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COMPARATIVE STUDY OF A POTTERY SAMPLE FROM SASANIAN ISLAMIC SITES OF FARS AND SIRAF

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ABSTRACT

Pottery as a major artifact crafted by human is a key elements to reconstruction of the past cultures. Presence of important Sasanian-Islamic sites in the Fars region reflects the variety and concentration of different groups of people in this area. Extensive archaeological investigations in the region have provided us with a mass pottery collection to be used in better understanding the Sasanian and early Islamic societies through more precise, technical studies. The present paper sets to give a better picture of the pottery assemblages from the Sasanian-Islamic sites (Bishapur, Sar Mashhad, the city of Gur, Darabgird, Istakhr) and the historical city of Siraf as a main port of the Sasanian era through macroscopic and laboratorial analyses of the available material.

KEYWORDS: Sherds, Istakhr, Bishapur, Archaeometric studies

INTRODUCTION

Extending from the Persian Gulf up to the Zagros ranges,the region of Fars as a favorable place for human settlements has appealed to human societies from early ancient times. During several thousand years the region has witnessed the rise and fall of several major cultures, and its vast, unique potentials have made possible the life and settlement of different societies. Its various geography and sustainable environmental resources have allowed the region to develop different prehistoric settlements that reached the zenith with the rise of the powerful Elamite Empire, and later two major empires and groundbreaking cultures of the East: the Achaemenian and Sasanian Empires. As a significant cultural base, the region still continued to play a major role following the decline of the Sasanians. Therefore, comprehensive studies to reconstruct the historical position and role of the region in development of the culture and identity of Iranian society assume high priority in cultural investigations.

The present work attempts at obtaining a greater detailed knowledge of the physical-chemical characteristics of the pottery from the Sasanian and early Islamic periodsto pinpoint the similarities between pottery assemblages from the Sasanian sites of Fars and the historical site of Siraf. This major objective will be fulfilled through typological and chemical analyses which will respectively allow determining the typological and compositional comparisons of the sample under study.

To this end, first separate survey programs were conducted at the sites of Bishapur, Sar Mashhad, the city of Gur, Darabgird, Istakhr and Siraf, during which fifty sherds were collected from the surface of each relevant site. The collected sherds were then designated with a sequential Arabic number from 1 to 50 following a site prefix: Bish for Bishapur, SM for Sar Mashhad, F for the city of Gur (after Firuzabad that hosts the archaeological site of Gur), Darfor Darabgird, ES for Istakhr, and Si for Siraf.

The entire sample was photographed and drawn before it was macroscopically analyzed in order to define such characteristics as paste color, firing quality, glazed surfaces (interior, exterior or both surfaces), decoration, temper and manufacturing technique (hand- or wheel-made). The resultant data was visualized as several graphs using statistical techniques. The final procedure involved selecting from each site four sherds that had already proved comparable in macroscopic analysis. These sherds were exposed to chemical analyses by XRD and ICP techniques. The analysis helped to determine the constituting elements of and the oxides present in the sherds as well as cross-site comparison of the detected elements.

HISTORY OF INVESTIGATIONS AT SASANIAN-ISLAMIC SITES OF FARS AND SIRAF

We owe the earliest accounts of Sasanian sites in the Fars region to the European travelers and explorers who arrived in the region in 12th century primarily aiming at visiting the remains of Persepolis and Naqshe Rustam. Along with these Achaemenian monuments, they also made independent visits to and documented the Sasanian stone reliefs in the area. In particular, Joseph Barbarv toured Iran between 1471 and 1475 visiting the stone reliefs at Naqshe Rustam, apart from the reliefs at Persepolis. Other travelers such as John Struys (1671), James Morier (1811), Robert Ker Porter, Eugène Flandin and Pascal-Xavier Coste, and Marcel-Auguste Dieulafoy and his wife Jane Dieulafoy (1881-2) have mainly enjoyed the splendor of Sasanian stone reliefs (Vanden Berghe 1379/2000: 20). However, by the second half of 19th century the arrival of the western archaeologists brought the major Iranian archaeological sites into focus, and excavations began at historical cities including Bishapur (Ghirshman 1962), the city of Gur (Huff 1977), Siraf (Whitehouse 1991) and Istakhr (Whitcomb 1979).

Bishapur

The ancient city of Bishapur lies 23km west of the Kazerun County. The most important Sasanian remains in the city are the Anahita temple, the audience hall, and the city wall. The first archaeological excavation at Bishapur was carried out by Roman Ghirshman and Georges Salles in 1935. Ghirshman has explained his works in a short preliminary report on this early endeavor entitled “Châpour. Rapport préliminaire de la première campagne de fouilles” (Salles & Ghirshman 1936). Ali Akbar Sarfaraz resumed the excavations during 1968-1978 (Sarfaraz 1987). More recently, the fieldwork have continued by different excavation teams including those led by Mehryar in 1995 (Mehryar 1999), Nowruzzadeh Chegini in 2004, and Nowruzi and Amiri in 2009-2010.

