Research Article

# Environmental hazards due to rate of siltation in the Wular Lake (Jammu and Kashmir), India

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## Abstract

The siltation rate in the Wular Lake shows abnormality in space and time, as evidenced from preliminary geological survey of its catchment. The Panjal traps, limestones (with scanty intercalations of black shales) and Karewas form the major provenance for the silt which drains into the lake. The lineament fabric suggests a strong structural control over the formation of the lake. The Tertiary uplift, as well as, the pulses of seismicity have been instrumental in modifying regional geomorphological relief and the resultant changes in the rate of siltation. The climatic changes have also influenced the varied rate of erosion and subsequent siltation. The topographic relief appears to have fluctuated in the recent geological past, as is evidenced from the silt deposits in and around the lake. The environmental significance lies in the fact that such a rate of siltation would result in shallowing of the lake floor and may prove disastrous during higher degrees of runoff (either due to excess precipitation or melting of ice). The present state of human interference, in the form of settlements around the lake and farming practices on the reclaimed and / or acquired land of the lake, are beyond permissible limits of the environmentally safety zones.

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## INTRODUCTION

Geomorphic and tectonic studies in the vicinity of Wular Lake reveal a major lineament control over its siltation rate. The intermontane basin of Kashmir (Burbank and Johnson, 1983; Agrawal *et al*., 1989 and Valdiya, 1993), developed during Neogene-Quaternary period (Burchfiel *et al*., 1992 and Burbank *et al*., 1996), is suggestive of fast uplift. An attempt has been made to identify such evidences of uplift and subsequent erosional episodes in the region in the light of geomorphic, structural and geochemical studies. The drainage anomalies and lineament fabric reveals a strong structural control over erosional characteristics. The patchy occurrences of Karewa formations also signify intense erosion. The historical record of the disastrous earthquakes, floods and draughts also point towards 'principle of Uniformitarianism' (present is key to the past). The fluctuating climatic conditions in the Kashmir valley also attribute towards erratic floods in the Jhelum River. The geochemistry of the water, in and around Wular Lake, also supports intense erosion of structurally weaker and chemically susceptible formations of its catchment.

### Geographical Location

The Wular lake ($34^0$ 20'N; $70^0$ 42'E), at an altitude of 1,530 mts above MSL, is located about 34 km northwest of the Srinagar city (Jammu and Kashmir) and is one of the largest fresh water lakes in Asia. It is elliptical in shape and has a length of 16 km and a width of 7.6 km (Fig.1). The lake is surrounded by lofty mountains to its northeast, northwest and east

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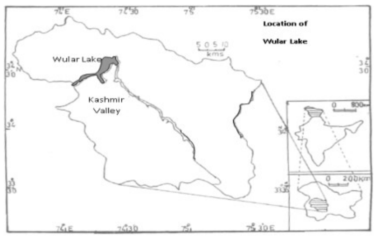


**Figure 1:** Location map of the Wular lake

It is surrounded by lofty mountains towards its Northeastern, Northwestern and eastern sides of the valley. It is a part of the basin shaped Kashmir valley which owes its origin to the neo-tectonic and ongoing evolutionary phases of the Himalayan orogeny. The streams like Madhumati, Erin Nala, Sukh Nag, Dudganga and Kausar Nag flow into the lake. The river Jhelum seeks the passage into the Wular from the southeastern and after taking 'U pin' turn flows towards Baramulla.

## Climate

The climate of the region around Wular is mainly altitude dependent. In and around the Wular Lake, the water temperature varies between 3.1-25$^0$C. The *kashmiri* proverb '*Kashmir, pankha postin*' (Fan and fur are a must in Kashmir) also illustrates its sudden variations. The four main seasons in the valley are spring (March–May), summer (June–August), autumn (September–November) and winter (December–February). The winter in the lake region experiences a heavy snow fall and the frost is so severe that the river Jhelum and the Wular Lake are often frozen over. Such sporadic frozen conditions have been recorded at least 8 times in the recent history. The winter in 1759 A.D., was so prolonged that the river was frozen as late as 31$^{st}$ March. The thunderstorms occur frequently in this region and the strong wind called *chang*, is a common occurrence during winter. The spring is however, wet and pleasant; the summer is hot and the autumn is dry and healthy. The region has also suffered from famines, not due to summer drought, but as a result of too mild winter and heavy seasonal precipitation. The records between 958 and 1899 A.D. reveal a string of 18 major famines in the valley (Pandit, 1978). The melt waters of the snow capped mountains are also the main cause for the flood situations in the river Jhelum. Another peculiar characteristic of Wular climate is unusual rains caused by south-west monsoon, which also creates serious floods in the valley, after it crosses the mountain barriers from the peninsular India.

