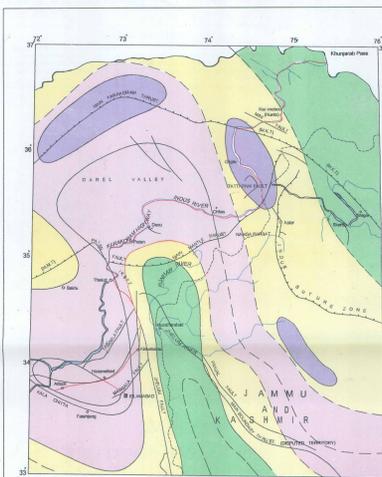
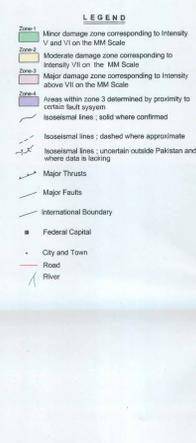


CHILAS - KHUNJERAB PASS SECTION



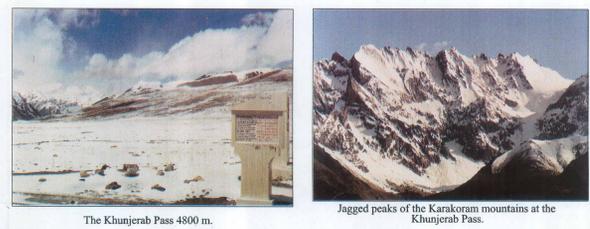
SEISMIC RISK MAP OF NORTHERN PAKISTAN



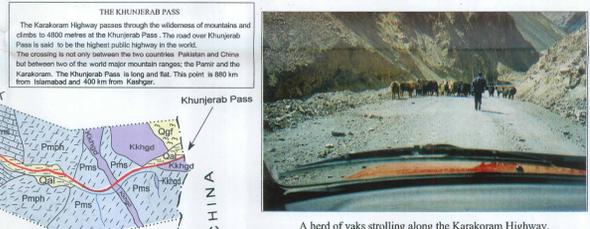
MAP SHOWING THE AVERAGE ANNUAL RAINFALL FROM ISLAMABAD TO KHUNJERAB PASS (Courtesy, Meteorological Department)



An ice bridge formed over the Hunza River due to a snow avalanche in the upper Hunza valley.



The Hunjerab Pass 4800 m. Jagged peaks of the Karakoram mountains at the Hunjerab Pass.



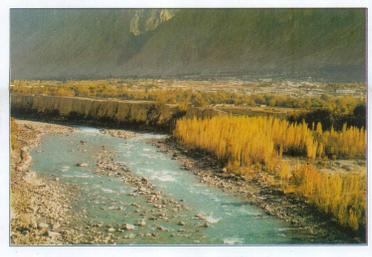
A herd of yaks strolling along the Karakoram Highway.



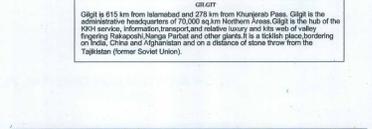
A fascinating view of the Pass glacier in upper Hunza.



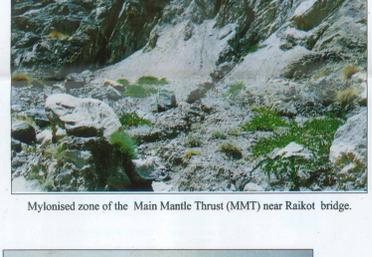
The Main Karakoram Thrust (MKT) zone near Chalt along the Karakoram Highway.



A panoramic view of Gilgit Town



Mylonized zone of the Main Mantle Thrust (MMT) near Raikot bridge.



Vertically exposed glaciofluvial deposits in Gandola area near Chilas along the Karakoram Highway; a source of debris slides.

LEGEND
 Minor damage zone corresponding to intensity V and VI on the MM Scale
 Moderate damage zone corresponding to intensity VII on the MM Scale
 Major damage zone corresponding to intensity above VII on the MM Scale
 Areas within zone 3 determined by proximity to certain fault systems
 Isostatic lines - dashed where approximated
 Isostatic lines - uncertain outside Pakistan and where data is lacking
 Major Faults
 Major Thrusts
 International Boundary
 Federal Capital
 City and Town
 River

SEST
 It is mainly a custom and immigration check post on the KKH at a height of 11000 meters and about 85 km from Hunjerab Pass. The road passes through some snow covered areas on the KKH. The journey between Sest to Hunjerab Pass is long and desolate. You can also visit the Hunjerab Pass from here as a day trip. This is the best place, going to China, where all the tourist facilities like hotels, banks, post office, customs, immigration, ticket office, shopping centres and petrol pump are available in Pakistan territory.

