Mineralogical analysis of schist stone from the Buddhist Complex of Zar Dheri (Mansehra, Pakistan)

Shakir Ullah / Muhammad Zahoor / Ahsin Shah / Owais Khan

Abstract

The Buddhist monastic site of Zar Dheri is of great historical importance due to its unique architectural elements and artistic style. In the 1990s, the archaeological mission of the Tokyo National Museum found the site with the main stupa. The archaeology department of the Hazara University of Mansehra, with the financial support from the Higher Education Commission under National Research Programme for Universities (NRPU), carried out a recovery excavation in 2020 to document what remained. The result of this excavation revealed important material remains, including pottery, bones, inscriptions, fragments of stone sculptures and structural remains. These remains are being used to reconfirm the chronology of the site. The present research was conducted to clarify the provenance of the schist stone used by the craftsmen of Zar Dheri for the production of sculptures. For this purpose, a portable XRF analyser, a non-destructive technique for measuring elemental composition from Magnesium (Mg) to Uranium (U) was used to analyse three samples from Zar Dheri and three from the local query. The mineralogical analysis of the schist stone indicates that the source from which the artists obtained the raw material is located in Kaly Parr, approximately 1 km north of the Zar Dheri site.

Keywords: Zar Dheri, Schist Stone, Cruciform Stupa, Gandhara, Urasa.

1. Introduction

Zar Dheri, a well-known Buddhist monastic complex, is located near Tambah, a small village on the right side of Shinkiari-Dadar road in District Mansehra of Hazara region. The latter comprises of the modern six north-eastern districts of Khyber Pakhtunkhwa in Pakistan: Haripur, Abbottabad, Mansehra, Torghar, Battagram and Kohistan. The three massive boulders situated close to Bareri Hill near the modern city of

Mansehra and recording fourteen edicts of Ashoka indicate that the region was, in the 3rd century BCE, under the control of the Maurya dynasty.

The important Buddhist complex of Zar Dheri was first recorded and published by Harold Hargreaves, then Superintendent of the Archaeological Service of India, in 1922-23. The first large-scale excavation project was initiated in 1995 at Zar Dheri, Mansehra, by the Tokyo National Museum Japan with the cooperation of the Department of Archaeology of the Government of Pakistan. The excavation project ran for five consecutive seasons from 1995 to 1999 and led to the discovery of the oldest cruciform stupa with a monastic complex. The recovery of 146 panels of schist stone sculptures, pottery, iron objects, bones and stucco objects was the result of this project (Koizumi 2011; Hameed 2012). However, due to limited time and security concerns, the Japanese team was unable to cover the entire site area and document every aspect to provide a complete historical profile of the region. After the completion of the excavation project of the Tokyo National Museum, the Buddhist complex of Zar Dheri was again under the influence of treasure hunters, locals and antiquities dealers for the next 20 years. Locals occupied the entire monastic complex and built many residential houses, while looters destroyed the Stupa complex to plunder its treasures. Recently, the archaeology department of the Hazara University of Mansehra conducted a salvage excavation with the financial support from the Higher Education Commission of Pakistan (HEC). The result of this excavation revealed important material remains, including pottery, bones and stone wall structures, stone inscriptions and fragments of stone sculptures (Shakir, Hameed and Zahoor 2021).

In 1999 the Japanese mission discovered 146 stone sculptures, mostly made of schist but also including stucco and stone architectural remains, were discovered in a 3x3-metre monastery cell, during the clearing of the monastery. They were discovered in three separate stacks of pieces (north, south and west block). According to Japanese scholars, these sculptures are stylistically similar to those discovered in Swat (Koizumi 2011). The Japanese team, due to the lack of relevant material known from the Hazara Division, conducted a comparative analysis of the sculptures discovered at Zar Dheri, at various sites in Swat and Butkara I, and at the stupa of Saidu Sharif I in particular. Based on the stylistic analysis of sculptures, the radiocarbon dating of the Himalayan cedar log from the threshold of the monk's cell F2 and the palaeographic observations made on the corpus of Kharoṣṭhī inscriptions, Koizumi

tentatively placed the sculptures in "the first half of Kushan period", without excluding that "the date should be put to a later period" (Koizumi 2011, 401).

With regard to petrographic surveys throughout Gandhara, the work initiated by Domenico Faccenna (see ref. in Olivieri 2022) is important. Scholars such as Farooq Swati (1997), Badshah Sardar (2005) Tahira Tanweer (2010) and Amjad Pervaiz (2015) are also of the opinion that schist quarries in Swat are widespread and varied in colouration and texture. Huge quarries are also found in the Buner district. However, no shale quarries for sculpting Gandharan Buddhist sculptures have yet been found in the Taxila Valley and Hazara region. Sir John Marshall also pointed out that schist stone was not available in the Taxila Valley; most stone carvings were imported from the Northwest Frontier Province, present-day Khyber Pakhtunkhwa, where schist stone was readily available (Dani 1986). The present research is therefore an attempt to reconfirm the source of the raw material (chloritoid-biotite-muscovite schist in Koizumi, 2011, Appendix 3) used to produce the stone sculptures at Zar Dheri, and to assess whether the sculptures were produced locally in a style comparable to that of ancient Uddiyana or whether the sculptures were imported from other regions (see also Pons 2019; Pons forthcoming).