Sar Mashhad

Sar Mashhad is located next to the road that links Bishapur to the city of Gur. This archaeological site is situated 40km east of Bishapur. Though the site still awaits extensive excavations, the preliminary surveys suggest that it belongs to the Sasanian period, with its major remains being a stone relief attributed to Bahram II. Herzfeld was the first to publish this relief, though his work by no means cites the name of this large city (Herzfeld 1941). This place was located 4 leagues from Jareh and 12 leagues from Tudj, on the basis of description in Farsnameh (IbnBalkhi 1968). The earliest reference to the site is that by M.T. Mostafavi who writes that “six kilometers to the northeast of Sar Mashhad there lie remains of a buried city called Khanijan by local people” (Mostafavi1964: 118).

Istakhr

As a major city from the historical period, most of the Sasanian kings were based at Istakhr. Some 3 kilometers separate this ancient city from Persepolis. The first report, or rather, popular description on Istakhr dates from 1672 when a British traveler John Stereos paid a visit to the ruinous city (Shahbazi 2003). Flandin and Coste were among the first scholars who studied parts of Istakhr with scientific-artistic goals. Further, Herzfeld and Schmidt also carried out excavations at the city at the same time with their fieldworks at Persepolis between 1932 and 1937 (Schmidt 1967).

Apart from excavating the defensive wall and Southern Barzan at Persepolis, Akbar Tajvidi conducted some limited excavations at Istakhr (Tajvidi 1976: 27). The next excavations were only conducted in 1970s when Whitcomb was assigned to publish the results of Schmidt’s excavations at Istakhr, though except for a brief publication (Whitcomb 1979: 363) the excavations still remain mainly unpublished.

City of Gur

The city of Gur lies 90km southeast of Shiraz and 10km west of Firuzabad. It has a round plan, with a minara at its center. A defensive ditch completely encircled the city. The first excavations at Gur and Qala Dukhtar were implemented by the Archaeological Center of Iran and the International Institute for Restoration of Historical Buildings with cooperation of the German Archaeological Institute. The German team carried out surface surveys at Gur during its restoration works at Qala Dukhtar (Hoff 1978: 191).

Darabgird

The historical site of Darabgird is located 275km to the east of the Shiraz County, not far from the modern city of Darab. The term “Darab” stems from “Darabgird” meaning the city of Darab. The city was likewise a major kiln in Fars during the Sasanian era. Though Muslim historians such as Hamza Isfahani, Ibn Miskawayh and al-Istakhri have ascribed the foundation of Darab to the Kayanian Dynasty (Hamza Isfahani 1922), the city is mainly famous for its Sasanian settlements so that some historians including al-Tabari speak of “Piri” or “Tiri”, the governor of Darabgird, who was a prince of the Sasanian court (Al-Tabari 1973).

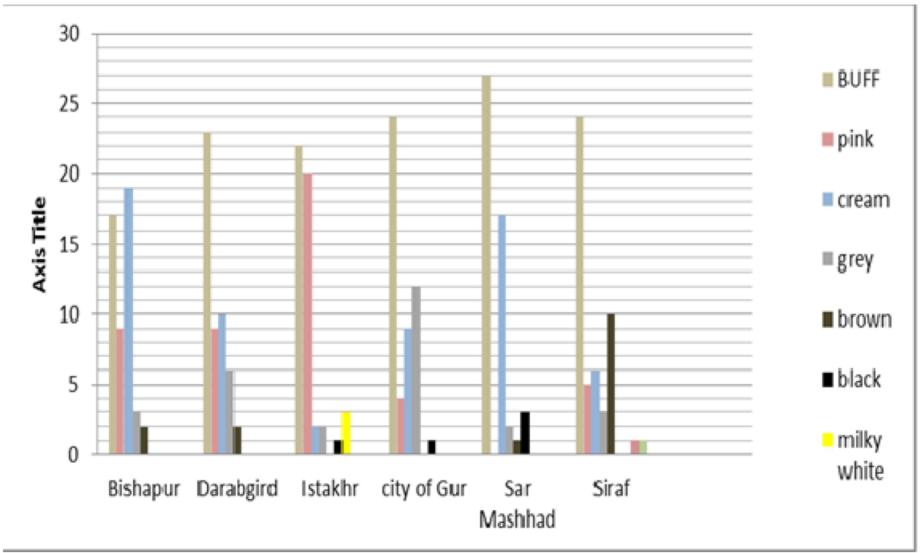
Siraf

Due to its glorious reputation throughout its long history, the port of Siraf has always caught the enthusiastic attention of visitors and explorers. The first account of the port comes from the writings of James Morier (1808-9). In 1933, Sir Orel Stein passed through Siraf where he also carried out limited excavations. Further, K. Lindberg in 1940, L. Vanden Berghe in 1960-61, and Alistair Lamb in 1962 visited Siraf (Eqtedari 1969). However, the first systematic excavation at Siraf was carried out in 1966 with a team led by David Whitehouse, which lasted seven seasons (Whitehouse 1991).

