# Geology of the Saraswatiriver –The lost Natural Heritage of the Indian Subcontinent

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**Abstract:** The Saraswati River supports the development of Vedic Civilisation in India. The river along with its tributaries constitutes the unique natural heritage of the country. Geological studies carried out to ascertain the existence of a huge paleo-river channel in the north-western alluvial plains point towards the presence of a mighty river system in near geologic past. The sedimentological characteristics of the alluvium in parts of Haryana point towards the presence of a trans-Himalayan river system. Remote sensing investigations carried out during the course of study to investigate the probable reasons for desiccation of this mega river reveal that major drainage diversions were caused due to Quaternary tectonics in the Lesser Himalayan terrain. This scientifically justified mythology, which has numerous religious monuments and structures associated with it, has a huge tourist potential.
**Key words**: natural heritage, Saraswati River, Geology, tourism,

## Introduction

Natural heritage is the legacy of natural features and associated intangible attributes encompassing a region. Saraswati River and the Hindu scriptures, the Vedas, comprise one of the finest examples of natural living heritage which is inherited from the past generations, maintained in the present and bestowed for the benefit of future generations. Saraswati, the Hindu Goddess of learning and knowledge, is said to have personified itself in the form of a major river system that existed in Vedic times in the Indian subcontinent. This mega river system had its origin in the glaciated Himalayas and it drained the northwestern part of the sub-continent before merging into the Arabian sea. The mighty river was the harbinger of life and along its course prospered many agrarian civilizations and subsequent mercantile societies like the Harappan, which utilized its wide navigable channels for trade and inland communication. The epic Mahabharatha has a description of the dessicating Saraswati River. The Holy Bhagwat Gita is supposed to have been compiled on the banks of Saraswati River by Sage Ved Vyasa near Kurukshetra. Near Kurukshetra is the town of Pehowa which derives its name from King Prithu who as per the Rigveda offered water to visitors for 12 days on the banks of the Saraswati river after performing funeral ceremonies of his father. It is an ancient place of pilgrimage. It is believed that Prajapati created the world and the four *varanas* of the Hindus at this place. The town contains two historically famous tanks, one sacred to god Brahma and the other to the goddess Saraswati.

The mythological Saraswati river has attracted the attention of geologists, historians, archeologists and religious organizations for varied reasons. The author feels that if the existence of this mythological river can be justified by geological evidences, in conjunction with epic and archeological information, then the drainage basin of this river along with its mythological monuments and ghats can become one of the major hubs of tourism in modern India. This paper encompasses the existing and newly generated geological information which substantiates the existence of a mighty Himalayan river system in the northwestern Indian alluvial plains with focus on Haryana.

