I/1. Ibrahim, M., Agha, Z.R. & Iqbal, M.P., 1975. A study of Kala-Chitta and Salt Range clays. Pakistan Journal of Scientific Research, Lahore, 27, 49-55.

Key words: Clay, Kala Chitta, Slat Range.

I/2. Ibrahim, M.Y.H., 1992-94. Sedimentology of Murree Formation and lithostructural mapping of Barian Area, Southern Hazara, Northwestern Himalaya-Pakistan. M.Sc. Thesis, Punjab University, Lahore, 124p.

A detailed geological study of a small part of the Attock Hazara Fold and Thrust Belt in Khaira Gali-Kuldana area of Galliat was carried out. Geological mapping at the scale of 1:21120 of an area of 50 square killometers was carried out in detail. Lithtostratigraphic units in the study area range in age from Middle Jurassic to Upper Eocene in age. Samana Suk Limestone of Middle Jurassic age is an oolitic dolomitic limestone and represents shallow carbonate shelf sedimentation. The Chichali Formation is composed of black shale condensed sequence deposited in a basin of restricted circulation and represents deepening of the basin. This continues into glauconitic Lumshiwal Formation deposited in middle subtidal conditions. Further deepening of the basin deposited pelagic Kawagarh Formation of Cretaceous age. It was deposited in lower subtidal conditions near the shelf edge. This was followed by sudden regression due to contact between Kohistan Island Arc and Indian plate, which resulted in general uplift continental conditions. Residual Hangu Formation of Danian age was thus developed on top of Kawagarh Formation. This was followed by a rise in sea level and deposition of shelf foraminiferal Lockhart Limestone of Paleocene age which is overlain by Patala Shale, Margalla Hill Limestone and Chorgali Limestone and Marl. All these are open shelf foraminiferal deposits. At this point in time collision between India and Asia took place mixed marine continental Kuldana Formation developed. This was followed by a rise of Himalaya, which shed debris in the foredeep. This formed fluvial Murree Formation molasses.
The sedimentary package is composed of lower Marine sequence from Jurassic to Middle Eocene dominated by carbonates with a residual lateritic horizon of Danian age. The upper part of the package starts from mixed marine fluvial sequence (Kuldana Formation) and an upper molassic sequence (Murree Formation) of Upper Eocene to Miocene age. Structurally the area is mapped in detail and is composed of Chumbi Anticlinorium, Khaira Gali Synclinorium, Kali Mitti Synclinorium and Darya Gali Anticlinorium. The area is also cut by Thrust faults. General trend of the rocks is northeast to southwest. The rocks are cross folded and double plunging. The folds are tight to isoclina1 with a general vergence to southeast. Murree Formation of Upper Eocene to Miocene age is a molassic fluvial sequence deposited by a meandering river system. This sequence was derived from rising Himalaya after the collision of India with Asia in Eocene times. Facies, microfacies, diagenesis and provenance of this formation were studied in detail. For the purpose of foregoing sedimentological studies a section between Darya Gali and Kuldana Chowk was measured and sampled in detail. The Murree Formation is composed of an alternating sequence of gray to grayish gray sandstone and chocolate, maroon and brown shale. Conglomerates, breccias, limestone and marl are minor lithologies. This sequence was derived from rising Himalaya to the north as well as upper part of Kohistan Island Arc. The sandstones are lithic arenites which are texturally sub-mature and compositionally immature.
Key words: Sedimentology, structure, mapping, Murree Formation, Hazara.

I/3. Ichikawa, K. & Maeda, Y., 1965. Some Lower Cretaceous molluscan fossils from Yasin, West Pakistan. In: Matsushita, S. & Huzita, K. (Eds), Geology of the Karakoram and Hindukush. Results of the Kyoto University Scientific Expedition to the Karakoram and Hindukush, 1955, Vol. VII, 137-146. Nippon Printing & Publishing Co., Ltd., Japan.

This is a detailed study of Nerineids and Rudists collected from the highly fossiliferous beds near Yasin. The authors give information about the previous paleontological studies in the area (especially those of Hayden, 1915; Douville, 1926; Ivanac et al., 1956; Desio, 1959) and conclude that the Yasin fauna, as a whole, may properly be referred to the Lower Aptian and/or thereabouts. They determined and described the following species and showed them in eight plates:
Plesioptyxis matsushitai n. sp.
Plesioptyxis huzitai n. sp.
Adiozoptyxis cf. A. coquandiana D'ORBIGNY

Horiopleura haydeni DOUVILLE
Horiopleura haydeni var.
Key words: Paleontology, Nerineids, Rudists, Yasin, Eastern Hindukush.

