Archaeology & History in the Lebanon Issue Twenty : Autumn 2004, Pp. 34-38.

PROVENANCE OF SILVER ARTEFACTS FROM BURIAL 27 AT SIDON

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Introduction

Geochemical tracers clearly evidence the global impact of human induced activities since early times (Murozomi *et al.*, 1969; Settle and Patterson, 1980; Boutron *et al.*, 1994; Shotyk *et al.*, 1998). Most of the environmental contamination arose from archeometallurgy that led to Metal Age definition (Copper, Bronze, Iron Ages). Most particularly, precious metals such as those encountered in ancient burials provided independent evidence of elaborate human social interaction. Silver (Ag) is of particular interest due to its early use and associations with other deposits (Lucas and Harris, 1962; Wertime, 1973; Nriagu, 1983). Indeed, native Ag occurs in very small quantities and more than two thirds of silver ores are associated with lead (Pb), zinc or copper ores (Nriagu, 1983). These deposits can be identified owing to their relative proportion of stable Pb isotopes (m=204, 206, 207, 208) of which the three latest are end members of natural uranium (U) (m=238, 235) and thorium (Th) (m=232) decay chains. Depending on their initial U and Th content and their age, different ore bodies shall display specific Pb isotope signatures (Doe, 1970). Pioneer studies by Brill and Wampler (1965), Patterson (1971), Barnes *et al.*, (1974) and Gale (1978) have demonstrated the usefulness of such properties to determine the provenance of early metals, the transient development of metal technology and to reconstruct ancient trade patterns.

Because levels of the Early Bronze Age are easily accessible at the Sidon excavation (see description by Doumet-Serhal, 2003) a unique opportunity exists to investigate Ag trade patterns at the onset of the Middle Bronze Age (beginning of the second millennium) when little is known regarding precious metal trades and the beginnings of silver smelting from Ag-bearing Pb ores. Ag artefacts were found from burial 27 and sub sampled for stable Pb isotope determination (see Doumet-Serhal, p. 21 for a detailed description). Samples were rinsed with milliQ type water and diluted HCl acid to remove soil and extraneous components. Ag-associated Pb was then leached with concentrated HNO3 and purified through AG1x8 anionic columns (Manhès *et al.*, 1978). Ratios of the stable Pb isotopes were determined by thermal ionization mass spectrometry at CEREGE on a Finnigan MAT 261. Calibration and mass fractionations were determined by concurrent analyses at the National Institute of Standards and Technology (NIST) SRM981 (common Pb reference material). This preliminary report provides mean values of 206Pb/207Pb and 208Pb/206Pb for some Ag artefacts. Further isotopic analyses will provide more accurate determinations. These can be compared to known isotopic imprints from ancient Pb-Ag mines in order to reconstruct the provenance of Ag artefacts in Sidon.

