by earlier scientists on the origin of fluvial landscapes in NW of India and part of Pakistan and the early civilization

I, the author of this paper, wish to give a brief highlight on the scientific research carried out on the palaeo - course of Saraswati river and the Civilization that flourished on its banks by Liviu Giosan (May, 2012) and his fifteen member

team and K. S. Valdiya (January, 2013) who have not only included a large number of data based on their own investigations of the terrain in question, but also updated their paper by including all the relevant data recorded till the writing of their papers by the earlier researchers.

#### 1.1. Liviu Giosan and his fifteen member team

Giosan, et. al., report: "The Harappans settled the Indus plain over a territory larger than the contemporary extent of Egypt and Mesopotamia combined" (Giosan, et. al., 2012). On the interfluves in Punjab, they dated the latest fluvial channel deposits to approximately 10, 000 yrs BP ago (Fig.1B), confirming that large - scale fluvial sedimentation ceased at the beginning of the Holocene. They report the rivers in Punjab started to incise after 10, 000 yrs BP ago, but before 3, 900 yrs BP ago. They recovered sandy fluvial deposits approximately 5, 400 yrs BP old at Fort Abbas in Pakistan (Fig.1 and 2). They report that the recent work by Saini et al. (2009) on the upper Ghaggar - Hakra interfluves in India also documented Holocene channel sands that are approximately 4, 300 yrs BP old. They observed dunes younger than 1, 500 yrs BP old on the edge of the expanding

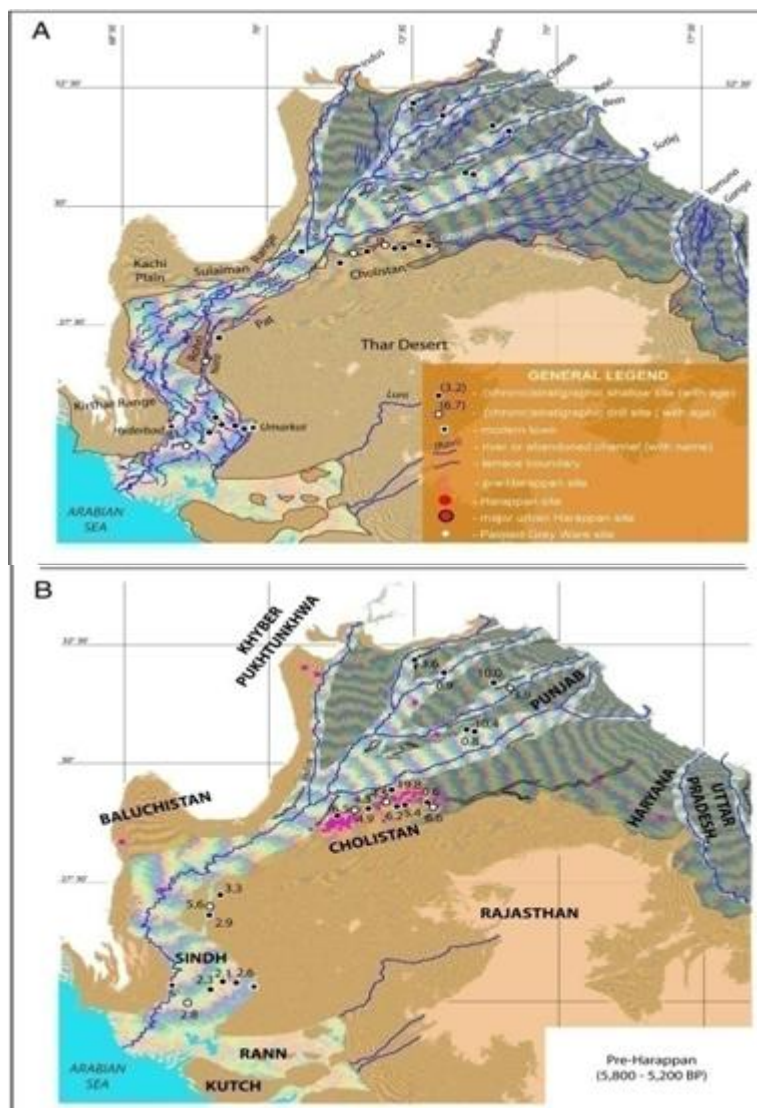
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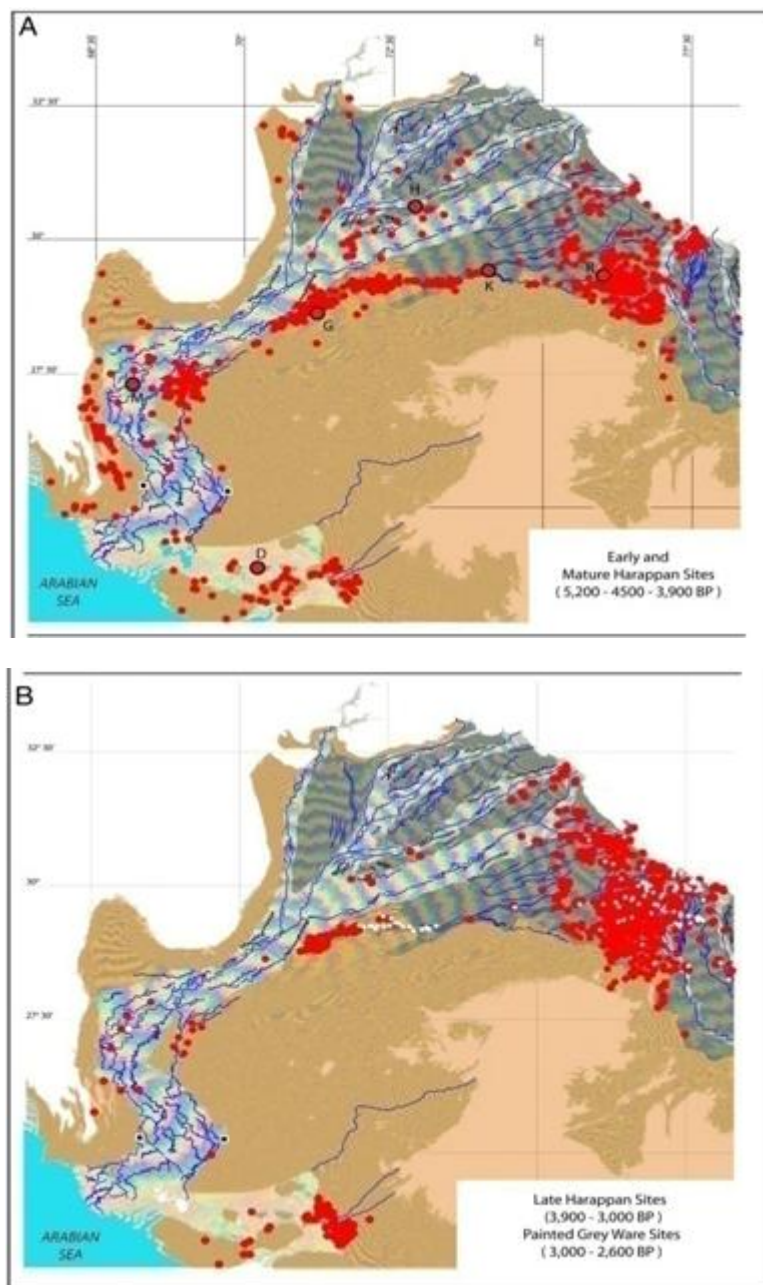
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Thar Desert have begun to cover this region of the interfluves, but sediment originating from the Indus - Punjab system, the Ghaggar - Hakra, or from both of these river

systems was deposited as late as 4, 250 yrs BP ago (Giosan, et. al., 2012 & Fig.1B).