**Drainage of the Saraswati Basin**

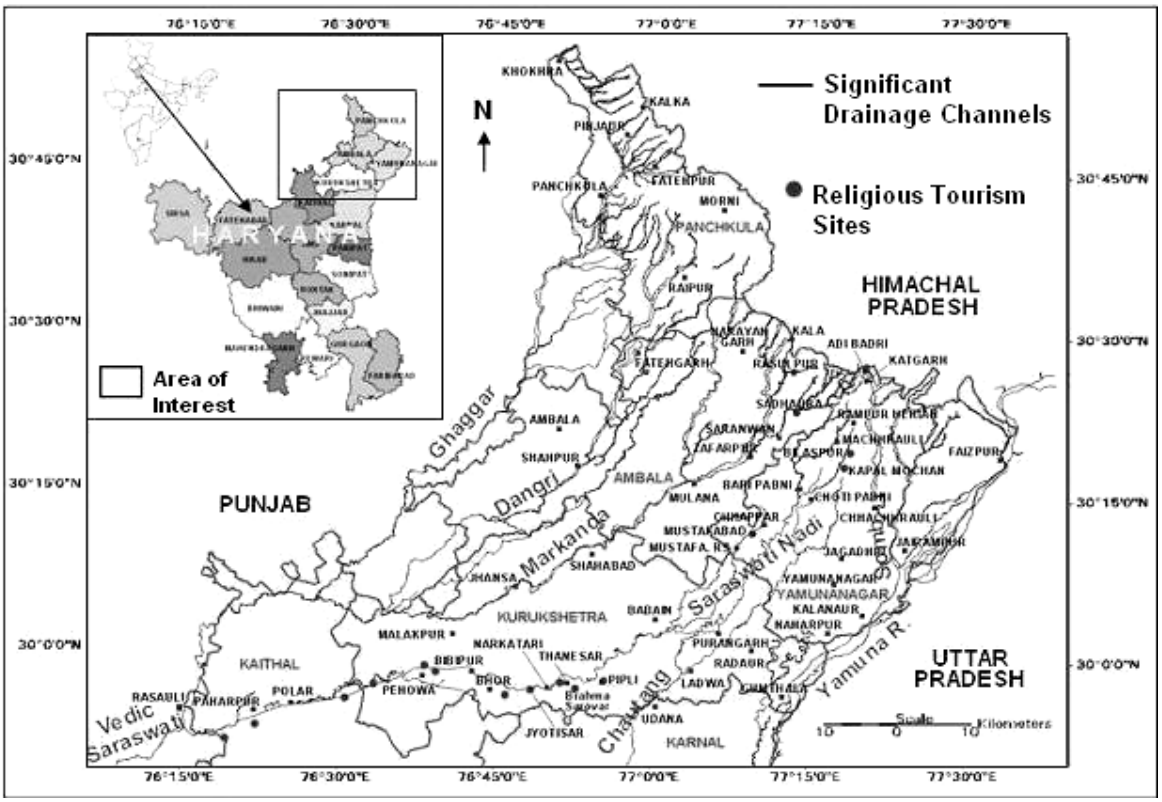
The primal source of information about the existence of Saraswati river is the Rig Veda wherein the Saraswati River is described as a major water carrier (Rig Veda, 1.3.12), swiftly flowing (Rig Veda, 7.95.1), having huge carrying capacity (Rig Veda, 6.61.8), fierce and roaring (Rig Veda, 6.61.7 and 6.61.8) and mightiest of all the river channels draining the region (Rig Veda, 6.61.13). The Himalayan river, as per the Vedas, is supposed to have bestowed upon the people huge material and spiritual benefits. Yajur Veda describes the mighty Saraswati river to have formed by the merger of five celebrated rivers (34:11) the Drishadvati, the Satudri (Satluj), the Chandrabhaga (Chenab), the Vipasa (Beas) and the Iravati (Ravi). Atharva Veda, later Brahmana literature, Manusmriti, epic Mahabharata and Vamana Puran contain numerous references and associated discussions about this river.

The five rivers of Punjab viz., the Jhelum, the Chenab, the Ravi, the Beas and the Satluj; and the Yamuna river along with the Ganges constitute the major present day Himalayan drainage channels nourishing the alluvial plains of the northwestern India. These rivers and their tributaries, along with the rivers of the Rajasthan and Gujarat exhibit a complex evolutionary history which is closely related to the degradation of the Aravalli mountain system, the emergence of the Himalaya as the major mountain chain, the consequent topographical changes in the Himalayan terrain and the alluvial plains which resulted in major drainage readjustments.