2. Previous research in the region: an overview

Ancient Urasha (Ali et al. 2009: 145), the modern Hazara region of Pakistan's Khyber Pakhtunkhwa province, remained a junction between Central Asia, West Asia and South-East Asia during the Achaemenid, Greek and Maurya periods of Indian history. Trade and commerce between Central Asia and the western world took place via the ancient silk routes that passed through this region. The Buddhist religion reached Central Asia and China through a dense network of routes connecting major centres across Gandhara, among which those of Taxila and what is now Hazara (Neelis 2011; Shakirullah, Junaid and Nawaz 2016). The region of Hazara has numerous archaeological sites of national and local importance that link us to our past as custodians and attract thousands of tourists from all over the world. The following is an overview of previous studies conducted in the Hazara region, including Zar Dheri, the subject of this study. This was the time when Hargreaves was appointed superintendent of the Frontier Circle, in the modern Pakistani province of

Khyber Pakhtunkhwa. Hargreaves pointed out many archaeological sites, such as the Ashoka rock edicts and the stupa of Zar Dheri in the Mansehra district and the sites of Jaulian, Pippala, Jandial and the Badalpur monastery in the Haripur district. He also initiated a series of measures for the conservation and preservation of endangered sites and estimated and fixed the expenses for this work (Hargreaves 1922).

Later, when the report of the Archaeological Survey of India was published, exploration work continued in the Taxila valley, which lies partly under the Hazara division (part of the Haripur district) and partly in the Rawalpindi district of the Punjab province. But the northernmost districts of the Hazara region, namely Abbottabad, Mansehra, Battagram, Tor Ghar and Kohistan, were neglected. Exploratory activities continued after the creation of the archaeology department of the Hazara University of Mansehra. The Abbottabad district, home to the Hazara division, was first the subject of a detailed survey by the same department in 2006-2007. In the results of this survey, many sites from the Buddhist, Hindu Shahi, Islamic, Sikh and British periods were reported (Ali et al. 2010).

Archaeological activity in the Haripur district was initiated by foreign archaeologists and traced back to the prehistoric period with the discovery of Khanpur Cave in 1964 by Eden Johnson and later by Farid Khan. In 1988, the Pakistan government's archaeology department discovered a Buddhist complex at Garh Mauriyan, near Sarai Saleh (Qamar 1990). Recently, the Directorate of Archaeology of the Government of Khyber Pakhtunkhwa took the initiative to carry out surveys in the Ghazi tehsil of the Haripur district in 2003. The result of the exploration revealed 73 Buddhist, 3 Hindu shahi, 3 prehistoric and 4 Islamic sites. The remaining area of this district was investigated by the archaeology department of the Hazara University of Mansehra in 2007-2008. The same department conducted an extensive exploration in the Mansehra district in 2014-16 in collaboration with UNESCO, Islamabad. The survey was later extended to the Tehsil Mansehra and Tanawal regions. Although these field surveys uncovered hundreds of archaeological sites/monuments, due to limited funds, archaeological investigation in the remaining unexplored parts of Mansehra was initiated from Babu Sar Top, the highest residential area in the district occupied by seasonal nomads during the summer season (Hameed et al. 2021).

Archaeological remains excavated by Eden Johnson in 1964 in Khanpur Cave have traced the cultural history of the Hazara region back to the prehistoric period (Ali et al. 2009). From the evidence of Iron Age

cemeteries (also known as the Gandhara grave culture), the archaeological history of the Hazara can be traced back to the Mauryas (but also to the Achaemenids). The political rise of the Indo-Greeks and Saka-Parthians is well documented, in addition to the discovery of a silver coin of Menander at Bedadi Mansehra (Ali et al. 2009), by the pottery from Pir Manakrai (Khan 2003) and Panian in the Haripur district (Qamar and Khan 1998), which presents remarkable similarities with the pottery from Bhir Mound, Sirkap, Barikot and other sites in ancient Gandhara. The Buddhist monuments (stupas and monasteries) still visible in the Hazara division, particularly in Zar Dheri, were all built during the Kushan and post-Kushan period (2nd-4th century AD).

After Hargreaves' survey (1922-23), the first long-term scientific excavation was conducted at the Zar Dheri site by a joint team of archaeologists from the Tokyo Museum in Japan and the Federal Department of Archaeology of Pakistan from 1995 to 1999. The five consecutive seasonal excavations at the site led to the discovery of a cruciform stupa with monastic complexes (Koizumi 2011).

3. Objective

To re-confirm the source of schist stone found at Zar Dheri, a team of the archaeology department of the Hazara University carried out a mineralogical analysis on a sample of sculptures from the site. The results could potentially help to understand whether the production of sculptures was indigenous or whether it depended upon an adjacent centre of production of Buddhist art.