**Figure 1:** (A) Morphology of the western Indo - Gangetic plain with interfluves (in gray mask), incised valleys (no mask), terrace edges (as dashed black lines), and active and fossilized river channels (in blue). Legend further indicates sampling locations and types. (B) Pre - Harappan sites with modern region names, chronological information (youngest fluvial deposits at all sites), and selected town names. (After Giosan et. al., 2012.).

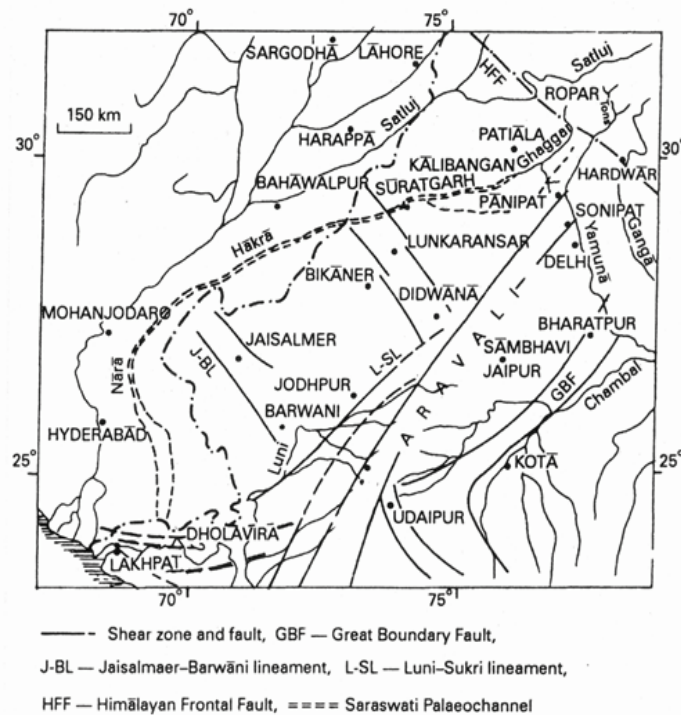


**Figure 2:** Settlements on morphological units of the western Indo - Gangetic plain (see Fig.1 for color conventions and legend). (A) Early and Mature Harappan sites, with names of some major urban centers: D = Dholavira; M = Mohenjo - Daro; G = Ganweriwala; H = Harappa; K = Kalibangan; R = Rakhigarhi. (B) Late Harappan (red) and Painted Gray Ware (white) sites. (After Giosan et. al., 2012.).

Giosan, et. al., have recorded there was a proliferation of smaller, village - type settlements, between 3, 900 and 3, 000 y ago, especially in the Himalayan foothills and the western part of the Ganges basin along the Yamuna River and on the Yamuna - Ganga interfluvium (Giosan, et. al., 2012 and Fig.2 B).

### 1.2. K. S. Valdiya

Valdiya reported: “The larger part of the Saraswati domain cut by many faults across the river from its source to the sea experienced neotectonic movements with attendant uplift, subsidence and displacement of ground, including those of the hill ranges and rivers as a number of lines of evidence of geomorphic, structural and seismological (including palaeoseismological) studies unambiguously demonstrate” (K. S. Valdiya, 2013 and Fig.3).



**Figure 3:** Simplified structural map of the terranes through which the Saraswati River flows in northwestern India. The faults shown by thicker lines have influenced the course of the Saraswati. Broken double lines show the ancient course of the Saraswati. (From Valdiya, based on works of S. Sinha Roy, A. B. Roy and S. K. Biswas.) (After Valdiya, 2013)

Valdiya further records, “The clay beds are composed of well - crystallized smectite, which is of Himalayan origin. Saini *et al.* (2009) found a suite of heavy minerals such as tourmaline, greenish - brown amphibole, garnet, sillimanite, kyanite, ilmenite and biotite in the brown micaceous sandy facies of sediments similar to the modern - day sediments of the mountain - fed (Himalayan) rivers like Yamuna and Ganga” (K. S. Valdiya, 2013). He writes: “In the extreme northeastern Haryana at the foot of the Siwalik hills in the valley of the Somb at Adibadri Puri in Yamunanagar, archaeologists found terraces characterized by pebbles of metamorphic rocks (phyllites, mica schists, quartzites, metabasites) of distinct Himalayan affinity – derived from the rocks of the inner (northern) Lesser Himalaya” (K. S. Valdiya, 2013). He records, “Very similar pebbles occur in the higher terraces lining the two banks of the anomalously wide and straight course of the east - flowing petty Bata stream, within the Siwalik terrane. The Siwalik is wholly made up of softer sandstones, maroon claystones and shales. The remnant of the terraces can be seen at Garibnath and Sudanwala” (K. S. Valdiya, 2013).

## A PLAUSIBLE VIEW / MODEL ON THE LOST RIVER SARASWATI AND ITS TRIBUTARIES WHICH CREATED FERTILE PLAINS IN NW OF INDIA AND THE EARLY CIVILIZATION ASSOCIATED WITH BY THE AUTHOR

### 2.1. The purpose of my research

This is to record / clear that none of the earlier researchers, till the writing of my paper, have recorded, conclusively: Upstream palaeo - mouth of the river Saraswati; The width, i. e., covering both the banks and flow direction of the Saraswati right from its palaeo - mouth to Rann of Kutch;

Whether the Saraswati and Ghaggar were one and the same river or different (however, most of the earlier researchers consider both the rivers as one and the same); Between Saraswati and Indus, which was the mightiest river that changed the course of the river and included the water and sediment load of the dominated river in the area downstream of Cholistan and up to Rann of Kutch; where from the earliest human communities from Neolithic, who inhabited on the banks of the Saraswati, came; and lastly what was the flow direction and course of the river Ganga when the river Saraswati / Yamuna was flowing in the Haryana and the downstream.

All the maps published in the journals, books and other medium by the earlier authors have shown, based on satellite imaginaries and not based on ground verification, the course of the Ghaggar River along Bhagwanpura, Kunal, Bhirrana, Banawali in Haryana; Suratgarh, Aunparh and up to Kalibangan in Ganganagar district of Rajasthan. And again the Ghaggar River has been shown to join with Hakra river of Pakistan where the Ghaggar - Hakra course has been shown in the downstream areas, such as Fort Abbas, Marot, Bahawalpur, Derawar Fort, Ganweriwala in Cholistan region of the present day Pakistan. Further in the downstream areas the Ghaggar - Hakra River has been shown flowing southerly where it is called Nara that flows near Kot Diji, Chanhu Daro and finally to the Rann of Kutch (Fig.3).