I/4. Idrees, M. & Hammad, A., 1977. Petrology of Utla Granite, Gadoon area, M.Sc. Thesis, Peshawar University, 33p.

Key words: Petrology, granite, Swabi.

I/5. Iftikhar & Jehanzeb, 1987. Report on the groundwater resources in Daggar valley, Buner, Swat, N.W.F.P. M.Sc. Thesis, University of Peshawar, 55p.

A programme for groundwater investigation in Daggar valley, Buner in the North West Frontier Province of Pakistan started in January 1984. The objective of the investigation was the determination of the ground water potential of the valley and the most suitable area for withdrawal.
In order to determine the hydraulic characteristics of the sub-soil, hydrogeologic studies were carried out and six testholes were drilled. Four of them were converted into testwells of which one is suitable as potential production well. The results of the studies show that the alluvial fill can be considered as aquifer of mainly fine grained material with some sand and gravel layers varying both in lateral and vertical sense. The alluvial fill is more than 100 m thick and occasionally more than 200 m. the transmissivity of the wells ranges from 300 -0 500 m^2/day in the western part of the valley, and only 20-100m^2/day in the eastern parts. The depth to the ground-water table is generally less than 15m except in the south-western part from Jowar to Tursak and on the higher elevated old river terranes. Recharge of the ground-water occurs near the mountainous boundary by inflow from the bedrock (mainly limestone) and run-off from the mountains and precipitation on the plain percolating downward through the alluvial fill. Ground-water development with tubewells is only feasible in the valleys south-west of Daggar, due to the availability of sufficient sand and gravel layer in the alluvial fill.
The recharge of the ground-water in this area is 23x10^6m^3/year pf 18870 acres feet/year and it is recommended during ground-water development not to withdraw more than this amount initially. Water levels should be monitored at regular intervals to assure the effects of the ground-water development.
Key words: Groundwater, Buner, Swat.

I/6. Ihsan, M., Badshah, K. & Ali, S., 1983. Petrology of a part of Ambela Granite Complex, Babaji syenite, Buner-Swat, North West Frontier Province. M.Sc. Thesis, University of Peshawar, 88p.

Key words: Petrology, granite, Ambela, Buner, Swat.

I/7. Ikramuddin, M., Fan, F., Tahirkheli, R.A.K., Jan, M.Q., Majid, M., Haneef, M., Shah, M.T., & Afridi, G.A. 1987.Reconnaissance lithogeochemical survey of parts of northwest Pakistan. GSA Abstract with program, 19(7).

Several recent studies have demonstrated that hydrothermally altered rocks associated with various types of mineral deposits generally contain high contents of Ti and low K/Ti ratios. In order to further test the usefulness of Ti and K/Ti ratio as guides to mineralization, a reconnaissance lithogeochemical survey of northwest Pakistan was carried out. About 200 rocks, collected from various parts of the area extending from Peshawar to Gilgit, were analyzed for T1, Rb, K, and Au. The rocks studied include ultramafics, gabbro, diorite, granodiorite, granite, pegmatite, aplite, quartz veins, andesite, dacite, rhyolite, gneisses, schists, amphibolite, greenstone, and carbonates. Most of the rocks studied are fresh and unmineralized with the exception of a few samples from Besham area, which are associated with Pb-Zn mineralization. The majority of the rocks have very low contents of Au ranging from 0.1 ppb to 5 ppb. The mineralized rocks of Besham area, however, contain high contents of Au, one sample containing 250 ppb. There are at least 5 different rock types, collected from unmineralized areas, which contain Au concentrations 5 to 10 times higher than the background levels. The T1 contents of rocks are generally low varying from 0.01 ppm to 1.5

ppm with ultramafic rocks containing the lowest values and acidic rocks the highest values; each type of rock has a very narrow range of values. The rocks from mineralized area of Besham contain up to 20 ppm T1. There are several localities in the area which contain significantly higher T1 contents and lower K/T1 ratios compared to the background values. The T1 contents and K/T1 ratios of the rocks from Pakistan suggest that the detailed lithogeochemical and pedogeochemical surveys of certain areas may prove to be very useful in locating potential mineral deposits.
Key words: Reconnaissance, geochemistry.

I/8. Ilyas, M., 1973. Geological mapping of Lowari Pass area with special references to prospects of constructing a tunnel. M.Sc. Thesis. Punjab University, Lahore.

Key words: Mapping, Tunnels, Lowari pass.