4. Methodology

A portable X-ray fluoresces (XRF) (model TrueX 960 Drawell LAN Scientific mineral analyser) (Fig-6) was applied for mineralogical analysis of schist stones from Zar Dheri and from the local quarry called *Kaly Parr*. The XRF is a sensitive technique that requires free contamination samples with minimum preparation. It is a non-destructive method for determining the percentage of magnesium (Mg) or uranium (U) in an elemental mixture. It has two major parts: Energy dispersive system (EDXRF) and the wavelength dispersive system (WDXRF). For a single XRF analysis,

time depends on the number of elements to be determined and the required accuracy and varies between 2000 to 5000s (Okunade 1999).

The experimental work is performed in the Experimental Archaeology Laboratory (EAL) at the Department of Archaeology, Hazara University Mansehra, Pakistan. To determine whether the instrument was in the best condition before analysis, it was tested by standard calibration block (316ss LANScientific) (Fig-5) having the standard data. The instrument has a standard sample for spectrum analysis which is tested by Institute of Iron and steel and published by the research institute, which is suitable for metal material quality inspection, calibration equipment, evaluation methods, unified test value and can also be used for product control, finished product quality supervision and so on (Fig-6).

For sample collection, an unfinished schist stone slab recently reported from Zar Dheri (Fig-2c) was selected. Three samples (s#288, 289, 290) taken from three different positions of the schist stone slab after removing the surface layer. Similarly, three samples (s# 285, 286, 287) from the local quarry of *Kally Parr* in the vicinity of Zar Dheri site were also selected. The central core of the samples was selected for analysis to avoid any traces of alteration on the surface of the samples. These samples were again grinded and turned into powder-samples of about 100 grams each. The instrument then simply pressed on the sample's powder and 'fired' using a trigger. An area up to 5mm deep and 8mm broad corresponds to the examined volume. The detector inside the device measures the spectrum of secondary X-rays that an X-ray beam shot into the sample emits. These secondary X-rays reflect the overall chemical composition of the volume being analysed. Before each analytic session, a calibration function that is incorporated into the instrument's CPU was executed. The procedure analyses the X-ray spectrums and calibrates the internal electronics and sensors using factory settings. The results of analysed samples are explained and discussed in table 1 and figures 6-13.
The results show that the percentages of Titanium (Ti), Manganese (Mn), Iron (Fe), Zinc (Zn), Zirconium (Zr), Magnesium (Mg), Aluminium (Al), and Silicon (Si) in all analysed samples is almost similar. It is found that Iron (Fe) and Magnesium (Mg) are the dominant elements in the samples along with other minor elements that clearly indicates that there is no such difference in the provenance of raw material selected to produce stone sculptures at Zar Dheri Buddhist complex.

5. Results and Discussion

The introduction of stone sculptures in Taxila became more popular in the Gandhara school of art in the 1st century AD (Marshall 1960). All the evidence points to the introduction of these sculptures from outside, i.e. from proper Gandhara (cis-Indus) and Swat (Faccenna 2005; Olivieri 2022). The Gandhara school of art, which used shale as a raw material, followed the technique of relief carving: the shale blocks were hewed out of the hills, the flat surfaces were chiselled, and finally, figures were drawn with a pointed tool, which were then rubbed and polished. According to Sir John Marshall, schist stone was not available in the Taxila Valley. Most stone carvings were imported from other regions in Gandhara (Dani 1986; Faccenna 2005; Olivieri 2022). The fact that all the architectural components of Zar Dheri are composed of the same material called schist is the most significant aspect to point out. The same applies to almost all archaeological discoveries in the Hazara division. Zar Dheri is located in an area in which no local source of schist stone has been found, and the Buner district has been considered as the main source of schist stone located too far from Zar Dheri (Koizumi 2010). The result of the present study (Figs. 6-13) revealed the authenticity of the origin of schist stone, which is the local quarry in Kaly Parr.

According to the results of this analysis (Figs. 6-13), the concentrations of each element in both schist stone samples are similar, which shows no difference in their composition. Based on these results, it can be cited that Kaly Parr was the source of schist stone for the production of stone sculptures at Zar Dheri. These results also reconfirmed the previous perception on the origin of schist stone, which was imported from Buner. Table 1 shows that iron is the main component (56%) of the schist stone used in the sculptures from Zar Dheri, where the concentration of iron was also high (63%) compared to the rest of the elements. The other elements also show the same percentage ratio in both samples, as shown in the table above.[1]

During the height of Buddhism in the area, Hazara, or ancient Urasa, was another important centre for Buddhism and Buddhist art, but so far little investigation has been done to explore its importance. This is also confirmed by the statement of Xuanzang, who does not mention the

[1] For the composition of stones from other regions, see the refs in Pannuzi ed. 2015 [in particular Giuliano 2015 and Guida et al. 2015] and Arrighetti et al. ed. 2019).