I, the author of this paper, believe that the earlier researchers, perhaps, instead of indicating / showing a broad flood plain of the mighty river Saraswati that was having voluminous discharge and sediment load, as shown by me (Fig.6, i. e., A - B - C - D), assumed / shown a single pathway, that is only its right bank, right from Adri Badri in Haryana, south of Patiyala in Punjab, Kalibangan, Suratgarh,

Aupgarh in Rajasthan, Fort Abbas, Ganweriwala in Cholistan region of the present day Pakistan and finally to the Rann of Kutch.

## 2.2. The investigations by the author

The palaeo - course of Saraswati River and the civilization that flourished within its regime and the basin is given by me in figure 6, i. e., A - B - C - D and has been described in the foregoing chapters. I have shown the full width (Fig.6, A - B - C - D) that is either banks of the Saraswati river right from its palaeo - mouth in the Upper Proterozoic rock formation from Upper Cretaceous - Palaeocene in the state of Uttarakhand to Haryana, Punjab, Rajasthan, and Cholistan and Mohanjodaro in present day Pakistan (Fig.6).

It is to be noted that as the river Saraswati was having enormous volume of sediment load and water with high velocity / current in comparison to the river Indus, it pushed / shifted the flow of the river Indus further west in a stretch of about 140 km in the present state of Pakistan and after adding the water and sediment loads of the river Indus in this stretch, finally flowed to the Rann of Kutch (Fig.6). So the figure submitted by me in this paper not only covers the right bank of Saraswati river shown by the earlier researchers (author's observation) but also covers the left bank of the river Saraswati such as Adi Badri, Kunal, Bhirrana in Haryana, western part of Bikaner including Lunkaransar, western part of Jaisalmer including Kishangarh in Rajasthan and Mohanjodaro in Pakistan (Fig.6, A - B - C - D).

For the formation of the Saraswati river Basin and the origin and development of earliest civilization along its plains, we have to give a suitable views / hypotheses / model based on the facts / points. We know there is no model - independent test of reality in the search of scientific discovery. A well constructed model having all elements and concepts creates a reality of its own.

Any view or hypothesis for the lost Saraswati river and the civilization that flourished on its banks is a good view or hypothesis if it satisfies following requirements: i) The location, the arrival and departure time and flow direction of the river Saraswati / Yamuna at its palaeo - mouth in the rocks of Upper Proterozoic / Precambrian when it brought the voluminous water and sediment loads and settled the water and sediment loads first in the deep and wide basins of Sirmaur and Siwalik and later in the shallow downstream basins in the present states of Haryana, Punjab, Rajasthan, and finally in the Cholistan, west part of Bikaner, west part of Jaisalmer, and Mohanjodaro located in the southeast part of the present day Pakistan which were transformed into a fertile lands; ii) The age of rock on which it flowed right from palaeomouth up to Mohanjodaro; iii) The width, depth, and alignment of the palaeo - valleys that were converted into fertile fluvial plains / lands; iv) The age, nature, and source of the sediments it deposited; v) The dry channel marks on the surface, in case the river has lost its course in the area; vi) The existence of a favourable terrain consisting of Precambrian rock formations and forested environment which might have been connected to sea / ocean / lake / basin and became means to flourish the earliest life such as

fish, reptiles, mammals and ultimately the human race that lived and moved in this terrain right from Homo sapiens (around 200, 000 BC) to Modern man (around 40, 000 years to present); vii) Where from the early inhabitants of the Vedic period in the present states such as Haryana, Punjab, Rajasthan and Pakistan (Cholistan, and Mohanjodaro) came from; and finally viii) Where and when the life was originated which after evolution and development settled in the NW region of Indian sub - continent.

We know that the huge volume of sediments deposited in the Indus and Saraswati river basins was possible as a result of mountain building activities which happened during: - the Upper Cretaceous - Lower Eocene, Upper Eocene, Middle Miocene, and Pliocene - Pleistocene. In these events the Middle Miocene uplifting was very strong which affected the rocks of the Lesser Himalayan zone, i. e., the rock formations of Proterozoic, which exist immediately north of Main Boundary Fault (MBF) and south of Main Central Thrust: - MCT (Fig.5, 6, and 7).

The author now is discussing the scenario right from Upper Cretaceous to Holocene, about the lost Saraswati River and the Ghaggar River: - a tributary to the river Saraswati, and their connection with each other, the time period during which the great Sirmaur basin, Siwalik basin, and Saraswati river basin were formed (Fig.4, 5, 6, and 7).

First let me discuss / explain as how to locate the palaeo - course of the Saraswati: - the river Yamuna, a glacier - fed Himalayan River that was flowing in the remote past i. e., in Upper Cretaceous to Lower Holocene.

## 2.3 Locating Palaeocourse course of the river Saraswati

To find out the palaeocourse of the river Saraswati on the map three straight lines, one each on right and left bank and one at the centre of the palaeo mouth of the Saraswati river should be drawn, where the river width is clear on the surface, parallel to the water flow direction for 100 kms or more, from the starting points marked on the outcrop of sloping surface of the Proterozoic rock, located at the palaeo mouth of the river that was existing during basin formation. These lines will show the water flow directions of the palaeo river course from the palaeo mouth of the river to the low marine basin from the Upper Cretaceous period to Lower Miocene and further Middle Miocene to Pleistocene and even up to Holocene (Fig.4, 5, 6, and Rawat, 2015).

Further, to know the exact location and size of the triangular area of the marine basin and fresh water basin in the area further downstream, it is advisable, to draw the three lines from the palaeomouth of the river from the ground surface where the river width may be clear. The downstream limits of the marine basin and fresh water basin can be established by the detailed surface and subsurface investigations. By this way the main width of the marine as well as fresh water basins can be generated (Rawat, 9).

I, the author of this paper, have discovered by following the above model the palaeocourse of the rivers, the marine as well as the fresh water basins, and the correct locations of Oil and Gas deposits of few well known oil and gas deposits

of India such as Patan, Indrora, Kalol and Wavel in Cambay basin; Bombay High, Neelam and Heera in Bombay offshore basin; a few deposits around Karaikal in east coast of Tamil Nadu; and Ravva and G1 field in Krishna - Godavari basin. This model has revealed that the Digboi and Jorajan in Assam basin have been found coinciding with the actual located / investigated oil and gas deposits with the assumed locations of oil and gas deposits by this theoretical model (Rawat, 2015).