## Topography

The main hill ranges that enclose the Kashmir valley are Zanskar range, North Kashmir range, Lesser Himalayas (Pir Panjal range). The Zanskar range runs along the southeast – northwest axis all along the northern extremity of the valley. It is an offshoot of the Great Himalayan range and before culminating at Nanga Parbat, it encloses the Kashmir valley on its north, northwest, northeast and also along its east


**Figure 2:** The topographical features of Wular lake

The North Kashmir range forms the watershed between the Jhelum and Kishanganga and has its origin at the Zoji-La pass, as a bifurcation of the Great Himalayan range. The Lesser Himalayas around the Wular lake are mainly constituted of Pir Panjal and an offshoot called Ratan Pir.

## Physico-chemical parameters of the Wular lake :

**Table 1:** The chemical analyses of the lake water indicated the following physico-chemical parameters

| Parameters | Range |
|---|---|
| Depth of water (in mts) | 0.1 – 4.0 |
| Average pH | 7.1 – 9.9 |
| Electrical conductivity | 57.0 – 429 |
| Dissolved oxygen (mg/lit) | 1.3 – 15.4 |
| Total alkalinity (mg/lit) | 67.0 – 378 |
| Chloride (mg/lit) | 11.0 – 81 |
| Calcium (mg/lit) | 4.6 – 73.9 |
| Magnesium (mg/lit) | 0.8 – 36.1 |
| Silicate (mg/lit) | 0.0 – 11.5 |
| Sulphate (mg/lit) | 0.1 – 1.9 |
| Total dissolved solids (mg/lit) | 23.5 – 1198 |
| Iron (g/lit) | 65 – 1900 |

The data regarding the flow of water in and out of the lake, as obtained by the Department of Urban Environmental Engineering (Govt. of Jammu and Kashmir) shows a wide variation depending upon the seasons. Its inflow varies between 1030 and 43314 cusecs; while the outflow ranges between 870 and 31800 cusecs. The annual silt deposition in the lake, calculated during 1970-1980 (excluding tributaries), indicated an average value of 3,331 acre ft/ year.

## Drainage of the river Zelum

The overall drainage pattern of the Kashmir valley is of antecedent type, characteristically developed during the orogenic phases of the Himalayan uplift. Deep gorges, as well as, steep-walled ravines are an evidence of the rapid elevation of the region with a continuous down-cutting made by the stream (Valdiya, 1992).The Jhelum is a large eastern tributary of the river Indus and drains the region to the west of Pir Panjal formations. It is an important river in the Kashmir valley and probably, must have been one of the seven rivers (*Sapta-sindhu*) mentioned in the *Rigveda*. The Kashmiri name for this river is *Vyeth*. It flows in a direction parallel to the Indus at an average elevation of 1666.6 mts. It drains about 2,300 square miles of alluvial lands in the Kashmir Valley and receives its waters from glaciers located in the north of the valley. The Pir Panjal range forms its boundary on the south and west