COMPARATIVE STUDY

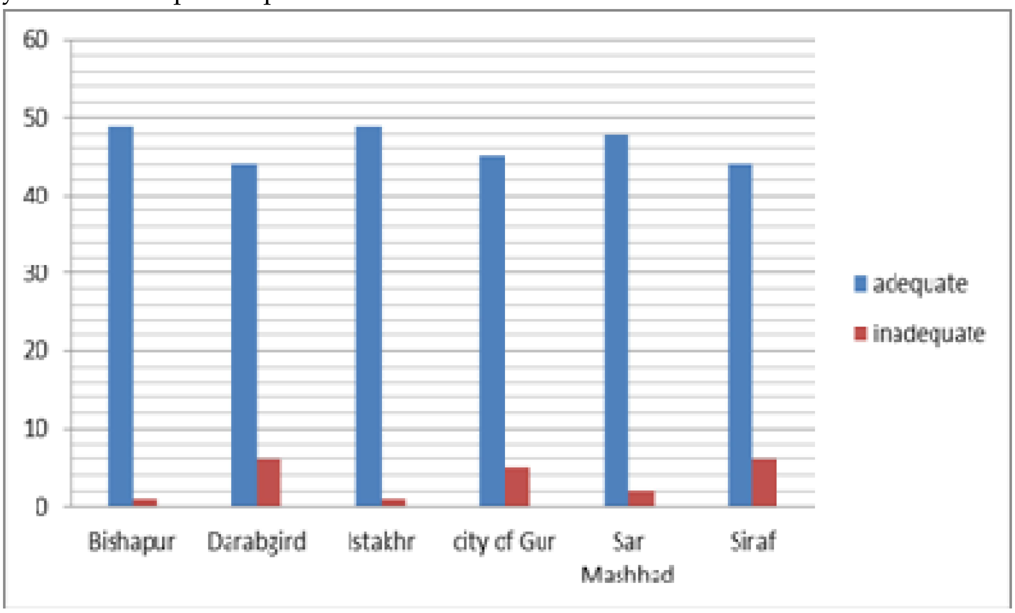
For the comparative or macroscopic analysis of the pottery from the Sasanian-Islamic sites of Fars and Siraf, fifty sherds were selected from each site and were macroscopically inspected to determine their typological characteristics including paste color, firing quality, glazed surface, decoration, temper, and manufacturing technique. The results are given in six graphs. What follows is a brief description of these graphs.

Graph 1 illustrates the sherds by their paste colors (buff, pink, cream, grey, brown, black, milky white, white, orange), where buff predominates.



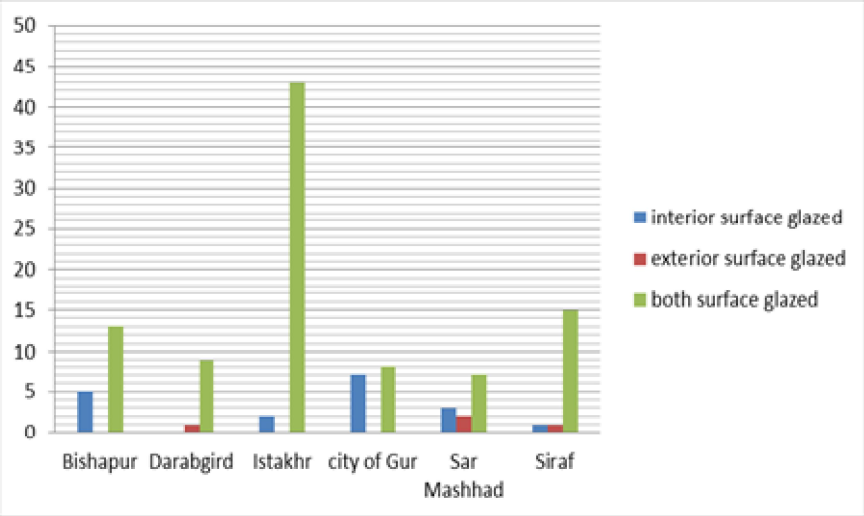
Graph 1. Statistical chart of different paste colors

Graph 2 illustrates the material in terms of adequate or inadequate firing, where the sherds from Bishapur and Istakhr with 98 percent of adequately fired examples represent the most adequately fired in the sample, followed by Sar Mashhad (96%), the city of Gur (90%), and Siraf and Darabgird (88%).



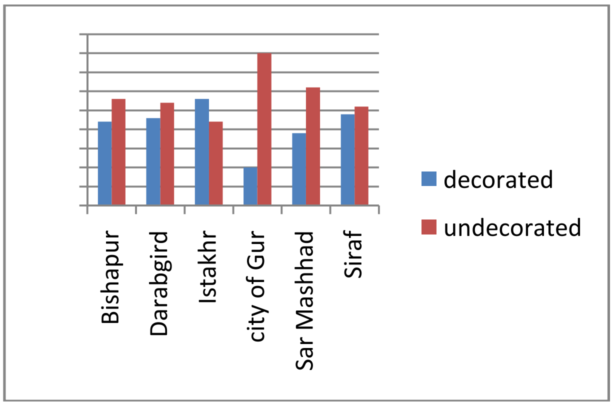
Graph 2. Statistical chart of firing quality of the sample

Graph 3 suggests that almost all of the analyzed sherds are glazed, falling in three categories of fragments with glazed applied on either interior or exterior or both surfaces.

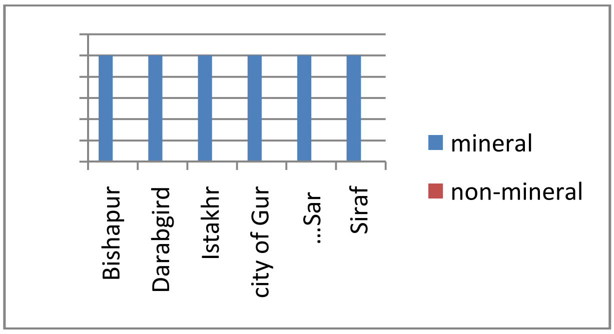


Graph 3. Statistical chart of different glazed surfaces

Since decoration is an important factor in studying pottery collections, the fifth graph (Graph 4) was plotted to present the percentage of decorated sherds in the sample. Accordingly, 56 percent of the material from Istakhr, 48 percent from Siraf, 46 percent from Darabgird, 44 percent from Bishapur, 38 percent from Sar Mashhad, and 20 percent from Gur city included a sort of decoration.