In Haryana, Ghaggar is the major seasonal river, which after originating near Sarahan in Himachal Pradesh, enters the state near Pinjore (Fig. 1). The path of the river closely follows the inter-state boundary between Haryana and Punjab and the river finally enters the state near Sirsa from where it moves on to Bikaner before disappearing in the deserts of Rajasthan. Tangri is a relatively small seasonal stream and is a tributary of the Markanda (Aruna) river which originates near Nahan (Lesser Himalaya) and enters Haryana near Ambala. The.Saraswati stream is a small seasonal rivulet which originates near Machhrouli in Yamuna Nagar district and flows through Yamuna Nagar, Kurukshetra, Kaithal and Fatehbad districts before joining Ghaggar river near Shatrana in Patiala district of Punjab. Somb stream originates in the frontal Siwalik hills near Adi Badri and carries water during rainy season. River Yamuna along with its tributaries, the Ashni, the Giri and the Tons, is the only perennial river which after originating from

Yamnotri glacier in Garhwal Himalayas, Uttrakhand, skirts the eastern boundary of the state with Uttar Pradesh from Hathnikund to Palla before entering Delhi. All these rivers have a southwesterly flow direction which is in sharp contrast to the southern rivers of the state namely the Sahibi, Indori, Dohan and Kasavati which flow from South to North, apparently due to change in topography (Chaudhri, 2008b).

The Saraswati River and its tributaries nurtured numerous civilisations, the spatial remains of which offer a glimpse into the uniqueness of this mega river channel. In Haryana, about 103 Early Harappan (2500-2200 BC) archeological sites (Sahai, 1999) related to Saraswati River civilisation have been identified. These sites fall in Ambala, Kurukshetra, Jind, Sonipat, Rohtak, Bhiwani and Hisar districts. Archaeological and scriptural studies which attempted to trace the path of this lost river have been carried out by Stein (1942), Wakankar (1987), Frawley (1999) and others.




After Gupta et al., 2008)

Fig. 1 Schematic map of Haryana showing the disposition of major drainage channels.

About two centuries ago, a British geologist with Geological Survey of India, Oldham (1886) was amazed to see a vast dry river bed which could be traced from Tohana in Hissar District (presently in Fatehbad district) to the Eastern Narra in Sind district. The interest in the Saraswati river which generated after the translation of Rig Veda in English by Max Mueller resulted in a debate over the possible location of this river. The ideas of Hillebrandt (1891) regarding the possible location of Saraswati river in the Arachosia region of Afghanistan, to fit in the then prevalent Aryan Invasion Theory, were rejected by MacDonnel and Keith (1912). The Aryan Invasion Theory has been blasted and contested even on genetic mapping basis wherein it has been proved beyond doubt that population of India is endemic. Signatures of paleo-drainage of rivers that drained the region have been worked out by numerous workers including Yash Pal et al. (1980), Valdiya (1996), Radhakrishna (1999) and Gupta et al. (2004). Bakliwal and Grover (1988) suggested the piracy of Yamuna by Ganga as the major cause of drying up of the Saraswati river due to tectonic disturbances in the Delhi-Hardwar Ridge zone, Luni-Sukri Lineament, Cambay graben and Kachchh fault. Puri and Verma (1998) suggested the probable origin of the Saraswati river from glaciated Tons Fifth order basin at Naitwar in Garhwal Himalaya. Rao (2003) reported the presence of Himalayan glaciated waters 8,000 to 14,000 years old from deep wells in Pokhran region of Rajasthan suggesting thereby the scientific credibility of the lost Saraswati river. The stable isotope data of this water matched very well with the water from Cholistan desert in Pakistan. Chaudhri (2007a, 2008a) while working on active faults and related tectonic elements which affect present day human population in the region in the frontal Himalayan terrain recorded the tectonic signatures of Quaternary drainage readjustment which resulted in the transformation of major rivers into ephemeral streams in the northwestern Himalayan region.

Remote sensing studies of the Saraswati River paleodrainage basin utilizing Indian Remote Sensing satellite 1C LISS III PAN sharpened false colour composite satellite imagery and high resolution Google earth imagery are being carried out on ERDAS Imagine software. The standard techniques of image enhancement and visual interpretation utilising linear stretching, contrast and brightness enhancement, band combinations and edge enhancement are being utilized to identify the presence of paleochannels in Haryana. The state has a rather dense network of canals which have to be identified and distinguished from probable past drainage channels utilising high resolution imagery. Satellite images of different periods in a year, viz. pre-monsoon, flood period and post-monsoon have been studied to delineate the hidden paleochannels based on their anomalous moisture content. The investigations have revealed the presence of numerous paleo-channels in Haryana especially in and around Kurukshetra, Kaithal, Jind, Fatehbad and Sirsa districts. Gupta et al. (2008) have also recorded paleochannels in Haryana.