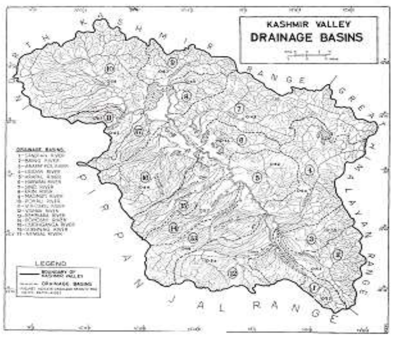


**Figure 3:** Main drainage of the Kashmir valley

The river Jhelum originates at Verinag from a spring situated at the foot of the Pir Panjal in the south-eastern part of the valley of Kashmir. It flows through Srinagar and the Wular lake before entering Pakistan through a deep narrow gorge. Before it flows into Wular lake it traverses through Dal Lake, into which it allows settling of its coarse sediments. On emergence from the Wular Lake near Baramula, it runs through an eighty-mile long gorge at an average slope of 33 feet per mile. It ends in a confluence with the Chenab at Trimmu in District Jhang which is a main tributary of the Indus River. The main tributaries of Jhelum, which drain into the Wular lake are Madhumati or Bodkol in the north and Erin river in the east. Apart from these two tributaries, Sind river, in the southeast and Pohru river, in the southwest of the lake, join the main drainage of the Jhelum


**Figure 4:** The bird's eye view of the Wular lake

A bird's eye view over the region around Wular suggests a major structural control over its formation. The 'U' pin bend of the Jhelum is a major evidence for the structural control. The other geomorphic features, observed during the field survey around the lake also are supportive of its structurally controlled drainage. These include:

## Drainage Anomalies

1. The south-westerly drainage of the Madhumati has a major knick-point at the foot hills of the Hampathar and Rishipur forest zones. Towards south of this knick-point, the gradient of the river drastically gets reduced and then it merges into the Wular lake. After the 'U pin' bifurcation, it turns towards east-southeast towards Sopore (Fig.5).
2. The main drainage anomaly occurs at the Naz nadi which appears to flow towards north-northeast.
3. Sukhnag River and its tributaries exhibit almost a parallel drainage pattern in the northeasterly direction, along their courses before joining the Jhelum. These tributaries, however, show 'U' pin bends at a number of places indicating a lineament control over their formation.
4. The drainage of the Kashmir valley also appears to be structurally controlled. This basin shaped valley drains its waters from all sides towards the Jhelum. But, the variation in the type of drainage patterns is very peculiar. The source regions of the streams such as Liddar and Sind rivers exhibit a radial pattern while their confluences with the Jhelum are braided. Although, the northeastern and southwestern extremities of this basin, have a normal dendritic pattern, there are variations from trellis to centripetal types in different regions. These variations are suggestive of a major structural control towards southwestern region of the Jhelum.

## Lineament Fabric

The lineaments in the vicinity of Wular have been depicted with the help of aerial photographs and the drainage network from toposheets. The major lineaments which have controlled the direction of Jhelum and its tributaries are as shown in Fig. 6 and have been shown and described below:

1. Madhumati-Jhelum lineament: It extends in the northeast-southwest direction and is responsible for the 'U' pin bifurcation of the northwesterly trend of the Jhelum River. The field studies have revealed that this lineament probably, traverses a major fault trending ENE-WSW with a down throw towards its southeast.
2. Pohru-Jhelum lineament: It extends along northeast-southwest direction and is responsible for the main trend of the river Jhelum, as well as, for the source region of the Pohru River. The

slight truncation, observed in the trend of this lineament, might have occurred during the initiation of the Madhumati-Jhelum fault along it.

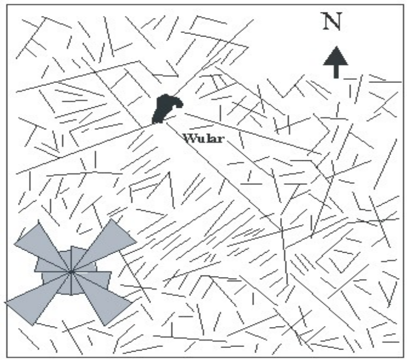


**Figure 5:** Drainage lineament map of the region around the Wular lake

**Minor Lineaments:** Lineaments with limited extent have also been observed along the streams such as Firozpur nadi, Ganga-Jatan nadi, Karshen nadi and Gundar or Kaneara nadi.

### Planar Surfaces

The presence of a distinct planar surface in the region around Wular is suggestive of a major structural control over its formation. This surface has been identified at elevation of 1550-1600 mts and was, probably developed as a result of faulting along the Jhelum-Madhumati lineament which, subsequently was subjected to rapid depositionary episodes during the upliftment of the Himalayan region. Its low gradient has been the major cause of the flood conditions in the Jhelum River.