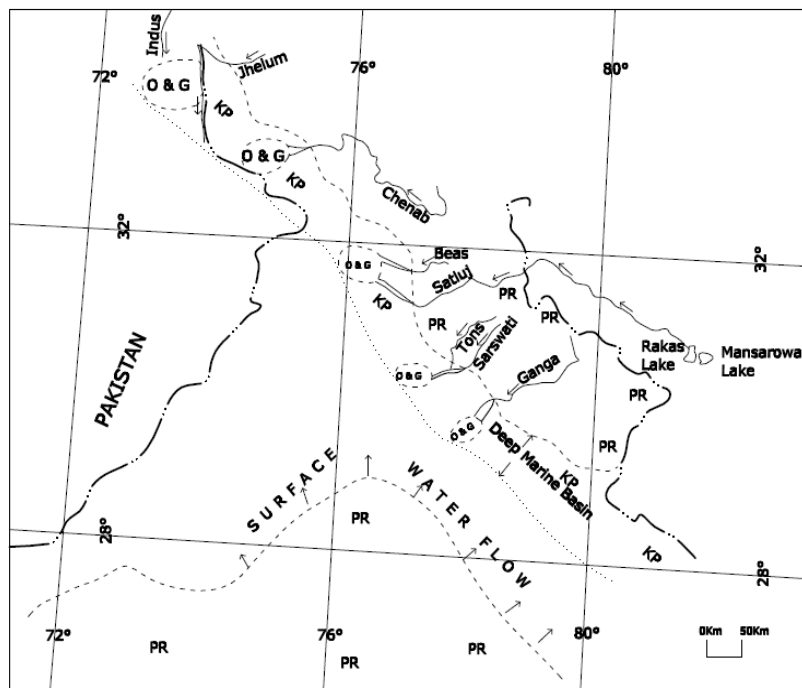
Similarly the Oil and Gas deposits of other countries of the world such as Chinook, Stones, St. Malo/Jack, Lagan and Tiber of Gulf of Mexico, United States of America; Iraq, Iran, Saudi Arabia, Yemen, Oman, United Arab Emirates, Kuwait, and Persian Gulf falling within the Tigris and Euphrates rivers; and Pakistan have also been found coinciding with the assumed locations of oil and gas deposits by following this theoretical model (Rawat, 2015).

#### 2.4 The scenario during Upper Cretaceous - Lower Eocene period

Bangar writes in his book the Himalayan Mountains were formed as a result of the uplifting phases which took place during the Tertiary period. And the first uplifting phase of the Himalayan orogeny started during the Upper Cretaceous - Lower Eocene period. In this phase the sediments of the Tethys Sea were folded into longitudinal ridges and basin. This is the time when the water along with huge volume of sediments and organic matter started flowing in the rift basin between Himalayan belt and the Indian Shield (Bangar, K. M., 2001; Fig.4).

#### 2.5 The scenario during Upper Eocene

During Upper Eocene times, the Tethyan Himalayan zone was uplifted to from a land mass. The emplacement of granites took place in the metamorphic rocks of the Higher Himalayan zone. The Lesser Himalayan basins became shallower (Bangar, K. M., 2001). This time also these rivers were emptying their waters and sediment load in the Sirmaur basin (Fig.4).



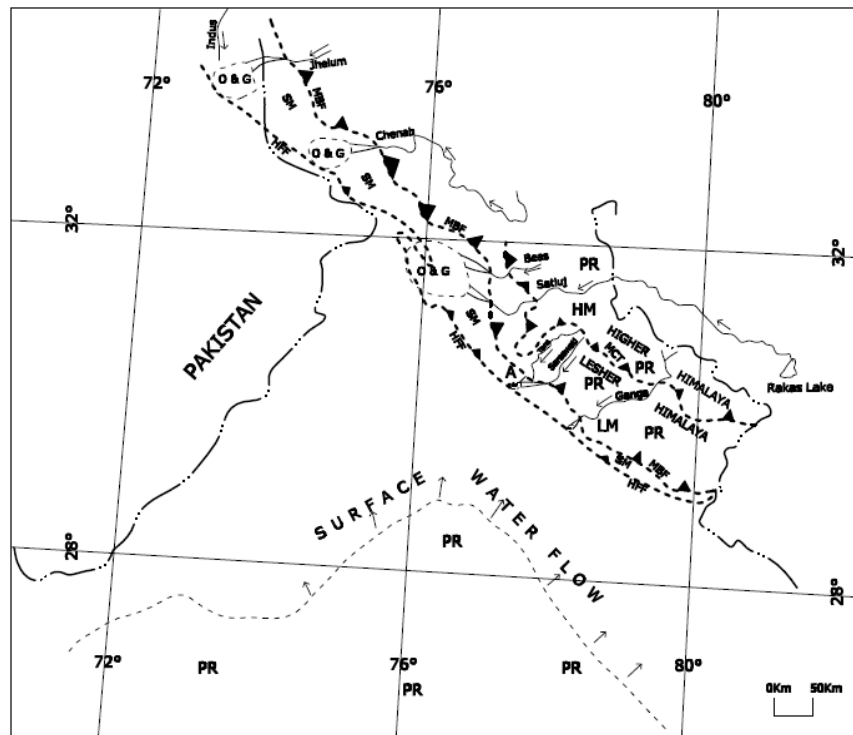
Note: The geological map is part of the published map on 1 cm = 50 km scale of the GSI, 1998.

**Figure 4:** Sirmaur marine basin filling during Upper Cretaceous – Lower Eocene and up to Upper Eocene; PR = Precambrian, KP = Upper Cretaceous – Lower Eocene/Upper Eocene sediments; O & G = Oil & Gas (After J. S. Rawat, March 2022)

#### 2.6. The scenario during Middle Miocene

Bangar writes, ‘The upheaval took place during the Middle Miocene period. This orogeny which was very strong, affected mainly the rocks of the Lesser Himalayan zone’ (Bangar, K. M., 2001). Valdiya writes, ‘There was continuous build - up of compressive strain, and the buckled - up Himalayan crust broke up at 21± Ma along what was to

become the Main Central Thrust: - MCT (Valdiya, K. S., 2010 and Fig.5). The Middle Miocene upheaval also resulted in the formation of a “Foredeep” between the Himalayas and the northern edge of the Peninsula. Later this Foredeep where Shiwaliks are found was filled with the sediments brought by the Himalayan Rivers mentioned in foregoing paragraphs (Fig.5).



Note: The geological map is part of the published map on 1 cm = 50 km scale of the GSI, 1998.

**Figure 5:** Siwalik basin filling from Middle Miocene to Middle Pleistocene; PR = Precambrian; HM = Higher Himalayas; LM = Lesser Himalayas; MCT = Main Central Thrust; MBF = Main Boundary Fault; HFF = Himalayan Frontal Fault; S M = Siwalik sediments (Middle Miocene to Middle Pleistocene); O & G = Oil & Gas; Note: - the Ghaggar river, a tributary of Yamuna that joins the main river Saraswati/Yamuna at point A (After J. S. Rawat, March 2022).

Valdiya writes a series of longitudinal thrust faults, called the “Main Boundary Faults” (MBT) were also formed (Fig.5). However, the initial displacement along the MBT occurred at about 11 Ma (Valdiya, K. S., 2010).

So I, the author, record that both in situ marine as well as terrestrial organisms, which were brought by the Himalayan glacier - fed rivers after Middle Miocene orogeny might have been trapped, mixed with, enclosed, buried, and preserved by a rapid and huge / colossal volume of continental sedimentary debris and then buried deeply again by the sediments, in succession, during the floods in the low marine Siwalik basin, and later on, with the passage of time, slowly cooked to yield oil and gas (Rawat, J. S., 2015).

