

GEOLOGICAL STUDY FIELD TRIP REPORT

Field Work: 21 AUGUST 2017 to 25 AUGUST 2017

Study Areas: NOTHERN PAKISTAN.

Field Report By:

MUHAMMAD HAFEEZ

ROLL NUM: 1406

SEMESTER: 6TH

Session: 2014-2018

Department of Geology, UOM.

Acknowledgement

I am very thankful of Allah Almighty that we successfully completed our field trip to northern Pakistan.

I am also very thankful of my teachers that they gave us their precious time that I successfully completed the trip and learn some things from my respected teachers.

Introduction:

In third field work we studied the Northern Pakistan regions in the place of Shangla, Besham and Gilgit Baltistan regions also study the different prospects like Indian plate and its evolutional history also study the Kohistan island arc, Indus suture zones, and Asian plate.

Tectonic History of Northern Pakistan:

Initially there was a super continent known as Pangea and the ocean around the Pangea that time is Panthesa, by the passage of time the Pangea split into two sub continents known Ghondwana, and the Laurasia .Ghondwana further split into five continents.

Indian plate is one of them. Initially the Indian plates was situated into southern hemisphere and Asian plate was situated into the northern hemisphere , so the Indian plate are move toward the Asian plate from south to north, the neo Tethys ocean are been consumed and new ocean was opening on the backside of the Indian plate known as Indian ocean.

When the subduction occur at certain depth the magma is generated and these magma moves upward due to the density contrast and form a chain of volcanoes known as island arc in this case this island arc was known as **Kohistan island arc.** The Kohistan island arc was initially intra oceanic island arc, because of presence in between Indian plate and Asian plate also known as the sandwich between Indian and Asian plate so the neo Tethys Ocean are breakdown into oceanic part of the Indian plate that was sub ducted under the oceanic part of the Asian plate. Later on the margin of ocean-ocean converted into the Indian type which is known as Andean margin because these Tethys ocean in which the backside of the Kohistan island arc are consumed by due to back arc spreading.

The boundary between the Kohistan island arc and Indian plate is known as Indus Psamgpu suture zone and in Pakistan these suture are bifurcated into two due to the presence of the Kohistan island arc. The southern suture is known as MMT (main mantle trust) it’s also known as Indus suture while the northern boundary is MKT (main Karakorum trust) it’s also known as Shayok trust .the southern side of the MKT is Kohistan island arc and northern side are Asian plate, so the rock becomes metamorphose on both sides because of closure to the subduction

DAY: 1

Manglaur Formation:

Age: Pre Cambrian to Cambrian

Lithology: Garnetiferious Schist, Micaceous quartzite with alternative layer of Psummites, Amphibolite's Graphitic schist, Marble (Tremolite bearing marble).

The group is mainly composed of augen/porphyroblastic granite gneiss, pelite-psammite schist's, graphitic schist, marble, migmatites, amphibolites and non-porphyritic tourmaline bearing granites gneiss. The base of this group is not exposed. Its top is unconformable with the overlying Alpurai group of Chaudhry et al. (1992).



Micaceous Schist of ManglaurFormation



White color vein type marble

Swat Ortho Gneiss/Granitic Gnesis

Age: Cambrian to Carboniferous

Lithology: Ortho Gnesis are present the photolith of these gnesis is granitic igneous rock there gnesis are alternative light and dark color bands

Also present Augen structure in metamorphose granitic rocks in granitic rock the porphyritic texture are present there when they become metamorphose result augen structure are formed its due to the regional metamorphism. Radioactive minerals also present in swat ortho granite like venenite.

