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Possible Sources of Iron in Hassanlu, Iran

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Abstract

Iron Age has been playing an important role in the history of mankind, by introducing Iron, societies have been expended and political power has been established. In Iran several arguments have been established for introducing Iron, possibly till the definite research has not been established it is not possible to say with certain. In this article by WLXRF spectroscopy which has been done on the Iron object which has been discovered in Hassanlu to suggest some possible sources for it.

Keywords: Iron, Hassanlu, Iron Age, WLXRF

Introduction

Geographical condition of Hassanlu site

Many archaeological site belong to Iron Age has been found. Among these sites in North West of Iran, Site of Hassanlu (fig.1) has been situated in North West of Iran in the south of Uremia Lake. This site which is situated on the central hills of the region is 25 meter above the plain[3].

Site has been excavated first time in 1933 by archaeological survey of Iran which after several season works, famous golden cups has been found.

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3 .Dyson 1965: 183

Site has been continuously excavated till 1970 by foreign and Iranian scholars who were head of mission by Dayson[4].

Site had been occupied from 6000 BC till Sasanian period, which layers of V and IV are belonging to Iron Age[5].

Spread of Iron Technology

About the spreading of iron technology there are different opinions among scholars, lack of written document about Iron emerging technology we are fully depend on archaeological material. But before new material come out from earth we are depend on excavated material.

Existence of iron has been reported by archaeological sites in Egypt, Mesopotamia, Caucasian, region, Europe and even China. Some of the scholars wrote (Piggot, 1999).

In Iran, Iron has been found in Caucasian region. Wertime (Wertime, 1973) wrote Iron was continuation of technology of Bronze ages and technology was not important to the region. But melting of Iron ores need smith working group which were different from other metal working.

Literature Background

First iron object in Iran which has reported from Sialk II, possibly was meteorite stone[6]. After passing Bronze Age, and discovering of Iron, this era has been classified to several sub classes. In Iron age nearly Iron object didn't find, possibly the technology of Iron age was an open gate for Iron age II, only chemical composition of Iron object of Marlik shows in Iron age I, Iron has been using for decoration of bronze objects[7]. Only in Iron age II production of Iron has been vogues in Iran[8].

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2. leving and Young, 1977:711

3. Dyson, 1978, (1):101.

1 . Moorey,1994:282

2. Piggot,1989:69-97

3. Moorey, 1994:92-93

4. Tylecote, 1973

5. D.A. Khakhutayshvili

Tylcote has done several analyses from object discovered in Marlik excavation[9]. Piggot recently has done researches and extensiones of Copper, Bronze and Iron in central plateau of Iran has been investigated. He has hinted to emerge of Iron Age II in the 1100- 800 BC in the following region. Khakhutayshvili[10] wrote that the origin sources of Iron in Iran from Caucasian region. And mentioned the Iron has been produced due to technological production of copper smelting[11].

Daum[12] mentioned the iron in the east of Mediterranean has taken place of bronze and spread it in contemporary different cultures[13] .

Sample Preparation

Ten Samples from layer IV (fig. 2-12) has been selected from National Iranian museum in Tehran, which has been found in Hassanlu excavation in 1997 AD, the objects have been corroded for long period burial in the ground, naturally we have selected from cores of samples for our analyzing samples. After that they have been transferred to XRF lab in basic science building of Tarbiat Modares University.

Methodology

The lab samples for better result has been powdered and after that pressed on the capsule which has been covered by Boric acid with diameter of nearly three centmeter and transferred to XRF instrument.

Faculty of basic science laboratory has been made in Philips Company of Netherlands with PW 24024 lamp and spectroscopy result has been shown in Table 1&2 (fig.13).