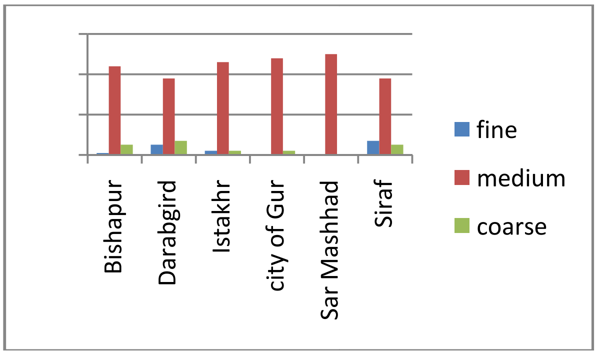
Graph 4. Statistical chart of decorated sherds



Graph 5. Statistical chart of tempering materials

From Graph 6, it is clear that the entire sample under study contained tempering materials

Graph 6 illustrates the sample in terms of manufacturing quality, i.e. fine, medium or coarse.



Graph 6. Statistical chart of sample in terms of manufacturing quality

Archaeometric Analysis

For archaeometric determinations, four sherds from each Sasanian-Islamic sites of Fars and Siraf, which were to some extent similar to each other in terms of paste color, glaze, temper, firing quality and decorations based on the comparative study and the data on Table 1, were exposed to XRD and ICP experiments separately.

The analyses revealed the constituting elements and existing oxides in each example. The photographs and drawings of the sherds from each site selected for chemical analysis are shown in Figs. 1 to 6.

