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ORIGINAL PAPER

Average and core silver content of ancient-debased coins via neutron diffraction and specific gravity

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Abstract The measurement of the fineness of debased ancient silver coins has proven to be a very difficult issue, which has been studied for a long time. In this paper, this subject is analysed, and the various consequences of the silver surface enrichment (SSE) are discussed exploiting the most recent investigations. A new model is proposed for the complex object that is an ancient-debased silver coin, based on the silver profiles measured on some sectioned specimens. The model is applied to a sample of 43 coins, mainly Roman victoriati, Cisalpine and Illyrian drachms (from late III to I century B.C.). The coins are investigated in two different ways: neutron diffraction (ND) and specific gravity (SG). The results of the two measurements are combined via the proposed model to provide a more complete numismatic information of the original fineness of the monetary alloy. As a result, a relation between SSE thickness and SG is derived, which, for these coinages, allows to estimate the original alloy silver content from a simple SG measurement; the same method can be used to study other debased coinages, provided that all the procedure (ND and SG) is applied.

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Introduction

An ancient silver coin was not simply a token, like in modern currencies. In fact, ancient monetary systems were based on the intrinsic value of the coins. The silver content was, together with the weight, the parameter which defined the overall value of a coin. Therefore, the study of the fineness, or equivalently silver content (in this paper, % stands for wt% when it refers to coin fineness), would give interesting historical information, but it is not easily measured. Among the latest non-destructive techniques developed as archaeometrical tools, one can mention mass spectrometry coupled with laser ablation (LA-ICP-MS: Sarah et al. 2007; Sarah 2008; Blet-Lemarquand et al. 2009), X-ray fluorescence (XRF: Walker 1980; Kasztovszky et al. 2005) and particle-induced X-ray emission (PIXE: Bugoi et al. 1999; Ager et al. 2013) as techniques for testing the surface composition of ancient coins. In contrast, prompt gamma activation analysis (PGAA: Kasztovszky et al. 2005; Corsi et al. 2015; Corsi 2015), fast neutron activation analysis (FNAA: Guerra and Barrandon 1998) and all the various neutron analyses (Calliari et al. 2013; Canovaro et al. 2013; Kirfel et al. 2011; Xie et al. 2004; Kockelmann et al. 2003) provide results on the overall coin volume. Remarkable, even if not fully non-destructive, is the latest work of Butcher and Ponting (2015).

The work of Walker (1976) encompassed the XRF analysis of about 2000 Roman Republican coins; his interpretation of the XRF data as bulk results, specifically regarding debased series like Victoriati, caused a distorted perception of this subject for nearly 30 years. He found very stable characteristics, with the silver content oscillating in the narrow

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