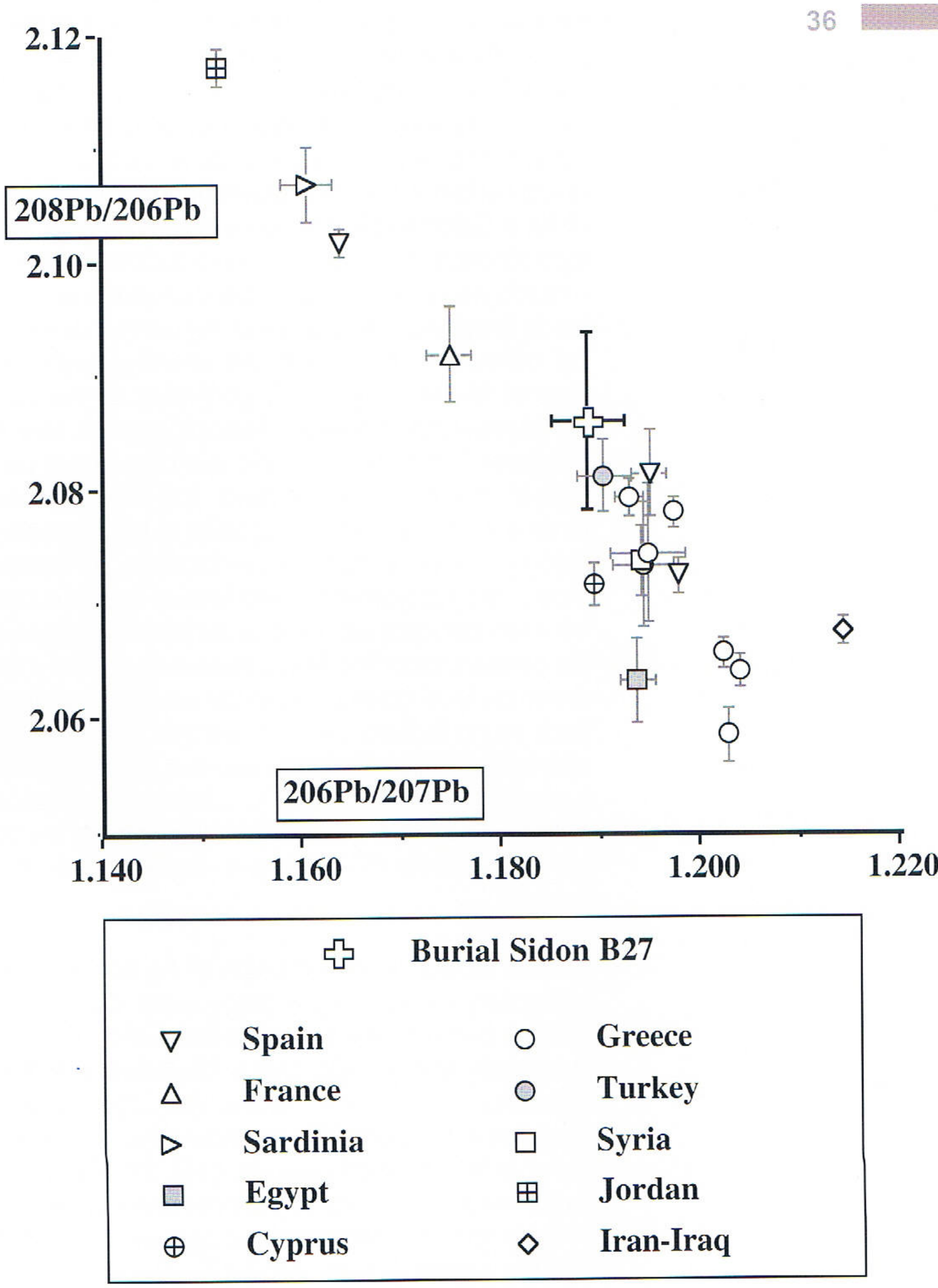
Lead Isotope Systematics

Metal trades in the Eastern Mediterranean during the Phoenician period (9th-7th century BC) and later have been well investigated, in particular, the development of mining in the Iberian peninsula (Rio Tinto). Meanwhile little is known of the preceding Third Millennium and the onset of Ag smelting. Ag artefacts from burial 27 at Sidon display mean 206Pb/207Pb ratios (1.189±0.004, fig. 1) that are remarkably homogeneous compared to the ratios measured for weapons from the same period and the same location (1.126 to 1.192, Le Roux *et al.*, 2003). This reproducibility in the isotopic imprints makes an investigation of the provenance of Ag at Sidon and the documenting of Ag smelting outbreak in the Eastern Mediterranean feasible. This reproducibility also suggests that these silver artefacts are not secondary melted products as it is often expected with Cu made weapons. The scarcity of Ag ores (as compared to Cu) and technological difficulties arising from Ag smelting might constrain the achievable sources for Ag trade. This is confirmed by the comparison of Ag artefact signatures along with known isotopic imprints from Pb-Ag ore bodies in the Mediterranean basin. The most likely sources of provenance are limited to Greece, Turkey, Cyprus and Syria. The Mesopotamia region does not seem to be a contributor to the Ag trade at the beginning of the Middle Bronze Age (fig.1). Imprints from various locations are detailed in figure 2 where we clearly see that neither the well-known Greek Laurion mines, nor the Iberian Rio Tinto deposits are the sources of the Ag artefacts found at Sidon. On the contrary, both the Taurus Anatolian, and to a lesser extent, the Ægean region (Siphnos) correspond as the most likely sources of provenance for Ag items found in Sidon (fig. 2). If we only take into account the most accurate 206Pb/207Pb ratio, Cyprus could also be considered as a potential source. Further analyses are needed to confirm these sources and to rule out other isotopic sources such as Syrian deposits and/or Iberian mines (Murcia) as long as evidence of such a long-distance trade of Ag during this period is lacking.