name of the capital of ancient Urasa but mentions the existence of a stupa and monastery 4 or 5 li (1 km) south of it (Li Rongxi 1996). A recent investigation conducted by the writer could provide credence to this claim. Very dilapidated remains of a Buddhist establishment at the Mochikot site in Abbottabad were identified about the same distance from Mangal, the probable capital of Urasa/Hazara. Due to its proximity with Kashmir, the Hazara region likely received influences from this region. What is more, being located along the historic Silk Roads, Hazara must have been significantly influenced by those who travelled there, blending their artistic influences with local art. Its border was touched by Gandhara and Uddiyana, which greatly influenced its art, although Uddiyana seems to have played a unique role in the formation of its cultural artefacts (cf. Olivieri 2022).[2]

6. Conclusions

Investigating the composition of the schist stone at the Zar Dheri site was an important component of this study. The composition of the schist stone was statistically identical to that of schist stone found in nearby quarries. The excavation team from the National Museum in Tokyo was unaware of the area and local questions and, on the basis of comparison, concluded that the schist raw material for the Zar Dheri site was imported from Buner (part of ancient Uddiyana), while the present study shows that the material, particularly the schist used in the production of artistic and architectural elements at the Zar Dheri site, was acquired from the local source in the nearby mountain known as *Kally Parr*. However, it is significant to note that no individual Buddha or Bodhisattva sculptures were discovered at Zar Dheri; all that was discovered were panels, jambs and architectural components. This is a feature that can also be observed in the production of sites such as Butkara I and Saidu Sharif, and one that sets aside these productions with those from the Peshawar Valley, where statues of the Buddha and of Bodhisattvas hold a prominent position.

[2] It should be considered though that it is difficult to speak of Hazara, Gandhara, Uddiyana as separate geographic entities (for instance in the sense of modern districts). Certainly, as recent research shows, these regions might have been - at least for some time - governed by local elites / different princely lineages. But eventually, they also became under the control of the Kushans. Clearly, these different regions were tightly connected to each other.

Hazara is thought to have had a special geographical location. It lies north-west of Taxila and north of Kashmir, close to the east of two other ancient provinces, Uddiyana and Gandhara, known to be important Buddhist centres and home to a significant number of Buddhist institutions. Moreover, it was accessible to Indian and Western influences at the same time. The area and its art may therefore have been influenced by various sources and it is likely that its artists created their own distinctive style in the form of the "Urasa school of art", just as the artists of Uddiyana did, receiving direction and influence from the major centres of Gandhara. However, further investigation may be needed to further strengthen the current evidence.

Acknowledgments

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Figure 1 a) A typical Gandharan-Corinthian pilaster; b) false-gable excavated from Zar Dheri; c) a false-gable excavated from Zar Dheri (Source, Peshawar Museum).

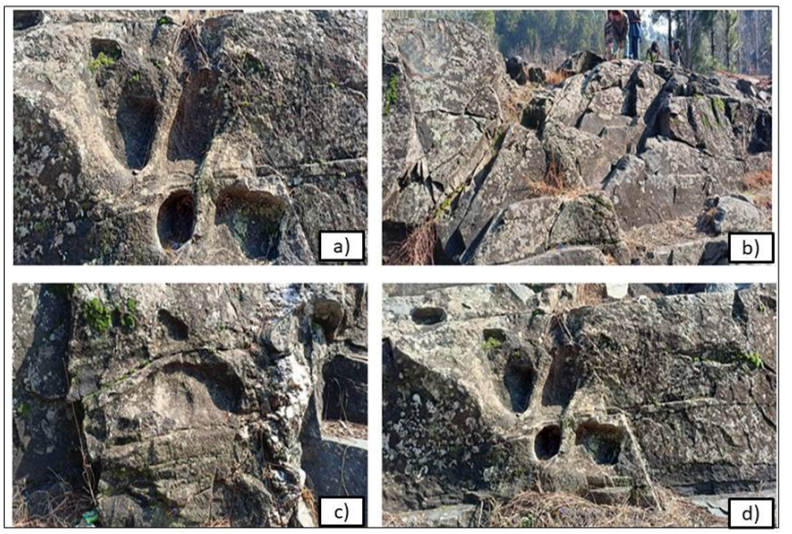

Figure 2 a) quarry with cup marks; b-c) natural formation of the schist stone d) local quarry of schist stone with chiselling marks (Courtesy Ahsin 2020).

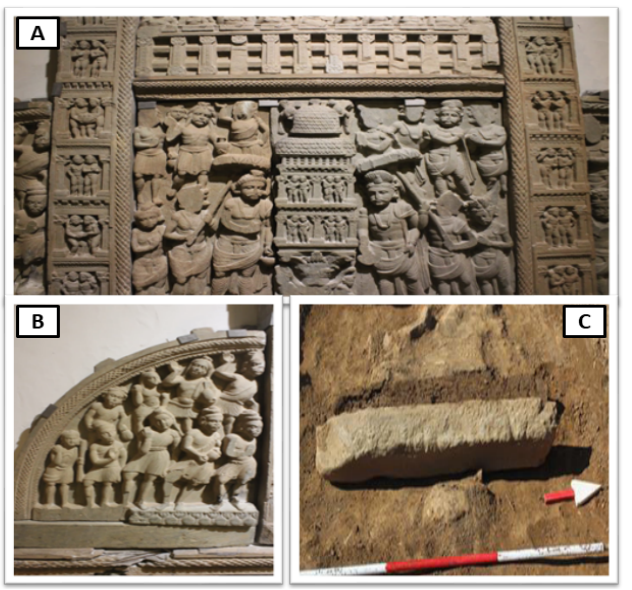

Figure 3 a-b) a false-gable excavated from Zar Dheri; c) unfinished schist stone reported for Zar Dheri.