I/9. Ilyas, M., 1983. Development, mining and beneficiation of China clay. Second National Seminar on Development of Mineral Resources, Peshawar, 3, 10p.

Key words: China clay, beneficiation.

I/10. Ilyas, W., 1983-85. Geotechnical studies of landslides with special emphasis on slope stability along Karakoram Highway between Thakot and Besham, District Swat. M.Sc. Thesis, Punjab University, Lahore, 117p.

Engineering geological investigations were carried out about the landslides and slope stability problem along the Karakorum Highway between Thakot and Besham. The project area mainly comprises of Thakot metasediments, Lahor granite, Shang granite gneiss and minera1ised scree (near Besham).These are mainly controlling the rugged topography and other geomorphological features of the Project area. The general trend of stresses is SE.-NW.
So far the stability of the region is concerned; the detailed analysis for critical slopes is performed. Among different modes of failure encountered, the plane failures are proved to be unstable particularly near Maira and at Kandaurgai. Other than this a large variation in discontinuities is observed that controls sliding in hard rocks and highly weathered rocks which are responsible for mass wasting and rock fall. Road alignments were studied keeping in view landslide problems and slope stability, for potentially unstable regions remedial measures are also given. 1 h: 2V cuts slopes and benches are proposed. Benches may be provided at each 8 meters interval.
Key words: Geotechnical, landslides, slope stability, KKH, Thakot, Besham.

I/11. Imam, S.A. & Kidwai, A.H., 1960. Magnetite deposits of Dammer Nissar, Chitral State, West Pakistan. Geological Survey of Pakistan. Information Release 7, 65p.

Key words: Mineral deposits, magnetite, Dammer Nisar, Chitral.

I/12. Imran, H.M., 1973. Geology and petrology of the area on the right bank of Tarbela dam with special emphasis on igneous rocks. M.Sc. Thesis. Punjab University, Lahore, 97p.

Key words: Geology, petrology, Tarbela.

I/13. Iqbal, A., 1964. Soapstone deposits of Sherwan in Hazara District. Science and Industry 2, 19-24.

The geology and mode of occurrence, with chemical analyses are reported for nine deposits of soapstone. Theses are mostly found near basic intrusions. Prospects for large-scale mining development are discussed.
Key Words: Mineral Deposits, soapstone, Abbottabad, Hazara.

I/14. Iqbal, A., 1997-99. Petrophysical interpretation, reservoir geology modeling and reserves estimation of Silver Gas Field, Middle Indus Basin, Pakistan. M.Sc. Thesis, Punjab University, Lahore, 159p.

This thesis deals with Petrophysical interpretation and development geology of “Silver Gas Field" which is a fictitious name of an existing Gas field in Punjab plat form within middle Indus basin. Drilling record shows that stratigraphic column in the gas field is table (2.1) with their thicknesses. Based upon various kinds of data (mud log and wire line log data), different reservoir parameters were determined individually and reservoir zonation was also described. Variation in reservoir properties were illustrated with the help of various maps including, structural cross-section, stratigraphic cross section iso-porosity maps, iso-saturation maps, net pay maps and net lime maps. Reserves estimation of the "Silver Gas Field which was at its discovery stage has been accomplished on the basis of volumetric equation. Structurally "Silver Gas Field" is a broad gently dipping monocline with conjugate normal faults in the NNW of the area. Only the original gas in place of Samana Suk formation was estimated which is about 124 billion cubic feet (BCF). For the reserves estimation, well data of five wells was used all of which were gas producing.
Key words: Hydrocarbon, reservoir geology, Indus Basin.

I/15. Iqbal, H., Basit, A.A. & Haroon, M., 2000. Subsurface temperature distributions in Upper Indus Basin. Abstracts, Third South Asia Geological Congress, Lahore, p.30.

Key words: Subsurface geology, Indus Basin.

I/16. Iqbal, I., 1989-91. Slope stability analysis and feasibility studies of sub-grade along Murree-Kohala Road. M.Sc. Thesis, Punjab University, Lahore, 140p.

Landslides are wide spread in Pakistan like other Countries and cause enormous economic loss as well as loss of human lives, particularly when engineering structures are designed and constructed without ana1ysing the slope stability conditions. Pakistan has a very intricate Geological history with numerous active tectonic zones. The project area (Murree –Kohala road) has a very diverse sliding phenomenon particularly along the road. The climate conditions of the project area are such humid to semi-arid. The major part of the road is on the escarp face with variety of slope conditions, from strategic and regular communication point of view, Murree –Kohala road has great national importance. It is the shortest land route bridging Pakistan and Azad Kashmir for the supply of basic needs. This road is also important from defence point of view.
The road (Murree -Kohala) originated as a foot -way, then it developed into mule track, further it took the form of jeepable track and finally to overcome the expenditure, the same track was constructed in the form of road.
Key words: Slope stability, feasibility, Murree-Kohala.

