

A Chemical Study on Some Archaeological Samples from Marlik in Iran¹

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Introduction

From the archaeological interest, the chemical studies were performed on archaeological samples excavated from Marlik in Iran.

Marlik is located at the northwestern part of Iran (Fig. 1) and it is said to have prospered ca. 900 B.C. and now it remains as ruins.

In 1961, Marlik was excavated by Dr. E. O. Neghaban and his members. The details were published as "Marlik".²

Any investigation from the chemical point of view, however, has not been performed on these samples. So, the present paper deals with the results obtained through chemical analyses, in such a manner as to trace the relation between chemi-



Fig. 1. A map of Marlik.

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¹ Presented at the 22nd Annual Conference of Chemical Society of Japan (1969).

² E. O. Neghaban. *Marlik*, Offset Press, Tehran (1964).

cal compositions and informations from archaeological and historical points of view.

These samples were offered by Dr. E. O. Neghaban who was a curator of the Iran Bastan Museum, on the occasion of the 5th International Congress of Iranian Art and Archaeology (1968, Tehran).

Materials

No. 1. Shell-like Pottery

In the picture shown in "Marlik"², potteries of this kind are linked together with a string through the holes and look like a necklace. This bead is made of unglazed pottery, therefore it is estimated to be a kind of old type beads. The detailed figure is shown in Fig. 2, revealing a brown body upon which white clay has been placed except along radial line. The surface glaze and body are not so hard, therefore it is supposed that it was baked at a lower firing temperature.

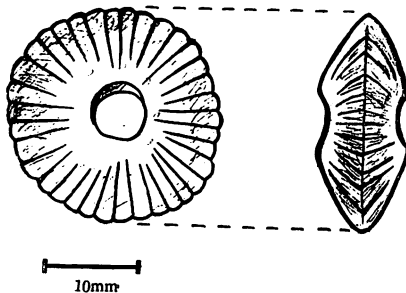


Fig. 2. Schematic diagram of Shell-like Pottery.

No. 2. Bead of Agate

This bead could be estimated to be an agate from the color and external appearance (Fig. 3).



Fig. 3. Schematic diagram of Bead of Agate.

No. 3. Glass Bead

A layer of weathered surface covers the glass bead. It is easily pulverized. Under the weathered surface layer one can see the blue glass body (Fig. 4).



Fig. 4. Schematic diagram of Glass Bead.

No. 4. Small Lump (Amber)

It looks like a small clod of soil. Under a layer of soil, there is weathered surface beneath which the brown translucent body itself can be seen (Fig. 5).

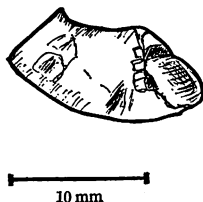


Fig. 5. Schematic diagram of Small Lump.

No. 5. Bronze Button

It is made by metal and its shape looks like a small dish, of which diameter is 11 mm (Fig. 6). At the center of the dish there is a small leg. From these configurations, this metal dish is supposed to be one kind of buttons. The patina surrounds its body and a few places of the edges are chipped. This patina is incrustated not only on the surface but also in its body.

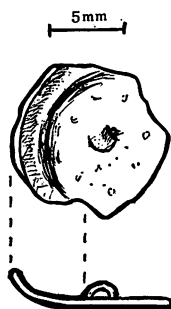


Fig. 6. Schematic diagram of Bronze Button.

No. 6. Mosaic Glass Cup

This mosaic glass cup was restored to the original state, and its picture is shown in Fig. 7. It is made from two kinds of materials, one being green glass, another white paste. The latter is used to make white diaper patterns. The diaper consists of a cross section of small picks bundled together, and looks like a flower of plum. Spaces of these white patterns are filled up with green glass. This mosaic glass has been believed to be the oldest mosaic glass cup ever excavated in the world.

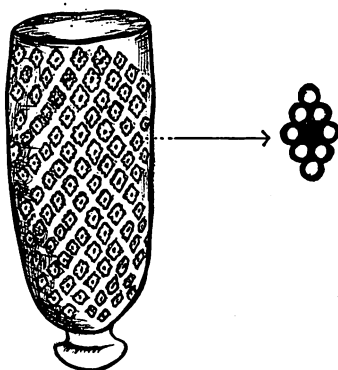


Fig. 7. Schematic diagram of Mosaic Glass Cup.

Experimental

Semi-quantitative analyses were performed on the archaeological samples by using the internal standard method of emission spectrochemical analysis.

The quantitative analytical methods used especially for the amber were usual manner of the elementary analyses for carbon, hydrogen, nitrogen, sulfur, oxygen and ash. The quantitative analysis for copper was carried out by the colorimetric determination with 2,2'-Biquinoline.³

Results and Discussion

Results of spectrochemical analyses are shown in Table I. According to the results, in No. 1 sample, the chemical compositions of the glaze are quite similar to its body.

