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A Mineralogy and Elemental Analysis of Sasanian-Early Islamic Potsherds from the Jahangir Archaeological Monument in Ilam Based on Petrography, XRF, ICP, and TL Methods

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Abstract

To date, no experimental investigations utilizing petrographic, XRF, ICP, or TL methodologies have been undertaken for the analysis of Sasanian and Early Islamic pottery in Western Iran. Consequently, the findings of this study are anticipated to contribute valuable insights into the pottery production processes prevalent during this historical period in Western Iran. To achieve this objective, eight pottery specimens retrieved from the excavations of the Jahangir monument were submitted to the Research Institute of Cultural Heritage and the Geological Survey for petrographic analysis, while two samples each were designated for XRF, ICP, and thermoluminescence assessments. The primary research inquiries pertain to elucidating the composition and structure of the pottery, determining the firing intensity in the kiln, and discerning whether the pottery is of indigenous or imported origin. The outcomes of the experiments indicate the presence of three predominant compounds—quartz, iron oxide, and calcite—in the majority of samples procured from the Jahangir monument. Nonetheless, certain pottery specimens incorporate mica particles or chert stone in the clay composition. With few exceptions, the pottery is ascertained to be domestically manufactured, denoting its local provenance within the region. The texture of the selected pottery samples is characterized as silty, porphyritic, and inhomogeneously silty. The identification of calcite in the clay of all Jahangir pottery suggests a maximum kiln temperature of 800°C during the firing process. Furthermore, notwithstanding a limited number of exceptions, the scarcity of soil variations in the majority of pottery specimens implies a shared geographical origin.

Keywords: Pottery, Petrography, XRF, ICP, Thermoluminescence Dating, Jahangir.

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1. Introduction

In contemporary archaeological research, the pursuit of more precise scientific insights has become commonplace through the integration of interdisciplinary sciences, such as experimental mineralogy employing techniques like petrography, and chemical experiments involving methodologies like X-ray fluorescence (XRF) and inductively coupled plasma (ICP). Experimental studies serve as a foundational approach for the identification of minerals and elements constituting archaeological artifacts, notably pottery (Sardari et al., 2017: 66). The investigation of clay materials, referred to as elemental analysis of pottery, is executed through geochemical methods like XRF, inductively coupled plasma mass spectrometry (ICP-MS), and mineralogy employing polarized light microscopy. Archaeometric research, conducted over several decades on pottery, is introduced in the context of pottery analysis, aiming to apply systematic methodologies and facilitate the proper classification of studied objects based on scientific and experimental data. The classification of information often reveals similarities and differences in pottery manufacturing methods across distinct regions (Emami, 2012: 323).

Chemical studies traditionally consider the constituent elements and compounds of a substance, while phase studies focus on identifying the crystalline structure and minerals of the material (Pourmomeni, 2018: 146). Over four seasons of excavation at the Jahangir monument between 2015 and 2019, it was observed that a substantial portion of the extant cultural material comprises pottery shards. The examination of these shards holds significant potential for enhancing our understanding of the cultural developments within the region. This investigative task was undertaken through an experimental study designed to address inquiries arising during the research on selected pottery samples. Petrographic studies were conducted with the specific objective of furnishing precise information about the characteristics and mineral composition of selected pottery recovered from the Jahangir monument, as well as from other Sassanian-Islamic sites in Western Iran.

2. Research problem

The questions for this research are: (1) What are the mineralogical characteristics of Jahangir pottery, and (2) Based on the results of the analysis performed on the selected pottery of this monument, were they local or imported?

3. Research methods

The methods used in this research are petrographic-mineralogical and geochemical X-ray diffraction (XRF) experiments and inductively coupled plasma mass spectrometry (ICP-MS). These were done in order to help us understand the change and continuity of pottery technology and the main source of pottery production. In this research, eight pottery sherds discovered during the excavation of the Jahangir monument were selected, examined, and sent to the Research Institute of Cultural Heritage and the Geological Survey for petrographic testing, two samples for XRF and ICP, and two samples for thermoluminescence.

4. Background

The background can be expressed and analyzed in the form of archaeometric studies. To date, no scientific research using experimental methods on Sasanian-Early Islamic pottery in Western Iran has been published, and the existence of this research gap necessitates such studies more than ever.

5. Geographical location of the Jahangir monument

Jahangir monument is located at UTM: 606595m E, 3752695 m N, in Zarneh District in Eyvan County, 70 km northwest of Ilam Province in Western Iran, near the Kangir Border River (Fig.1).