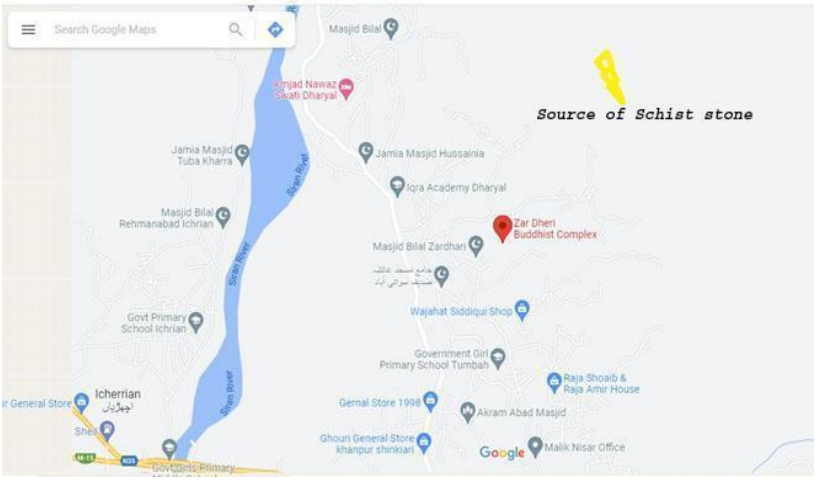

Figure 4 - Source of schist stone nearby Zar Dheri (Google Map).

Standard sample certificate

Standard samples for spectrum analysis

Certified Reference Material

Standard number (SS316)

Set date: 2017-1-2 Standard number: SS316 Release date: 2017-1-10

Data description

This series of spectrum analysis standard samples, Tested by Institute of Iron and Steel and published by the research institute which is suitable for metal materials quality inspection, calibration equipment, evaluation methods, unified test value, and can also be used for product control, finished product quality supervision and so on.

Standard value of standard samples for spectrometer analysis

Elements	Cr	Mn	Ni	Mo
Value	16.75	1.09	10.29	2.15

The handheld XRF 316SS Standard sample error range:

Elements	standard value	Machine error	Upper limit	low limit
Cr	16.75	+/-5%	15.916	17.591
Mn	1.13	+/-15%	0.961	1.299
Ni	10.29	+/-5%	9.775	10.805
Mo	2.15	+/-10%	2.047	2.263

Figure 5- XRF standard samples for spectrum analysis.

Figure 6- Portable XRF used in analyzing schist stones.

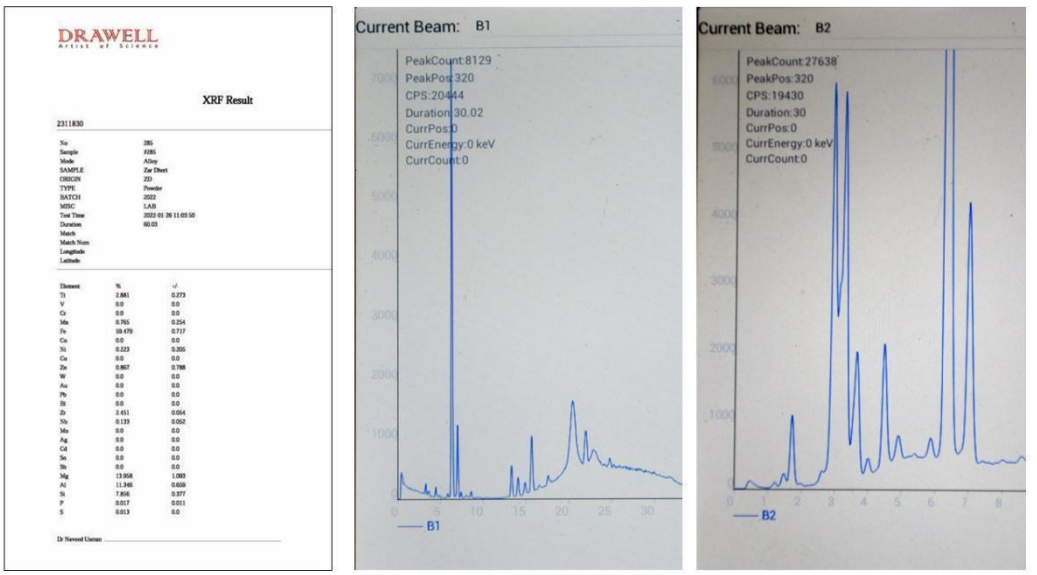

Figure-6 Spectrum and percentage result of schist stone from local query (sample 285).

