

Full length article**A PRELIMINARY INVESTIGATION OF GEMSTONES, MINES, MINERS AND PROBLEMS IN GILGIT-BALTISTAN, PAKISTAN**

Muhammad Alam¹, Yasmeen Bano², Abdur Rasheed¹, Sajid Ali³, Abdul Lateef⁴

1. Government Degree College, Gilgit, 15100 Pakistan
2. Fatima Jinnah Women Degree College, Gilgit 15100 Pakistan
3. University of Baltistan, Skardu
4. Geological Survey of Pakistan

ABSTRACT

Gilgit-Baltistan possesses a complex history of crustal evolution and rich diversity of geological environments, and is favorable for various types of mineralization and production of gemstone all over GB. Two batholiths; Kohistan Batholith and Karakorum Batholith which are hosting gemstones mineralization. This investigation reveals that thirty-two precious and semi-precious stones are mined, 95% of the total gemstones produced in Pakistan come from GB. These varieties of gemstones come from 2150 mines which are in working conditions scattered all over GB and number of miners involved is 25000. Miners face problems like lighting, ventilation and drilling. They lack the basic safety equipment like helmets, mining shoes, gloves, googles and masks. Due to the fumes of explosives, miners are suffering from different diseases like Silicosis. The main gemstone-producing areas are Hunza valley, Sumayar (Nager Valley), Shengus and Haramosh (District Gilgit), Bulachi and Mir Malik (District Astore), Istak Nalah and Shiger Valley. The common gemstones mined are ruby, pargasite, spinel, corundum, sapphire, calcite, aquamarine, tourmaline, beryl, quartz, topaz, albite, microcline, apatite, fluorite, emerald, marganite, diopside, tanzanite, axinite, felsite, kunzite, emerald and garnet.

KEYWORDS: Gemstones, prospects, miners, primitive methods, Gilgit-Baltistan (GB)

*Corresponding author: (Email: muhammad.alam@gcgilgit.edu.pk)

1. INTRODUCTION

Gilgit-Baltistan (GB) is divided into three geotectonic blocks separated by two major suture zones. From north to south these are the Eurasian Plate which is abducted on the Kohistan Island Arc along the northern suture zone called Main Karakoram Thrust (MKT). The Kohistan Island Arc in turn is abducted on the rocks of the Indian Plate along the Indus suture Zone or Main Mantle Thrust (MMT)[1]. The metamorphism due to these tectonic activities provides a conducive environment

for the mineralization of gems and ore minerals [1]. According to a report [2] submitted gemstone mining is done for a long time in GB, however, due to primitive and unscientific mining methods, the stones extracted are destroyed [3].

Gemstone mining is becoming difficult day by day due to quitting of the profession by the miners due to hardships; conservations in gem bearing areas by the local communities, high costs of the equipment used in mining, lack of safety equipment, government restrictions, grant of exploration licenses and mining

leases, weather conditions and low production due to use of primitive methods as well [4]. It is important to explore new gem bearings areas with valueable contents of gemstones to encourage the miners to continue this profession by providing trainings based on modern scientific lines and international standards so that they may mine the gems without any damage to them. During gemstone mining miners use (wahbox) which is disastrous for the sensitive plants to grow. For ecosystem of the mountainous area, blasting is also harmful. The environment is disturbed for many such reasons like blasting and excess use of explosives [5].

PMDC (1978) carried out gemstones mining activities first time in GB like Hunza, Heramosh and Istak Nalah to study feasibility of gemstone mining sites in Gilgit-Baltistan [6]. After the exploratory works by PMDC other private mining companies rushed to the area for gems mining. But these private companies did not play their positive role given in mining concession rules and done unscientific mining activities by destroying this mineral wealth of the area. Hunza Valley is famous for gemstone production since many decades [7].

This study has been conducted to know about the gemstones mined in different areas of GB and the methods they use in mining. How many miners are working in areas and how much mines are in active condition and what are their problems.