GLACIERS ALONG THE KKH
 KKH comes close to four glaciers that are among the world largest outside the arctic zones. The black Butura glacier and white Pass glacier are about 2600m high. These glaciers extend up to 50 and even 70 km in length. The snow of Butura glacier flows by sea down the valley in 1970 and blocked down a large part of the concrete bridge. Mountain glacier activities a mudflow which blocked the Hunza river and formed 2.5 km long lake and buried a 130m long Hindukush bridge under the debris. The Gulmit glacier is extending out over the KKH and has changed its course frequently. The trend of glacier pressure and mudflow is marked only by that of avalanches and debris flows.

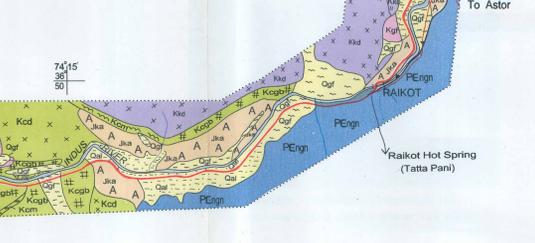
MAIN KARAKORAM THRUST (MKT)
 The Main Karakoram Thrust of the Northern Algeashier represents the collision zone of the southern margin of the Eurasian plate to Asia and marks northern limit of Kohistan arc. It extends into Balistan through Haspula and Mithani to Chilas and Shyok valleys respectively. The general trend of the MKT is E-W and ENE, shows medium to high dip towards the N and NW. It is a high angle, asymmetrically active thrust containing a large number of elements of low to medium intensity.

HUNZA-NAGAR
 For pure nature beauty the Hunza valley is a central place on the KKH. Hunza is commonly used as reference to the entire broad valley below Sest. The Nagar occupies the entire south side and some of the north side near Chalt. Hunza-Nagar is a place of great goodness. The very edge of the Ancient Asian continent is exposed near Chalt. Nagar also includes 7700 metres high Rakaposhi and the lower Hunza glacier.

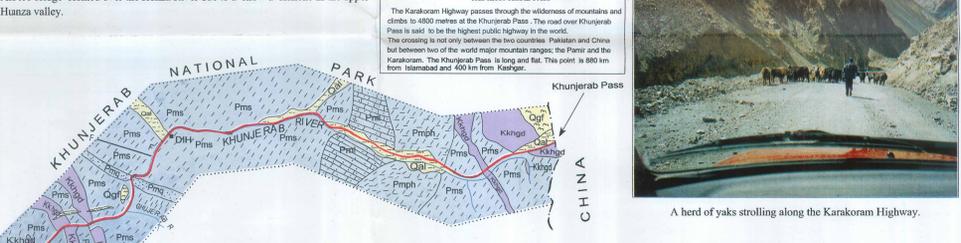
CONFLUENCE OF GILGIT AND INDUS RIVERS
 The confluence of Gilgit and Indus rivers popularly known as "The Triple Junction" of three great mountain ranges - the Himalayas, Karakoram and Hindukush near Jaglot Farm; a place 50 Km from Gilgit.

AN HOUR DRIVE SOUTH OF GILGIT
 An hour drive south of Gilgit, the road leaves the KKH and crosses a bridge known as Alam bridge to enter into the Indus gorge. From the Alam bridge Sestali dam is located about 170 km south of Gilgit. The road is very winding and runs on the right bank of the Indus for about 150 km in a narrow gorge before entering into the Skardu valley.

ASTOR VALLEY
 Astor valley is located under the foothills of Nanga Parbat in Diamir District. There are two ways to approach Astor from Gilgit. One route starts from Jaglot via Bujji upto Sheelari and the other is from Raikot along the west bank of the Indus River upto Sheelari. The road then follows the Astor River up to the Astor valley and over the Buzali Pass. It was an ancient caravan route and was the only link between the British India and Gilgit.