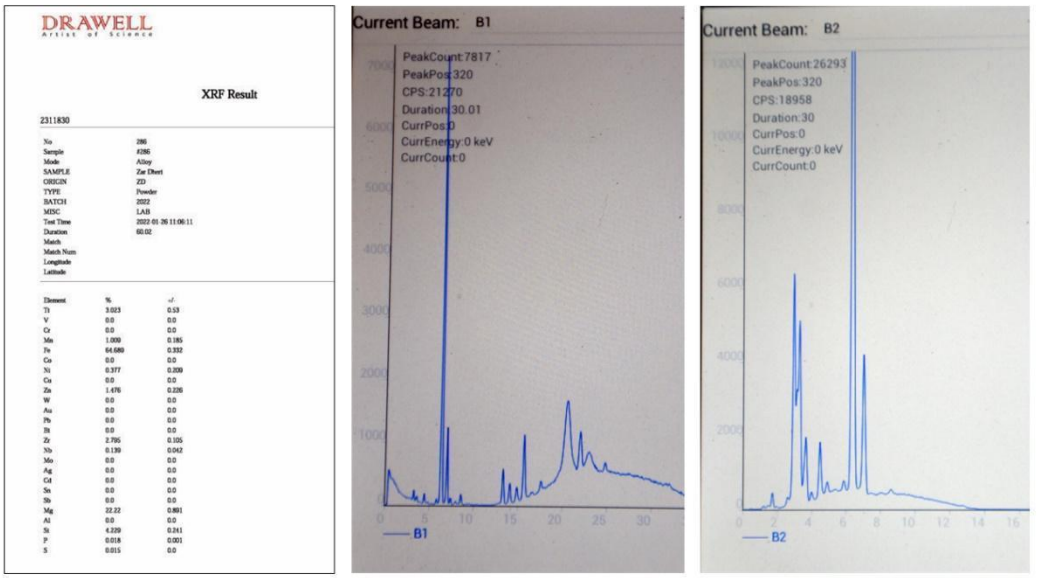

Figure -7 Spectrum and percentage result of schist stone from local query (sample 286).

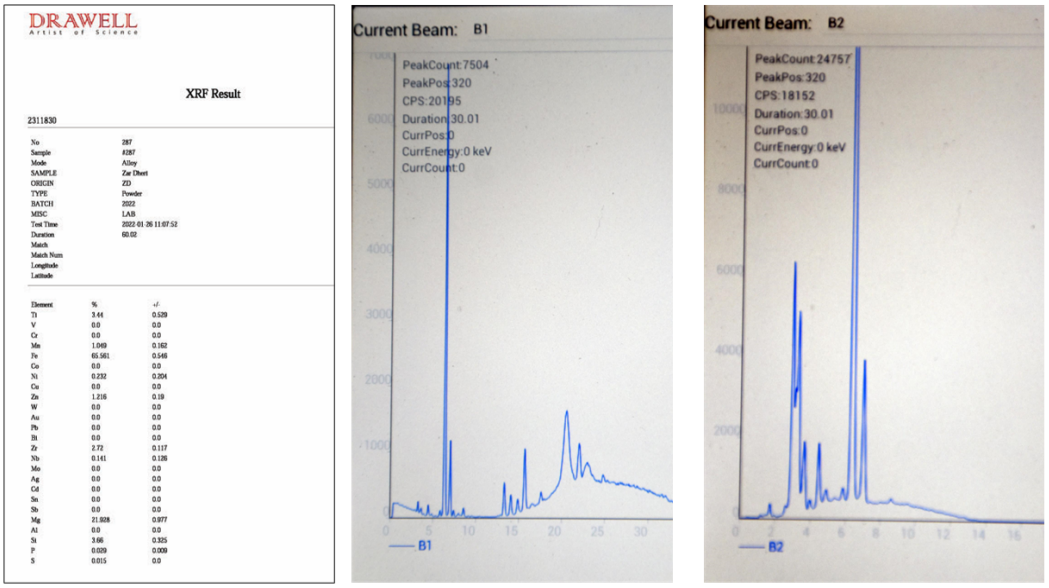

Figure-8 Spectrum and percentage result of schist stone from local query (sample 287).