Figure 1. Sherds from Siraf

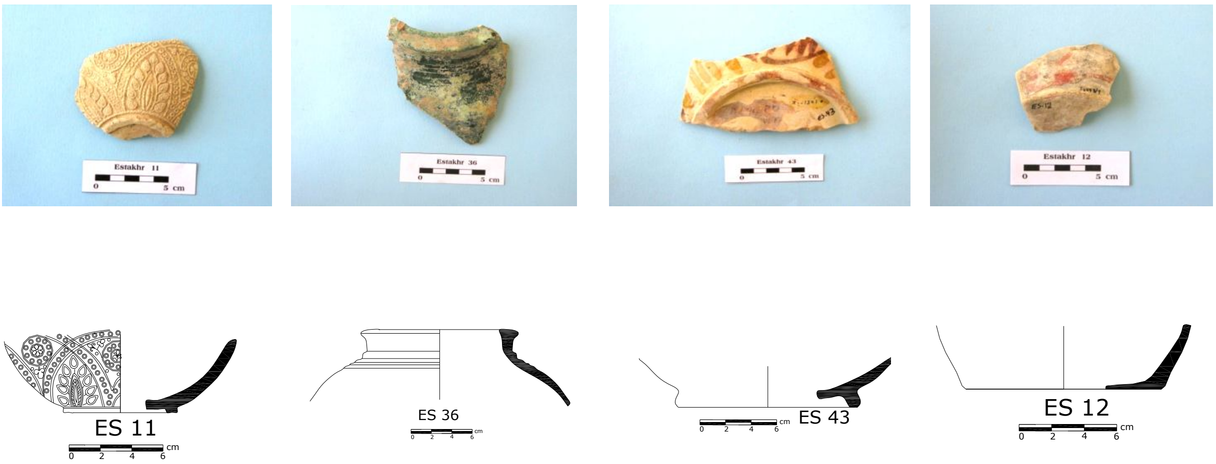


Figure 2. Sherds from Istakhr

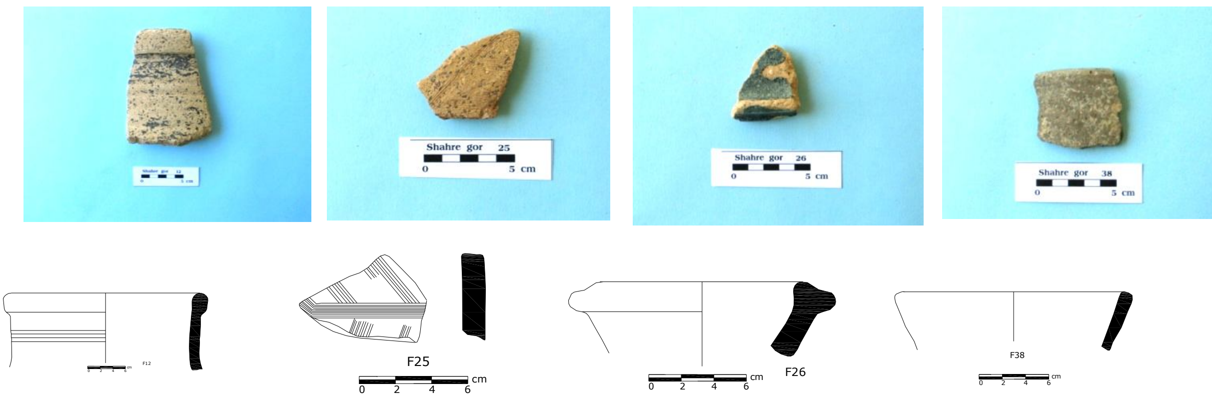


Figure 3. Sherds from the city of Gur

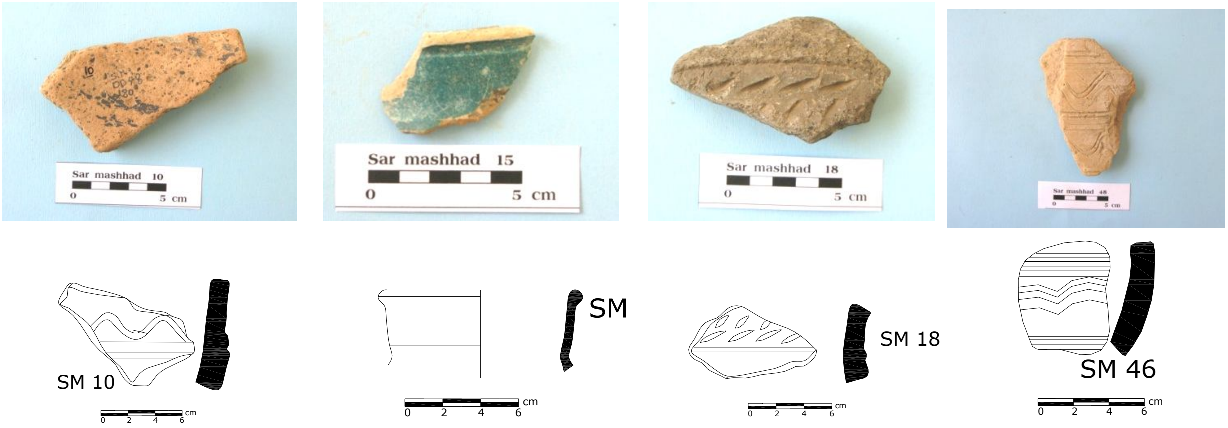


Figure 4. Sherds froms Sarmashahd

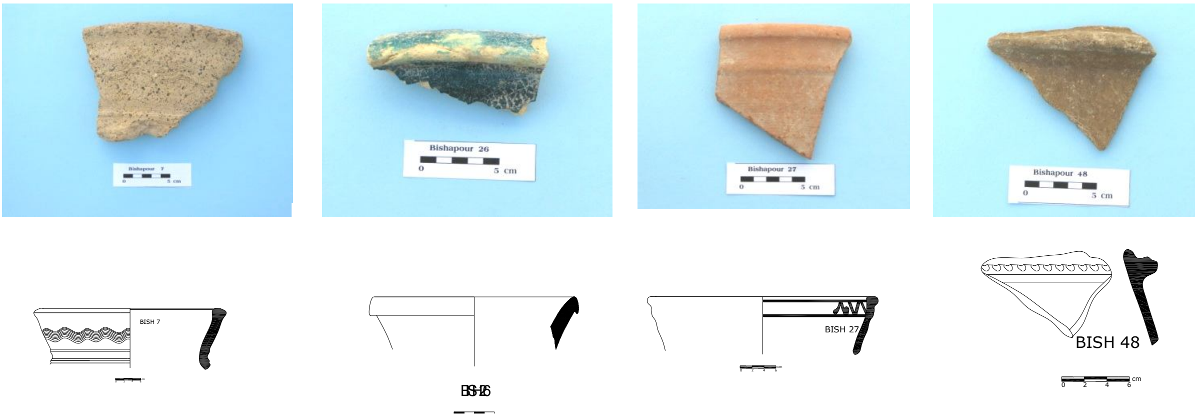


Figure 5. Sherds froms Bishapur

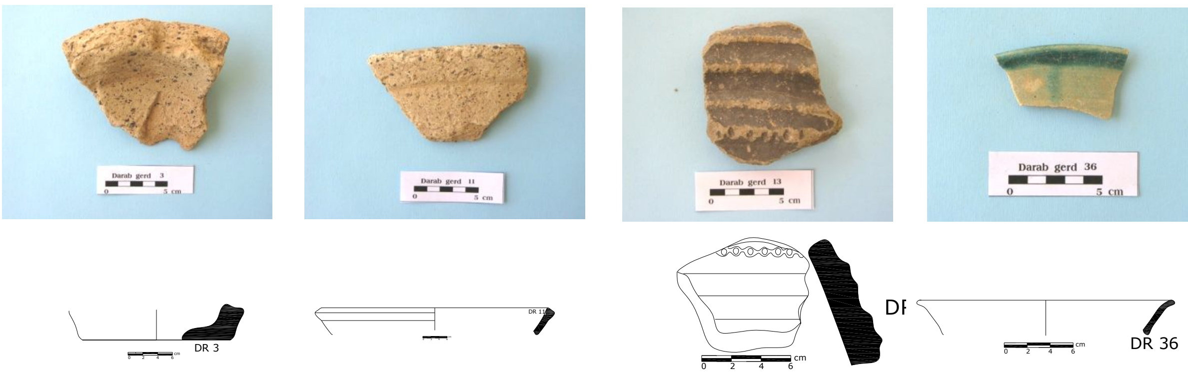


Figure 6. Sherds froms Darabgird

Table 1 shows the characteristics of selected sherds from Siraf, Istakhr, Gur, Sar Mashhad and Darabgird. Given the results of the comparative analysis and the macroscopic similarities, 24 sherds were selected for archaeometric characterizations out of the total of 250 sherds collected from the surface of Sasanian-Islamic sites of Fars and Siraf. The table illustrates the characteristics of the selected sample (See, Papageorgiou & Liritzis, 2007).