Satellite images provide important clues for initiating a comprehensive ground based geological investigation for confirming the presence of paleochannels based on sediment characteristics. For validating the satellite image information regarding the presence of paleo-channels, ground based site specific sedimentological studies were carried out by

the author at different locations in Haryana. On the basis of these investigations three significant signatures of the presence of paleochannels have been identified along the Vedic tract of the erstwhile Saraswati River (Fig. 2). The textural and dense mineral analyses of the sediments coming out with water have been carried out to ascertain their major source terrains and depositional environments (Chaudhri, 2008c).

Dense mineral (Specific Gravity more than 2.89) assemblage is used for source rock identification; to work out the heavy mineral zones and dispersal pattern, correlation of unfossiliferous rock units; to determine the vagaries of pre-erosional weathering and tectonic history of source terrain; to understand the diagenetic changes including role of intrastratal solution; and basin analysis (Chaudhri, 1971).

Heavy mineral analysis of the fine to very fine sand size fraction of the sediments was carried out by heavy liquid separation technique (sodium polytungsate) to ascertain their source terrains and compare these with those of the Siwalik Group. A significant aspect of the study is to determine as to whether the fluvial channel(s) that deposited these sediments in Haryana were from a seasonal rivulet originating in the low lying Siwalik Hills with reworked Siwalik sediments or was it a major river originating in the glaciated Higher Himalayas and having some definite Higher Himalayan mineralogical inputs.


Fig. 2 Map of Haryana showing the location of sites where signatures of the presence of a mega-river have been identified.

### Site 1: Kapil Muni Temple Sarovar

The hermitage sites of ancient *rishis* and ascetics are usually situated close to some perennial source of water. Kalayat is one of the pilgrimage spots in traditional 48 *kos* Kurukshetra *Bhumi* and is dedicated to Saint Kapila, the author of Hindu Sankhya philosophy. The town is located on a mound which rises 10 m above the general ground elevation in the region and appears to be relocated over a buried settlement. A few

kilometres from Kalayat lies the early Indus Valley Civilisation (or Saraswati River Civilization) site Balu. A major tributary of the Saraswati River, the Apaya or Apaga (Chitang) river flowed near Balu. It is believed that the Saraswati River used to flow through Kalayat, district Jind, Haryana (Chaudhri, 2007b). The Kapil Muni (6050 BC) Temple located at Kalayat is in a brackish water zone where no natural surface flow of water is discernible. The temple is a potential religious tourist spot with its heritage location and architecture. In the vicinity of the temple is an old *sarovar* which is ritually cleaned and filled by local religious organisations. In December 2005 water started oozing out into the tank. The water was clear, odourless and sweet to taste and had a lower TDS content in comparison to the local municipal supply water (Chaudhri, 2006). The presence of natural flow of sweet water created a stir in the water starved region (Chaudhri, 2007c). The gush of water, which was initially like an artesian flow, subsided after about a fortnight but the water still continues to flow. The sediments coming out with oozing water were collected in a sieve for textural and heavy mineral investigations.

Megscopically, the sediments are grey in colour and contain high percentage of muscovite flakes with golden ferruginous coating making them appear significantly different from the surrounding sediments. Textural studies reveal that the sediments are fine grained. Majority of the grains are angular to sub-angular in outline although a few sub-rounded and rounded grains are also present. The sediments coming out with water show a moderately well sorted nature.

The heavy mineral suite recovered from the Kapil Muni Temple Sarovar comprises tourmaline, hornblende, kyanite, staurolite, epidote, zoisite, garnet, biotite, chlorite, corundum, rutile, titanite and brookite.