I/17. Iqbal, M., 1973. Geology and Petrology of Aligram-Kabal Area, Swat District. M.Sc. Thesis, Punjab University, Lahore, 99p.

A geological map on a scale of 3 inches to a mile, covering more than seventeen miles area around Aligram-Kabal, Swat District, is presented. The rocks of this area, previously mapped as a single unit, are now subdivided into four map able units on lithological basis. Detailed petrography, mineralogy and structural features of these four litho-types are described. Modal analysis and mineralogical data on 40 thin sections is included. Joints orientation diagrams of measurements on perfectly developed joint surfaces are given. Based on field and laboratory evidence, plausible explanations regarding the petrogenesis of the rock exposed in the area are given.
Key words: Petrology, structure, stratigraphy, Swat

I/18. Iqbal, M., 1990-91. Structure, stratigraphy and petrography of the western limb of the Hazara-Kashmir Syntaxis, Garhi Habibullah-Shinkiari area, Northern Pakistan. M.Sc. Thesis, University of Azad Jammu & Kashmir, Muzaffarabad, Pakistan, 105p.

The Garhi Habibullah-Shinkiari area lies along the western limb of the major northwest plunging antiformal structure known as the Hazara-Kashmir syntaxis. The 293 km2 area has been mapped in this study. The western limb of the Hazara-Kashmir syntaxis has been divided into four fault-bounded tectonostratigraphic zones. These are named as the Muzaffarabad-Balakot zone, the Garhi Habibullah-Abbottabad zone, the Panjal zone and the Mansehra zone. These zones belong to different tectonic and stratigraphic provinces which have been juxtaposed during the Himalayan thrusting. The Muzaffarabad-Balakot zone lies to the east of Main boundary fault. This zone constitutes late Proterozoic to Cenozoic sequence. This sequence is involved in the Muzaffarabad-Balakot southwestward overturned anticline. The late Proterozoic Dogra formation forms the core of the Muzaffarabad-Balakot anticline. The Dogra formation is unconformably overlain by the early Cambrian Muzaffarabad formation. The Ordovician (?) Yadgar formation disconformably overlies the Muzaffarabad formation. The Yadgar formation is unconformably overlain by the Paleocene-Eocene sequence which includes the Hangu Formation, Lockhart Formation, Patala Formation and Margala Hill Limestone. This was followed by the late Eocene Kuldana and Miocene Murree molasses. The most of the Paleocene to Miocene sequence along the overturned limb of the Muzaffarabad-Balakot anticline is faulted.
The Garhi Habibullah-Abbottabad zone lies between the Main boundary fault and Garhi Habibullah fault. This zone is involved in the Garhi Habibullah syncline. The Cambrian Abbottabad group lies in the core and Hazara formation along the limbs of the anticline. In the Garhi Habibullah syncline, the late Proterozoic Hazara formation is unconformably overlain by the Cambrian Abbottabad group of rocks. The Jurassic sequence has been eroded from the core of the syncline due to later Himalayan uplift.
Key words: Structure, stratigraphy, petrography, Hazara-Kashmir syntaxes.

I/19. Iqbal, M., 1994. The Geology of Siwalik rocks in Potwar area. Geological Survey of Pakistan, Information Release 269.

The field work was sponsored by the Geological Survey of Pakistan in collaboration of
YALE and HOWARD Universities, U.S.A. to interpret the geology of Siwalik rocks in Potwar Area.
Moreover, in GSP Museum, there were not a sufficient number of vertebrate specimens. It was a great help for the development of palaeontological museum.
Key words: Stratigraphy, paleontology, Siwalik, Potwar.

I/20. Iqbal, M., & Ali, S.M., 2000. Correlation of structural lineaments with oil discoveries in Potwar Area, Pakistan. Abstracts, Third South Asia Geological Congress, Lahore, p.54.

Key words: Structure, oil, Potwar.

I/21. Iqbal, M., & Ali, S.M., 2001. Correlation of structural lineaments with oil discoveries in Potwar Sub-Basin, Pakistan. Pakistan Journal of Hydrocarbon Development 12, 73-80.

Key words: Structure, oil, Potwar.

I/22. Iqbal, M.I.A., 1985-87. Geology of Dunga Gali-Barian Area, District Abbottabad. M.Sc. Thesis, Punjab University, Lahore, 105p.