No. 3 Glass Bead: The body of the glass bead was found to belong to the soda-lime glass type. The bead is not a particular one judging from major components, because more than one hundred archaeological glass samples from Iran are of soda-lime glass type.⁴ A spectrochemical analysis was performed on the weathered layer and its body. It is of some importance that the contents of such elements as magnesium, sodium and potassium were found to decrease in proportion to the distance from the glass itself, according to the results shown in Table I.

No. 4 Small Lump: The analyses were carried out only inner part of the clod. From the result of the open tube test, it became clear that this material was consisted of an organic substance.

Elementary analyses were performed on this material. The results are shown in Table II. As can be seen in the table, the contents of each element are in pretty

³ E. B. Sandel, *Colorimetric Determination of Traces of Metals*, Interscience Publishers, Inc., New York (1959) 3rd Ed, p. 407.

⁴ T. Muroga, *Bulletin of the Chemical Society of Japan*, Vol. 43, No. 3, p. 581 (1970).

TABLE 1. The Results of Spectrochemical Analyses

Element Sample	Fe	Si	Mn	Sb	Mg	Pb	Sn	Ni	Al	V	Cu	Ag	Na	Ti	Co	Ca	K	Cr	Ba	Sr
No. 1. Soil of Hole	++ ++	++ ++	+	±	+ ++	+	±	+	+	+	+	±	+	+	+	++ ++	±	+	+	+
Surface (Glaze)	+	++ ++	+	±	++	+	±	+	++	-	+	±	±	+	+	+	-	+	+	±
Body	++ ++	++ ++	+	±	++	+	±	+	++	±	+	±	+	+	+	++ ++	±	+	+	+
No. 3. Weathered Surface	+	+	+	-	++	±	+	±	++	-	++	±	+	+	-	++ ++	-	+	+	+
Body	++	++	+	-	++	±	+	±	+	-	++	±	+	±	-	+	+	+	±	+
No. 5. Bronze Button	±	+	-	-	±	++	+	±	±	-	++ + ++	++	-	-	-	±	-	-	±	-
No. 6. White	++	+	+	+	++	±	-	±	++	-	++	±	±	+	±	++ ++	-	±	±	±
Green	+	+	+	+	+	±	±	±	+	-	++ ++	±	±	+	±	+	-	±	±	±

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TABLE 2. The Results of Quantitative Analysis of No. 4 (Amber)

Elements	Analyzed (%)	Literature* (%)
Carbon	70.35	75.48
Hydrogen	9.12	10.30
Oxygen	19.16	12.07
Nitrogen	0.07	0.20
Sulfur	0.0	0.1
Ash	tr	0.85
Total	98.70	99.00

* *Encyclopaedia Chimica*, Vol. 3, p. 673.

good agreement with the contents of amber.⁵ Therefore it may be estimated that this clod is an amber and used as accessory. As there has been no description about amber in the "Marlik", it seems to be a new finding that amber was excavated from Marlik.

No. 5 Bronze Button: From the results of spectrochemical analyses, this sample contains copper, tin and lead, therefore this was made not of copper only, but of bronze.⁶ The copper content of this metal is 72.13%. From the shape, this metal may be considered as a sort of button.

No. 6 Mosaic Glass Cup: The green part of the cup is of soda-lime glass, and color origin is copper. The white part contains much calcium and silica, magnesium and aluminum. Therefore it is one kind of calcareous substance and plaster.

Besides these samples examined here, golden ornaments, bronze manufactured good and many kinds of jewels were excavated from Marlik. These facts tell us that ancient Iranian people had achieved a high level in their techniques in the metallurgy and quite advanced techniques of workmanships.

Acknowledgment

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Résumé

In 1961, Marlik was excavated by Dr. E. O. Neghaban and his members. Marlik is located at northwestern part of Iran and it remains as ruins. From this ruins many kinds of materials, gold, silver, bronze, glass beads, amber, agate,

⁵ *Encyclopaedia Chimica* Vol. 3, p. 673, Kyoritsu Shuppan Co., Tokyo, (1964).

⁶ T. Dono, *Nippon Kagaku Zasshi*, Vol. 84, p. 321 (1963). *ibid.*, Vol. 84, p. 324 (1963).

pottery and clay image, were excavated.

The present paper deals with the results obtained through chemical analyses, in such a manner as to trace the relation between chemical compositions and informations from archaeological and historical points of view.

From the results of chemical analyses, it was concluded that the unglazed beads, the glass beads and mosaic glass cup belonged to the soda-lime glass type. A small metal dish contained 72.13% of copper and small amount of tin and lead. From shape and contents, this metal dish could be thought to be the bronze button. A small lump contained 70.35% of carbon, 9.12% of hydrogen, 19.16% of oxygen, 0.07% of nitrogen and trace of ash, and was concluded to be made of amber. It is the first information that the excavations from Marlik contained amber.