The heavy mineral assemblage of the Siwalik Group has been investigated by Chaudhri (1972, 1975, 1984, 1991). The dense mineral suite comprises zircon, tourmaline, rutile, epidote, garnet, chlorite, biotite, staurolite, kyanite, sillimanite and rare to very rare andalusite, enstatite and hornblende. The opaque minerals include ilmenite, magnetite, hematite and limonite (Chaudhri, 2000).The heavy mineral suite of Kapil Muni *Sarovar* thus contains corundum, brookite and titanite in addition to the heavy minerals from the Siwalik Group of northwestern India. The dense mineral assemblage comprising garnet, hornblende, kyanite, staurolite, epidote, zoisite and biotite is indicative of derivation of the sediments from high grade metamorphic rocks. Rutile and brookite might have been derived from basic igneous rocks while titanite and part of hornblende appear to have been contributed by acid igneous rocks. Titanite is frequently associated with ultra high pressure (UHP) metamorphism (more than 6 GPa) in subduction zone plate setting in high-pressure granulite-facies terranes (Ye, 2002; Chopin, 2003) now exposed in the Indus-Tsangpo Suture zone. Honneger et al. (1989) reported blueschists along the Indus Suture Zone. Parrish et al. (2006) evidenced peak UHP metamorphism along the northern margin of the Indian plate at 46.4 ± 0.1 Ma and retrogressive growth of titanite between 46.4 and 44 Ma.

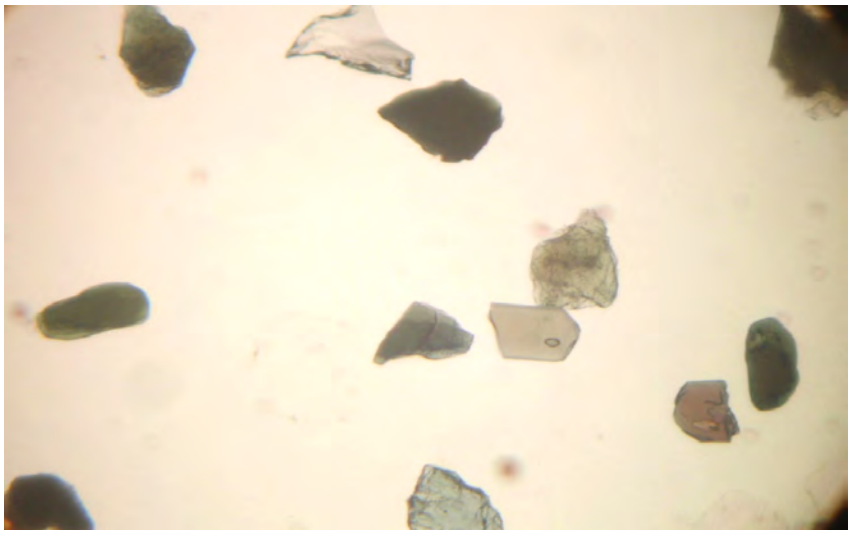


Fig. 3 Photomicrograph of angular fragments of dense minerals recovered from Kalayat.

In northwestern Himalaya, corundum has been reported from early Palaeozoic, Pan-African (500 ± 50 Ma) granites that intruded the Chail, Salkhala, Haimanta Formations. Garzanti et al. (2007) recorded a similar heavy mineral assemblage from Higher Himalayan source rocks in Marsyandi River, Nepal.