2. GEOLOGY OF THE STUDY AREA

The brief geology of the study area comprised of the gem bearing areas of Gilgit-Baltistan (Fig.3). The Hunza Ruby belt is comprised of the rocks of the Darkot group (meta sedimentary) intruded by intrusive bodies

(Karakorum Batholith) which is 7000 to 10000 feet in thickness and is continuous up to fifteen miles which is mineralized .The limestone member which is isoclinally folded and regionally metamorphosed to a white-grey banded coarse crystalline massive and generally friable marble, lies sandwiched between the Karakorum Batholith at the north and the underlying garnetiferous schist member at the south. It is extensively criss crossed and replaced by acidic dykes ranging in grain from aplite, through granite to typical pegmatite including workable mica pegmatites. The upper and lower parts are generally more heavily affected by the intrusive dykes which apparently are the offshoots from the Karakorum Granodiorite.

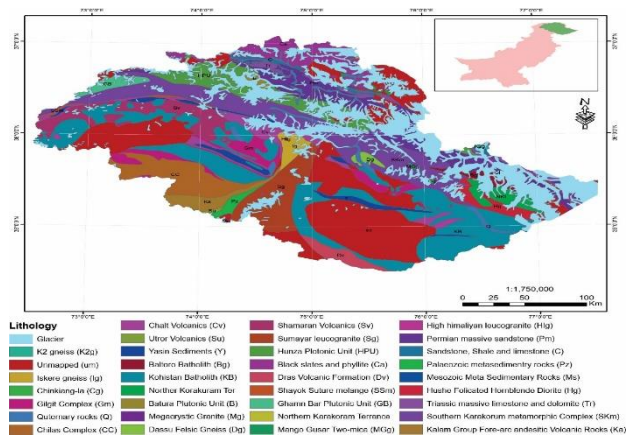


Figure 1. Geological map of Gilgit-Baltistan

3. ORIGIN OF RUBIES

The Hunza Rubies are the products of recrystallization of the aluminous impurities in the original limestone by regional metamorphism [8][9]. Origin of Rubies is due to hydrothermal solutions [2]. This view based on field observation that Hunza ruby has come into existence as the last of the main creative events of the geologic history of Hunza. The

field observations about origin of ruby are as under.

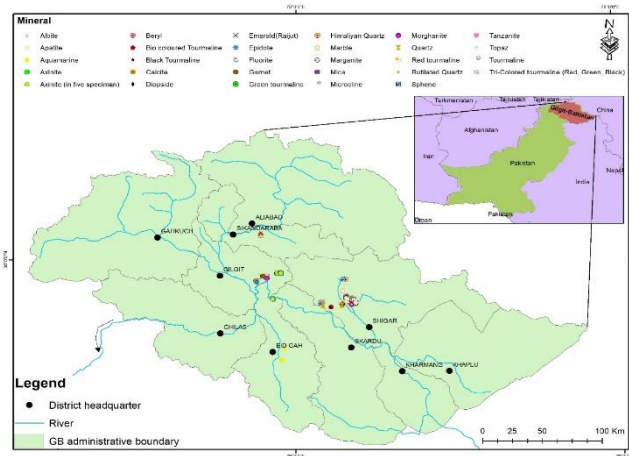


Figure 2. Map of study area showing different gemstone locations

1. Richer (in quality and quantity both) Ruby/Spinel mineralization has been found at the places where marble blocks are trapped by some intrusive dykes (aplite, granite or pegmatites).
2. When bedding planes of the host marble are obliquely cut at low angles by some dyke or especially by its offshoots at some distance from the main intrusive.
3. Rubies/Spinel is mostly found along bedding or cleavage planes of the marble.
4. Ruby crystals are seen growing at the expense of the calcite crystals of the host marble.
5. Rubies are developed along limited zones, only when the same beds are cut by certain intrusive at certain angles.
6. Single ruby crystals as well as clusters of crystals are found loosely packed in envelopes of fuchsite flakes or more commonly of phlogopite flakes giving rise to typical onion type of bodies along mineralization planes.