Table 1: Macroscopic characteristics of sherds selected for laboratorial analysis

specifications	Sherd type			Manufacturing technique		temper		Manufacturing quality			Paste color					Glaze color		Firing quality		decoration	
	rim	body	base	wheelmade	handmade	mineral	Non-mineral	coarse	medium	fine	cream	grey	buff	pink	brown	green	Other colors	inadequate	adequate	plain	decorated
Si 11		*		*		*			*						*			*			*
Si 12		*		*		*			*				*			*			*		*
Si 13			*	*		*			*					*		*			*		
Si 20	*			*		*				*			*						*		*
Es 11			*	*		*			*				*						*		*
Es 12			*	*		*			*				*				*		*		
Es 36	*			*		*			*			*				*			*		*
Es 43			*	*		*			*				*				*		*		
F 12	*			*		*		*					*						*		*
F 25		*		*		*			*					*				*			*
F 26	*			*		*			*				*			*			*		
F 38	*			*		*			*			*							*	*	
sm 10		*		*		*			*		*								*		*
sm 15	*			*		*			*				*			*			*		
sm 18		*		*		*			*			*							*		*
sm 46		*		*		*			*				*						*		*
Bish 7	*			*		*			*		*								*		*
Bish 26	*			*		*		*					*			*			*		
Bish 27	*			*		*			*					*					*		*
Bish 48		*		*		*			*						*				*		*
Dr 3			*	*		*			*				*						*		
Dr 11	*			*		*			*				*						*		*
Dr 13		*		*		*		*				*							*		*
Dr 36	*			*		*			*				*			*			*		

Wet Chemical Analysis

The archaeometric analysis started with the wet chemical testing. The procedure involved observing the surface of the sherds and their surface deposits, the results of which revealed that the analyzed sherds might have been produced at a single place.

The outer surface sediments relate to later periods while the inner sediments belong to a time much closer to manufacturing of the vessels to which the sherds originally belonged. Finally, the amount of different deposits on the surface of the sherds was obtained through integrating the results into a table.

A qualitative analysis consists of experiments that determine the presence or absence of a particular compound, but not its content or quantity. The elements identified in this experiment include non-organic compounds. These experiments deal with the ways in which the solutions with anion and cation ions are handled by qualitative analysis (Shah Hoseini, 2010).

Reactions of Iron (III)Cation

Effect of ammonia solution—Reaction of ammonia solution with iron (III) cation forms iron (III) hydroxide, which is a brick red precipitate.

$Fe^3 + 3NH_4OH \downarrow$ (brick red) $+ 3NH_4^+$

Reactions of Iron (II) Cation

Effect of ammonia solution—Ammonia solution reacts with iron (II) cation to form an iron (II) hydroxide, a green precipitate.

$Fe^{2++} 2NH_4OH \rightarrow Fe(OH)_2\downarrow$(green) $4NH_4^+$

Reaction of Aluminum (Al_3^+)

Effect of sulfide (S2-) ion—Sulfide ion reacts with aluminum cation to form an aluminum hydroxide, a white precipitate, due to rapid hydrolysis of aluminum sulfide.

$3S^{2-}+2Al^{3+}+6H_2O \rightarrow 2Al(OH)_3\downarrow(white)+3H_2S\uparrow$

Reactions of Calcium (Ca^{2+}) Cation

Effect of carbonate ion—Carbonate ion reacts with calcium cation to form a calcium carbonate, a white precipitate. This precipitate is soluble in acids and forms CO2 gas.

$CaCO_3 + 2H^+ \rightarrow Ca^{2+} + CO_2\uparrow + H_2O$

Reactions of Manganese (Mg^{2+}) Cation

Effect of carbonate ion—Sodium or potassium carbonates react with manganese cation to form a manganese carbonate, a white precipitate. This precipitate is soluble in acids and generates CO_2. If ammonium carbonate is used, the formation of the precipitate will require long-term boiling of the solution.

$MgCO_3 + 2H^+ \rightarrow Mg^{2+} + CO_2\uparrow + H_2O$

$Mg^{2+} + Na_2CO_3 \rightarrow MgCO_3\downarrow (white) + 2Na^+$

Identification of Sulfate Anion

Barium cation reacts with sulfate ion to form a barium sulfate, a white precipitate. This precipitate is insoluble in acids.

$SO_4^{2-} + Ba^{2+} \rightarrow BaSO_4\downarrow (white)$

The results of the above analyses are shown in Table 2.