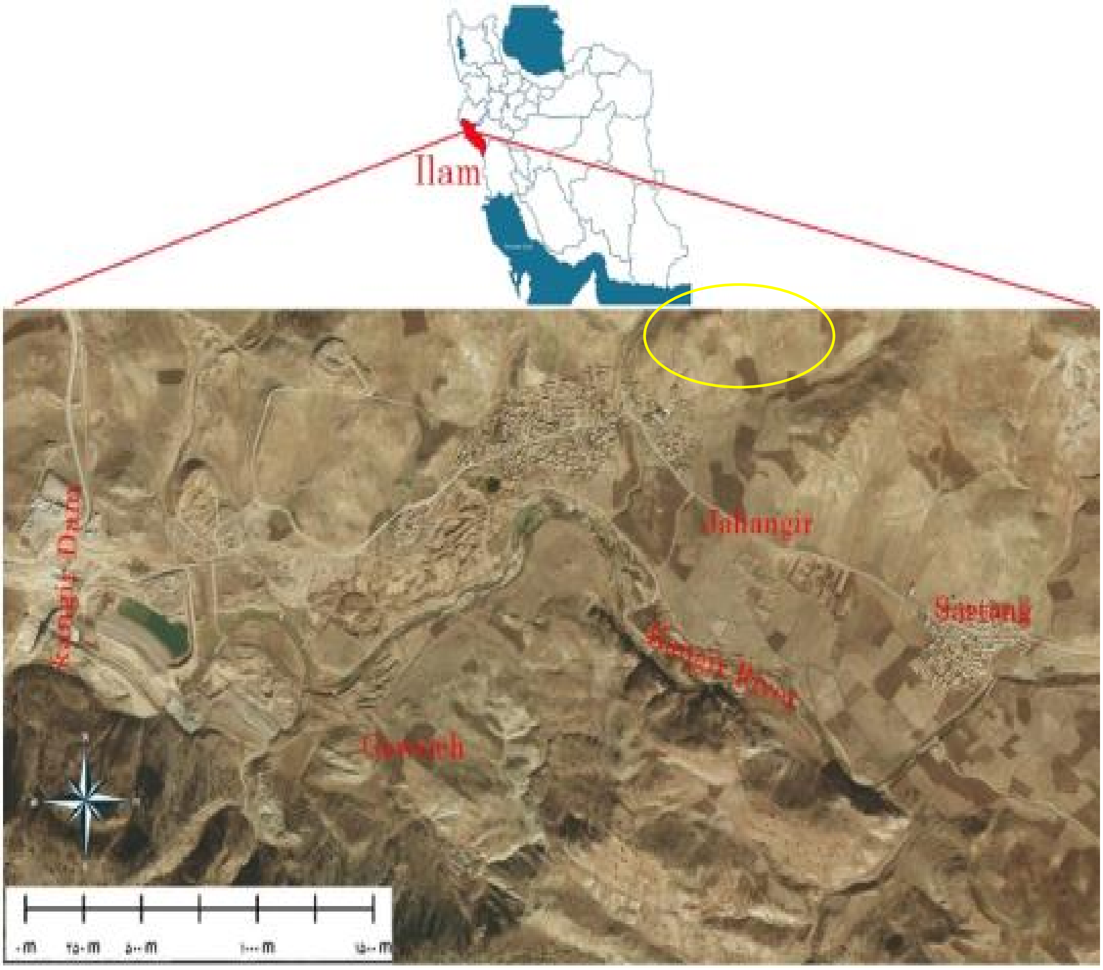


Figure 1. Geographical location of Jahangir in Ilam Province (Khosravi and Baghsheikhi 2019)

The monuments belong to the Sasanian era, which was also used during the early Islamic period. Their architecture, like other structures of the Sasanian period, includes a hall, eyvan, stoop, rooms, etc., which are all situated around an open space (courtyard). In these monuments, piers, round or rectangular columns, and arches have been used. They have been constructed using mortar immersion with riprap and half-baked and beaten gypsum mortar (Khosravi 2017; 2020, 2021a, 2021b)(Fig. 2).

.Figure 2. Rooms at Jahangir after excavations

Geology of the region In accordance with the geological classifications of Iran, the region (Stoeklin, 1968; Nabavi, 1976; Eftekharnejad, 1980) falls within the tectonic framework of the Zagros Folded Belt or Outer Zagros, thus exhibiting stratigraphic-tectonic characteristics attributable to the tectonic unit of the Zagros Folded Belt. The Zagros Folded Belt, situated in the southwest of Iran, features a northeastern unit corresponding to the well-known tectonic zone identified as the Main Recent Fault. From a global tectonic perspective, the Zagros Folded Belt constitutes a passive continental margin, in contrast to the Sanandaj-Sirjan zone, which constitutes an active continental margin. The Neo-Tethys ocean, extending northwest-southeast from Kermanshah to Central Lorestan and Eastern Khuzestan and further to Kharg Island in the Persian Gulf, is integral to this geological setting. Given Ilam Province's location within this delineated zone, the exploration of the geological history of this region in Iran is contingent upon the discernment of events occurring during the formation of the Zagros (Aghanabati, 2006: 19).

The Quaternary formations in Ilam Province are outcomes of the erosion of exposed formations within the province, with a predominant presence of fine-grained limestones in the structure of most clays. The significant synclines in the province, including Eyvan-e Gharb, Shirvan, Chardavol, and Mehran, are enveloped by quaternary sediments, constituting agriculturally fertile areas within the province (Geological Survey, 2016). On geological maps, a substantial portion of Eyvan City comprises calcareous formations, recognized as vital sources of water supply. The surrounding regions of these formations hold importance for residential settlements due to the availability of water resources. Given these circumstances, the area of Eyvan County has maintained historical significance for human habitation, attributed to the presence of calcareous formations and accessible water resources (Fig. 3).