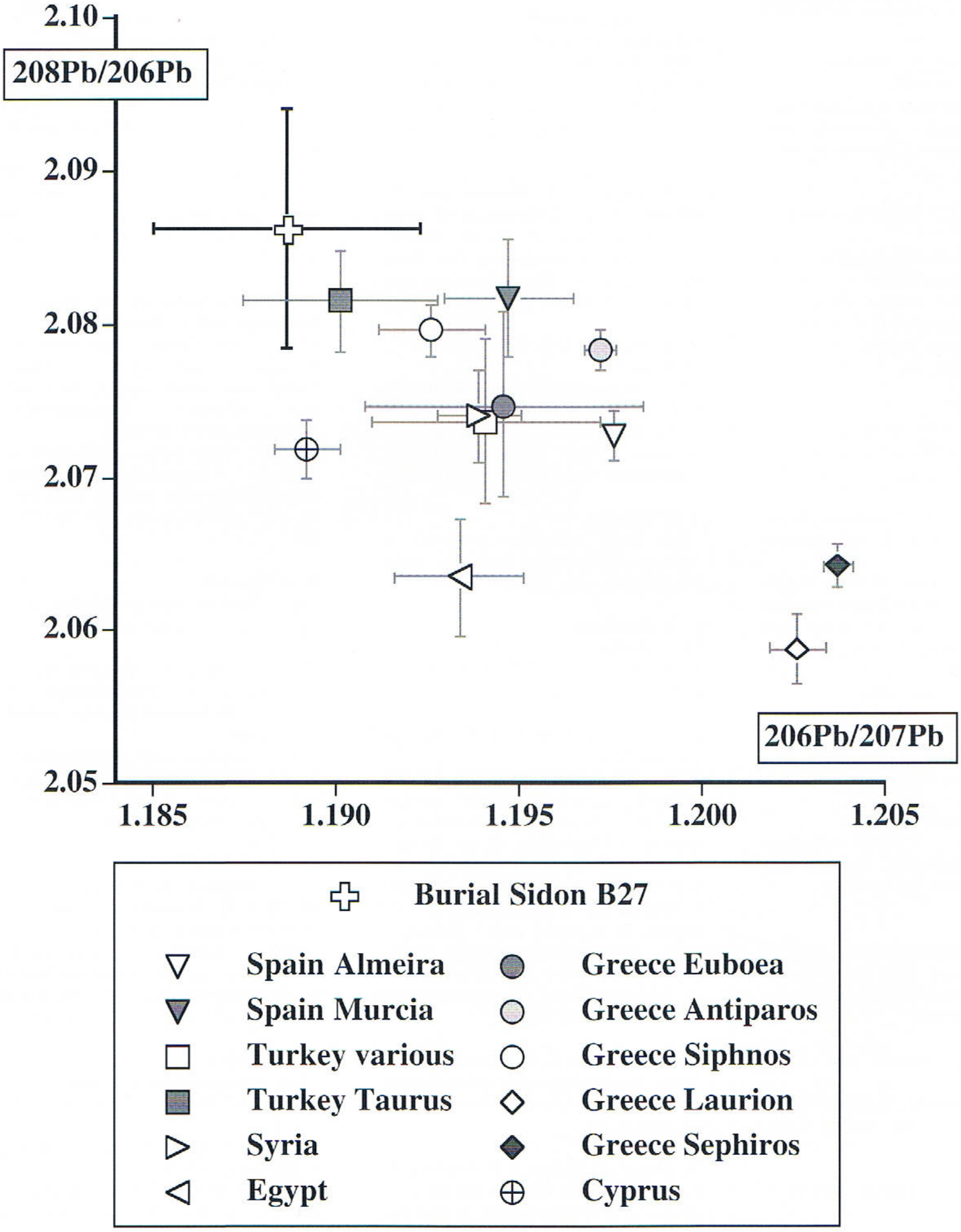
Isotopic evidence for the origin of Ag artefacts found in an early second millennium warrior burial at Sidon exists. Our findings clearly suggest trade patterns between the Lebanese coast and Central Anatolia at the onset of the Middle Bronze Age. This is consistent with the early development of metallurgy in this region (Tylecote, 1987). The extensive isotopic mapping of lead ores in the Central Taurus mountains (Yener *et al.*, 1991) indicates that Ag found in Sidon could originate from the Aladag region located in its Ala Daglari range. This regional trade has already been suggested by Ag and Pb artefacts found in Mesopotamia (between 2500 and 1500 BC) which conform with the Aladag isotopic imprint (Yener *et al.*, 1991).

Aknowledgements

We are grateful to W. Barthelemy and F. Desenfant for their technical assistance with sample preparation and mass spectrometry analyses.



1 Comparison of isotopic imprint (208-Pb/206Pb vs. 206Pb/207Pb ratios) of (B27) burial Ag artefacts to those of Mediterranean Pb-Ag deposits (data from Barnes *et al.*, 74; Craddock *et al.*, 1985; Gale *et al.*, 1981, 1988; Ludwig *et al.*, 1989; Sayre *et al.*, 1992; Seeliger *et al.*, 1985; Stos-Gale and Gale, 1981, 1992; Stos-Gale *et al.*, 1995, 1996, 1997; Vavelidis *et al.*, 1985; Wagner *et al.*, 1985; Yener *et al.*, 1993).



2 Blow up of fig. 1 with detailed isotopic imprints of ore deposits that conform with signatures of burial 27 Ag artefacts (see references in fig. 1).

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