Some tourmaline and occasionally a little garnet may also be present. The porphyroblasts are stretched and at places, augen shaped. This type is off-white to pale-white with black biotite flakes. It shows light rusty to grey weathering colors. It also shows boulder weathering. Presence of psammitic xenoliths is very common.
Also present massive biotite granite, it is relatively fine-grained and may contain Porphyroblasts of K feldspar. Its mineralogy is similar to that of porphyroblastic granite gneiss. However, it is fine-grained and massive looking though foliated. It



Jobra formation:

Age: Pre Cambrian to carboniferous

Lithology: Wolustonite bearing talc silicates, garnet schist, Amphibolite's

In Jobra formation is unconformable with overlain Alporae group

Alpurai group:

Alpurai schist of Kazmi et al. (1984) has been raised to the rank of group as Alpurai group by Pogue et al. (1992). Pogue et al. divided the group into four formations.
The oldest one is Molarghazar formation overlain by Kashala formation followed by Nikanai Ghar formation and capped by Saidu formation, with age of the group as Palaeozoic to Mesozoic on the other hand Chaudhry et al. (1992) divided their Alpuri group into psummits, pelites and amphibolite's in lower part named it as Salampur formation and the upper part containing gametiferous calc-pelite, marble, graphite, garaetiferous calc-pelites as Tilgram formation, "with a pronounced unconformity between the two formations. The age of Alpurai group of Chaudhry et al. (1992) is stated to be Precambrian.

Marghazar Formation:

Age: Age of the Marghazar Formation as Permian.

Lithology: Marghazar Formation is composed of about 70% amphibolite and 30% pelite-psammite. It falls in the upper amphibolite facies of regional metamorphism.
Lower sequence of swat granitic gneiss other lithology are garnetiferious schist, marble its lithology is same as kashala formation but here presence of amphibolites which is form by the metamorphism of gabbro/basalt.



Kashala Formation

Age: Late Triassic

Lithology: Garnetiferious Schist, graphitic schist miceous marble, Talc Schist, Marble

In some place the Garnetiferious schist indicates meteoric impact in which the water dissolved some minerals which is susceptible to the weathering so they dissolved it when this process again and again the result the dissolved minerals are precipitated there when the water are evaporated and mosaic like feature form on the lithology of Kashala Formation their dissolved minerals may be Gypsum, Feldsper, Calcite.

Medium grain of marble associated with quartz veins and conodont are also partly present there.

There is gradational contact between Kashala Formation and Saudi formation.

According to Hussain et al. (1998) the Kashala Formation is comprised of over 100m of brownish grey marble and interbedded calcareous phyllite. The marble sampled from the middle part of the Kashala formation yielded of Late Triassic age.



Nikanai Ghar Formation:

Lithology: Massive Dolomite and Marble. The type section is designated in the Nikanai Ghar Mountain in southern Swat. Nikanai Ghar Formation as comprised of white to grey thick bedded or massive, finely to coarsely crystalline marble and dolomitic marble. The sequence also includes thin beds of calcareous schist, schistose marble and calcareous quartzite.

Age: The age of the Nikanai Ghar Formation, according to DiPietro et al. (1999) is Late Triassic based on the underlying Kashala Formation, which is Late Triassic and also on the presence of palaeoniscoid fish teeth.

Saidu Formation:

Age: Age according to Kazmi et al. (1984) may be between Palaeozoic to Mesozoic.

Lithology: Graphitic Phyllite, Graphitic schist, and Phyllite, and the Garnetiferious schist are very less common in Saidu Formation

Earlier it was called Phyllitic Schist's, In Saidu area, the upper contact is marked by MMT. Distinguish between Saidu Formation and Kashala Formation is Garnetiferious schist in Saidu these are less common while Kashala Formation the Granetifereous schist are abundant.



Indus Suture Mélange Zone

A Mélange is a mappible unit which lack internal continuity of strata. In Pakistan it's bifurcated into three suture: Mingora Mélange Zone, Charbagh Mélange zone, Shangla Melang Zone,

Mangora Mélange Zone

Lithology: Talc Carbonate Schist, Greenstone, Talc Megnesite Schist, and ultramafic rocks like peridotite, serpentinite, pyroxinite, and hornblendite are also present

The difference between greenstone and green schist is that, greenstone are not foliated and does not give soupy touch while green schist are foliated and give soupy touch.

Talc carbonate schist are sometime also associated with emerald.



Shangla Mélange Zone

Lithology: Blue Schist and diagnostic feature of this blue schist is due to the presence of Glaucophane ,pinkish peamontite schist the pinkish color due to the presence of manganese , also present serpentinite, pyroxinite The protolith id due to igneous rocks blue epidotes also present which show retro gradation.