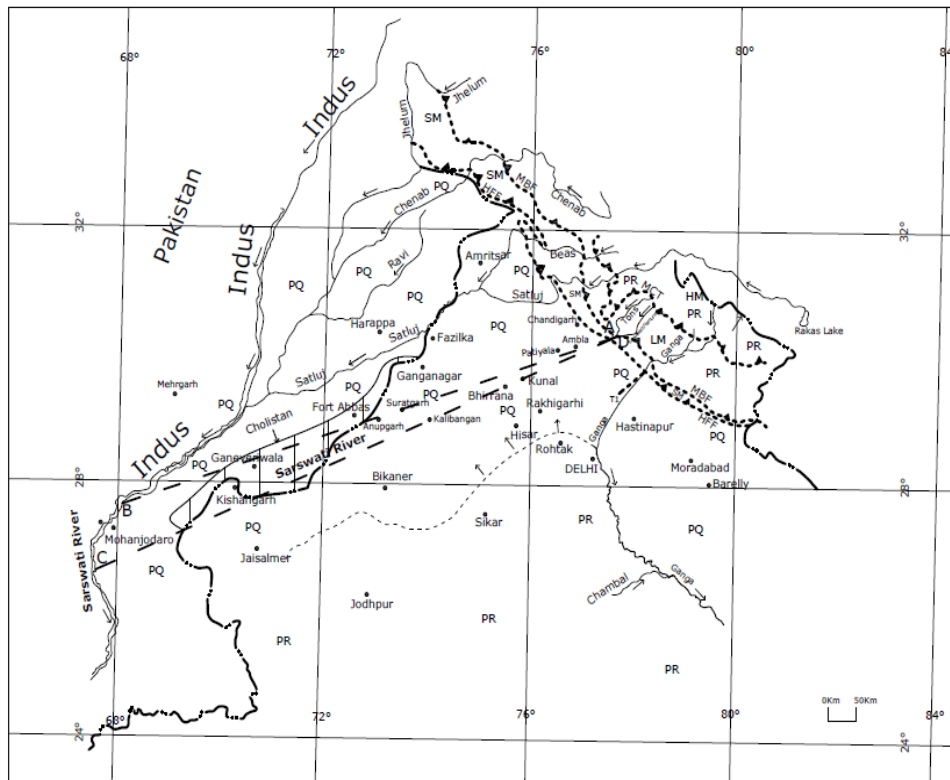
It may be noted that we get hydrocarbons in the Sirmaur and Siwalik basin, a 2, 500 km long NW - SE trending basin, ranging in age from Upper Cretaceous to Middle Miocene in the region of present day Pakistan and Assam region of India only, but not in the shallow basins, which are, more - or - less, perpendicular and located to south of the Sirmaur and Siwalik basin where the sediments belong to Upper Pleistocene to Holocene.

## 2.7 The birth of the river Ghaggar, a tributary of the river Saraswati

The present dry and seasonal monsoon - fed, but not a glacier - fed, river Ghaggar is, in fact, flowing along the abandoned course of the river Saraswati (Fig.7; here A - B - C - D is the palaeo - channel of the lost river Saraswati, and the Ghaggar river is within A - B - C - D from MBT to Ottu in Haryana; Note: - the river Ghaggar is overlapping / occupying the lost river Saraswati course, i. e., A - B - C - D). The Ghaggar River, which was flowing in S 30° W, was a tributary to river Saraswati, originating from MBF in the Siwalik Hills, immediately after about 11 Ma ago (Fig.5).

## 2.8 The scenario during Pliocene - Pleistocene and Lower Holocene (time up to about 8, 500 yrs BP)

Bangar writes, ‘During Pliocene - Pleistocene the Himalayan foot hills rose higher and the broad folds developed in the rocks of the Foredeep’ (Bangar, K. M., 2001). These developments occurred after bedrock uplift and erosion began 1 to 2 million years earlier at the leading edge of the MBT. As per Valdiya the Himalayan Frontal Fault (HFF) was also originated in about 1.6 million years ago, i. e., in Middle Pleistocene (Fig.5).



Note: The geological map is part of the published map on 1 cm = 50 km scale of the GSI, 1998.

**Figure 6:** Saraswati basin filling from Upper Pleistocene (time – say about 30, 000 yrs BP) to Lower Holocene (time – say about 8, 500 yrs BP); PR = Precambrian; HM = Higher Himalayas; LM = Lesser Himalayas; MCT = Main Central Thrust; MBF = Main Boundary Fault; HFF = Himalayan Frontal Fault; T1 = Suspected Tear Fault; SM = Siwalik; PQ = Upper Pleistocene - Lower Holocene (time: - from about 30, 000 yrs BP to about 8, 500 yrs BP ago) sediments; Note the Ghaggar river, a tributary to Saraswati/Yamuna river, joins the main Saraswati/Yamuna river at point A; A - B - C - D = Showing the Saraswati / Yamuna river in Upper Pleistocene and up to Lower Holocene, i. e., up to 8, 500 yrs BP ago (After J. S. Rawat, March 2022).

On the other hand the river Saraswati, which flowed in S 70° W from its palaeo - mouth in Upper Proterozoic / Precambrian rocks, right from Upper Cretaceous / Paleocene / Miocene and up to Middle Pleistocene, i. e., just before starting of last glacial maximum (30, 000 yrs ago), first deposited the sediment load in the Sirmaur and Siwalik basin, running almost in NW – SE from 66 Ma to 30, 000 yrs ago i. e., for about 65.7 million years (Fig.4 & 5). This river maintained more - or - less the same flow direction, S 65° W, in Upper Pleistocene and up to Lower Holocene, i. e., up to 8, 500 yrs BP in the Saraswati basin, a wide - about 60 km to more than 100 km and depth - more than 400 meters, right from Adri Badri in Haryana to Mohanjodaro in Pakistan (Fig.6, A - B - C - D).

The river Saraswati / Yamuna was about 60 to 80 meters wide at its palaeomouth in the rocks of Upper Proterozoic from Upper Cretaceous - Palaeocene to Upper Pleistocene to Lower Holocene in the present state of Uttarakhand, about 10 to 12 km wide just south of Patiyala, about 50 to 55 km in the areas of Kalibangan, Suratgarh and Anupgarh, about 55 to 60 km in the areas west of Bikaner, about 60 to 70 km in the areas of Cholistan, about 70 to 90 km in the areas of Jaisalmer, and about 90 to 140 km in the area of Mohanjodaro.

It may be noted that the river Ganga (Fig.6) during the time from about 30, 000 yrs ago to about 8, 500 yrs ago, was flowing in the region of present state of Uttar Pradesh where at present the river Yamuna is flowing (Fig.7). So it appears that the river Ganga (Fig.6), during the time from about 30, 000 yrs ago to about 8, 500 yrs ago was flowing very close to Aravali Hills in the state of Haryana (Fig.6). And, as the Ganga river was flowing (Fig.6) very close to Aravali Hills, therefore the inhabitants of the Saraswati Valley Civilization saw the Saraswati / Yamuna river flowing between the river Ganga and the river Sutlej. It appears, however, they could not see the upstream reach of all the rivers flowing in NW of Indian Sub - continent. As the Saraswati river valley was very close to the Aravali Hills, the original inhabitants of this region who evolved and developed to modern man in the forested regions of Aravali Hills finally chose to settle in about 10, 000 yrs ago, start agriculture and other works in the great fertile lands generated by the river Saraswati in the present day Haryana.