Table 2. Results from wet chemical analysis of sherds from Siraf, Istakhr, Gur, Sar Mashhad, Bishapur and Darabgird

Samples sediments	CA^{2+}	MG^{2+}	FE^{3+}	FE^{2+}	AL^{3+}
Si 11			*	*	*
Si 12	*	*			
Si 13			*		*
Si 20		*		*	
Es 11			*		
Es 12	*		*		*
Es 36	*	*			
Es 43		*		*	
F 12			*		*
F 25		*		*	
F 26	*				
F 38		*			
sm 10		*		*	
sm 15	*		*		*
sm 18			*	*	
sm 46		*			
Bish 7				*	*
Bish 26			*		
Bish 27	*			*	*
Bish 48				*	
Dr 3	*		*		
Dr 11					
Dr 13		*			
Dr 36	*		*		*

The above experiments yielded the following results:

Samples Dr36, SM15 and Es12 included contents of Fe, Al and Ca ions. The Samples Si11 and Es36 contained Fe^{3+}, Fe^{2+} and Al^{3+} and Ca^{2+} and Mg^{2+}, respectively.

Given these latter samples are glazed, it is revealed that their underlying biscuits were under different conditions; as a consequence since they are glazed the results from XRD and ICP analyses may suggest that they might have been made of similar clay resources and under similar firing processes, but were glazed in different places.

X-Ray Diffraction

The x-ray diffraction system is greatly effective in elemental characterization of pottery, mortar, corrosion products, pigments, plaster, soil, etc samples. The sample is bombarded with x-ray beam in the range 0.1-100 Å. The result is a diffractogram or diffraction pattern.

Every crystalline sample has a unique diffraction pattern which allows identification of the type of compound through its comparison with standard diffraction patterns. The final results are presented qualitatively (Mar'ashi 2004).

According to the results from XRD analysis, after interpreting the laboratorial peaks, the main phase in Samples Es12, SM15 and Dr36 included:

Augite (Ca (Fe,Mg) $Si_3)_6$)

Quartz (SiO_2)

Gehlenite ($Ca_2Al_2SiO_7$)

where, in samples SM15 and Es12 one of the main phases is amorphous, and the middle phase is albite, which is shared by both samples.

In sample Dr36 the main phase is Albite ($NaAlSi_3O_8$) and middle phase is Amorphous, which when regarded in general the movement of peaks in the both samples is very comparable

Samples Si11 and Es36, however, showed quite similar primary and secondary phases the main phase was,

Amarphouse

(Augite) $Ca(Fe,Mg)Si_3O_6$

SiO_2 Quartz

(Na $AlSi_3O_8$) Albite

($Ca_2Al_2SiO_7$) Gehlenite

while the middle phase was, Hematite Fe_2O_3. Presence of this middle phase results in existence of iron in the sample which in turn leads to a darker color. In sample Si11, which still preserves its original brown color, iron has not been fully oxidized to change its color from brown to grey.

ICP Analysis

This laboratorial approach represents an elemental analysis of the material and rests on the influence of gas on the elements. This method is very sensitive even affecting the metals and tiny particles, and is capable of distinguishing the trace elements (Table 3).

As analysis of the above charts reveals, samples Si11 and Es36 closely resemble each other, and they are shown in green in Table 3. The analysis also demonstrates that Es36 and Si11 include very low iron content, and contain lower titanium relative to the other examples.

Samples Si12, 13, 20, Es11, 43, F12, 25, 26, 38, SM10, 18, 48, Bish7, 26, 27, 48, and Dar3, 11, 13 are quite similar in their iron contents. Further, samples Es12, SM15 and Dar 36 are closely related in terms of iron and lead contents.

CONCLUSION

In this study six Sasanian sites were selected, and a small sherd assemblage comprised of fifty samples was collected from the surface of each site.

The sample was first macroscopically analyzed. Since some of the sherds from different sites were almost identical in terms of their visual characteristics, a single example from each color or type category (grey, brown and buff, and glazed) was selected from each site.

Accordingly, four sherds represented each site in the final analysis, which on the whole amounted to a sample comprised of 24 examples. At first stage, macroscopic observations and comparisons showed similarities between Es12, Sar15 and Dar36.

Table 3. Results of elemental analysis of sherds from Siraf, Istakhr, Gur, Sar Mashhad, Bishapur and Darabgird