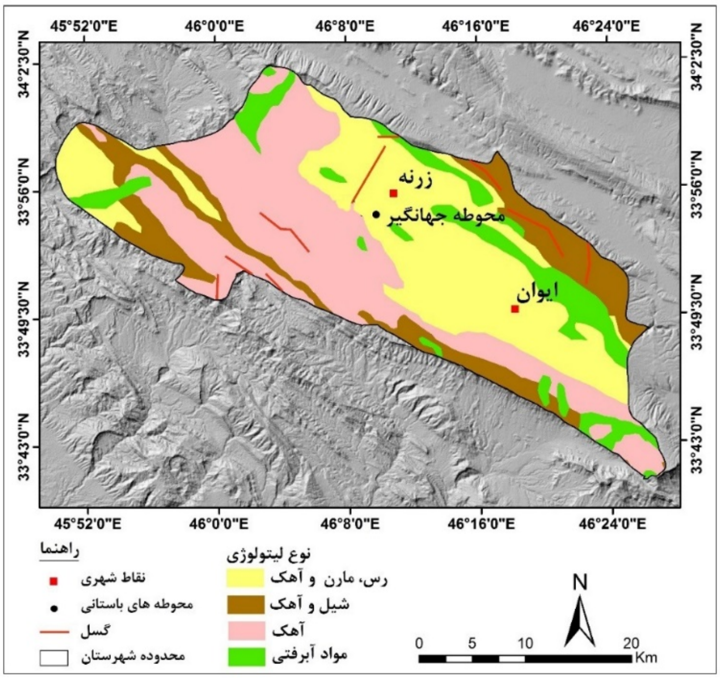


Figure 3. Geological map of Ivan and the location of Jahangir. Type of lithology: Yellow: clay, marl, and lime, Brown: shale and lime, Pink: lime; green: alluvial material (Khosravi and Baghsheikhi 2019).

7. Petrographic examination of pottery

Petrography is a common method in geology and archeology. It is used in geology to study rocks and minerals, but in archeology it is used not only in the study of stone objects and materials but also in the study of pottery. In general, the application of petrography for the study of pottery can provide archaeologists with a variety of information, some of the most important of which include: geological information about the origin of the clay used in pottery production, geological and technological information about materials added to the clay, technical information regarding pottery baking including temperature and firing conditions, information about the potter's actions while making pottery (Naghshineh et al., 2013: 68).

For petrographic examination, eight samples obtained from Jahangir were selected (fig. 4). Regarding the technique of manufacture, one is handmade and the rest are wheel-made. As for the degree of firing, except two samples, all are well-baked. The craft quality of the samples is mostly mediocre and the three pieces are rough. The temper of all samples is mineral. The color spectrum of the clay of this pottery is buff, greenish buff, gray, brown, light brown, orange. The color spectrum of some of the glazed pieces is blue, green and brown. Wet hand smoothing has been done on the inner and outer walls of some samples.

In the petrographic method, each piece of pottery is mounted to a glass plate (slide) and to pass light through the sample in order to identify minerals in the pottery, the size of the grains, their roundness or angularity, the thickness of the pottery is reduced to 30 micrometers (Shepard, 1956: 139-140). At this thickness and under the polarizing microscope, the minerals in the clay show special optical properties (Amanollahi, 2009: 127). With this method, three aspects of the structure of pottery can be examined: (1) detailed information on the composition of mineralogy for determining the origin of clay, (2) determining the nature and characteristics of non-plastic components and (3) certain properties of those components such as particle size and distribution and their relationship to each other in order to help us understand the potter's method for preparing and forming the clay, and estimating the firing temperature based on changes that occur in minerals at high temperatures (Bakhtavar et al., 2021: 155).

Figure 4. Samples of selected pottery for petrographic analysis (Khosravi and Baghsheikhi 2019).

For petrographic analysis, eight thin-section samples with a thickness of 30 microns were taken from Jahangir pottery. The specimens were then examined by a James Swift (Prior) polarizing microscope (Table 1). In the following table, each component of the pottery is marked with an asterisk (*), and if a component is not present, it is separated by a dash (-) (Beheshti, 2019).

Table 1. Results of the petrographic examination of Jahangir pottery (Khosravi and Baghsheikhi 2019)

SAMPLE CODE	QZ (CLEAN)	QZ (CLOUDY)	FE-OXIDE	CC	PL	AM & PX	V.R	GROG	CHERT	TEXTURE
1	*	*	*	*	*	*	*	-	-	Inhomogeneous (Porphyritic)
2	*	*	*	*	-	-	-	-	-	Inhomogeneous Silty
3	*	*	*	*	*	-	-	-	*	Inhomogeneous (Porphyritic)
4	*	*	*	*	-	-	-	*	-	Inhomogeneous (Porphyritic)
5	*	*	*	*	-	-	-	-	-	Inhomogeneous (Porphyritic)
6	*	*	*	*	-	-	-	*	-	Inhomogeneous (Porphyritic)
7	*	*	*	*	*	-	-	-	*	Inhomogeneous Silty
8	*	*	*	*	-	-	-	*	-	Inhomogeneous (Porphyritic)

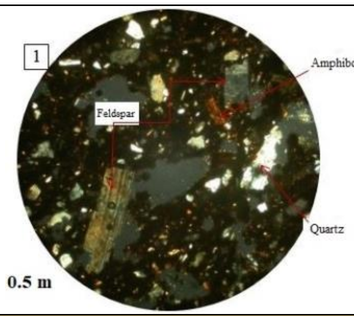
Qz (Clean) = clear quartz and phenocryst; Qz (Cloudy) = cloudy quartz and polycrystalline; Fe-oxide = iron oxide; Cc = calcite; Pl = plagioclase; Grog = previous clay and pottery pieces; AM & PX = amphibole and pyroxene; Chert = chert stone pieces; V.R = igneous rock.

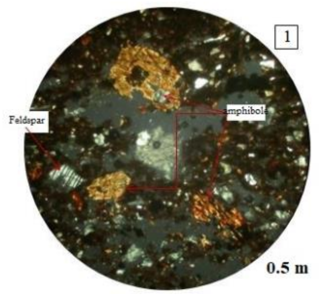
According to the results, the filler components based on metamorphic origin include quartz, plagioclase, pyroxene, and chert stones. Fossil fragments were also observed in one sample. The texture of most specimens is porphyritic or coarse. In silty texture, the components of the sample do not exceed 0.5 mm, and in porphyritic texture, the size of macrocrystalline pieces is between one and two millimeters. The most common minerals in all samples are clear quartz and polycrystalline. The samples were divided into three groups based on mineralogical similarities and differences (Table 2).

