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 Cite this: *J. Anal. At. Spectrom.*, 2015, **30**, 730

## Compositional analysis of a historical collection of Cisalpine Gaul's coins kept at the Hungarian National Museum

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The Cisalpine Gaul's coinage has been produced by different tribes settled in northern Italy between the 4th and the 1st century B.C. During this wide chronological period several types of silver drachms have originated, nowadays classified by numismatists in different typologies. To verify the presence of a debasement along the years and to investigate the exchange ratios among different drachmas, the rich collection of the Hungarian National Museum in Budapest has been analysed. Measurements have been performed at the Budapest Neutron Centre with the Prompt Gamma Activation Analysis (PGAA), a bulk technique which enables overcoming of surface enriched layers and alterations. This technique allows silver and copper to be quantified, while to check the presence of tin and other minor elements X-ray fluorescence (XRF) has been used. Results show that the silver content falls from 94% of the first emissions up to 50% of the Cenomans' and Insubres' tribes late typologies. This strong debasement takes place between the III and the II century B.C. and could be related to the military efforts in the decades around the second Punic war. At the same time, we observe the transition from a binary silver–copper alloy to a ternary one, made of silver, copper and tin.

 Received 2nd November 2014  
 Accepted 20th January 2015

DOI: 10.1039/c4ja00398e

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### Introduction

The application of scientific analyses in the numismatics field dates back at the 18th century, when the first chemical (and destructive) compositional measurements have been performed on ancient coins. Nowadays, many different techniques are available to answer specific questions concerning historical issues faced by numismatists. Compositional analyses intended to provide the quantification of the main alloying elements remain however the most important and useful in this specific research field. In particular, compositional data of major elements are specifically important for the study of devaluation in antiquity, which is a common feature for economically developed societies. Nowadays, the average level of inflation has in general no impact on the circulating coins of contemporary currencies, as they are produced with non-precious metals. Nonetheless, in ancient times devaluation processes had an immediate effect on the coin weight and/or on the so-called fineness, which is the content of precious metal (gold or silver).

For this reason compositional analyses, along with a careful analysis of average weights, are particularly suited to provide useful data for the study of economic changes in antiquity. Once these technical data are available, metrological relationships among coins of a certain denomination produced in different periods or among foreign currencies can be studied. A very famous example is provided by the study on the devaluation of the Roman silver denarius.<sup>1</sup> However, debasement is a rather common practice and can be found in different historical periods and geographic areas. Other experimentally proven debasements are *e.g.* those concerning the Visigothic gold coinage,<sup>2</sup> the gold dinars issued in the Iberian Peninsula,<sup>3</sup> the gold Aksumite coinage,<sup>4</sup> the Carolingian silver denarii<sup>5</sup> and the Roman-age tetradrachms from Alexandria.<sup>6</sup> To gain compositional data, several techniques have been employed along the years.<sup>7</sup> While between the 50's and the 70's the most used were those based on activation<sup>8</sup> or on chemical analyses,<sup>9</sup> in the last two decades an approach based on mass spectroscopy (*e.g.* ICP-MS) prevailed.<sup>10</sup> Nevertheless, requiring the latter approach sampling or micro-sampling, a neutron technique has been preferred for this work.

In the last few years, a wide plan of scientific analyses has been developed to fully characterize, from a chemo-physical point of view, the so-called Celtic coinage from northern Italy. These coins, also known as Cisalpine coins or “Celtic coins of the Po valley”, had been produced by the human communities settled between the French region of Provence and northern

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