INAA OF SOME ANCIENT COINS FROM POST GUPTA PERIOD AND MUGHAL SALTANAT

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ABSTRACT

Non-destructive analysis of some electrum coins from post Gupta period and of coins from different mints of Mughal emperors, Shahjahan and Aurangzeb, have been done by instrumental neutron activation analysis (INAA) using ^{252}Cf neutron source. The elemental content of these coins are determined by comparator method by measuring the activities of the radioisotopes formed after (n,γ) reactions, at their corresponding photopeaks. It is found that identified electrum coins contain copper as a major component and hence can be termed as cupro-electrum coins. As regards the analysis of coins from different mints there is no much variation in silver content while copper content varies from mint to mint. Coins from both the emperors are found to contain considerable amount of gold.

Keywords Electrum, Mint, INAA, Ancient coins, India

1 INTRODUCTION

Chemical analysis of gold objects and coins are rarely found in the literature because ancient gold objects, composed of metals of high fineness, can seldom be sampled for analysis because of their rarity, high value or small size. Non-destructive methods are therefore of special importance for the examination of such objects. Caley[1] has exhaustively discussed the validity of specific gravity method for the determination of fineness of gold objects and it is one of the oldest known methods of assay. While Meloni and Maxia[2] have analysed some Norman Suebic coins of Italy by thermal neutron activation analysis[3] method and determined the gold content upto 4%. The present paper deals with the analysis of few electrum coins by non-destructive INAA.

Further, survey of the literature in Indian Numismatics shows that research workers in this field are mostly interested in the study of ancient coins from different periods, their types, monograms on the obverse or reverse, the legends and systems. However, the study of coining techniques is often neglected and its importance is underestimated. In ancient days, the minting was mostly the state monopoly and in many cases, the minting was entrusted to professional gold and silver-smiths. The present work also covers study of variation in metallurgical composition of coins from Mughal emperors, Shahjahan and Aurangzeb, minted at different places.

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2 EXPERIMENTAL

In order to avoid any damage to precious ancient coins, they are not cleaned or treated in any manner before or after irradiation. Each sample and standard, AR grade metals, are weighed accurately and irradiated for 24 h in ^{252}Cf neutron source (thermal neutron flux $\sim 10^9 n \cdot cm^{-2} \cdot s^{-1}$, the irradiation facility being shown in Ref.[4]. The activity of the samples after (n,γ) reaction was measured with a high purity germanium detector (resolution 2.5 keV at 1332 keV), coupled to multichannel analyzer and interfaced with an IBM PC-XT. Presence of different elements in various coins was confirmed by measuring the half-life and energy of radioisotope formed after (n,γ) reaction. Contents of copper, arsenic, gold, antimony and silver were estimated from the area of photopeaks at 1346 keV (^{64}Cu for 500 s), 558 keV (^{76}As for 500 s), 412 keV (^{198}Au for 500 s), 563 keV (^{122}Sb for 500 s) and 632 keV (^{108}Ag for 20 s) respectively, using calibration curves (Activity versus weight plot) of corresponding standards. Each value presented in the result table is an average of at least three independent measurements.

3 RESULTS AND DISCUSSION

3.1 Elemental analysis of electrum coins from post gupta period

We have analysed few electrum coins, as identified by numismatists, from post Gupta period of Northern India. These are known as Laxmi type coins first introduced by Gangeyadeva and later minted by his successors in gold and silver in their base form or in cupro-electrum alloy. The results of which are given in Table 1.

Table 1
INAA of various elements in some ancient electrum coins

Coin name	Weight /g	Percentage of elements				
		Cu	Au/10^{-3}	Ag	As/10^{-2}	Sb/10^{-2}
N debased Mahipal Deva Laxmi type						
1	3.926	13.05±0.07	4824±5	19.51±0.08	–	–
2	4.220	34.21±0.06	3451±4	13.73±0.04	2.10±0.02	10.5±0.1
3	4.009	52.8±0.1	2572±3	11.9±0.1	1.69±0.01	16.2±0.1
4	4.032	14.39±0.08	12990±13	11.03±0.07	–	0.64±0.01
5	3.826	32.8±0.1	2759±3	18.72±0.06	–	0.93±0.01
N debased Madan Varman Laxmi type						
1	3.933	45.8±0.1	2759±3	17.28±0.06	1.97±0.01	2.04±0.01

An examination of Table 1 shows that all the six coins studied contain copper, gold and silver while arsenic is present in only three coins accounting only upto 0.02%. Antimony is also found to be present in all the coins, except one (N debased Mahipal Deva Laxmi type 1), ranging from 0.006 to 0.16%. The later two metals may be acting as an impurity in the alloy.