### Karewa Beds

Smaller and detached deposits of Kareva beds occur at a number of places in the form of tablelands, which are silts and clayey material drained by the streams. These have been identified in mostly all parts of the Kashmir valley, particularly in the vicinity of Bandipur, Pampur and Srinagar. These posses rich soils of varying composition and are known for good agricultural produce. The Pampur soils are known for the cultivation of saffron. All these Kare was are the result of deposition that was laid down during the sporadic uplift of the Himalayan zone (Valdiya, 2001). Their ages have been speculated to be Late Neogene to Quaternary; and are more than 1300 m thick successions. These have been grouped into lower and upper formations- Horpur and Nagum formations, based on their composition, provenance and structural orientation. The lower formations are dipping and are mainly composed of sandstones and gravelly horizons, which are suggestive of uplift, folding and erosion of the region. These beds show dips of about $5^0 – 20^0$ along the flanks of the Pir Panjal hills, before abutting at the mountain sides. The upper Kare was, on the other hand, are perfectly horizontal and represent the reminiscent of an earlier phase of intensive deposition. These are spread over an area measuring 13 to 26 kms in width and 80 kms in length. Their occurrence at an elevation of 3800 mts in the Pir Panjal hills has been considered as an evidence for the lacustrine nature of these deposits formed as a result of tectonic uplift (Bhatt, 1978; Bhat, 1987 and Singh, 1982). This strange deposition of almost horizontal strata, 2130 mts above the present river bed, has intrigued most of the geomorphologists searching for their genesis (Valdiya, 2001).

### Springs

Kashmir is known for its springs all over its limits. The presence of such spring indicates geo-pressured zones within the earth's crust. Such springs are observed at Verinag, Sukhnag, Nilnag, Anantnag, etc. The occurrence of thermal springs in the region is also an indication of the stresses present in the subsurface of the earth.

### Earthquakes

The seismicity in the Himalayan zone is of immense importance, not only with the point of view of past geological evolution of the region but also for its prediction for the future. In 2092-2041 B. C., during the regime of Sunder Sena, the ruler of Kashmir valley, a major earthquake struck the region, which created a rift at the middle of the city Sandimatnagar and the flood waters from the Jhelum swept the whole town and soon submerged it. It is said that this submerged city is now the site for the Wular lake. In 1904, a spill channel was excavated through the swamps of the lake to carry flood water at some distance away from the main channel, to reduce the intensity of floods. Such devastating earthquakes have also been recorded during 855-83, 1841, 1893 and 1903 A.D. The creation of extensive sutures and reactivation of preexisting Jhelum fault have been reported after the disastrous earthquake of $8^{th}$ October, 2005 in the western Himalayan zone (Kumar, 2007). These remote sensing studies have indicated spatial association of co-seismic landslides with the pre-existing Jhelum fault and Main Boundary Thrust (MBT). It has also given rise to new trends in the alignment of landslides, which indicates reactivation of a new faults or fractures in this region.

### Flood Hazards

The flood hazards in the Jhelum river have been given due importance since historical times. Avantivarman's engineer minister, Suyya (855-83 A.D.), carried out desilting of the river bed between the Wular lake and Baramulla to speed-up the water discharge from the valley. But, it also gave way to reclamation of large tracts of land for cultivation. He had also changed the course of the Jhelum to allow irrigation of dry and barren portions of the valley. The flood affected region around Wular and Dal lakes, prepared by Reza *et al*., (1978), has been shown in Fig.6.

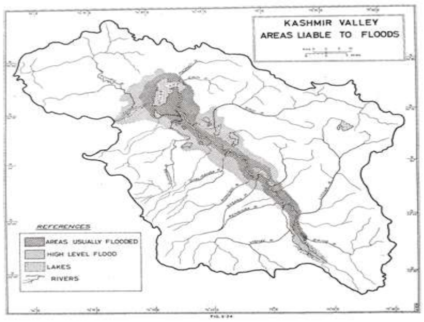


**Figure 6:** Flood affected region of the Jhelum river

## Palaeo-glaciation Studies

The evidences of the palaeo-glaciation have been suggestive of presence of ice covered peaks in the region around Wular lake. There are at least four major episodes recorded in the region but, the data is insufficient to suggest their presence in the near vicinity of the Wular lake (de Terra and Peterson, 1939 and Agrawal *et al*., 1989). Although, the glacial evidences are lacking in the vicinity of Wular lake, it is beyond doubts that the floods resulted due to the water draining from such high lands have deposited sediments in the geological past and present.

