

Lead weight from Fraser Island compared with sources in France and China

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Abstract

The weight resembles lead from Beishan and Tonglin in China, but is highly unlikely to be from either source. Its best match is with lead mined in France.

Introduction

A comparison of the isotope values of an ancient lead weight found in a stranded beach on Fraser Island, Queensland, with samples in a large global database showed that it resembled lead from mines in France (Ward *et al.*, 1999).

Subsequent research has extended the database, including a substantial input from Dr Huang Bin, of the Chinese National Non-ferrous Metals Corporation, Guilin (SIROTOPE, unpublished data). Recent interest in Chinese maritime explorations in the 15th century (Menziés, 2002) suggest that the weight, which was apparently used as a sinker on a fishing net and is dated probably to the 15th Century AD (Ward *et al.*, 1999), might have originated in that country.

We have compared the new data with the isotope values for the lead from Fraser Island.

Present Study

We assume, as a working hypothesis, that the lead is from a single source, and accept that this source might not yet be represented in our data set. This possibility is unlikely, however, for China is now well represented in the SIROTOPE database (Gulson, 1986) by a large number of samples. A South American origin, by means of a voyage or drift of wreckage from Chile or Peru, can be set aside because no South American sample in the data base has similar isotope values.

Two-dimensional paper-based graphical plots, and three-dimensional computer-based rotatable scatterplots (Abacus Concepts, 1991), offer useful ways to visualize and analyze

multidimensional data. Such plots of the isotope ratios $^{208}\text{Pb}/^{206}\text{Pb}$, $^{207}\text{Pb}/^{206}\text{Pb}$, $^{206}\text{Pb}/^{204}\text{Pb}$, $^{207}\text{Pb}/^{204}\text{Pb}$, and $^{208}\text{Pb}/^{204}\text{Pb}$ show that no specific Chinese deposit coincides with the data for the weight. The plots show that it lies close to an outlying data point from Beishan Guangxi province (Chen *et al.*, 1987) with other similar samples from Tonglin. However, the overwhelming majority of the samples in these groups lie away from the weight data. For example, for Beishan the majority of points ($n=48$) have lower $^{206}\text{Pb}/^{204}\text{Pb}$ ratios and for Tonglin, the majority have higher $^{206}\text{Pb}/^{204}\text{Pb}$ ratios ($n=23$). If the isotopic results for these two groups are truly representative of these mining areas, it is highly unlikely that the weight is made of lead from these sources.

To check our visual examination we subjected the isotope data to numerical analysis, using fuzzy k-means (A.W. Ward *et al.*, 1992) and SYSTAT (Wilkinson, 1987). These analyses identified several distinct groups in the Chinese data set. Repeated analyses under varied conditions placed the lead weight with a subset of 53 Chinese samples. We continued our analyses after setting aside the samples that were not in this subset, displaying the results as dendrograms. In this way the samples that most resembled the lead weight were identified. Although these samples are similar, they are from separate collections in different localities. This suggests that the groupings in the subset might be accidental, and do not positively identify the weight with a source in China.

We then took the weight data and the nearest Chinese samples, and added the Haut-Allier and Pontgibaud 1 and Pontgibaud 2 leads that had been previously identified with the weight by Ward *et al.* (1999). Numerical, cluster, graphical (Figure 1) and 3D analyses of this set showed that the weight is, in all analyses, most like the material from France.

The resemblances in particular are: Haut-Allier (4 samples, two of which alternate depending on whether or not we use 3 or 5 variables—from this we infer that these two samples are borderline), Pontgibaud 1 (Brousse, 3 samples), Pontgibaud 2 (Rosier & Roure, 2 samples each). Cluster analysis puts all of these samples with the Fraser Island lead in a single group.

Providing that the lead weight is from a single source, we conclude that it matches best with lead mined in France.