Table 2. Grouping of Jahangir pottery samples based on petrography (Khosravi and Baghsheikhi 2019)

Group	Specimen No.	Petrographic Characteristics of Pottery
1	1	Igneous rock, iron oxide, amphibole, quartz, plagioclase and calcite
2	3, 7	Quartz, iron oxide, chert stone, calcite and plagioclase
3	2, 4, 5, 6, 8	Quartz, iron oxide, calcite and grog

Group 1: Sample No. 1 is in this group. The sample has an inhomogeneous texture, or porphyry (the presence of large pieces in the clay paste). The main ingredients of the clay are many parts of amphibole minerals, along with quartz and plagioclase. Amphibole and plagioclase minerals are the major constituents in igneous rocks. A limited amount of igneous rock remnants were also observed in the clay. Amphibole, plagioclase, and quartz were found in almost equal proportions, with a frequency of 5% in the clay. Calcite is also present in coarse form and has limited dispersion in the clay. It seems that in this sample, igneous rock has been used as filler and temper, and considering the formations of the region, this sample may not have been native to the region and was produced elsewhere and used here (Fig. 5).





Photomicrograph, sample no. 1, XPL light, length of field of view 2.7 mm, porphyritic texture, another view of the sample. Quartz and feldspar minerals in pottery clay are reminiscent of the igneous rock used in the form of temper.	Photomicrograph, sample no. 1, XPL light, length of field of view 2.7 mm, porphyritic texture, quartz minerals, feldspar, and amphibole are observed in the section.

Figure 5. Section of pottery samples no. 1 from Group 1 of Jahangir (Khosravi and Baghsheikhi 2019)

Group 2: Includes samples no. 3 and 7. This type of pottery has a carbonate and homogeneous clay that is seen in a light cream color. Pieces of chert stone and quartz mineral have been used as temper. This type of pottery differs from other samples in terms of clay composition, minerals used as fillers, and temper. Due to the existence of chert, sandstone, and quartz sources in the region, however, the indigenousness of the pottery is quite clear. The chert stone is about 10%, and the calcite mineral constitutes 5% of the sample volume. The pottery clay is wholly homogeneous and carbonate-rich (Fig. 6).

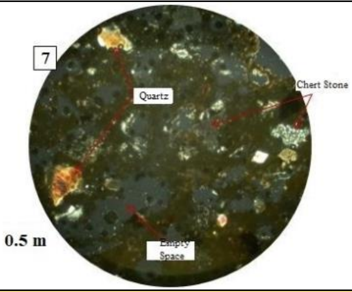
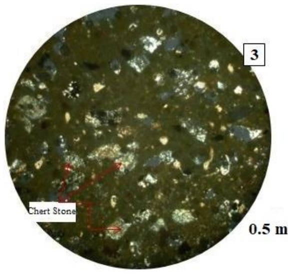
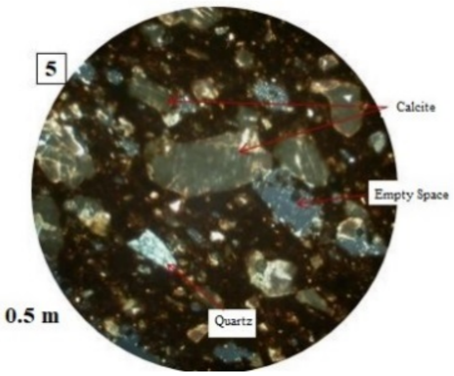
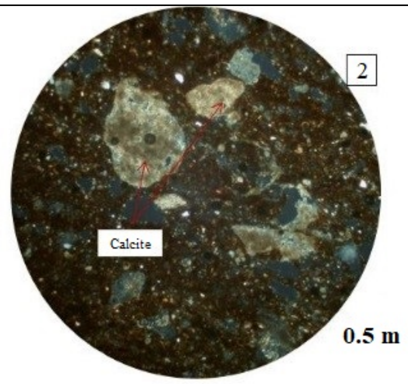
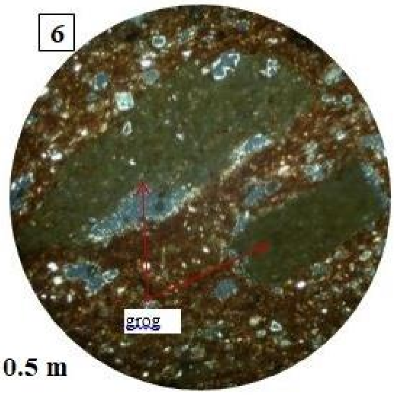
	
Photomicrograph, sample no. 7, XPL light, length of field of view 2.7 mm, inhomogeneous silty texture. Chert and quartz fragments are found in the carbonate clay. There are lots of voids in the clay.	Photomicrograph, sample no. 3, XPL light, length of field of view 2.7 mm, inhomogeneous silty texture. There are many pieces of chert and quartz minerals in the carbonate clay.