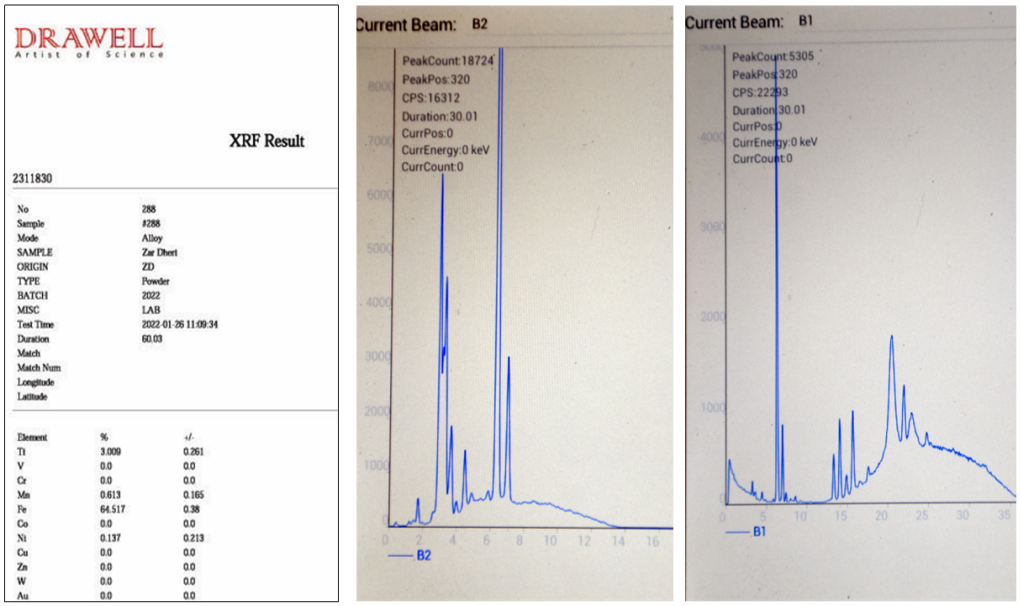

Figure-9 Spectrum and percentage result of schist stone from Zar Dheri (sample 288).

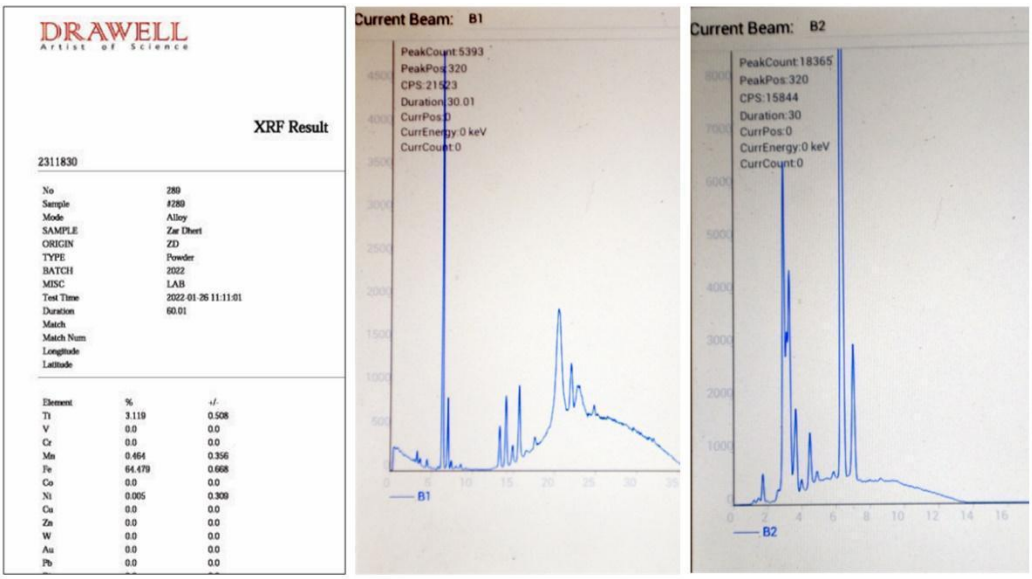

Figure-10 Spectrum and percentage result of schist stone from Zar Dheri (sample 289).

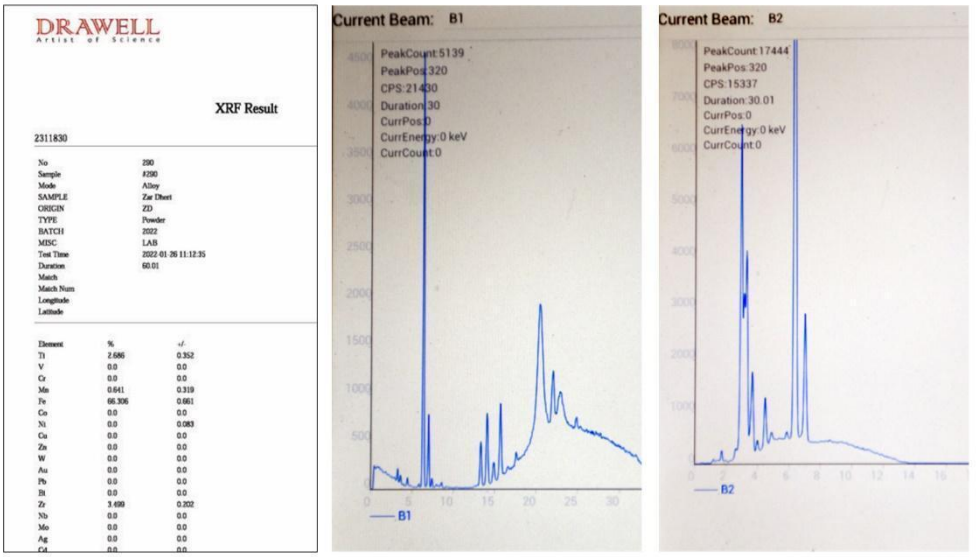

Figure -11 Spectrum and percentage result of schist stone from Zar Dheri (sample 290).