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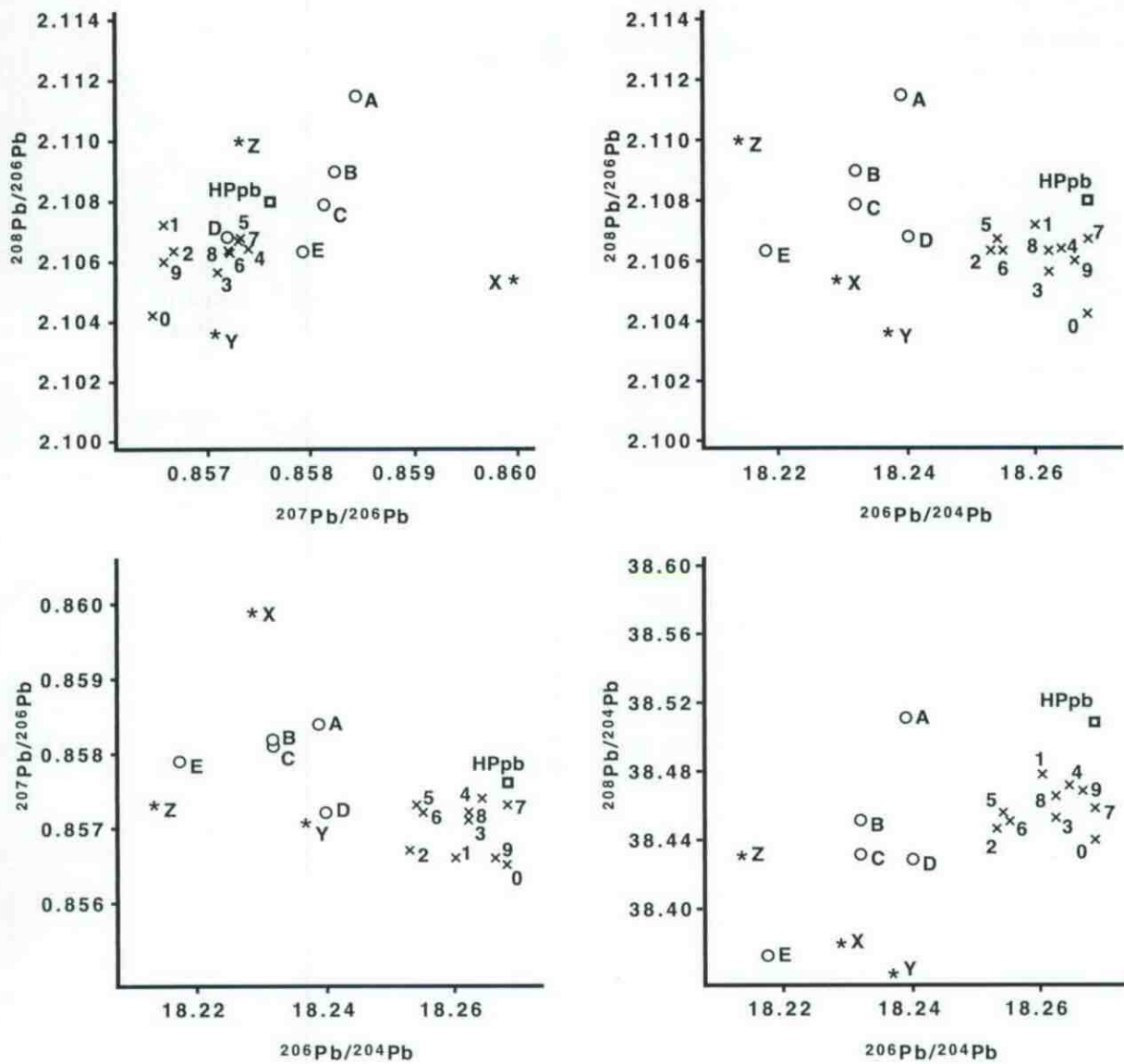


Figure 1. Comparison of isotope ratios for the lead from Fraser Island (HPpb), France (samples 0-9 and A-E), and China (samples X, Y, Z).

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