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1. Piggot,1999:205
2. T.W.Daum, University of Wisconsin, Milwaukee
3. Piggot, 1999:200

754-1	MgO	Al2O3	SiO2	P2O5	SO3	Cl	CaO
(%)	0.349	0.101	0.868	0.022	0.163	0.102	0.217
754-2	Na2O	MgO	Al2O3	SiO2	P2O5	SO3	Cl
(%)	0.597	0.515	0.385	5.63	3.493	0.493	0.101
754-3	MgO	Al2O3	SiO2	P2O5	SO3	Cl	K2O
(%)	0.869	3.499	11.494	0.521	0.356	0.059	0.347
754-4	MgO	Al2O3	SiO2	P2O5	SO3	Cl	K2O
(%)	1.085	0.327	2.143	0.278	0.26	0.059	0.182
754-5	MgO	Al2O3	SiO2	P2O5	SO3	Cl	K2O
(%)	1.203	1.145	7.502	0.272	0.371	0.387	0.566
754-6	Na2O	MgO	Al2O3	SiO2	P2O5	SO3	Cl
(%)	0.374	1.314	1.527	5.753	0.167	0.488	0.168
754-7	Na2O	MgO	Al2O3	SiO2	P2O5	SO3	Cl
(%)	0.615	1.586	3.328	12.644	0.197	0.585	0.131
754-8	MgO	Al2O3	SiO2	P2O5	SO3	Cl	K2O
(%)	0.7	1.628	6.508	0.166	1.69	0.344	0.276
754-9	MgO	Al2O3	SiO2	P2O5	SO3	Cl	K2O
(%)	0.98	1.732	5.946	0.289	0.402	0.7	0.547
754-10	MgO	Al2O3	SiO2	P2O5	SO3	Cl	K2O
(%)	0.752	0.314	1.78	0.149	0.344	0.299	0.22

754-1	Fe2O3				
(%)	98.176				
754-2	K2O	CaO	Fe2O3	Cu	Pb
(%)	1.629	1.12	85.714	0.171	0.152
754-3	CaO	TiO2	Fe2O3		
(%)	2.208	0.095	80.552		
754-4	CaO	Fe2O3	Co		
(%)	3.29	90.65	0.149		
754-5	CaO	Fe2O3			
(%)	1.725	86.83			
754-6	K2O	CaO	Fe2O3		
(%)	0.318	1.84	88.05		
754-7	K2O	CaO	TiO2	Fe2O3	Cu
(%)	0.651	0.739	0.168	79.269	0.088
754-8	CaO	Fe2O3	Cu		
(%)	1.04	85.012	2.636		
754-9	CaO	Fe2O3			
(%)	1.998	87.405			
754-10	CaO	Fe2O3			
(%)	0.301	95.84			

Result and Discussion

Results shows all of the objects were manufactured from Iron with corrosion rate of 80%, than other sample 1, rest of samples has high percentage of SiO2 which shows slugs been mix at the time of melting, In sample 1 the SiO2 are less than 1% and shows the high techniques in melting of Iron ores. For proof of this argument the microscopic and metallographic are needs. In sample 2 Phosphor present with high percentages, we don't know it has related with cover on the Iron object or is not unknown for us. Pb and Cu are more that other samples in this sample however it is less than 2%.Present of MgO ،Al_2O_3 ،CaO و ،SO_3 shows high coarseness may be due to the ores or fuel which has been used during the melting.

Conclude we may write total iron object in Hassanlu are belong to Iron Age and can not assume that iron is re melting of copper slugs.

Conclusion

The result of WLXRF from ten samples of Hassanlu IV which the Fe has been extracted from Iron Ores, but due to carrion has high percentage of oxide in the objects. Spectroscopy shows high percentage of SiO2 (except sample 1) that shows when the Iron ores during the reduction will combine with slugs and naturally result of high percentage of SiO2 in the slugs. Possibly sample 1 has been produced by better technology or imported to the site. In samples 2 & 8 the amount of Cu is about 2% and the present of sulphore had more than traces we may conclude it has been extracted from Chalcopyrite mines Boruit and possibly from a sulphide and mixed with oxide ore stones or possibly re melted again.

Ti as traces show that the ores which has been used were poor in Ti, possibly copper smiths were not familiar with melting of copper and for melting, extracting of Iron needs special Iron smiths which possibly they were immigrants people brought this technology to the Hassanlu.

Acknowledgment

Finally, I dedicate this article to Professor Khademi Nodoushan who helped me. I would also like to thank Mr. Sarlak, Curator of Prehistory Museum of Iran, because he gave me samples.