This report incorporates a comprehensive geological study of nearly 25 sq. km. area between Dunga Gali and Barian on the Murree-Abbottabad road. The study includes the preparation of a geological map on the scale 1:7040. Stratigraphically the rock units range from Upper Jurassic to Eocene and represent the sequence of the Hazara Province of the Kohat-Potwar Basin. It is primarily a limestone-shale sequence reflecting a stable shelf facies. Structurally, the area shows the development of a few synclinoria and anticlinora, within which a generally tight parallel to similar asymmetric to overturn style of folding predominates. A number of dipslip-strike faults, both of the normal and reverse type are present. A petrographic study of all rock units, based on fairly representative field sampling, is also present.
Key words: Geology, mapping, stratigraphy, Jurassic, Eocene.

I/23. Iqbal, M.W.A., 1969. The Tertiary palecypod and gastropod fauna from Drug, Zinda Pir, Vidor (Distt. D.G. Khan), Jhalar and Chharat (Distt. Campbellpur), West Pakistan. Geological Survey of Pakistan, Memoirs Palaeontologica Pakistanica 6, 77p.

Key words: Tertiary, Paleontology, D.G.Khan, Cambellpur.

I/24. Iqbal, M.W.A., 1969-70. Bibliography of Tertiary pelecepod and gastropods species of West Pakistan. Geological Survey of Pakistan, Records 18, 63p.

Key words: Bibliography, Tertiary, Paleontology.

I/25. Iqbal, M.W.A., 1972. Paleocene bivalve and gastropod fauna from Jherruk-Lakhra-Bara Nai (Sind), Salt Range (Punjab) and Samana Range (NWFP). Geological Survey of Pakistan, Memoirs 9, 104p.

This is an exhaustive study of gastropod and bivalve fauna of Paleocene age. The three areas are well known for their rich faunal assemblage and have been investigated by several workers in the past. The present detailed compilation also contains three maps, three charts, five figures and nine plates.
Key words: Paleocene, Paleontology, Sind, Salt Range, Samana Range, Hangu.

I/26. Iqbal, M.W.A., 1981. The Tertiary bivalves and gastropods of Pakistan. Geological Bulletin, Punjab University 16, 141-145.

The purpose of this paper is to present a resume of the paleontological research on the Tertiary bivalves, and gastropods of Pakistan. The writer (Iqbal, 1972a) presented a detailed account on the subject for the first time during the 13th Session of the Science conference, Scientific Society of Pakistan, March, 1972.
Later on a brief paper on the Tertiary bivalve and gastropods of Sind was also published (Iqbal, 1972).
The writer (lqbal, 1974) also presented a paper on the Baluchistan fauna during the Seminar on Development in Geological Sciences in Pakistan, University of Baluchistan, September, 1972. The biostratigraphic research conducted by the writer during 1963 to 1980 has given more emphasis to the Tertiary bivalve and gastropod fauna, In most of the cases, the bivalve and gastropod species were found extremely useful in determination of the specific stratigraphic problems and reconstruction of the depositional history of the geological formations in which they occur. Moreover, the world-wide geographical distribution and comparative analysis of the fauna proved helpful in understanding of the basinal distribution, the possible oceanic connections in between the various n certain, geological time, and the genetic relationship between certain species.
Key words: Tertiary, Palaeontology, Bivalves, Gastropods.

I/27. Iqbal, M.W.A., 1983. Tertiary biostratigraphy study based on bivalve and gastropode fauna. Geological Bulletin, Punjab University 18, 9-17.

The biostratigraphic study of the Tertiary formations based on bivalve and gastropod fauna includes large faunal collection from different lithofacies representing various basinal provinces and covering a large geographic areas of Sind, Baluchistan, Punjab and NWFP. Forty six sections representing twenty six major localities were measured. The study consists of systematic treatment and description of 373 species including 36 new species) revision and redesignation of previously described faunal distribution within and outside Pakistan, determination of Index Species, assignment of age and correlation and paleoecology paleontology.
Key words: Tertiary, Palaeontology, Bivalves, Gastropods.

I/28. Iqbal, M.W.A., 1986. Geology of Siwalik rocks in Potwar area, Pakistan. Geological Survey of Pakistan, Information Release 269.

Key words: Geology, Potwar, Siwaliks.

I/29. Iqbal, M.W.A. & Shah, S.M.I., 1980. A guide to the stratigraphy of Pakistan. Geological Survey of Pakistan, Record 53, 37p.

Key words: Stratigraphy.