Green Serpentinite Shangla Mélange FM



Blue schist Shangla mélange zone

Day: 2nd

Besham basement complex

Age: Late Archean to Late Proterozoic Age (up to 1800-2400 million years)

Lithology: In Besham complex has oldest rocks present of Indian plate, In Besham Complex has different rock units involve**:** Quartzo Feldspathic Gnesis, Quartzo Feldspetic Schist, Meta Quartzite, Amphibolite, Lahore Sodic Graphite, and Magmatite Boulders Para Gneiss.

Western boundary mark by Purnd Fault (between Besham and Swat Block)

Eastern boundary mark by Takhot Fault (between Manshehra Block and Besham Block)

Northern boundary of Besham mark by MMT

There is an Indian Syntax which is large overturn fold which convex toward hinterland or a hair pin like structure along this syntax abrupt change in its center so Besham complex is an core of Indus Syntax's and they are formed by pre Himalayas Orogeny because they are very old and Himalayas are recently formed so their orogeny is Hazara orogeny.

The Besham complex is unconformable with Karora group.



Besham complex foliated Gneiss



Besham complex Amphibolite



Besham complex (intrusion of granodiorite)

Karora group:

Age: Pre Cambrian

Lithology: The term "Karora formation" to describe a sequence of marine Meta sediments which was deposited unconformable over the Besham group. This unconformity is marked by Meta Conglomerate
Other lithology includes: Amphibolite's, granodiorite of Debonair its granodiorites are partly align due to metamorphose by Himalayas in granodiorites its grain show Mylanitization process occur because its grains are likely powder and unequal form, also present Z-type drag fold which is formed by trust fault/strike slip fault



Jijal complex:

Age: Age is Cretaceous

Lithology: About 85% ultramafic rocks present in Jijal complex includes Dunite, lherzolite, Garnet Granulite, Garnet hornblendite, hornblendite. Jijal complex from the southern part of the Kohistan island arc, the southern 3-4 km Alphine type ultramafic rocks mainly Diopsidites present.



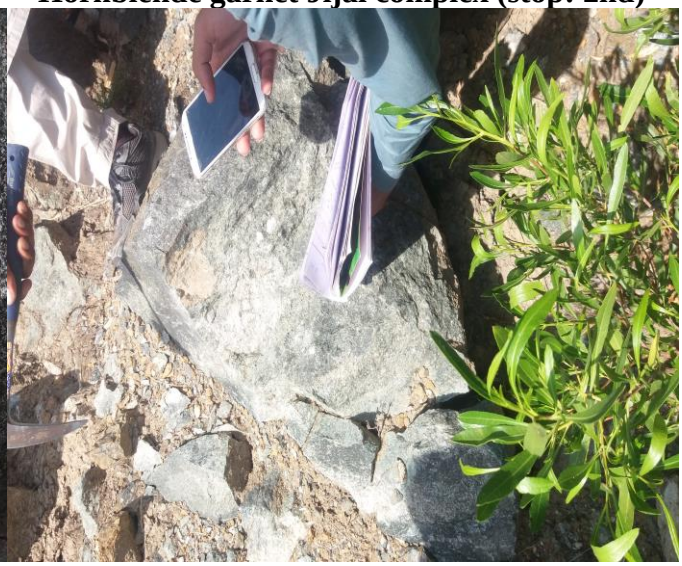
Dunite Jijal complex (stop: 1st)



Hornblende garnet Jijal complex (stop: 2nd)



Garnet granulite Jijal complex (stop: 3rd)



Garnet hornblende Jijal complex (stop: 4th)

Kamila amphibolite:

Age: Age is about 100 million years ago

Lithology: Gabbro Norite, Norite, Amphibolite/ortho amphibolite, Pyroxinite, Horblendite and leuco Granite intrusion also present, Kamila and Jijal complex boundary mark by Patan shear zone



Chilas complex:

Age: Age of Chilas complex is about 85 million years

Lithology: Their main lithology is Gabbro Norite and about 85% ultramafic rock and 15%mafic rocks present in this complex, their lithology is: dark blushed color Dunite, greenish color Pyroxinite, Troctolites, peridotites, hornblendite Xenolith are present Pegmatite's vein are also present.