### 2.9. The scenario after Lower Holocene, i. e., 8, 500 yrs BP and the fate of river Saraswati and prominence of river Ghaggar

Singh, A. K, et. al., have recorded 4 levels of terraces exposed along the left bank of the Yamuna River: terraces YT4, 10.7 ± 2.2 ka; YT3, 9.5 ± 2.3 ka; YT2, 8.9 ± 1.9 ka and YT1, 6.1 ± 1.2 ka. The tentative age for Ghaggar surface



is about  $10.7 \pm 2.2$  ka (Singh, et. al., 2001). Singh et. al., have suggested that a major change in climate from a cold, dry climate with strong seasonal variations prevailing since 50 ka to warm and humid climate at about 10 ka resulted in a change in depositional processes from sediment gravity - flows to braided streams (Singh, et. al., 2001).

The author records that the present day dry and seasonal monsoon - fed river Ghaggar and the lost river Saraswati are not one and the same (Fig.5, 6 & 7). The river Saraswati / Yamuna totally changed its course in about 8, 500 yrs BP (Fig.7) towards the river Ganga basin. Singh et. al., have given the date of terrace formation in the Ghaggar river course about  $10.7 \pm 2.2$  ka and have related it to the last glacial period i. e., 18, 000 to 15, 000 yrs BP (Singh, et. al., 2001).

Malik Javed N. and Takashi Nakata have established, on the basis of geomorphologic investigations, the Ghaggar surface is the oldest, followed by the Kalak, Pinjore and Koshallia surfaces (Malik Javed N. and Takashi Nakata, 2003). They have correlated the 4 levels of the Yamuna River terraces with the 4 - level of terraces exposed along the Ghaggar River - Ghaggar, Kalka, Pinjor and Koshallia terraces. This gave a tentative age of  $8.9 \pm 1.9$  ka for the Pinjor surface (Malik Javed N. and Takashi Nakata, 2003).

The author observes the river Tons flowing in  $S 7^{\circ} E$  (Fig.4, 5, 6 and 7), a tributary to the river Yamuna which had been almost perpendicular to (**about  $77^{\circ}$** ) the flow direction of the river Yamuna, i. e.  $S 70^{\circ} W$ , from its palaeo - mouth at the time of Upper Pleistocene may be wholly responsible for blocking the river Saraswati / Yamuna, which was flowing towards the present state of Haryana before 8, 500 yrs BP ago by the glaciated material it brought from Himalayan mountains in about from 18000 to 15000 BP. In addition to the above phenomenon the deviation in the course of the Saraswati river could as well been caused by a process called river piracy. The headward erosion by the river Yamuna cut the channel deeper and deeper eventually leading to the capture of the flow of the Saraswati (Valdiya, K. S., 2002). Recent work has shown that the land to the east of the river Yamuna is 14 – 22 m lower than the land on the western side of the fault (Thussu, 1999).

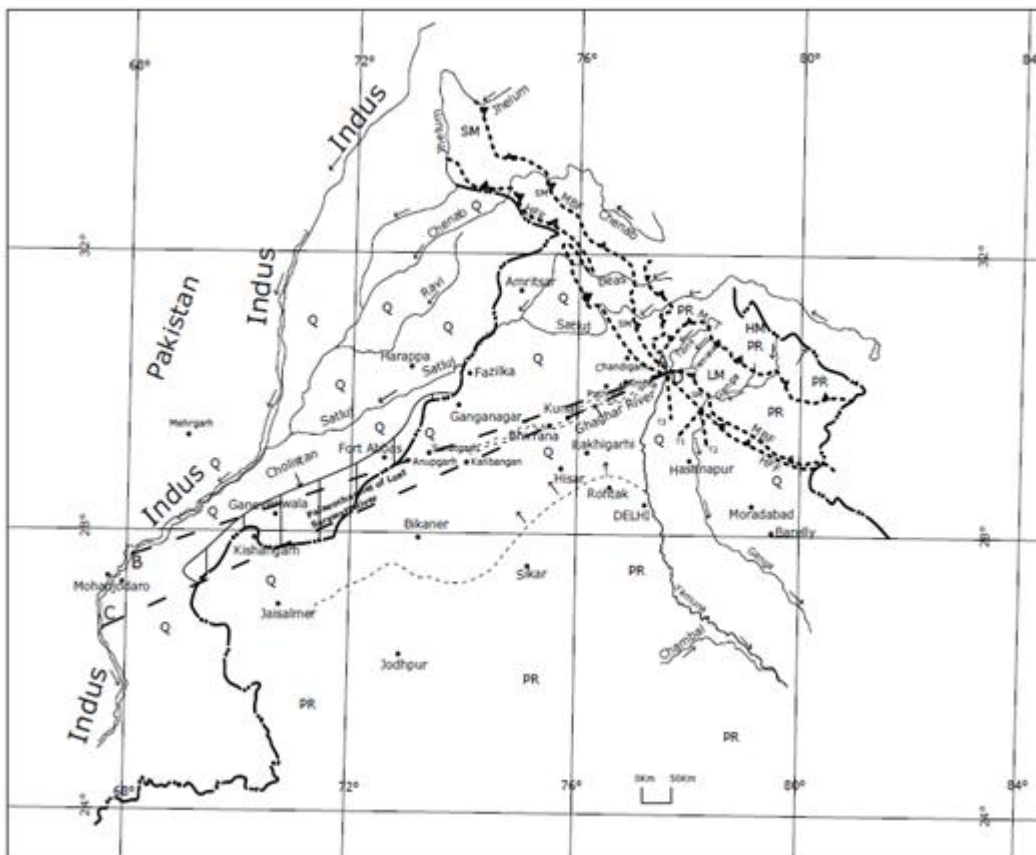
Thus these events were instrumental for converting the flow of the river Saraswati as a dry channel towards the Saraswati river basin i. e., in the present state of Haryana. As a result of these events the river Ghaggar, which was a tributary to the river Saraswati and not a glacier - fed, automatically, in

turn, occupied the abandoned / left out palaeo - channel of the river Saraswati in about 8, 500 yrs BP (Fig.7), since both were flowing as one body before 8, 500 yrs BP ago right from MBF to the downstream areas (Fig.6). However for blocking the flow of the river Saraswati / Yamuna towards the Saraswati river basin i. e., towards the present day Haryana a date of 8, 500 yrs BP, i. e., the lower side of  $10.7 \pm 2.2$  ka ( $10.7 - 2.2 = 8.5$  ka), has been taken by me - the author. The Saraswati / Yamuna water and sediment was diverted to south to south - east i. e., towards Ganga river basin, the river which was flowing in  $S 32^{\circ} W$  during Upper Cretaceous - Palaeocene and later flowed along a tear fault aligned in  $N 7^{\circ} W - S 7^{\circ} E$  (Fig.7).