## Geology

**Table 2:** The carboniferous, Permian and Quaternary formations are well developed on a large scale in the Kashmir valley

| Formations | Age |
|---|---|
| Flood plain deposits | Recent |
| Karewa formations | Quaternary |
| Zewan beds (shales and limestones) | Permian |
| *Gangamopteris* beds (shales, quartzites) | Lower Gondwana |
| Panjal Trap, Panjal agglomeratic slates | Upper Carboniferous |

The upper Carboniferous formations consist of a thick (over 2400m) Panjal volcanics consisting of bedded tuffs, slates, ash beds and andisitic and basaltic lava flows (Panjal traps). The slaty tuffs, at places, contain marine fossils allied to the fauna of the *productus* limestone. There are two major divisions which are differentiated on the basis of their formational variations. The upper division consists of bedded andesitic and basaltic traps while the lower is constituted of pyroclastic slates, conglomerates and other agglomeratic products, which are collectively termed as 'Panjal agglomeratic slates'. In general, these pyroclastics are massive aphyric flows of tholiitic type and at places, are alkaline in composition (Bhat and Zainuddin, 1979; Honeggar *et al*., 1982; Gupta *et al*., 1983; Pareek, 1983; Vannay and Spring, 1993). At places, their sub-aqueous nature has also been identified (Nakazawa *et al*., 1975). These have been assigned the age of 270-275 Ma (Kapoor, 1977). The Pir Panjal trap agglomerate slates form the main geological formations of the catchment of the Wular lake, which represent the products of glacial and volcanic activity. These were deposited in the shallow waters of fresh as well as marine waters. The sedimentary outcrops have been observed along the hill slopes near Bandipur, towards north of the village Ajas. These are the lower and middle Triassic limestone beds which are 200 m thick bands, along with intermittent trap horizons. While at Bandipur outcrops, the Upper Triassic beds rest over the Pir Panjal traps. Their origin has been assumed as intermittent eruptions of volcanic trap formations under marine conditions (Ahmed *et al*., 1978). The Panjal traps are directly and conformably overlain in several parts of Kashmir by a series of beds containing Gondwana beds (*Gangamopteris* and *Glossopteris*). The Gondwana plant bearing beds have been met at several localities, viz, on the north eastern slopes of Pir Panjal, at Banihal pass, Golabgarh pass and near Gulmarg. There are such occurrences on the opposite side of the Jhelum valley, at Vihi (near Srinagar), Marahom near Bijbehara and at Nagmarg near the Wular Lake. During the impingement of the northerly drifting Indo-Australian plate against the Eurasian plate, the collision began mostly during mid to late Eocene between 50-45 Ma (Allegre *et al*., 1984; Searle *et al*., 1987; Valdiya, 2001). It moved the Indo-Australian Plate, in a northerly direction at a rate of 15 cm / year and resulted into a collision with the Eurasian Plate. This collision, therefore, resulted in closing of the Tethys Ocean. The existence of such deposition has been determined by sedimentary rocks settled on the ocean floor and the volcanoes that fringed its edges. Since these sediments were light, they crumpled into mountain ranges rather than sinking to the floor.

Smaller patches of Zanskar rocks occur adjacent to the Wular lake. These are situated near the village of Manasbal and in the Sindh valley. These rocks consist of pale blue banded limestone overlying the blackish amygdaloidal trap, with a north easterly dip. To the west of these outcrops, the inliers of trappean formations again project in between the Zanskar formations, the later having quaquaversal dips around the former. To the north of the Manasbal lake, another patch of zanskar rocks occurs near the village Hajan, with other smaller patches in its neighbourhood. These converge into a larger mass, at the village Bandipora. At this outcrop, the Zanskars occupy a rudely triangular area on the left bank of Bandipora stream having a low and regular north easterly dip. The zanskar rocks consist mainly of purely white thick-bedded dolomitic limestones which are largely quarried for the manufacture of cement. The amygdaloidal traps are continuous with those at the mouth of the Sindh valley, Manasbal and the shores of Wular Lake. To the south of the lake another small dome shaped mass of amygdaloidal trap occurs under the calcareous rock. near Kandarbal.