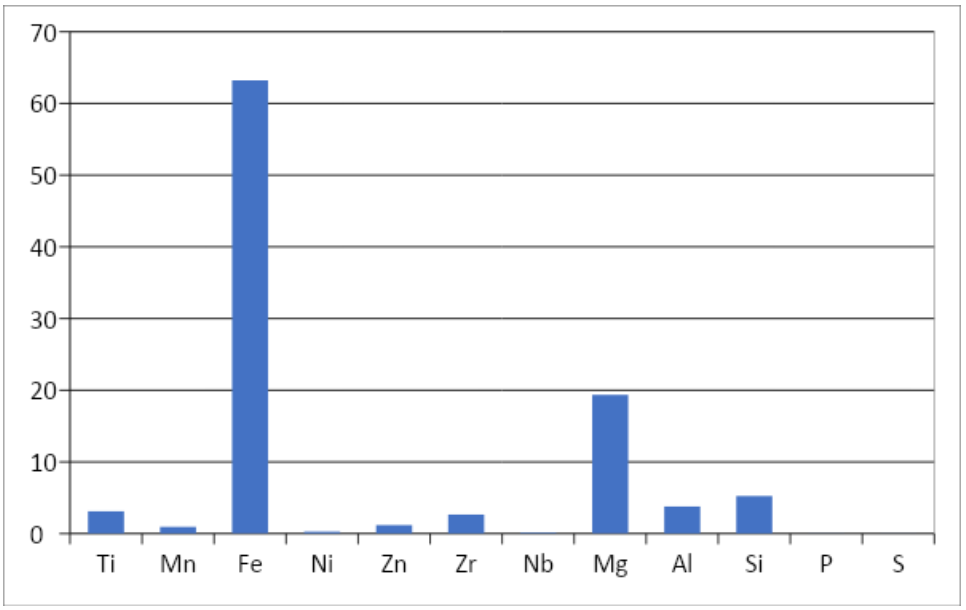

Figure-12 Composition of schist found in Zar Dheri.

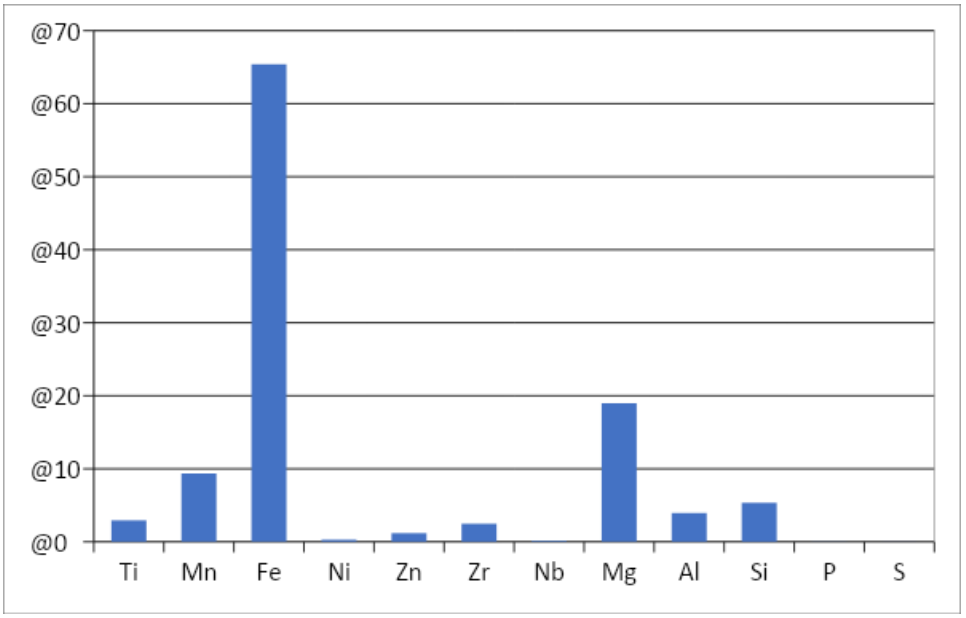

Figure 13. Composition of local schist at Kaly Parr quarry area.

Table of elements				
S.No.	Sample from Kaly Parr quarry area		Sample from Zar Dheri site	
	element	percentage	element	percentage
1	Ti	2%	Ti	2%
2	Mn	4%	Mn	1%
3	Fe	59%	Fe	63%
4	Zn	2%	Zn	2%
5	Zr	3%	Zr	3%
6	Mg	20%	Mg	20%
7	Al	4%	Al	4%
8	Si	6%	Si	5%

Table 1. Comparative table of components of schist from Zar Dheri and Kaly Parr quarry area.