It has been investigated by the earlier researcher that a large number of buried channels of the Saraswati river still contain sweet water as old as 22, 000 to 6000 yrs BP in the 60 – 250 m deep aquifer in the Jaisalmer district (Nair, et. al., 1999) and 12, 900 yrs BP to 4, 700 yrs BP in Cholistan (in Hakra reach of the river Saraswati) (Geyh and Ploethner 1995). A palaeochannel, near Jaisalmer, at a depth of 450 – 500 m has yielded 40, 000 yrs old sweet water, and in the aquifer shallower than 200 m the water is 17, 000 to 9, 000 yrs old (Reddy et. al., 2011 and Fig.6).

It has also been recorded that there were several spells of heavy rainfall between 40, 000 and 20, 000 yrs BP and again 9, 500 to 6, 500 yrs BP (Singhvi and Kale, 2009). The testimony of spores and pollens of such plants as Pinus, Astemesia, and Syzygium recovered from the lakes - Lunkaransar and Didwana demonstrates heavy rainfall in the period 8, 500 to 4, 000 yrs BP (Singh, et. al., 1974; Bryson and Swain, 1981). Recent high resolution oxygen - isotope dating of the material from the Lunkaransar Lake shows that the rainfall was of the order of 65 to 100 cm/yr and that the lake was filled to the brim in the period 6, 300 to 4, 800 yrs BP (Enzel et. al., 1999) – the period when the Harappa Civilization was in its mature stage (4, 600 to 3, 900 BP yrs ago).

The river Saraswati, i. e., the present day river Yamuna after its departure (Fig.7) from the states of Haryana, Punjab, Rajasthan, and southeast part of Pakistan (Cholistan - covering Ganweriwala, Fort Abbas, and Marot; and Mohanjodaro) to the Ganga river basin occupied the region where the river Ganga was flowing (Fig.6) during the time from about 30, 000 yrs ago to about 8, 500 yrs ago (Fig.6). And the river Ganga (Fig.6) after about 8, 500 yrs ago changed its course and thus occupied the region where it is presently flowing (Fig.7).



Note: The geological map is part of the published map on 1 cm = 50 km scale of the GSI, 1998.

**Figure 7:** The lost river Saraswati basin filling in the state of Haryana and downstream areas, from Upper Holocene (time – say about 8, 500 yrs BP) to till date by a seasonal monsoon - fed river Ghaggar (see A - B); PR = Precambrian; HM = Higher Himalayas; LM = Lesser Himalayas; MCT = Main Central Thrust; MBF = Main Boundary Fault; HFF = Himalayan Frontal Fault; T1 = Suspected Tear Fault; T2 = Suspected Tear Fault; T3 = Suspected Tear Fault; SM = Siwalik; Q = Upper Holocene sediments (from 8, 500 yrs BP to till date); Note: - the departure of the Saraswati river to the Ganga river basin in the Lower Holocene (time - at about 8, 500 yrs BP) and now called Yamuna from source to downstream areas; A - B - C - D = Showing the Palaeo - channel of the lost Saraswati river; = = = Showing dry and seasonal monsoon - fed bed of river Ghaggar that overlaps the Palaeo - channel of the lost Saraswati river - A - B - C - D (After J. S. Rawat, March 2022).

The author records the rivers Saraswati / Yamuna and Ghaggar must be considered different, since the waters of both the rivers right from Upper Miocene to Lower Holocene (up to about 8, 500 yrs BP) and from Siwalik Hills to the state of Haryana and in the downstream areas were coming from different sources (Fig.6 and 7). However, they were flowing as one body from MBT and through the terrain of Siwalik Hills to the states of Haryana, Punjab, Rajasthan and Pakistan (Fig.6). At present the course of the dry and monsoon - fed channel of Ghaggar emanates from Main Boundary Fault and flows first in S30<sup>0</sup> W in the forested Siwalik Hills for about 20 km up to Adi Badri in Yamunanagar: - a site of natural water pond, and then roughly in S65<sup>0</sup> W from Adi Badri to Ottu in Haryana (Fig.7).

And once there was departure of the Saraswati river from the states of Haryana, Punjab, Rajasthan, part of southeast of Pakistan the inhabitants who were living in the areas of Bhirrana, Kunal, and Banawali in Haryana, Dalewan and Lakhmirawala Punjab, Kalibagan, Suratgarh, Anupgarh, and Kishangarh in Rajasthan and Cholistan - covering Ganweriwala, Fort Abbas; and Mohanjodaro in Pakistan migrated *en masse* earlier to north, northeast, and later to south and southwest of these areas where there were fluvial

plain consisting of well compacted and solidified soil and availability of water for drinking and irrigation purposes. In the mean time between 8, 500 yrs BP ago and 5, 000 yrs BP ago the habitats located within the river regime of Saraswati of the original inhabitants were totally submerged or washed away by the flood water and sediment load that was brought by the river Ghaggar during intermittent incessant rains.

The author thus submits a plausible view that the sediments deposited in the Saraswati / Yamuna river basin in Haryana between about last glacial maximum (30, 000 yrs BP) to last glacial period (18, 000 to 15, 000 yrs BP) and up to Lower Holocene, i. e., up to 8, 500 yrs BP ago, should belong to the river Saraswati / Yamuna (Fig.6). As a result the older sediments (based on OSL dating) should be 26.0 ± 2 ka to 21 ± 2 ka old (Valdiya, K. S., 2013 and Fig.6), and the younger fluvial sediments that is the sediments brought mainly from Siwalik Hills and deposited after 8, 500 yrs BP (Fig.7) should belong to the river Ghaggar and its tributaries which has had been a dry and seasonal monsoon - fed river, but not a glacier - fed river after about 8, 500 yrs BP (between 5.9 ± 0.3 ka and 2.9 ± 0.2 ka (Valdiya, K. S., 2013) that is, between 6, 000 and 2, 900 yrs BP old).

### Modern Man might have Originated and Developed From Luca in the North - Western Region of the Indian Sub - Continent

This is to clear that for the life such as fish, reptiles, mammals and ultimately the human race was originated and developed from LUCA: - the Last Universal Common Ancestor or Last Universal Cellular Ancestor. So the fact remains that modern biological systems at some point were descended from the Last Universal Common Ancestor: - LUCA, the latest or the ancestral to all existing life on the Earth followed by bacteria, archaea, and prokaryotes, a unicellular organism having no nucleus, which in turn was followed by eukaryotes, a unicellular organism with a nucleus, which evolved in the fresh waters resting on sedimentary deposits rich in minerals, metals, and clays in "the palaeo - floodplains located at the palaeomouths of the fresh water flows / rivers" on the Hadean surface in the Archaean Eon (Rawat, April 2021 and November 2021).

Now it is summarised that, contrary to the common belief that associates the origin of life with marine environments, the life and / or first cells could have emerged at inland i. e., in the sediments in the flood plains at the palaeomouths of fresh water flows / rivers on Hadean surface in Archaean Eon which were connected to salty ponds, lakes, basins, oceans. However these sites might be very near to the surface hydrothermal vents, volcanic eruptions, and Archaean rocks. Thus the surface hydrothermal vents / springs and volcanic eruptions might have provided a natural bridge between the surface scenario (atmosphere, lithosphere, and hydrosphere) for prebiotic chemistry and the probable first habitat for early biology (Rawat, April 2021 & November 2021).