7. Hunza valley produces the following gemstones from different localities, ruby, pargasite spinel, corundum, sapphire (black and blue), calcite, aquamarine, beryl, quartz and garnet.



Figure 3. A blue sapphire and ruby specimen from Hasanabad Mines and Dorkhan Mines

3.1 Chumar Bakor

The elevation of Chumar Bakoor mines is about 4600 meters. Its location is $33^{\circ} 43' 66''$ and $73^{\circ} 45' 90''$. The stones mined from this area are calcite, topaz, albite, microcline, aquamarine, tourmaline, apatite, beryl, fluorite and quartz.

The rocks exposed in study area are calc silicate rocks and amphibolites belonging to the southern Karakorum Metamorphic complex (KMC) as well as in the intrusive Sumayar Pluton [10]. The intrusive (pegmatites) are in the form of (sill, dykes and lenses) exposed. The thickness of pegmatite bodies ranges from 0.5 m to 1.5 meter. The gemstone pockets are common.

3.2 The Pegmatites swarm of Bulachi, Heramosh and Istak Nalah

The Pegmatites of Bulachi area are situated just on the other side of the Skardu river in Astore district.

These pegmatites between Heramosh and Istak Nalah along the Indus River are of same origin [11]

These Pegmatites are hosted by parent rock which is beryllium and lithium rich. Beryl,

aquamarine, black tourmaline, topaz and fluorite are the main gemstones in these pegmatites. Istak Nalah pegmatites produce multi colored tourmaline due to Lithium rich pegmatites. The other gemstones produced are aquamarine, black tourmaline, topaz, apatite and garnet due to presence of the granitic pegmatites.

According to the miners the gemstones produced from Heramosh area are: emerald. topaz, marganite, apatite, black tourmaline, garnet, fluorite, calcite, diopside, microcline and quartz.

Similarly, Bulachi Area contains green tourmaline, red tourmaline, tri-colored tourmaline (Red, Green, Black), black tourmaline, apatite, fluorite, calcite, topaz, marganite, diopside, beryl, tanzanite, axinite and albite.

3.3 Istak Nalah

Istak Nala is rich in green tourmaline, black tourmaline, bi-color tourmaline (green and red), marganite, fluorite, quartz, aquamarine and topaz.



Figure 4. A gemstone mine in (a) Chumar Bakoor (Nager) (b) Istak Nalah (Skardu) and (c) Bulachi area (Astora)

3.4 Pegmatites swarm of Shiger, Braldo and Basha Valleys

Dassu mines are located at 2420 meters. The location of mines is $34^{\circ} 22' 59.3''$ and $72^{\circ} 9' 45.5''$. About 150 square kilometers area has the pegmatite swarm. The Shiger valley pegmatites are gem bearing as well as non-gem bearing. One of the gems' bearing

pegmatite is muscovite schorl-beryl garnet pegmatites and another one is muscovite schorl pegmatite [12]. Based on field observations we can conclude that the pegmatites of Basha and Braldo valleys are same in origin. These pegmatites are zoned and coarse-grained in nature and have gems like quartz, feldspar, muscovite and black tourmaline.

3.5 Gemstones found in Shiger, Braldo and Basha valleys

According to the miners of the areas following gemstones are found in these valleys are aquamarine, ruby, zoisite, microcline, albite, garnet, quartz, topaz, tourmaline, calcite, marganite, apatite, fluorite, felsites, diopside, kunzite, emerald, sapphire, pargasite and axinite.



Figure 6. Gemstone mines in Shiger valley

4. METHOD

In Gilgit-Baltistan the mining sites of gemstones are located at high elevations. Some of the mines are at low elevations like Aliabad, Dorkhan and Hasanabad (Hunza Valley). In Shiger valley the ruby-emerald mines are easily accessible which are located near Shiger main road. The mines at Chumar Bakor, Istak, Shiger, Heramosh, Bulachi, Braldo and Basha valleys are at high elevations and only accessible in summers from June to October. To study these mines twenty-five (25) days field was conducted in these entire gem bearing areas. The method adopted was to reach at the actual sites of mining and mines

were visited. A questionnaire was developed to Interview the miners about gemstones produced in these mines. Meetings were done with miner associations to know about their problems and needs. Examinations of the gemstones available at site with miners and confirmations were made about the stones produced from these mines. Miners and mines (abandoned and working conditions) were counted for confirmations.