All these coins can be termed as cupro-electrum rather than electrum coins (as identified), copper being the major component. The content of gold and silver is different in different coins but the ratio of Au:Ag is found to be of the same order in first three coins ($\sim$ 0.25) and in the later two coins the ratio is $\sim$0.15 while fourth coin shows a ratio of 1.16. These observations indicate that the coins studied are either minted from different mints or are from different sources of alloys.

3.2 Elemental analysis of coins from different mints in mughal saltanat

Coins of Shahjahan in all the three metals gold, silver and copper were issued from Ahmedabad, Akbarabad, Allahbad, Kashmir, Katak, Lucknow, Patna, Shahjahanbad, Surat and Ujjain. Gold and silver coins are known also from Agra, Akbarnagar, Bhilsa, Burhanpur, Daulatabad, Gulkunda, Jahangirnagar, Kabul, Khambayat, Lahore, Multan, Pattandeo and Thattah.

Table 2
INAA of various elements in some ancient coins from different mints in Mughal Saltanat

Coin name	Weight /g	Percentage of elements			
		Cu	Au/10^{-3}	Ag	As/10^{-2}
Shahjahan					
Multan	10.613	0.58±0.03	10.025±0.05	29.51±0.04	–
Surat	11.331	0.31±0.02	7.21±0.01	32.79±0.05	–
Ahmedabad	5.712	59.21±0.03	17.04±0.02	10.55±0.06	1.02±0.01
Lahore	10.908	1.06±0.04	22.71±0.03	29.99±0.02	–
Patna	11.405	0.46±0.03	22.44±0.03	33.50±0.05	0.085±0.001
Thatta	11.028	0.46±0.02	26.87±0.04	31.37±0.04	–
Aurangzeb					
Burhanpur	11.434	1.52±0.03	21.88±0.03	31.61±0.06	–
Aurangabad	11.326	0.83±0.04	31.82±0.05	31.31±0.04	–
Bareily	11.331	0.75±0.02	27.70±0.04	31.85±0.08	–

Copper coins of Aurangzeb are fairly known in comparison to the coins of his father Shahjahan, of the same metal. His coins were issued in the dam weight till the fifth year of his reign. Then the weight was reduced, perhaps due to the rise of the metal price. The largest number of places are known to have issued coins of Aurangzeb. In addition to above mentioned places, Azimabad, Gulbarga, Hyderabad, Kabul, Solapur are known to have issued his coins in all the three metals. Bareily, Jaunpur, Kashmir issued only gold and silver coins. Gold is exclusively known from Maliknagar while Adoni, Jinji, Kanji, Karambad, Peshawar, Puna, Udgir, issued only silver coins. Copper coins exclusively are known from Aurangnagar, Bairrat and Udaipur. The elemental analysis of some coins from Mughal emperors Shahjahan and Aurangzeb minted at different places are presented in Table 2.

It is seen from Table 2 that there is no much variation in silver content of the coins from different mints of both the emperors except the Shahjahan coin from Ahmedabad mint which is copper based and hence is also found to contain arsenic which is uaually

associated with the source of copper ore. As regards the concentration of copper, it varies from mint to mint ranging from 0.31% to 1.06% and 0.75% to 1.52% in Shahjahan and Aurangzeb coins respectively. Further, it is also found that coins from both the emperors have considerable amount of gold and thought to be deliberately added. Aurangzeb's coins show higher percentage of gold than those of Shahjahan.

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REFERENCES

1 Caley E R. Ohio J Science, 1949; 49:73-82
2 Meloni S, Maxia V. V Grazz Chim Ital, 1962; 92:1432-1442
3 Hevesy G, Levi H. Math Phys Medd Dan Vid selsk, 1936
4 Rajurkar M S, Vinchurkar M S. Int Appl Radiat Isot, 1992; 43:1515