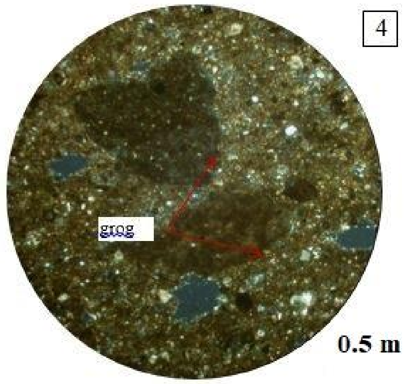
Figure 6. Sections of pottery samples no. 3 and 7 from Group 2 of Jahangir (Khosravi and Baghsheikhi, 2019)

Group 3: Includes samples nos. 2, 4, 5, 6, and 8. Calcite and grog pieces have been used as temper, either separately or in combination. The microscopic texture of the samples is porphyritic (inhomogeneous), and the minerals are seen in the form of temper in the pottery clay. In samples no. 2 and 5, large pieces of calcite are used as a temper. Calcite is their major mineral and has formed about 30 to 40% of the sample volume. In samples nos. 4, 6, and 8, grog parts, along with calcite, have been used as a temper. These samples are similar to Nos. 2 and 5, with a slight difference in the percentage of components. Grog fragments found in the pottery are the remnants of dark clay minerals that can be seen as coarse-grained particles in the paste. The clay of this group is non-carbonated (Fig. 7).

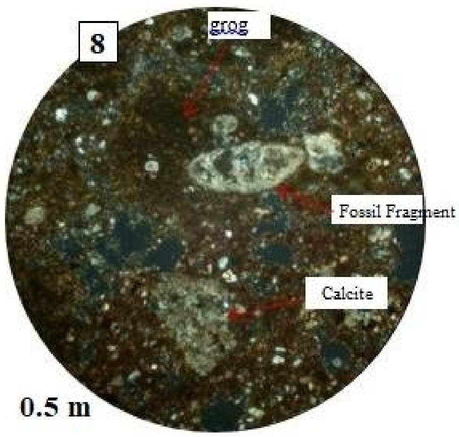
	
Photomicrograph, sample no. 5, XPL light, length of field of view 2.7 mm, inhomogeneous silty texture; large pieces of calcite mineral can be seen in the center of the image.	Photomicrograph, sample no. 2, XPL light, length of field of view 2.7 mm, inhomogeneous silty texture; large pieces of calcite mineral can be seen in the center of the image.



Photomicrograph, sample no. 6, XPL light, length of field of view 2.7 mm, inhomogeneous silty texture; large pieces of grog can be seen in the center of the image.



Photomicrograph, sample no. 4, XPL light, length of field of view 2.7 mm, inhomogeneous silty texture; large pieces of grog can be seen in the center of the image.



Photomicrograph, sample no. 8, XPL light, length of field of view 2.7 mm, inhomogeneous texture: large fragments of grog and calcite are seen along with a fossil fragment.

Figure 7. Sections of pottery samples no. 2, 4, 5, 6, and 8 from Group 3 of Jahangir (Khosravi and Baghsheikhi, 2019).

7.1 The firing temperature

The most important part of pottery manufacture is the baking process, which turns the soil into a strong and durable product. The baking process depends on the nature of the raw materials, the reactions, and the transition of materials between the minerals (Noghani & Emami, 2013: 56). Calcite or carbonate-based minerals disappear at a temperature of 800° C, and due to the geology of the region, carbonate formations and exposures are abundant, and calcite was observed in the samples. Therefore, all Jahangir pottery is baked at less than 800°C.

7.2 The voids

As mentioned, examining the voids in the pottery clay can be useful for analyzing the quality of their craft. As a result, in microscopic studies of the 8 samples of Jahangir pottery, only two limited voids were observed in circular and oval shapes (Fig. 8).

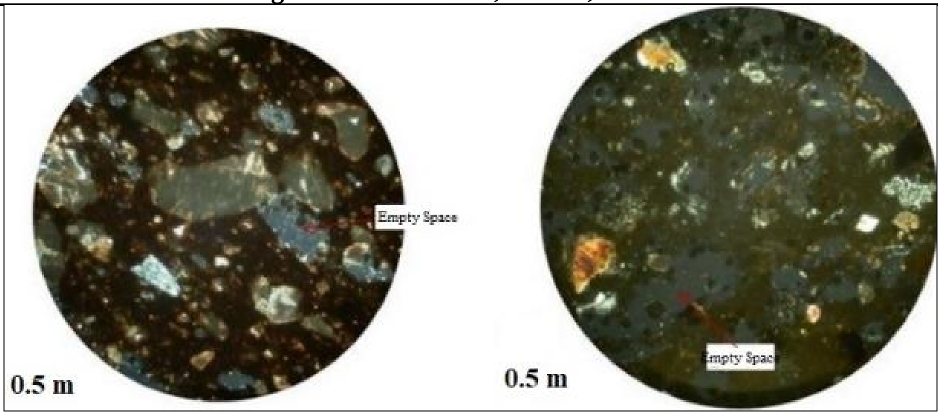


Figure 8. Voids in Jahangir samples, PPL light and 4x magnification (Khosravi and Baghsheikhi 2019)

8. Geochemical studies of Jahangir pottery

Chemical examination is a tool for the study of the constituent elements and the presence of rare elements in the body of an instrument, or more commonly, the study of quantitative data in the chemical texture of an instrument. This method is commonly used in comparative studies that require knowledge about the source of archaeological findings. XRF and ICP-MS analysis methods were used for the geochemical study of Jahangir pottery. For this task, two samples of Jahangir pottery were selected for analysis (Fig. 9).