In the case of life as per Norio Kitadai, et. al., "The concept, *"Habitable Trinity"*, involves a coexisting atmosphere, water, and landmass with continuous material circulation between the three of them that is driven by the Sun. This setting is one of the minimum requirements for the emergence of life. Elements consisting of life body such as C, H, O, N, and nutrients are provided from the three components: atmosphere (C and N), water (H and O), and landmass (nutrients) " (Norio Kitadai, et. al., 2018). NICK LANE writes in his book, 'The lack of oxygen on the early earth was a major environmental constraint before Cambrian period and once it was added to the environment the evolution flourished'. He further writes, 'the biology is all about genes, and their behavior is all about the environment' (NICK LANE, 2016).

So a congenial environment has had been the most important for the creation and evolution of anything in this Universe such as: i) coming into existence of the building blocks of everything in the Universe - the Dark Matter Particle (Rawat, 2018); ii) formation of planets and stars (Rawat, 2020); iii) formation of rocks (Rawat, 2020, April 2021, and Nov.2021); iv) formation of water bodies such as oceans, lakes and basins (Rawat, J. S., 2020); v) origin and evolution of life (Rawat, April 2021, and Nov.2021), and v) vast fluvial land / savannahs for the benefits of humans for doing agriculture and establishing their habitats (Fig.6 and 7).

The author suggests that there were absence of perennial flows of fresh water flows / rivers on the Hadean surface in the Archaean Eon as we see in the modern rivers (Rawat, April 2021 & Nov.2021). So, as per author there were existence of the sediments rich in minerals, metals, and clays, globally, on the Hadean surface in the Archaean Eon, similar to the petroleum deposits generated mainly from hydrocarbons at the palaeomouths of the Palaeo Rivers all over the Earth between Upper Cretaceous Period and Pliocene Epoch (Rawat, April 2021 and Nov.2021).

The fluvial networks on the Hadean surface in the Archaean Eon would have played the same central role as modern rivers in eroding and transporting continental material from the nutrient rich Archaean rocks, hot springs, minerals, and metals from the Hadean surface in the immediate vicinity of the site of sediment deposits and connecting salty water bodies, like ponds, lake basins, and oceans (Rawat, April 2021 & Nov.2021).

STUEKEN, E. E., et. al., write, "Life, as we know it, could probably not have originated without active geological processes (e. g. rock and hydrological cycles) and the environmental conditions that result from these processes" (STUEKEN, E. E., et. al., 2013). So, the author believes that, it was possible, the life might have originated and evolved everywhere in the sediments in the palaeo - floodplains at the palaeo - mouths of the fresh water flows / rivers on the Hadean surface in the Archaean Eon on the Earth: - a global phenomenon (Rawat, J. S., April 2021 & Nov.2021). However the first early evolution and development of life such as fish, reptiles, mammal right from LUCA might have been in certain region only since Devonian period depending upon the environment and uncertainty. We know uncertainty is the fundamental inescapable property of the Universe.

So we believe that life: LUCA originated and developed in the sediments of flood - plains at the palaeo - mouths of the fresh water flows / rivers on the Hadean surface in the Archaean Eon. And the elements were either brought by the rivers / fresh water flows from the Archaean rocks, surface hydrothermal vents, hot springs or leaching from minerals and metals deposited in the flood plains. In India, at present, the Archaean rocks are existing as cratons, like Dharwar Craton in Southern India, the Bastar Craton in Central India, the Singhbhum Craton in Eastern India and the Bundelkhand Craton in Northern India. The Cratons have Palaeoarchaean nuclei, 3310 to 3560 Ma in age, comprising granitic gneisses and basic - ultrabasic rock complexes. And the Aravali a NNE - SSW trending mountain range stretching about 700 km from Delhi to Champaner in northern Gujarat which formed during Upper Proterozoic Era / Pre - Cambrian period, i. e., in around 1900±100 Ma, is located in the terrain of Bundelkhand Craton.

And we know that the modern man evolved on the Earth about 40, 000 years ago from the present time as a product of about 3149.960 million years of molecular or chemical or a non - Darwinian evolution, from about 3750 Ma (a tentative age suggested by the author of this paper which is subject to confirmation, i. e., when the LUCA came into existence) (Rawat, April 2021 and November 2021).

The site of original inhabitants of Saraswati River Valley civilization is very close to the Bundelkhand Craton of Archaean Eon therefore there were every possibility of origin and evolution of *first* life from its molecular or chemical or a non - Darwinian evolution to biological evolution to finally modern man in this region of Indian - subcontinent, where there was presence of a glacier - fed Himalayan river - Saraswati / Yamuna right from Upper Cretaceous period (author's view). The early human communities from Neolithic, who were moving from Gujarat to Haryana in the Aravali Hills, when became consciousness of their surroundings and wanted to progress in their life, they first settled near the forested region of the Aravali Hills and started agriculture in the fertile land, domesticated forest dwelling animals, and other things within the river regime in about 10, 000 yrs BP ago in Haryana, such as Bhirrana, Kunal, and Banawali. So there is no point in believing and discussing the migration of Aryans from the west to the Saraswati Valley in about 3, 500 yrs BP ago.

We know that the Saraswati and the Aryan issue / problem started when the mainstream Ideology believed that the Vedas were composed by Indo - Aryans shortly after their migration to India around 1500 BCE. The author raises the question, how the Aryans who migrated in about 3, 500 yrs BP ago praise it as a 'best of mother', 'best of river', and 'best of goddess'? This is undoubtedly a chronological impossibility. Were they ignorant to wait until they reached a defunct river (Saraswati departed in about 8, 500 yrs BP ago) to name it "Saraswati, " when they could have so renamed instead the Indus itself or any of its five tributaries encountered in their eastward migration? So Indo - Aryan migrations theory, which postulates an extended period of migrations of Indo - European speaking people into South Asia between ca.1, 900 and 1, 400 BCE, doesn't exist and thus should be abandoned / rejected once forever.

I am of the strong opinion that if all the above *Habitable Trinity* were existing in the area of Egypt in the Nile river basin, Mesopotamia in the Tigris and Euphrates river basin and China, too then there were every possibility of origin and development of life such as fish, reptiles, mammals and ultimately the human race from the LUCA, otherwise, I believe, the civilization that flourished in these areas and other parts of the world, including other parts of India might have migrated from the Saraswati River Valley Civilization of the Indian sub - continent.

## 2. Conclusion

The author of this paper believes that all the decisions about Harappa Civilization (Harappa civilization was first identified in 1920 in the Punjab region and then Mohanjodaro in 1921, which are in Punjab and Sind provinces of Pakistan, respectively. The ruins of Mohanjodaro have already been designated a UNESCO World Heritage site in 1980.) declaring it as the first largest and oldest Civilization in the world might have been taken without taking into account the recent geological discoveries by the author that it was the river Saraswati containing enormous volume of sediments and water and flowing with

high velocity / current in a 960 km length right from Adri Badr to Mohanjodaro and finally into Rann of Kutch.

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