MINERAL SHOWINGS ALONG THE KARAKORAM HIGHWAY



NORTHERN AREAS OF PAKISTAN

Administrative set-up
 The Northern Areas of Pakistan spread over 72,496 sq kms and are located between latitude 34° 30' to 37° N and longitude 72° 30' to 77° E. These are administratively divided into five districts, namely Gilgit, Diamir, Baltistan, Gilgit and Chitral. There is a Deputy Commissioner for each district and a Chief Secretary for the whole of Northern Areas. The valleys of Swat, Chitral, and Kaghan adjacent to Northern Areas are under the administrative control of the North West Frontier Province of Pakistan.

Topography, Drainage and Climate
 The Northern Areas of Pakistan show the largest area of topographic relief above 6000 m anywhere in the world. The Karakoram is entirely precipitous mountains with deep cut valleys, long glaciers and numerous peaks of 6000 m or higher elevation. It is a wild, treacherous and beautiful landscape where very few people live and only deserves the title of 'Roof of the World'. The enormous differences in relief between the 7000-8000 m summits of the Nanga Parbat-Haramosh Range as well as the high Karakoram and the river valleys that drain through them have been enhanced by extremely high recent uplift and erosion rates. The 6500 m of vertical relief between the summit of Nanga Parbat and the Indus River is probably the world's greatest single step.

Geology and Tectonics of the Area
 The Northern Areas are drained by a number of rivers. The Indus River is the master stream of the area which rises immediately north of Mount Kailas and flows westwards into Ladakh dividing the Karakoram Mountains to the north and the Zaskar and Himalayan Ranges to the south. It is fed by the Gilgit, Hunza and Ishkuman rivers from the north, and the Shyok and Karal rivers from the south. The Indus River cuts through the Ladakh Range to the Skardu Basin and then through the Nanga Parbat-Haramosh massif along the great chain of the Indus gorge in Balistan. The course of the Indus then swings south through Chilas and Basha cutting through the barren mountains of eastern Kohistan. High steep-sided mountains and deeply incised river valleys characterize the entire length of the Karakoram Range.

Geology and Tectonics of the Area
 The Northern Areas are one of the most complex and difficult terrains in the world exhibiting a great variety of rock types and structures. The exposed rocks range in age from Pre-Cambrian to Recent and comprise mostly igneous and metamorphic rocks of various types.

Geology and Tectonics of the Area
 On the basis of broad regional tectonic set up, the area is characterized by continent-continent and continent-arc collision zones. The continent-continent collision boundary in Southern Tibet is traceable along the Indus Tangeze Suture (ITS) which bifurcates further west into the continent-arc collision zones, the Main Karakoram Thrust (MKT) and the Main Mantle Thrust (MMT). The MKT and MMT are the suture zones characterized by the association of ophiolite melanges and in the case of MMT blueschists and high pressure granulites. The MKT and MMT extend E-W in northerly curved arcs, terminated in eastern Afghanistan by the N-S Deo-Zaskar-Warrior Suture.

Geology and Tectonics of the Area
 The MKT and MMT enclose an area of 40,000 km² which is occupied by volcanic, plutonic, and subordinate sedimentary rocks variably deformed and metamorphosed. These rocks are considered to represent a collage of island arc and back-arc system (Tucker et al., 1990) developed in response of northward subduction of the oceanic lithosphere in Cretaceous time. The arc at present is split into Kohistan and Ladakh as its western and eastern parts by the N-S trending Nanga Parbat-Haramosh massifs of the Indo-Pakistan Continental Plate.

Geology and Tectonics of the Area
 Northern Areas of Pakistan, thus comprise two continental plates with a sandwich of the Kohistan arc. The Karakoram-Asian Continental Plate, bounded to the south by the MKT, consists of mainly Palaeozoic and subordinate Mesozoic sediments into which have been emplaced (i) the Khunjerab-Wakhan-Tirichmir granulites of the Jurassic to Cretaceous age to the north and (ii) the Karakoram batholith of Cretaceous to Tertiary age to the south (Debon et al., 1987).

Geology and Tectonics of the Area
 The Indo-Pakistan continental plate is made up of Pre-Cambrian to Cambrian basement, and Palaeozoic to Mesozoic and Tertiary cover. Several episodes of plutonic activity ranging from Pre-Cambrian to Permo-Triassic and even Himalayan age have been recorded in the Indo-Pakistan Continental Plate margin in Northern Areas of Pakistan.

Geology and Tectonics of the Area
 The geology of the three tectonic elements is briefly described in a sequential order starting from south to north.