## Structural Control

Recurrence of volcanicity and / or seismicity in the Himalayan zone is an evidence of the dynamicity of the Himalayan zone where the Indian plate flexes and slides beneath the Eurasian plate (Halder *et al*., 1992 and Rajendran *et al*., 2003). However, the evidence for palaeo-earthquakes has also been predicted all along the Himalayan zone, based on the following evidences (Sukhija *et al*., 1999 a and b; Bagati, 2001):

- Multiple fault terminations at a single stratigraphic horizon.
- Tilted or folded formations overlain by stratified and less deformed sequences of colluvial wedges in normal faults.
- Modified magnetic susceptibility.
- Cyclic stratigraphic sequence of turbidite deposits.
- Uplifted Holocene shore lines and raised reef tracts.

Seismotectonic maps of Himalayas have also contributed in understanding its structural evolution (Khattri, 1992). The presence of micro-seismicity along nappes, associated with various deformational phases, has been evidenced along MBT (Thakur *et al*., 2001). Studies carried out by Seeber *et al*., (1981) and Khattri and Tyagi, 1983, have identified a subsurface 'ramp' in the Himalayan zone, associated with a decollement, which is instrumental in the deformational process. Similar observations about accumulation of stress and strain along such decolluments in the lesser- and sub-Himalayan zones have been predicted (Pandey *et al*., 1995 and Ambraseys and Bilham, 2000). It must be during such neo-tectonic and seismic episodes that the drainage of the palaeo-geographical surfaces in the Himalayas got disrupted and gave rise to drainage anomalies. The Jhelum river, therefore could have been a tributary of the Indus river, which drains the northern region of the Jhelum catchment, and was disrupted due to neo-tectonic uplift. These movements, triggered by seismic activity, led to the formation of lineament controlled faults along N-S, NW-SE and NE-SW have diverted the drainage of wular in the form of 'U pin' bends. The Indo-Australian plate continues to be driven horizontally below the Tibetan plateau, which forces the plateau to move upwards. The major rise of Himalayan mountain range, however, geared up between 5-10 m.y. ago. The Arakan Yoma highlands in Myanmar and the Andaman and Nicobar Islands in the Bay of Bengal were also formed as a result of this collision. Eventually, the folded mountain ranges were subjected to severe deformation and metamorphism until late Eocene. Due to the rigorous erosion of the elevated regions, rivers were heavily loaded with sediments of varied chemistry. These rivers carved out huge basins and led to the formation of flood plains with meandering morphology. As the uplift continued with varying rates, the rivers migrated laterally and often encroached each other's flood plains (Kumar *et al*., 1989; Kumar and Singh, 1980; Tandon, 1991; Tandon *et al*., 1984). The sedimentalogical studies have also revealed that this uplift was further revived during 5.1 to. 22 m.y. ago (Choudhauri, 1973); Raju, 1967 and Johnson *et al*., 1983). With continuation of subduction and uplift, there was a development of Intermontane basins during Neogene-Quaternary times all along the Himalayan and Tibetan regions. These basinal features may be grouped into three categories namely, i) extensional basins north of Himalayas, ii) basins with fault and rift systems and iii) 'thrust up' or 'piggy back' basins (Burchfiel *et al*., 1992 and Burbank *et al*., 1996).

## Interpretation

The preliminary geological field survey in and around Wular lake revealed that the major factors responsible for the silt deposition in the Wular lake are: Lithology of the geological formations along the catchment of Jhelum, whose tributaries drain into the Wular lake,

- Structural and tectonic factors related to the rock formations bordering the Catchment of the tributaries of Jhelum,
- Extreme climatic variations (such as frost, hot and wet conditions)
- Palaeogeo-geological and –topographical conditions of the terrain and
- Environmental conditions of the present day (deforestation, land acquisition, farming practices, etc.).

