data is in general necessary to understand the different processes, for the second question analytical data, especially trace elements in precious metals, may be enough to tackle a certain number of cases.

The non-destructive analysis of gold objects may be performed by a large number of techniques, however the determination of trace elements, and mainly those representative of the original gold ores, is certainly a hard task. The large number of trace elements determined by ICP-MS, using either laser ablation or solution analysis, makes this technique relevant to investigate the raw material sources. The non-destructive analysis of gold objects may be performed by a large number of techniques, however the determination of trace elements, and mainly those representative of the original gold ores, is certainly a hard task. The large number of trace elements determined by ICP-MS, using either laser ablation or solution analysis, makes this technique a fundamental one to investigate the raw material sources.

Laser ablation sampling removes about 1μg and is considered non-destructive. However, the quantity of sample necessary for solution work is still quite small, at about 2mg, and may allow the analysis of objects that cannot be moved to the laboratory. The questions are how far the analysis is representative of the object’s composition and whether the dissolution procedures are reliable. Laser ablation sampling removes about 1μg and is considered non-destructive. However, the quantity of sample necessary for solution work is still quite small, at about 2mg, and may allow the analysis of objects that cannot be moved to the laboratory. The questions are how far the analysis is representative of the object’s composition and whether the dissolution procedures are reliable.

We have analysed several gold coins of different compositions by 12MeV proton analysis and used them as standards and samples to check the possibilities and limitations of ICP-MS when using solution methods. To certain gold coin solutions, with a range of compositions, we added separate amounts of several important elements, such as the platinum group elements and tin, to check the linearity of the results. We have also checked the accuracy of the results when decreasing the quantity of initial sample and to establish a reliable analytical procedure. The limits of detection where determined as well as the reproducibility of the analysis.

The results obtained by laser ablation and solution procedure ICP-MS are compared with those obtained by activation analysis. The solution ICP-MS technique was applied to a group of gold Celtic coins to investigate possible changes in gold source and alloying procedures.

**KEYWORDS:** Metals, ICP-MS technique, Celtic.

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**RESTORATION OF AN AFRICAN IRON-AGE SMELTING FURNACE**

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Melville Koppies is an important precolonial national historical-site in Johannesburg, South Africa. It contained several well-preserved Iron-Age smelting furnaces, but in 1998 two of...
these were vandalized, one so badly that it cannot be repaired. We were approached to undertake restoration of the other one, which dates from the Late Iron Age ±1100 AD. As none of us had any experience with this, we decided to begin by determining the state of vitrification of the furnace wall. Examination showed the furnace wall to be exceedingly crumbly in places but quite solid in others. XRF and XRD analyses were done by PPC Ltd, a local cement company. These proved that the local soil was used in construction and that the furnace bottom had been vitrified at approximately 1 100°C, but that the furnace wall had been heated only to 400°C or less. There is thus a possibility that this furnace was used as a forge, and not for smelting. Some months were spent, both in SA and the UK, in identifying possible solvents and consolidants, and in testing for the best method of application, concentration of consolidant and drying time of the pieces to be refitted. As consolidant we selected B₆₇ (poly-isobutyl methacrylate), and solvents industrial methylated spirits (IMS) and cyclohexanone, which produced good strengths and minimal colour change on drying. We will report data on strength development of the consolidated pieces at the conference. The furnace has been successfully restored. The consolidant/solvent combinations worked well, causing only minimal darkening in places. These results should be of use to anyone who has to repair or restore a fired-earth structure.

KEYWORDS: Metals, South Africa, smelting furnace.

**Composition, Simulation and Manufacture of the Celts Cast Tin Bronze Coins**

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A large number of cast bronze coins called *potins* by the numismatists have been analysed by fast neutron activation technique using a cyclotron. The coins were made in central and western France by the Turones and the Pictones tribes. These coins showed tin contents of over 20 wt% in early examples with an increasing substitution of tin by lead and a decrease in weight. Some *potins* contained a total of almost 40wt% tin and lead. Later *potins* made in the time of emperor Augustus and before the establishment of the Roman mints in Gaul were generally considered to have been bronzes but have now shown to be brasses.

Before the above compositional trends could safely be used as chronological indicators in their own right, further investigation was necessary. Several of the coins analysed were highly corroded so the analysis of the remaining metal might give an erroneous impression of the bulk composition. In order to observe the phase composition of the alloy and improve the understanding of the effects of corrosion on composition, about 50 *potins* of both French and English types were cut to allow analysis by neutron activation, phase analysis by electron probe microanalysis and structural analysis by optical metallography.

The substitution of tin by lead and the diverse colours of the alloys raised further questions. In order to investigate possible changes in composition of the parent alloy