Geology and Tectonics of the Area
 The Indo-Pakistan continental plate - It comprises (i) Nanga Parbat-Haramosh massifs, (ii) the Himalayan crystalline schuppen zone and (iii) the Himalayan fold belt. In the southern part the Himalayan crystalline zone is demarcated from the Himalayan fold belt by a prominent tectonic feature called the Main Boundary Thrust (MBT) which forms a continuous boundary between the post-collisional Murree and Siwalik formations and the pre-collisional crystalline rocks along the entire Himalayan belt. The description of the major orographic or tectonic units of the rocks of the Indo-Pakistan continental plate margin is:-

Geology and Tectonics of the Area
 1. Nanga Parbat-Haramosh massifs - Nanga Parbat is located to the northeast of Kohistan forms a sharp loop in the rocks, which are involved in a thrust around a gigantic cone, the highest peak of which is Duanir (8126m). The Nanga Parbat-Haramosh massifs is located on an individual orographic and tectonic unit constituting a tightly folded anticlinal structure and enveloping middle to high grade metamorphic rocks. The tectonic effects such as pygmy folding and comminution in microfolds are the indicators of continent to continent collision and can best be seen in most of the rocks of Nanga Parbat massifs. The rocks are mainly remobilized granitic augen-gneiss, slate, quartzite, schist, paragneiss and amphibolite.

Geology and Tectonics of the Area
 11. Himalayan crystalline schuppen zone - This zone is represented by the pre-collisional crystalline rocks along the entire Himalayan belt.

Geology and Tectonics of the Area
 111. Himalayan fold belt - It mostly comprises sedimentary rocks of the fore-deep and pre-collisional shelf and consists of tightly folded and faulted sediments of the outer Himalayan belt.

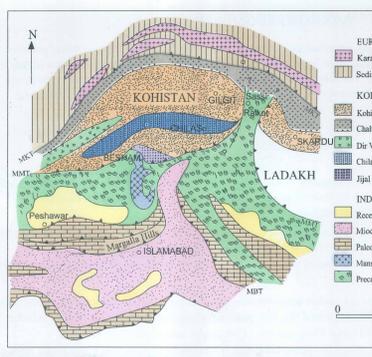
Kohistan Island Arc
 The Kohistan island arc lies between the Indo-Pakistan and Karakoram-Asian continental plates and comprises five principal units and extends from the MMT to the MKT. (i) basalt-ultramafic-mafic cumulates (Jijal ultramafics); (ii) Chilas complex of mafic to intermediate plutonic rocks; (iii) the Jaglot group (Gilgit formation, Gashu - confluence volcanics and the Thelichi formation); and (iv) the Chalt volcanic group and Rakaposhi volcanic complex. These rocks are intruded by the Kohistan batholith of felsic, intermediate and mafic composition.

Karakoram Asian Continental Plate
 The Karakoram Asian Continental Plate: The area forms a part of the Karakoram-Himalayan Fold and Thrust Zone. The rocks are predominantly pelitic and metamorphic and comprise phylites, schists, gneisses and marble. These rocks generally follow the arcuate trend of the major megathrusts in the area and show an increase in the grade of metamorphism from south to north.

Unconsolidated Sediments
 These sediments contain Upper Pleistocene to Recent alluvial glaciofluvial and aeolian deposits and are tectonically undisturbed except the sediments at Jalpur, which are characterized by the recent tectonics. They form platform cover in Indus plain and valley fills in intermountain basins.

Publications of GSP on Karakoram Highway
 Fayaz, A., Khan, K.S.A., & Latif, M., 1985. Mudflows and Avalanches along the Karakoram Highway. GSP - I.R. No. 247.
 Fayaz, A., Khan, K.S.A., & Latif, M., 1985. Landslide Evaluation and Stabilization from Gilgit to Thakot along the Karakoram Highway. GSP - I.R. No. 253.
 Fayaz, A., 1988. A short note on movement of Doh Glacier causing blockage of the Karakoram Highway. GSP - I.R. No. 329.
 Fayaz, A., Khan, K.S.A., Hussain, H. & Latif, M., 1999. Landslides and their control along the Karakoram Highway. Volume II GSP. Special Publication (under publication).
 Khan, K.S.A., 1971. Report on Landslides investigation in Gilgit and Hunza areas along the Karakoram Highway. GSP - WREG-GR-10.
 Khan, K.S.A., Fayaz, A., Latif, M., & Wazir, A.K., 1986. Rock and Debris Slides between the Khunjerab Pass and Gilgit along the Karakoram Highway. GSP - I.R. No. 272.
 Khan, K.S.A., Latif, M., Akhtar, J. & Fayaz, A., 1990. River bed Erosion Problems in Hunza, Ishkuman and Yasin River valleys, Northern Areas Pakistan. GSP - I.R. No. 275.
 Khan, K.S.A., Fayaz, A., Hussain, H. & Latif, M., 1999. Landslides and their control along the Karakoram Highway. Volume I GSP. Special Publication (under publication).