The heavy mineral assemblage of the sediments coming out with water, thus, reveals that the sediments were derived from high grade crystalline rocks exposed in the Higher Himalaya. Since the water channel that brought these sediments must have crossed through the Siwalik sediments, mixing of sediments from the Higher Himalayas and the Lesser Himalayas is inevitable. Further, majority of the sediments have angular to sub-angular outlines which may partly be attributed to their habit and mineralogy. The dominant mechanism of fluvial transport of dense minerals having specific gravity more than 2.89 in water is by traction and rolling on the river bed. This process ensures maximum rounding of the grains consequent to the breaking up of their corners on account of friction and attrition in the first hundred kilometres of its fluvial transport. Rounding of the grains is more for the coarser fraction than that for the finer grades. Angular kyanite is characteristic of high current velocity depositional environment. The presence of a high percentage of angular fragments at Kalayat, about 280 km away (crow flight distance) from their perceived source rocks in Higher Himalayas, is anomalous in normal fluvial dynamics. This feature requires that the high density mineral grains are carried as suspension in the river for the major part of their travel from the point of entrainment in the flow in the Higher Himalaya to the point of their deposition at Kalayat in Haryana. This in turn would require the presence of highly agitated water. Agitation in water is related to the morphology of the river channel and quantity of water in it. Considering the dynamics of the present case, it appears that the water channel that carried these sediments was a massive river, with very high volume of agitated water.

These characteristics of the river, incidentally and interestingly match very well with the Vedic description of the Saraswati River, ' a river that roared as it carried peaks of mountain as flowers in its flow' (Chaudhri, 2008 b). Further, the strategic location of the site, near the 6th Century BC heritage hermitage site of Kapil Muni whose ashram's were on the banks of Saraswati river, further strengthens the possibility of the presence of Saraswati River paleochannel near Kalayat.

**Site 2: Chyavan Giri Kund**

In August, 2007 water started coming out of Chayavan Giri *Kund*, a hermitage of Chayavan *Rishi* in Kalayat. The 6th century B.C. brick temple near the kund is a protected archeological monument and is a very good peaceful place for tourists. The water reservoir and the well maintained grassy lawns around this Saraswati river natural heritage remnant can serve as good picnic spot. The water which was pouring out at 4 locations in the *kund* was again sweet to taste. The rate of flow of water was around 25 litres per minute (Chaudhri, 2007d). The local population of the town was extremely enthusiastic about the natural flow of sweet water in the pond which once upon a time was filled with Saraswati River water when Chyavan Rishi used to inhabit the region. Daily congregation of religious minded people at the site became a routine affair and regular *aarti* of Saraswati River was performed at site. People took bucket(s) full of sweet water to their houses for religious activities. The water was clear, non-turbid, odourless and very little sand was coming out with it. The phenomenon of water oozing out of Chyavan Giri *Kund* is interesting considering the general groundwater scenario in the region. The region falls in brackish water zone and potable water having acceptable taste is not available to the people of the region even up to a depth of 400 m. Beyond this level, the quality of water improves but still it does not reach the level of sweetness of the Chyavan Giri *kund* water. Further, this phenomenon took place in August, 2007 and incidentally there was no rainfall for the past one month in the region. This situation suggested the possibility that the aquifer which was yielding water was getting recharged in the upstream recharge zone as significant rainfall was occurring in the Himalayan foothill region which forms the major recharge zone of aquifers in the alluvial plains.

The sediments coming out with water were collected on -80 mesh ASTM sieve. Megascopically, the sediments are grey in colour and are visibly fine grained in comparison to the sediments from the Kapil *Muni* temple s*arovar*. The sand has moderate proportion of muscovite flakes. The golden coloured flakes are conspicuous by their absence.

Textural studies of the sediments reveal their fine sand size and moderately well sorted nature. The sand sized fraction was cleaned and heavy liquid separation technique was utilized for separating the dense minerals. The transparent heavy mineral suite recovered from the water coming out of the Chyavan Giri Kund comprises tourmaline, hornblende, kyanite, staurolite, epidote, zoisite, garnet, biotite, chlorite, corundum, rutile and titanite. This heavy mineral assemblage suggests that the sediments have been derived

from very high pressure plate tectonic setting. The river channel that deposited these sediments was trans-Himalayan in character. The perennial river probably originated from glacial melt water in the trans-Himalayan region and during its flow across the suture zone it eroded the high pressure minerals along with the other high grade Higher Himalayan minerals mentioned above.