Sample / Elements	Si11	Si12	Si13	Si20	Es11	Es12	Es36	Es43	F12	F25	F26	F38	Sm10	Sm15	Sm18	Sm46	Bish7	Bish 26	Bish 27	Bish 48	Dr3	Dr11	Dr13	Dr36
Titanium	0	2.68	1.96	3.54	3.34	0.4	0	2.7	3	3.95	1.25	2.12	3.35	0.95	3.61	1.67	4.25	0	3.77	4.86	2.28	1.95	5.55	2.02
Vanadium	0	0.03	0.03	0.06	0.03	0	0.3	0	0	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0	0.03	0.03	0.03	0.03	0.03	0.03
Chromium	0	0.02	0.02	0.02	0.02	0	0	0	0	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0	0.02	0.02	0.02	0.02	0.02	0.02
Manganese	0	0.7	0.49	1.08	0.46	3.5	0	1.2	1.5	0.02	0.67	0.02	0.6	0.11	0.83	0.62	0.02	0	0.35	0.79	0.98	0.64	0.7	0.62
Iron	0.5	85.4	83.4	89.7	86	54	3.5	84	84	84.7	76.8	87.2	83.1	31.4	85.6	79.9	85.1	80	84.3	85.7	85.3	82.9	81.2	46.3
Cobalt	0	0.02	0.02	0.02	0.02	0	0	0	0	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0	0.02	0.02	0.02	0.02	0.02	0.02
Nickel	0	0.68	0.46	0.3	0.35	0.2	0	1.1	0.4	0.13	0.2	0.01	0.71	0.04	0.29	0.78	0.23	0.2	0.4	0.22	0.62	0.5	0.16	0.12
Copper	4	0.01	0.01	0.01	0.01	0.2	1.1	1.1	0	0.01	2.57	0.01	0.01	2.95	0.01	0.01	0.13	8.2	0.01	0.01	0.11	0.02	0.56	2.29
Zinc	0.1	0.4	0.23	0.36	0.53	0.4	0	0.5	0.3	0.21	0.26	0.03	0.27	0.01	0.2	0.35	0.29	0	0.68	0.4	0.35	0.26	0.56	0.12
Gallium	0	0.07	0.01	0.01	0.01	0	0	0	0.1	0.16	0.01	0.01	0.01	0.01	0.03	0.01	1.66	0.1	0.07	0.06	0.05	0.01	0.19	0.01
Yttrium	0	0.27	0.34	0.22	0.21	0.1	0	0.2	0.2	0.26	0.33	0.48	0.27	0	0.19	0.32	4.25	0.4	0.3	0.15	0.21	0.31	0.35	0.06
Zirconium	0.1	1.02	3.5	0.48	1.13	1.6	0.1	0.8	1.2	1.21	6.23	1.84	4.34	3.14	2.52	5.16	1.66	1.5	1.02	0.6	1.41	1.48	1.41	1.23
Niobium	0	4.12	6.83	2.41	3.74	8.2	0	3.4	4.7	4.37	7.11	4.86	5.36	2.57	2.94	7.93	4.25	7.6	4.41	2.8	4.26	7.26	6.68	2.65
Molybdenum	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Ruthenium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Palladium	0	0.02	0.02	0.02	0.02	0	0	0	0	0.05	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0	0.02	0.02	0.02	0.02	0.02	0.02
Silver	0	0.24	0.26	0.22	0.02	0	0	0.2	0	0.44	0	0.38	0.18	0.25	0.18	0.43	0.26	0.7	0.02	0.23	0	0.33	0.3	0.24
Cadmium	0.1	0.21	0.09	0.18	0.23	0.3	0.1	0.2	0.4	0.45	0.83	0.03	0.34	0.35	0.19	0.68	0.22	0.5	0.43	0.35	0.31	0.4	0.36	0.43
Indium	0	0.34	0.58	0.14	0.21	0.4	0	0.3	0	0.4	1.16	0.03	0.11	0.44	0.25	0.35	0.03	0	0.42	0.25	0.32	0.03	0.49	0.28
Tin	0.1	0.58	0.94	0.19	0.37	7.9	0.1	0.6	0.7	0.54	1.74	0.05	0.71	2.51	0.05	1.16	0.15	0.2	0.72	0.39	0.61	0.85	0.84	0.98
Antimony	0.2	0.2	0.15	0.05	0.05	0.1	0.5	0.1	0	0.05	0.27	0.05	0.05	0.05	0.1	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05
Tantalum	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0.13	0	0	0	0	0	0	0	0
Tungsten	0	0.02	0.02	0.02	0.02	0	0	0	0	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.3	0.02	0.02	0.02	0.02	0.02	0.02
Rhenium	0	0	0.16	0	0	0.2	0	0	0.2	0.08	0.01	0	0.02	0.01	0	0	0	0	0	0.02	0.09	0	0	0
Iridium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Platinum	0	0.02	0.02	0.02	0.02	0	0	0	0	0.02	0.02	0.02	0.07	0.02	0.02	0.02	0.06	0	0.02	0.02	0.02	0.02	0.02	0.02
Gold	0	0.02	0.02	0.02	0.02	0.1	0	0.1	0	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.07	0	0.02	0.02	0.02	0.04	0.08	0.02
Gold	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0.02	0	0	0	0	0.01	0.02	0
Lead	95	0.02	0.02	0	0.35	7.4	94	0.4	0	0.02	0.02	0.02	0.02	40.1	0.02	0.02	0.02	0	0.02	0	0.02	0.02	0.02	27.5

Later stages of the study revealed further resemblances. These sherds were all wheel made, and contained mineral tempers, with a medium textured fabric, and invariably had buff paste.

They were all well-fired and glazed. Other two related examples that macroscopically resembled each other and their similarity was also corroborated with laboratorial analysis included Si11 and Es36.

These two sherds were nearly identical, apart from the fact that the example from Siraf had brown paste and was poorly-fired, while the other was well-fired and had darker core.

Dark color of these two examples was the result of the high iron content in the clay resource from which they were formed.The second phase of wet chemical analysis revealed similar surface sediments on glazed sherds, which suggests that the original vessels might have been produced in a same place before they were transferred to separate places where the glazes were applied on them.

The XRD analysis brought to light the ways in which the original vessels were fired and their surface oxides were formed, which again showed similar firing processes and oxide contents.

And finally, the ICP analysis and comparing its results is suggestive of total resemblance of the constituting elements of the sherds even in their trace element. Based on the above analyses, it is our contention that some of the sherds studied in the present work appear to have been produced in a same workshop using a single clay resource so that their fabric are sometimes nearly identical.

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