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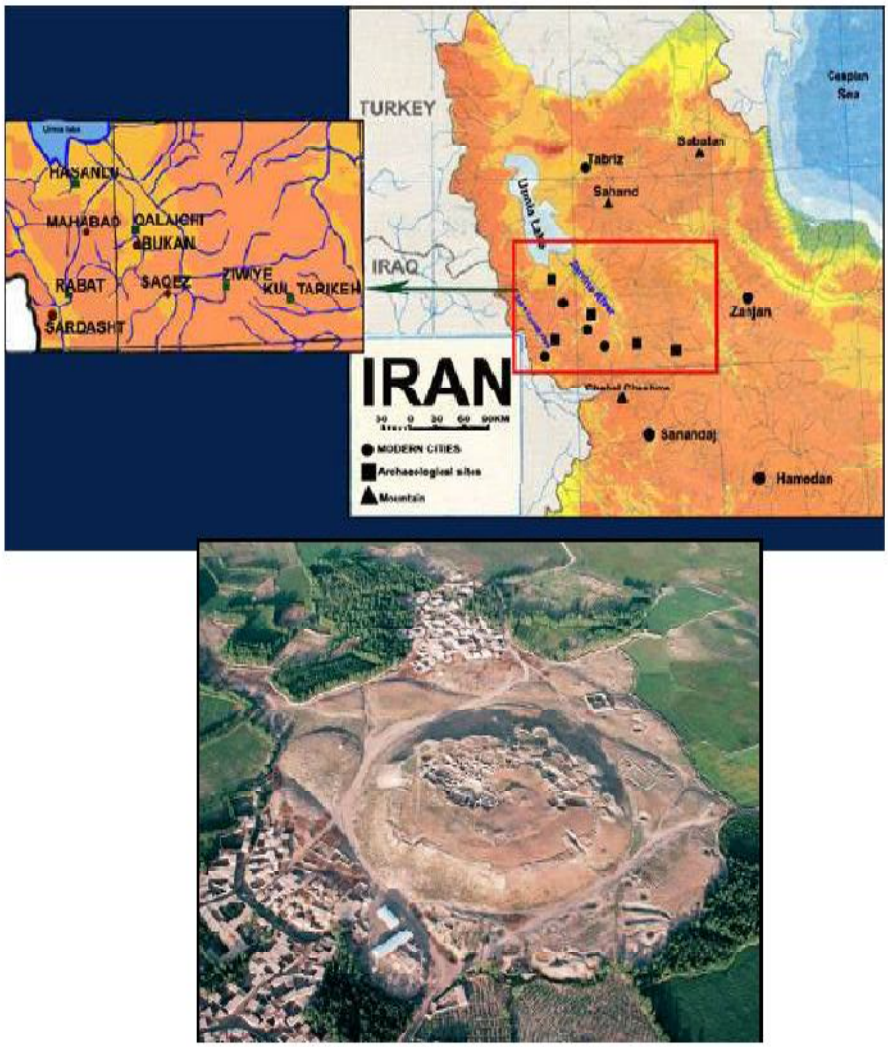