I/30. Iqbal, S., Khan, H., Nasreen, S., Ghani, A. & Qaiser, M.A. 1999. Geology and chemistry of limestone resources of Khyber Agency. Geological Survey of Pakistan, Information Release 685.

Large deposits of limestone occurs in Khyber Agency. Much geological work has been done on the area but very little mineralogical and chemical studies have been done. Xray diffraction analysis, derivatography and chemical analysis data for the limestone resources of Khyber Agency are presented. Utilization of these limestone deposit in cement, sugar and chemical industries is suggested.
Key words: Geochemistry, limestone, Khyber Agency, NWFP.

I/31. Iqbal, S. & Khan, M.Z., 1983. Geology of Yasin group around Chalt village northern Pakistan. M.Sc. Thesis, University of Peshawar, 133p.

Key words: Geology, petrology, Yasin group, Chalt.

I/32. Iqbal, S.M., Ahmed, S. & Rashid, S., 2000. Environmental geology and land use planning of Islamabad, Pakistan. Abstracts, Third South Asia Geological Congress, Lahore, 141-142.

Key words: Environment, land use, Islamabad.

I/33. Ishaque, M., 1983. Utilization of Hazara phosphate rock for fertilizer manufacture. Second National Seminar on Development of Mineral Resources, Peshawar, 3, 10p.

Key words: Phosphate, Hazara.

I/34. Ishihara, S., Kausar, A.B. & Karim, T., 1996a. Sulfur isotopic profile and granitoid series in the northern Pakistan. Geologica 2, 77-85.

Consult the following account for further information.
Key words: Sulphur, isotopes, granitoids, Northern Pakistan.

I/35. Ishihara, S., Kausar, A.B. & Karim, T., 1996b. Sulfur isotopic profile and granitoid series in the northern Pakistan. In: Kausar, A.B. & Yajima, J. (eds.), Geology, Geochemistry, Economic Geology and Rock Magnetism of the Kohistan Arc. Proceedings of Geoscience Colloquium, Geoscience Lab, Geological Survey of Pakistan, Islamabad, 15, 57-68.

Reconnaissance studies were made on δ^{34} SCDT of trace amounts of sulfides contained in various rocks and on magnetic susceptibility of Paleozoic to Cenozoic granitoids exposed along the Karakoram Highway. Kamila amphibolites of oceanic crust (?) give "mantle-value" of 1.3 permil, while pyroxenite and hornblendite of the infracrustal rocks yields 2.6 permil. Pelitic metamorphic rocks are more deviated to the positive values (2.3 - 10.2 0/00, average 5.2 0/00). Cretaceous-Tertiary granitoids of the Kohistan Arc and Eurasian Plate have average δ^{34}

SCDT values of 2.9 and 3.0 permil, respectively, and related ores are depleted in ^{34}S. These granitoids are generally ilmenite series, except for the northern part of the Kohistan batholith where small mineral showings have been discovered. Scarcity of oxidized granitic rocks in the high level plutonic zones of the Kohistan Block and Eurasian Plate may be one of the significant reasons for paucity of sulfide-forming mineral resources in northern Pakistan.
Key words: Isotopes, granitoids, Sulphur, Northern Pakistan.

I/36. Islam, F. & Farooq, M., 1987. Petrogenetic studies of the western part of the Kalam Dir, Igneous complex. M.Sc. Thesis, University of Peshawar, 52p.

Key words: Petrogenesis, igneous rocks, Kalam, Dir.

I/37. Ismail, M., 1973. Magnetic Survey of Chalt (Gilgit). M.Sc. Thesis, Punjab University, Lahore, 100p.

The magnetic survey in Chalt, district Gilgit, was carried out in the months of November and December 1974; January, February and March 1975. The purpose was to know the extension of the magnetite body, which was exposed at one place in the area. The portable Proton Magnetometer Model G-816 was used which measure the total intensity of earth's magnetic field. About 712 magnetic stations covering an area of about 5 miles^2 were made. The rough topography or systematic profiles. The profiles were laid along the pony tracks, jeepable road, on the bed of river and on top of the hill. Magnetite stations were plotted on the map with the help of the odolith. Readings were taken at each magnetic station by Proton Magnetometer. The observed readings were then corrected for diurnal variations. A total magnetic intensity map was constructed with the corrected data. The scale of the map was taken 1:2400 and the map was contoured at an interval of 50 Gamma. The total intensity map was interpreted. No appreciable anomaly was cited on the map.
Key Words: Geophysics, magnetic survey, Chalt, Gilgit.