REFERENCES
 Bakr, M.A., 1985. Geology parts of Trans-Himalayan regions in Gilgit Agency and Baltistan, West Pakistan. GSP Rec. Vol. VII. PL.3. Gilgit, J. and O. 1971. 1985. Geology map of the southern Himalayan in Pakistan and Adjacent areas, U.S.G.S., Reston, Virginia.
 Debon, P., La Fout, P., Durr, G., Sorel, F., and Zhemmaru, N.L., 1987. The India- Eurasia suture in Northern Karakoram and Northern Kohistan - A tectonic and geochronological study. Tectonophysics, 138, 1-20.
 Desio, A. and Martinis, E., 1972. Geology of upper Hunza valley, Karakoram, West Pakistan. Bull. Soc. Geol.-Ital., V. 91, p.283-314.
 Desio, A., 1974. Geotectonic Reconstructions of the Middle Indus Valley between Chilas and Beshan Gila, Pakistan. Soc. Geol.-Ital., V. 93, p.343-388.
 Ghazdar, M., Chaudhary, M.A. and Hussain, S., 1991. Geology and Petro-tectonics of South-Eastern Kohistan, North West Himalaya/Northern Pakistan. Kashmir Journal of Geology, Vol.8, pp.68-97.
 Hameed, M.T., Ghazdar, M.A., Khan, T., Khan, M.Z., Khan, K.S.A., 1992. Late Cretaceous igneous activity and tectonics of the Karakoram Basin in the Karakoram valley, North Pakistan. Geology in South-Asia. Proceedings of the First South Asia Geological Congress, Pakistan, pp. 203-207.
 Patterson, G. and Winslow, B.F., 1985. Rb-Sr dating of the Kohistan arc batholith in the Trans Himalayan of the Karakoram, tectonic implications. Earth Planet. Sci. Lett. 74, pp.45-57.
 Seedorf, G., Wallath, L., Hussain, A., and Hyland, M.D., 1995. Regional Geological map of the Dhar Chitri quadrangle, NWFP, Pakistan. Proceedings of Geoscience colloquium, V.13, special issue.
 Searle, M.P., 1991. Geology and tectonics of the Karakoram Mountains. John Wiley & Sons.
 Searle, M.P. and Khan, M.A., Geological Map of North Pakistan, GSP map series, Vol. IV, No.2.
 Shah, S.H. and Khan, R., 1998. Geology of the Jaglot quadrangle (43-11) Gilgit district, Northern Areas, Pakistan. GSP - I.R. No. 547.
 Shah, S.H. and Shah, S.S., 1988. Geology and mineral investigations of the Parit quadrangle (43-11) Gilgit district, Northern Areas, Pakistan. GSP - I.R. No. 224.
 Tahirshah, R.A.K., 1986. Tectonostratigraphic domains of Northern Collateral Belt in Pakistan. Published by Geoscience Laboratory, GSP, Islamabad (Map).
 Tahirshah, R.A.K., Mattar, M., Prout, F., and Sullivan, P., 1979. The India-Eurasia suture in Northern Pakistan. Synthesis and interpretation of data on state scale in a Fault and Descriptive Geology of Pakistan. GSP. Quatta, p.154-170.
 Teodoro, P., Patterson, M.G., Jan, M.Q. and Tappin, M.A., 1996. A re-evaluation of the stratigraphy and evolution of the Kohistan arc, northern Pakistan. Implications for magmatic and tectonic arc building processes. Jour. Geol. Soc. London, 153, p.681-693.
 Williams, V.S., Shaikh, I., Pasha, M.K., Khan, K.S.A., and Raza, Q., 1991. Preliminary report on the environmental geology of the Islamabad-Rawalpindi area, Pakistan. (unpublished).



Geological map of northern Pakistan. MBT = Main Boundary Thrust, MKT = Main Karakoram Thrust, MMT = Main Mantle Thrust