Figure 7a. A specimen of Aquamarine-Shiger (irocks.com)



Figure 7b. Topaz specimens-Shiger (FossilEra.com)

5. PROBLEMS

Due to lack of basic facilities like first aid box, the miners have different medical issues. Due to absence of roads, tracks and difficult terrain carrying the machinery to the mining sites is very difficult. Miners face problems like lighting, ventilation and drilling after the drivage of more than 100 feet. The mines do not meet the standards as specified in the mining concession rules and international standards. The Miners lack the basic safety equipment like helmet, mining shoes, gloves, goggles and masks. Due to the fumes of explosives (wahbox) and dust miners are suffering from different diseases like Silicosis (a kind of disease which slowly damages the lungs). Another problem is lack of equipment to repair the machinery at the mining sites.

6. RESULTS AND DISCUSSION

Following table give details of mines and miners working actively in entire GB. The detail of mines in respective valleys and number of miners is as under.

Table 1. detail of mines and miners in different valleys.

S.No	Area	No of Mines	No of Miners
1	Hunza Valley	40	400
2	Chumar Bakoor, Hoper (Distt. Nager)	200	4000
3	Heramosh (Distt. Gilgit)	250	4000
4	Basha and Braldo Valley	300	3000
5	Shiger (Distt. Shiger)	700	7000
6	Istak (Distt. Skardu)	200	2000

7	Bulachi (Distt. Astore)	100	1000
8	Mir Malik (Distt. Astore)	20	200
9	Distt. Ghizer	300	3000
10	Rondo Valley	40	400
	TOTAL	2150	25000

From the above figure it is concluded that gemstone mining is extensively done in Gilgit-Baltistan. All these miners do not work at the same time. They work time to time and season to season depending upon the weather conditions. All the mentioned miners are involved directly or indirectly in the field of gemstone mining which are contributing to the GB economy and earning to their families. The need of the hour is that the miners should be trained on scientific lines as well illegal mining should be discouraged. The gemstone mining industry should be given the status of industry, so that lot of people may benefit from this field. In this connection gemstone exhibitions should be arranged, a gemstone exchange and display center should be setup, trainings to the miners should be given in every district and mining equipment should be provided to the miners.

CONCLUSION

There are 32 varieties of gemstones (precious and semi-precious) mined here. Some of the common gemstones are Ruby, emerald, sapphire, quartz, tourmaline, aquamarine, topaz, spinel, corundum, garnet, calcite, fluorite, apatite, zircon, beryl, pargasite and microcline etc. The areas famous for gem bearing are Hunza, Nager, Heramosh, Istak, Shiger and Astore valleys. The miners involved in this sector are approximately 25000 and numbers of mines approximately are 2150.

There are difficulties in gemstone mining sector such as, lack of gemstone exchange centers; the miners could not get the actual price of their mined wealth. Poor health facilities at mining sites, the miners are suffering from various diseases like silicosis (a kind of lung disease), eyes itching, dust and explosives allergies etc. Difficult terrain and short working season cause great psychological pressure on miners. Poor mining methods also cause problems in mining such as ventilation; lighting and suffocation etc.

DECLARATIONS

Conflicts of interest/Competing interests:

The authors declare that they have no financial and non-financial competing interests.

Data availability: The data sets used or analyzed during current study are available from the Corresponding authors on reasonable request, and all data generated or analyzed during this study are included in this published article.

Code availability: Not applicable.

Author contributions: All authors equally contributed from introduction to conclusion under supervision of our principal investigator and this task completed with the collaboration of all authors. Muhammad Alam developed the main concept of research, and writing the manuscript. Yasmeen Bano did review before submission and proof read of the manuscript. Abdur Rasheed reviewed and edited the paper during review process. Abdul Lateef helped in the field work.

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