I/38. Ismail, M., 1975. Geology and petrology of Palai area, Malakand Agency. M.Sc. Thesis, Punjab University, Lahore, 63p.

Key words: Petrology, Palai, Malakand.

I/39. Iturrizaga, L., 1999. On the close connection between the development of postglacial debris accumulations and the Late Glacial glaciation history with case examples from subtropical mountain regions in High Asia (Hindukush and Karakorum Mountains). In: Book of Abstracts. XV. INQUA Congress. The Environmental Background to hominid evolution in Africa. Durban, South Africa 87.

A research study on a typology of postglacial debris accumulations in High Asia revealed that a considerable part of the debris accumulations in the Hindukush, Karakorum and Himalayas results from re-sedimentation of moraine deposits by postglacial slope processes. Especially the semi-arid mountain regions, which feature a high quantity of debris accumulations suggesting intensive weathering processes, show that in many valley sections the secondary debris production, i.e. the dislocation of glacial sediments, exceeds the primary debris production. The conventional classification into talus cones, alluvial cones, mudflow cones and related forms proves to be insufficient for an appropriate typology of debris accumulations in High Asia. It should be expanded to include in particular the glacial transitional debris accumulations as key forms of the secondary debris accumulation landscape. They contain the transformation of glacial sediments by slope processes into mixed forms of debris accumulations composed of glacial debris and slope material. The apparently homogeneous, mostly conical-shaped appearance of many debris accumulations may tempt one to classify them precipitously into the above-mentioned traditional division system and consequently leads to misinterpretations regarding their genesis. The residual debris accumulations provide homomorphologeous landscape elements in view of the talus cones, yet they do not represent accumulation forms but erosion forms formed from loose material. In many valley courses the disproportion between the size of the catchment areas and the corresponding debris accumulations is striking. This seemingly paradoxical relation can be

explained by taking into account the dislocation of moraine material deposited in the upper catchment areas. Another glacial-induced factor for debris supply is caused by the postglacial transformation of the glacially oversteepened trough valley flanks into the more stable form of the V-shaped valley, which results in various collapse accumulations. The misinterpretation of glacial sediments as pure slope sediments is one of the reasons in the controversial debate on the extent of the Last Glacial Maximum respectively the Late Glacial glaciation in High Asia. Therefore, it is necessary to establish detailed criteria for the differentiation of glacial and slope deposits in order to use them consistently as palaeoclimatic indicators.
In addition, characteristic features of the central-peripheric change of glacial transitional debris accumulations from the mountain centre to the foot hills and some aspects of the hypsometric change will be presented. In general, the debris landscape is conceived by means of genetic sequences. Important for the genesis and the chronology is the locational relationship between debris accumulations and glacier stages as well as to other geomorphological elements.
Field work was carried out in various valleys of High Asia including research areas in the E-Hindukush, NW-Karakorum, S-Karakorum (Mustagh-Karakorum), Nanga-Parbat Massif, Ladakh und Zanskar Range, Nun-Kun Massif, Kumaon and Garhwal-Himalayas (Kamet-, Trisul- and Nanda-Devi Massit) as well as in the Central Himalayas (Kanjiroba-, Annapurna-, Manaslu- and Makalu-Massif. In the presentation, representative case examples taken from the mostly semi-arid mountain regions for the glacially controlled formation of debris accumulations will be introduced.
Key words: Glaciation, paleoclimate, debris accumulation, Hindukush, Karakoram.

I/40. Ittekkot, V. & Arain, R., 1986. Nature of particulate organic matter in the river Indus, Pakistan. Geochemica et Cosmochemica Acta 50(8), 1643-1653.

Suspended sediments from the Indus River collected during 1981 through 1983 were analyzed for POC and its constituent fractions including amino acids, amino sugars and sugars. Percentage of POC decreased with increasing suspended matter concentrations, which suggested dilution of organic matter by mineral matter.
The concentrations of amino acids, amino sugars and sugars varied, respectively, between 180 and 2000 μg/l, 5 and 125 μg/l, and 60 and 1100 μg/l. Their contributions to POC varied between 2 and 60% for amino acids and amino sugars, and between 2 and 15% for sugars. They were high during low sediment discharge (February to June), and low during high sediment discharge (August and September). Suspended sediments associated with high sediment discharge periods were characterized by low ratios of:
(i) aspartic acid:β-alanine
(ii) glutamic acid:γ-aminobutyric acid
(iii) amino acids: amino sugars
(iv) hexoses: pentoses. These and the relative distribution pattern of the monosaccharides such as galactose, arabinose, mannose and xylose indicated that, not only dilution, but also differences in the sources and processes affect the POC transport in the Indus River. These result in transport of biodegraded organic matter during high sediment discharge periods: this appears to be common to other major rivers of the region, with depositional centers in deep sea areas. These rivers, with their high sediment loads, could contribute up to 8 to 11% of the global annual organic carbon burial in marine sediments.
Key words: Sediments, organic matter, Indus river.