Fig1: Top: map of Hassanlu in North West of Iran

Down: Aerial photograph of Hassanlu

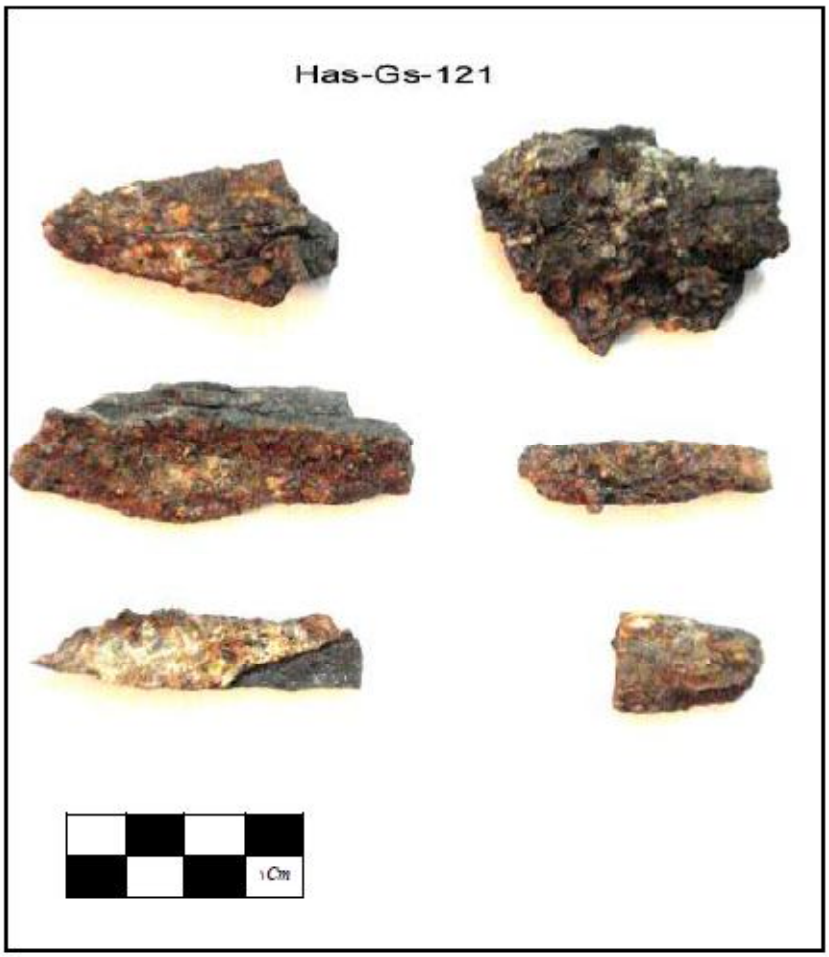

Fig2: Sample 1

Fig3: sample 1

Fig4: Sample2

Fig5: Sample 3

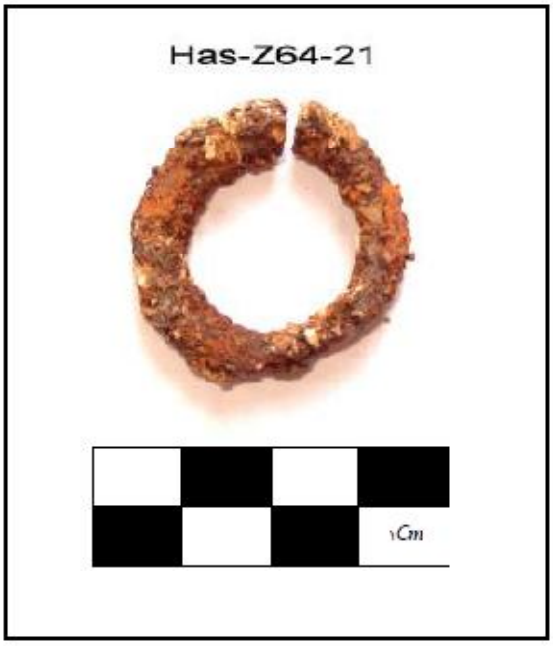

Fig6: Sample4

Fig7: Sample 5

Fig8: Sample 6

Fig9: Sample 7

Fig10: Sample 8

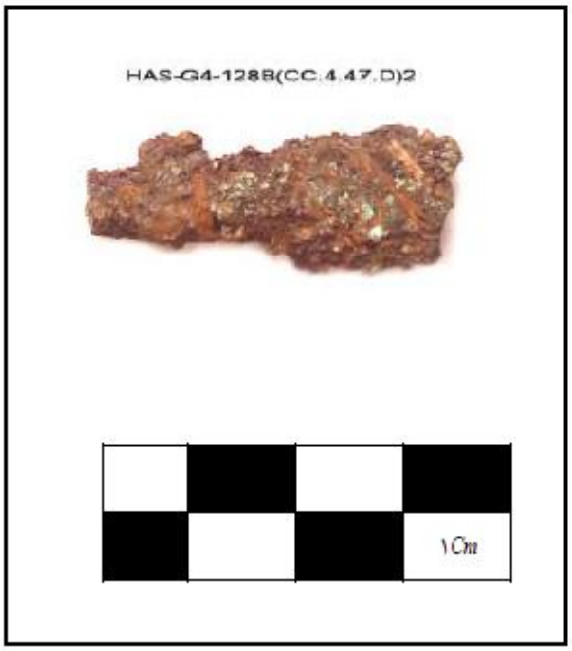

Fig12: Sample 10

Fig11: Sample 9

Figure 13. The experimental apparatus XRF, laboratory, Faculty of Science, Tarbiat Modarres University