The Indo-Australian and Eurasian plate collision continues even today, with Indo-Australian plate moving at the speed of 67 mm / year. This tectonic activity, therefore, compels the overlying formations to rise by about 5 mm / year. It, eventually, leads to folding, faulting and thrusting of the formations when rates are higher; and gentle tilting of the terrain, under mild impacts. These movements, in the area under study, have kept the region seismically active, leading to earthquakes from time to time (Kiyoshi *et al*., 1992, Valdiya, 1993). The younger uplifts of post Pleistocene have been recorded by Valdiya, 1992, where gravel deposits have been displaced and uplifted due to strong diastrophism. The presence of such faulting in the lower Karewa sediments in the Pir Panjal has been reported by Bhatt, 1978. These sediments have been subjected to offsetting of about 1400 to 1700 mts. The lineament analysis has revealed a strong structural control of the regional stresses that developed in the N-S direction during impingement of the Indian plate against the Eurasian plate (Valdiya, 1999 and Hodges, 2000). The Kashmir valley and its geological formations fall under the 'thrust top' or 'piggy back' type of basins (Burchfiel *et al*., 1992 and Burbank *et al*., 1996). The presence of reactivation of pre-existing faults in this valley has been observed by Vinod *et al*., 2006. These simply suggest the dynamicity of the subsurface stresses in the present day. In addition to tectonic causes, the lithological variation and susceptibility to physical and chemical weathering of the rocks in the Kashmir valley have also played a major role in the intense deterioration of the exposed mountain slopes. Due to deforestation and glacial conditions, the hills of the North Kashmir range have immensely contributed towards erosion and subsequent siltation within the Wular lake. These ranges bordering the lake area towards its northeastern, northwestern and eastern sides have been releasing their transported sediments within the lake. The geological formations such as Panjal agglomeratic slates, Panjal traps, along with intermittent sedimentary horizons of limestones and black shales have also been eroded due to their composition, geomorphic slope conditions as well as tectonic stresses (regional and local), that were operative during different geological ages (Gartner, 1990). The early Eocene diastrophism, although regarded as the major cause for the formation of the intermontane basins in the Northern Himalayan zones, there are certain conjectures associated with the presence of mega vertebrates at such high altitudes (Valdiya, 2001). With all probabilities, the sediments of Karewa intermontane basin in the Kashmir valley have considered as formations deposited during Late Neogene to Quaternary (Valdiya, 2001). The silt accumulation in the lake, therefore, is a resultant of the chemical susceptibility of the rock formations in the catchment of the Wular lake. These have been accelerated by the sporadic uplifts experienced by the region, as well as, due to the creation of faults and fractures at the time of seismic episodes. Under the envelope of climate, the litho-structural control has brought about erosion of the valley. Its untimely fluctuations, aided by extremity of temperature, have loosened the rock formations and made them ready for the next erosional on-slot. A major seismic episode during 2092 – 2041 B.C., had submerged the city of Sandimatnagar beneath the present Wular lake as a result of chocking of the drainage of Jhelum due to a massive landslide near Baramulla (Koul, 1925). Such fluctuations, as well as, reversals in drainage have been observed all along the Himalayan zone (Agrawal, 2006). It is now realized that seismic shocks may bring about local or regional tilting of the terrain and may lead to formation of depressions (basins). In order to maintain the critical angle, these depressions may initially receive material from the hinterland, and later on, from the foreland end of the wedge. On continuation of the process, these depressions may get coupled with the wedge along with their sand-fills. The depositional history of the Karewa sediments also indicates such a huge sequential evolutionary pattern of the basin formation. The Wular lake, today, is overexploited due to the land acqutition and is subjected to large siltation rates. These processes have been accelerated by the physical deterioration of the hill slopes around the Wular catchment. The very existence of the Wular lake is, therefore, threatened due to overexploitation of resources and encroachment by burgeoning population. These problems may be tackled effectively only by participatory management of the government and participatory efforts by the local population. The major thrust will have to be borne by the activities such as aforestation along the hill slopes,

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