**Site 3: Bhor Sayidan**

About 13 kilometres West of Kurukshetra (Thanesar) towards Pehowa lies the Bhor Sayidan village which is situated on an ancient mound and is an archeological site dating prior to 1375 BC. Folklore associates the place with treacherous murder of Bhurirava, son of Somadatta, Raja of Varanasi by Arjuna during the Mahabharata war. The village is named Bhor after him.The houses are built of old large size bricks having a size of 12 3/4" x 9 1/2 "x 2". A buried river bed has been discovered in the village. The estimated width of this paleo-river is more than 2 km. The left bank of the erstwhile river is covered by 9 m thick layer of intercalated light chocolate brown sandy clays and mud. Twelve beds have been identified in the succession.

The textural analysis of the sediments was carried out by sieve analysis. Sieving was carried out at quarter phi interval. The results indicate presence of fine to very fine grained, polymodal, moderately- to poorly sorted sediment population. The sediment characteristics are typical for low energy river bank and levee deposits. Shape of the grains was determined by visual estimation technique. Majority of the grains exhibit sub-angular to sub-rounded outlines while significant percentage of angular grains have also been recorded.

The non-opaque heavies from Bhor Sayidan comprise garnet, epidote, hornblende, kyanite, sillimanite, tourmaline, chlorite, cassiterite, biotite and muscovite. These high grade metamorphic minerals were probably eroded from the higher Himalayas by the rivers and streams draining the region. These fluvial sediments reflect the terminal waning phase of the erstwhile 2 km wide river in the vicinity of Bhor Sayidan as there is a distinct break in the lithologic succession with mud beds dominating over sand beds in the upper 5 m log. At a depth of 5 m from the surface, sand layers start dominating over the mud layers and gradually sand beds become dominant. Mud layers are reduced to thin intercalations and lenses. It appears that during the terminal phase there was gradual dessication of the river and the channel was subsequently periodically filled by muddy rainwater that might have traveled in the channel upon its conversion to a seasonal stream from an erstwhile mega-river.

In the present day scenario, 2 km wide river beds are nowhere seen in the region except the remotely sensed inferred paleochannels in Rajasthan and Rann sector of Gujarat.

The more than 2 km wide flood plain of the paleo-river; the higher Himalayan mineralogical characteristics of its dense mineral suite and their angular nature; and its Vedic location contribute in suggesting that the paleochannel might be of a major paleo-river, probably, the Saraswati River.

## Discussion and Conclusions

Investigations carried out at Kalayat in Haryana confirm the presence of a mighty paleo-river which brought sediments from the Higher Himalayan peaks. In the Indian context, there are three major antecedent rivers existing in the present day scenario. These are the Indus, the Satluj and the Brahamputra. All of these rivers have their origin in the vicinity of Mt. Kailash indicating thereby that this part of the Himalayan terrain was at a higher elevation than the rest of the intervening Himalaya since the time of India – Eurasia collision in the Miocene. These rivers, along with some other significant channels might have started flowing southwards after the melting of glaciers. In the present context, the first significant glaciation is supposed to have taken place about 34 Ma ago when Antarctica became glaciated for the first time (Deconto et al. 2003). Another major evidence of glaciations and hence the cooling of climate during Cenozoic comes from $\delta^{18}O$ record of calcite from deep sea sediment cores. Major trans-Himalayan drainage gradually established itself in the later part of the Cenozoic Era. During this tectonically active period in the history of Himalayas, new terrains in the Himalayan domain were repeatedly uplifted causing repetitive obstructions in the flow of the then established river system. Chaudhri (2005) documented the offset of rivers flowing in the vicinity of Chandigarh on account of active faulting in the region. Remote sensing analysis of drainage pattern of River Satluj reveals a significant drainage diversion near Shimla in Himachal Pradesh besides the diversion near Ropar. Ashni River and Giri River exhibit anomalous right angle turns on account of remobilization of the crust in the Lesser Himalaya due to renewed tectonic activity which resulted in the formation of an elongated wedge shaped upheaved landmass. Study of high resolution Google satellite images reveal that had this landmass not risen, the Giri and the Ashni river would have drained into the Ghaggar river as is evidenced by the presence of massive paleo-valleys of these rivers.