Chilas complex as the world's largest intrusion of mafic rocks and about 300 km long from north to south. Due to the presence of troctolite its texture known as Corona texture because olivine surrounding by pyroxene, Raikot slip fault are associated which is angular angular unconformity.



Chilas Gabbro Norite



Hornblendite Garnet Jijal Complex

Nanga Perbat ortho Gneiss:

Lithology: The main lithology of Nanga Perbat is Ortho Gnesis its protolith is igneous, also present Gabbro Norite Shear zone and linear landslide are give evidence to recognize in the field and there is contact between Nanga Perbat Gnesis and Chilas complex.

Jaglor Group:

Age: Late Jurassic to mid Cretaceous by Khan T. et al. (1994)

Lithology: Para Gnesis, Meta Phyllites, Meta sediments/psummites, slates, schist, and minor amount of volcanic tuff.

Jaglor group are divided into three formations their oldest one is Gilgit formation, Thelichi formation occurs in the core of the Jaglot syncline, and is therefore, younger than the Gashu-confluence volcanics and the Gilgit formation and is composed of a sequence of slates, marbles and metavolcanics and miceous Quartzite.

- Gilgit Formation:
- Jagho Formation
- Thelichi Formation



In Gaglor Group (Thelichi Formation of miceous schist)

Kohistan Batholith:

Lithology: The lithology of Kohistan island arc divided into four stages include acidic rock like Granites, Granodiorite, Pegmatite's, Basic to Intermediate rocks consisting of Gabbro's, Diorite, Tonolite.

Stage 1: Age of stage 1: up to 100 to 130 Million years, having metamorphose Fabric or Foliation occur in rock i.e. Graphite, and are pre collisional. Gneiss fabric develop by due to tectonic process occur in granite. Leuco granite are not cut by dykes in this stage 1, so it's younger than dykes because its cannot cut it.

Stage 2: age is about 80-95 Million years, and are formed by Syncollisional its further divide into earlier and late

In earlier stage 2: Basic to Intermediate rocks consisting to Gabbro's, Diorite and Tonolite.

In late stage 2: Acidic rocks containing Granodiorite, Leuco Granites, and Pegmatite's.

Stage 3: Age is 40-46 Million years and are younger Granite/ small body of Granite, Tonolite and Acidic sheets and are formed by post collisional. The stage 1 and stage 2 are intruded by stage 3.

Stage 4: Age is about 75-80 Million years and are present mafic dykes.



Chalt volcanoes:

Age: Carboniferous to Permian age

Lithology: The lithology of Chalt volcanoes is Met sediments, Azurite, Malachite, Meta andesitic, mafic igneous rocks, Mata Rhyolite rock/ phyllite and Meta sedimentary rocks are present. The rock unit includes small portions of quartzite, marble and conglomerate.



Yaseen Meta Sediments:

Age: Cretaceous

Lithology: Yasin group is characteristically Green Schist, and Shaly limestone, slate, trachytic and Rhyolitic tuffs, trachytic agglomerates and thin flows of trachyte and olivine basalt Chloride minerals also present due to highly weathered due to formed by the metamorphism of Basalt. Partial Gneiss fabric also present in some places that show the boundary between MKT and Kohistan island arc, it is a last point of the Northern Kohistan island arc, highly shear zone.



. Yaseen Meta Sediment Gneiss Fabric **Yaseen Metasediments Green Schist**

References: 1 STRATIGRAPHY OF PAKISTAN GSP MEMOIRS VOL. 22 by S. M. Ibrahim Shah.

A summary based on recent petrological research on Kohistan island arc complex M.qasim Jan.
Pogue, K...R., Sak, P.B. and BChattak, W.U., 1995, A geological reconnaissance of the Indus Syntaxis, Northern Pakistan. Abstract, Vol. 10th Himalayan-Karakoram, Tibet, intl' Workshop Switzerland.