I/41. Ivanac, J.F., Traves, D.M., & King, D., 1956. The geology of the N.W. portion of the Gilgit Agency. In: Haque, A.F.M.M. (ed.). Geological Survey of Pakistan. Records, 8(2), 27p.

This is one of the earlier and very important report of the geology of the Karakorum and Himalayan region of Pakistan. It contains details on stratigraphy, structural geology and petrography, along with information on the mineral deposits and a geological map. Descriptions are given for the Kohistan and Ladakh batholiths (granodiorites, granites, diorites, gneisses), Yasin group cretaceous clastic sediments, fossiliferous limestones, and volcanics, Chalt volcanics (greenstone complex), and Permo-Carboniferous (?) Darkot Group sediments.
Key words: Geology, stratigraphy, petrography, Gilgit agency.

I/42. Izatt, C., 1990. Thrust geometries and rates of shortening across the Himalayan external zones, Northern Pakistan. In Abstract volume, 5th Himalaya-Karakoram-Tibet Workshop, Milano, p.24.

As the Himalayan front of deformation migrated south across the Indian Shield the Mesozoic-Cenozoic passive margin and Tertiary Indo-Gangetic foredeep was progressively shortened and involved in the foldbelt. Gravity, seismic and field data confirm that basement under the passive margin was shortened only in the internal zones. Further south shortening in the external zones was "thin-skinned". Geometries of shortening depended upon mechanostratigraphy and basement architecture, whereas facies/thickness changes led to changes in thrust front geometry.
The most important domains of shortening across the external zones are as follows:
MAIN BOUNDARY THRSUT (MBT), emergent thrust system with ca. 130-km shortening, emplaced between 10-7.5 Ma.
SALT RANGE THRUST SHEET (SRT), emergent thrust propagating under the Potwar Plateau along an Eo-Cambrian evaporite horizon, c.a. 30-km shortening, emplaced between 4.5-0 Ma.
These shortening events give rates of shortening as high as 4-5 cm/yr, the total plate vector of India's flight north into Eurasia. Between 10-5 Ma most of the Himalayan shortening was taken up at the southern margin of the Himalayas rather than to the north.
Key words: Tectonics, thrust geometry, crustal shortening, Himalaya.

I/43. Izatt, C. & Chambers, A., 1992. Structure and stratigraphy north of the Main Boundary Thrust, Hazara and Kalachitta Hill Ranges, North Pakistan. Abstract Volume, 7th Himalaya-Karakoram Workshop, Department of Earth Sciences, Oxford University, England, p.42.

The northern margin of the Potwar Plateau is marked by the Himalayan foothills of the Hazara and Kalachitta Hill Ranges. Outcropping in these foothills is an imbricated section of passive margin strata that are more resistant to erosion than the softer weathering foreland basin sediments to the south. These imbricates have been found to contain strata relating to the following mega-sequences Pre-Cambrian Hazara Slates, of a deep intra continental basin. Lower Jurassic to Upper Cretaceous shallow water marine shelf carbonates and clastics. Palaeocene to Middle Eocene shallow water limestones and shales, with an upper series of evaporitic mans and mudstones. Miocene foreland basin sediments of continental origin.
The dominant phases of Late Pliocene shortening are:-
Dl- minor imbrication, thrusts dying out into fault termination folds.
D2- uplift of imbricated strata south over the foreland basin along the MBT.
D3- folding of imbricates and MBT, probably during shortening south in the N. Potwar Deformation Zone.
D4- uplift and shortening along the eastern margins of the Hazara Ranges associated with recent uplift in the Hazara syntaxes.
The topographic break between the Hazara/Kalachitta Ranges and the Potwar Plateau is not marked by the MBT, an alternative model is proposed.
Key words: Structure, stratigraphy, MBT, Kalachitta Range, Hazara.

I/44. Izatt, C.N., 1990. Variation in thrust front geometry across the Potwar Plateau and Hazara/Kalachitta Hill Ranges, Northern Pakistan. Ph.D. Thesis, London University, 353p.

Key words: Structure, thrust geometry, Potwar, Hazara, Kalachitta, Fold-and-thrust belt, West Himalaya.