The samples were analyzed in the XRF and ICP-MS laboratories of the Geological Survey. One of the physical methods for analyzing the chemical composition of elements is spectrographic analysis (Shepard, 1956: 143). X-ray fluorescence spectroscopy is one of the elemental methods of material analysis that is used today in industry and research centers in the fields of mine exploration, processing of materials and minerals, extraction, and smelting of metals (Golestani, 2004: 93).

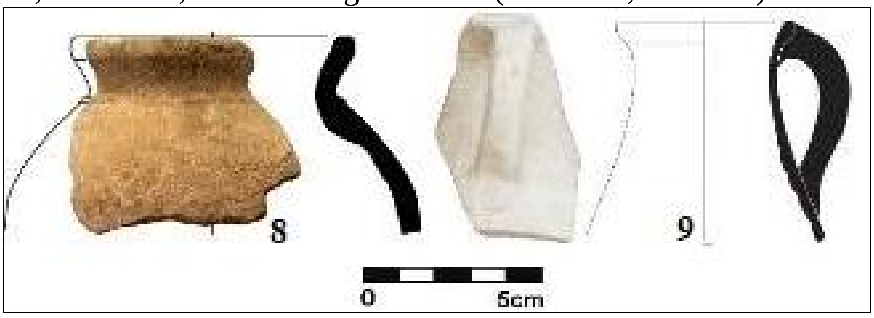


Figure 9. Selected pottery for XRF and ICP experiments of Jahangir (Khosravi and Baghsheikhi 2019)

In petrographic examination of the pottery, it was found that the major phase of this pottery samples is quartz mineral, calcite and iron oxide. The pottery clay has two compounds, carbonate and non-carbonate. Non-carbonate (clay) composition is the result of erosion processes, weathering of rocks and sediments in the region during different geological periods. Therefore, formation of clay minerals can be considered as the result of alteration and erosion of feldspar minerals (sodium-bearing, potassium-bearing and calcium-bearing). Other minerals and components in the body of pottery include amphibole and pyroxene, mica, chert and metamorphic rock. Each of these can be the concentration zone of trace elements, all of which are affected by processes occurring in the area on rocks and sediments (Tables 3 and 4).

Table 3. XRF analysis of Jahangir pottery samples (based on PPM) (Khosravi and Baghsheikhi 2019)

S.N XRF	**8**	**9**
S.N Petrography	**3**	**5**
Formula	(%)	(%)
Na2O	0.83	0.44
MgO	3.65	2.09
Al2O3	9.91	7.78
SiO2	40.5 5	27.56
P2O5	0.19	0.10
SO3	0.16	0.28
K2O	1.38	1.55
CaO	25.13	33.11
TiO2	0.83	0.95
MnO	0.17	<.1
Fe2O3	8.03	8.68
As2O3	-	-
SrO	0.13	0.07
PbO	-	-
ZrO2	0.05	<.1
L.O.I*	9.00	17.40

Table 4. ICP-MS analysis of Jahangir pottery samples (based on PPM) (Khosravi and Baghsheikhi 2019)

S.N ICP	**8**	**9**
S.N Petrography	**3**	**5**
Ag	0.8	<0.5
As	21.8	<2
Ba	411.9	299.2
Be	1.3	1.4
Cd	0.2	0.3
Ce	44.7	44.6
Co	24.1	24.4
Cr	137.2	123.0
Cu	24.2	24.7
Dy	3.8	2.2
Er	4.0	4.2
Eu	0.7	1.3
Ga	13.7	10.6
Gd	4.5	4.9
Ge	1.7	2.4
Hf	18.6	2.6
Ho	0.6	0.7
La	26.1	28.0
Li	22.5	17.0

Lu	0.3	0.3
Mn	715.1	263.3
Mo	<0.5	4.1
Nb	16.2	18.2
Nd	21.5	23.2
Ni	103.8	75.8
P	1275.5	852.7
Pb	29.1	14.2
Pr	5.3	6.4
Rb	55.6	68.9
Sc	14.5	12.8
Sm	4.7	4.5
Sn	2.7	2.8
Sr	679.8	383.9
Ta	1.4	1.5
Tb	0.4	0.2
Te	0.1	0.2
Th	18.5	18.2
Ti	3749.1	3933.6
Tl	0.6	0.6
Tm	0.2	<0.2
U	3.3	2.9
V	100.1	121.2
Y	20.0	20.2
Yb	2.5	2.5
Zn	69.5	60.4
Zr	317.4	309.6

In petrographic studies, calcite, quartz and iron oxide minerals were observed as the major components added to the pottery clay. For instance, the density and frequency of calcite in samples no. 5 of Jahangir is about 30%, and in sample no. 3 of Jahangir, quartz is the major constituent and has the highest density in the pottery clay. In the geochemical study of pottery, the composition of the clay has an important role in the abundance of elements that cannot be detected by petrography due to the fineness of the components (Diagram 1).

In the change process of rare earth elements shown in the following diagrams, samples of Jahangir are consistent and represent a common origin. In addition, two samples of Jahangir are different from other samples in terms of the abundance of rare earth elements.