A buried river bed about 2 km in width, near the Vedic location of the mythical Saraswati river is a very significant evidence which supports the probable presence of erstwhile Saraswati river channel near Kurukshetra. The sub-surface bore hole data, in and around Kurukshetra, reveals a predominance of sand layers after about 7 m to 9 m of upper mud layer. The sand layers thicken out towards the depth with occasional kankar beds intervening with the sand –mud intercalated layers. This lithology, in conjunction with geophysical subsurface resistivity surveys, supports the presence of a mega-river in its vicinity.

The present ground investigations along with remote sensing studies carried out by the author suggest that a major river system existed in the northwestern Ghaggar plains of Punjab, Haryana and Rajasthan. Satluj river probably joined this river system in the Himalayan terrain along with the Ashni and Giri Rivers. The Yamuna, the Tons and the Bata river probably flowed though the Markanda River and joined the Ghaggar River system. All these rivers, together, probably constituted the erstwhile paleo-mega river which has been termed in the Vedas as the Saraswati river. The five rivers of Punjab, including the Satluj, probably drained into this river till about 5 m.a. Subsequently, due to massive tectonic activity which affected the Lesser Himalaya and the adjoining fluvial

plains, river system got reorganized. Burbank (1992) recorded a change in the position of major rivers in the Neogene Gangetic foreland basin in Plio-Pleistocene time. Clift and Blusztajn (2005) on the basis of seismic reflection data obtained from drill core samples from the Arabian sea and Neodymium isotope data suggested that there was a shift in the source of Indus river sediments at 5 m.a. The major source of the detritus in the Indus before 5 m.a. was weathering products of rocks constituting the Indus Suture zone and the rocks exposed North of it. Subsequently, the Indus river started receiving detritus from the southern part of the Himalaya. This feature suggests a rerouting of the Punjab rivers in such a manner that instead of flowing towards East, the rivers due to change in ground slope, started westward migration and joined the Indus river. Due to uplift of the wedge shaped landmass referred to above, the Ashni and Giri rivers started flowing westward along the newly created valley to join the Yamuna River which by then had breached the frontal Siwalik hills in the form of Yamuna Tear Fault, to pursue a course independent of the Markanda river. Due to change in basement profile, a part of the erstwhile Markanda river channel inverted its flow direction and water started flowing in the newly created Bata stream in the direction of the Yamuna river. The Satluj river, also took a `U' shaped bend near Ropar in Punjab, and pursued a course independent of the Ghaggar River. Thus, the Markanda and the Ghaggar rivers were reduced to the status of seasonal rivulets. Numerous evidences of the presence of huge amount of water in these channels in the form of vertical river cut cliff faces measuring about 50 m in height (Chaudhri, 2002), 2 m to 3 m high pillar like remnants of Pinjore sandstones and clays in ephemeral streams and huge thickness of fluvial gravels in the piedmont reach of the Ghaggar river, are available, and these strongly suggest that it was a major river in the very near geologic past. The alluvial fans of these rivers extend for a distance of about 9 km to 18 km away from the hills towards the Punjab and Haryana alluvial plains again indicating their erstwhile magnitude.

Saraswati River drainage basin along with the numerous present day religious structures, bathing ghats, traditions, epics, vedic treatises, folklore and archeological structures represents one of the finest examples of a living natural heritage. This scientifically justified heritage has an enormous tourism potential and can become the most visited Hindu tourist circuit.

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