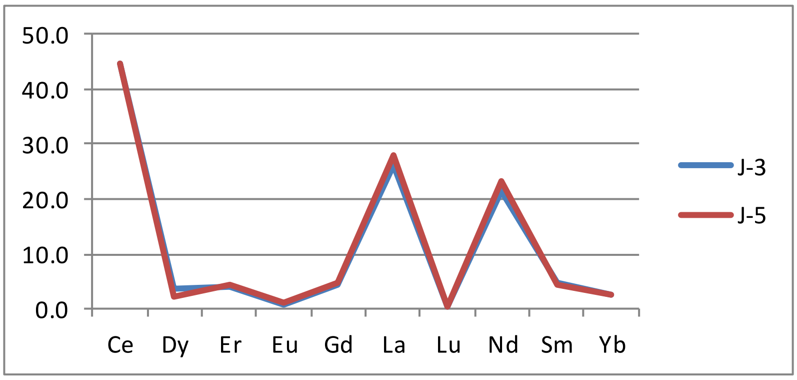


Diagram 1. Multi-element diagram of Jahangir pottery samples (Khosravi and Baghsheikhi 2019)

On the whole, considering the geology of Iran, the genetic origins of the examined pottery of Jahangir are very similar in many cases. The minerals in the pottery clay are the main cause of the concentration of rare elements. For instance, the presence of minerals such as quartz is the main factor in the concentration of light rare elements, and the presence of iron oxide and similar compounds is the main factor in the abundance of heavy rare elements.

9. Dating results

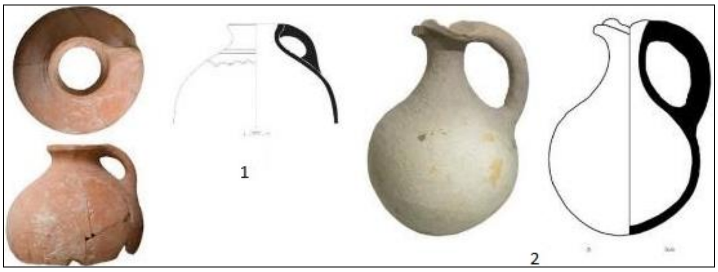


Figure 10. Descriptions of pottery sherds from Jahangir samples for thermoluminescence (Khosravi and Baghsheikhi 2019)

From the samples sent to the laboratory, two were selected that were likely to respond to the experimental process. The luminescence spectra obtained from the three samples are shown in Figures 11 and 12. The chronological values obtained from these spectra are also presented in Table 5. Experimental results suggest the dating of the Sasanian period for this site (Bahroloulomi, 2018) (Table 5) (Diagrams 2 and 3).

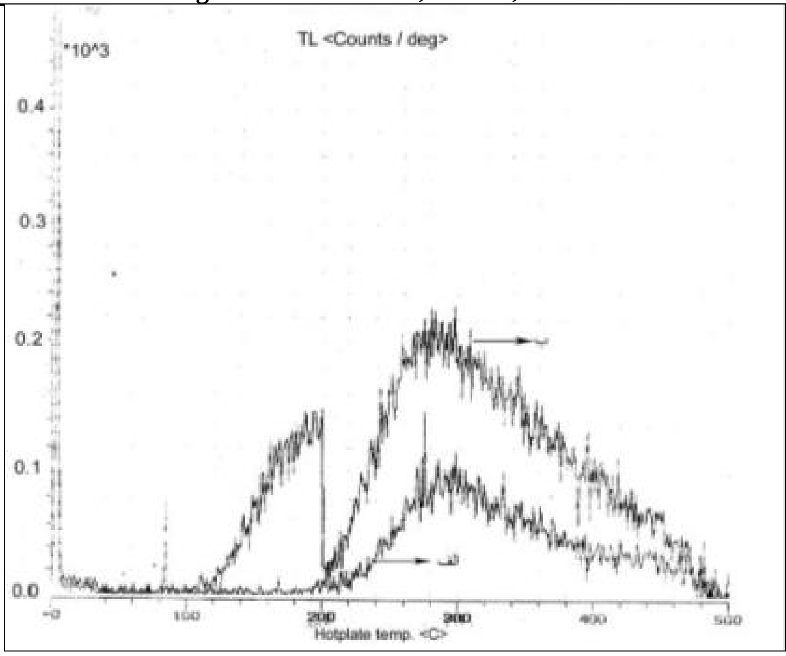
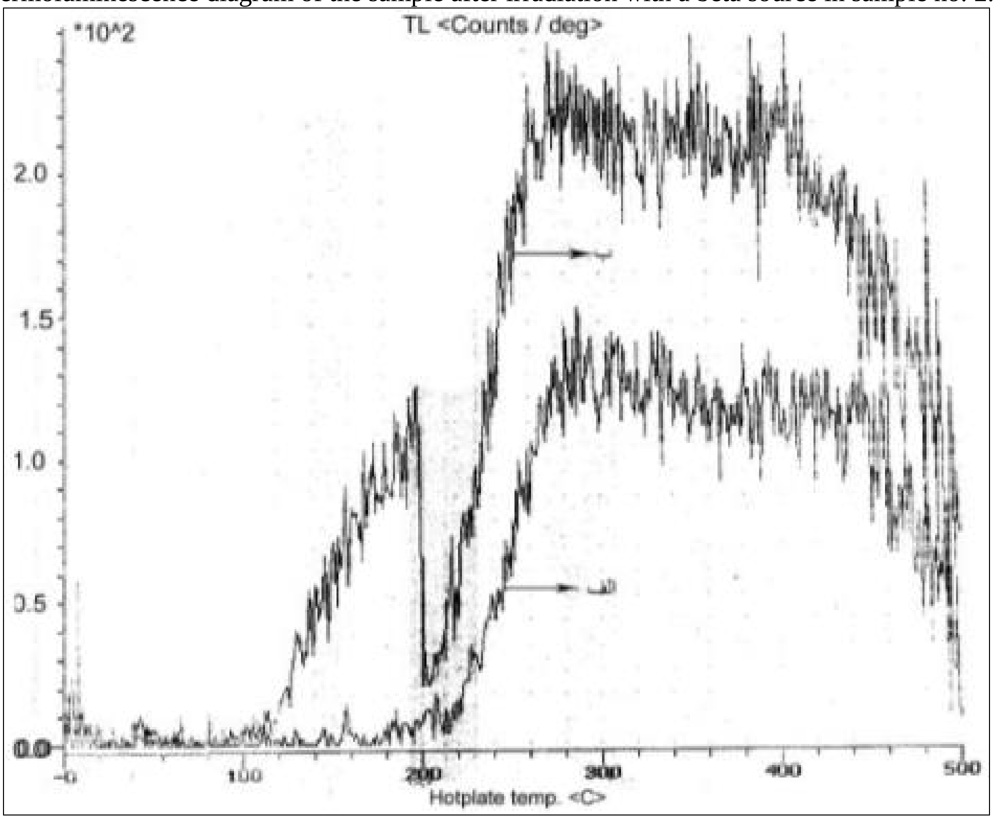


Diagram 2: A: Natural thermoluminescence diagram of the sample,
B: Thermoluminescence diagram of the sample after irradiation with a source in sample no. 1.

Diagram 3: A natural thermoluminescence diagram of the sample
B: Thermoluminescence diagram of the sample after irradiation with a beta source in sample no. 2.Table



5:Dating results for three slag samples (Khosravi and Baghsheikhi 2018)

Sample	Depth	Percentage of potassium oxide (K20%)	Thorium concentration (ppm)	Uranium concentration (ppm)	Gregorian Date	^{14}C Age BP
1	-180-250 cm	2.07	3.21	40.04	551 CE (496-606 CE)	1468±55
2	-25 cm	50.77	3.52	5.97	549 CE (489-609 CE)	1470±60

10.Conclusion

The outcomes derived from petrographic experiments conducted on selectively chosen pottery samples from the Jahangir monument revealed a consistent silty and porphyritic texture across the samples. Predominantly, the samples exhibit three compounds—quartz, iron oxide, and calcite—suggesting uniform composition and structure, indicative of a shared provenance. Nevertheless, structural variations are discernible in specific samples, such as the presence of chert in samples no. 3 and 7 of Jahangir. Sample no. 1 of Jahangir displays distinct characteristics, incorporating clay minerals of igneous origin, specifically amphibole and plagioclase, which, according to geological maps, are not indigenous to the region (Table 6). The pottery from Jahangir manifests a firing temperature below 800 degrees, implying insufficient firing. Furthermore, to ascertain the major, trace, and rare earth elements present in the pottery from the Jahangir monument, geochemical analyses were conducted using X-ray fluorescence (XRF) and inductively coupled plasma (ICP) methods. The investigation into the rare earth elements in Jahangir pottery demonstrates compatibility and signifies a shared origin, as evidenced by consistent alterations in these elements across all samples. Notably, changes in rare earth elements were observed universally across all examined samples.

Table 6. Minerals of the Jahangir pottery clay (Khosravi and Baghsheikhi 2019)

	Mineral Type	Presence	Absence
Jahangir	Clear Quartz & Phenocryst	*	
	Cloudy Quartz & Polycrystalline	*	
	Iron Oxide	*	
	Calcite	*	
	Plagioclase	*	
	Clay & Previous Pottery	*	
	Amphibole & Pyroxene	*	
	Chert Stone	*	
	Igneous Stone	*	

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بررسی کانی‌شناسی و تحلیل عنصری سفال‌های ساسانی - آغاز اسلامی بنای جهانگیر ایلام با استفاده از روش‌های پتروگرافی، XRF ،ICP و T.L

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چکیده

تا به امروز هیچ مطالعه آزمایشگاهی با استفاده از روش‌های پتروگرافی، XRF، ICP و T.L برای تحلیل سفال ساسانی و آغاز اسلامی در غرب ایران انجام نشده است. بنابراین، نتایج این پژوهش اطلاعات بیشتری را در خصوص فرآیند تولید سفال در این دوره تاریخی از غرب ایران آشکار خواهد کرد. بدین منظور ۸ قطعه سفال به دست آمده از کاوش های بنای جهانگیر برای انجام آزمایشات پتروگرافی به پژوهشگاه میراث فرهنگی و سازمان زمین‌شناسی و ۲ نمونه برای XRF و ICP و ۲ نمونه برای ترمولومینسانس انتخاب و مورد بررسی قرار گرفت. سؤالات این پژوهش در مورد چگونگی بررسی ترکیب و ساختار سفال (؟)، درجه پخت در کوره (؟) و بومی یا وارداتی بودن (؟) است. بر اساس آزمایشات انجام شده می توان نتیجه گرفت که در اکثر نمونه های به دست آمده از این اثر سه ترکیب کوارتز، اکسید آهن و کلسیت مشاهده شده است. اما در برخی از سفال ها از ذرات میکا یا سنگ چرت در خاک رس استفاده شده است. به استثنای تعداد کمی، تمام سفال‌ها تولید داخل هستند. به عبارتی محلی هستند و متعلق به خود منطقه هستند. بافت سفال در نمونه‌های منتخب سیلتی، پورفیریتی و سیلتی ناهمگن است. وجود کلسیت در خاک رس همه سفال های جهانگیر نشان می دهد که در دمای بیش از ۸۰۰ درجه سانتی گراد در کوره پخته نشده است. همچنین به استثنای چند نمونه، تغییرات نادر خاک در اکثر سفال ها نشان دهنده یک منشاء مشترک است.

واژه‌های کلیدی: سفال، پتروگرافی، سالیابی ترمولومینسانس، XRF، ICP، جهانگیر