THE ACQUISITION AND UTILIZATION OF RAW MATERIALS FOR DŌTAKU USING LEAD ISOTOPE ANALYSIS

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This presentation aims to examine the trends in metal raw materials used for bronze bell production by analyzing lead isotope ratios and ICP analysis results based on archaeological classification studies, focusing specifically on bronze bells. Specifically, in addition to examining the overall trends in metal raw materials throughout the Yayoi period as previously studied, we will also investigate the actual sourcing and utilization of metal raw materials for each group of bronze bells produced by different artisan groups. This aims to clarify the actual sourcing and utilization of metal raw materials in bronze bell production.

The primary materials examined in this presentation are the group of bronze bells "gaientsukichu 2 type". The vertical flowing-water-pattern bronze bells were definitely produced at the Higashinara site, as evidenced by the excavation of their molds. Furthermore, the three-pair-eared, four-section, kesatasuki-pattern bronze bells, which share many similar characteristics with the vertical flowing-water-pattern bronze bells, can also be assumed to have been produced at the same site. The horizontal flowing-water-pattern bronze bells are presumed to have been produced in the central Osaka Plain, and molds for the pair-eared, four-section, kesatasuki-pattern bronze bells have been excavated at the Karakokagi sites. Furthermore, differences in the casting tools used for production reveal underlying distinctions among artisan groups. In other words, it can be considered certain that the group of bronze bells "gaientsukichu 2 type" were produced at multiple archaeological sites.

A diagram was created based on the lead isotope ratio data from the vertical flowing-water-pattern bronze bells, the three-pair-eared, four-section, kesatasuki-pattern bronze bells, and the horizontal flowing-water-pattern bronze bells that underwent lead isotope ratio analysis. The lead isotope ratios of all bronze bells fall within or near Region A. A closer examination of the lead isotope ratios for the above group of bronze bells reveals that the vertical flowing-water-pattern bronze bells and the three-pair-eared, four-section, kesatasuki-pattern bronze bells tend to concentrate within a relatively narrow range within Region A. In contrast, the horizontal flowing-water-pattern bronze bells are widely distributed within Region A, with some also found outside this region. The Tatsuuma No. 407 bell and Tatsuuma No. 414 bell that are "gaientsukichu 1 type", the Yamazura bell that are “henpeichuu type” were produced at the Higashinara site. The lead isotope ratios of these bells are similar to those of “gaientsukichu 2 type” made at the Higashinara site. Based on the above, a correlation between differences in bronze bell artisan lineages and lead isotope ratios can be hypothesized.

Next, I examine the lead isotope ratios of bronze bells cast from the same mold among the horizontal flowing-water-pattern bronze bells. The following four sets correspond: Kamoiwakura No. 5 Bell and Kibi No. 2 Bell; Kamoiwakura No. 21 Bell and Kibi No. 4 Bell; Kamoiwakura No. 11 Bell and Kawashima Bell; Kamoiwakura No. 31, 32, and 34 Bells. The lead isotope ratios for the four sets show no approximation. While the necessary time lag for producing bronze bells using the same mold remains an open question, it is unlikely that a mold used once would be left unused for a long period before reuse. Considering this, it can be inferred that the production site of the horizontal flowing-water-pattern bronze bells likely obtained and utilized various lead raw materials within Area A at roughly the same time.

Regarding the values of lead isotope ratios, it is necessary to consider whether the presence of lead as an impurity in copper has an effect. I examine the results using ICP analysis of the Kamoiwakura

bronze bells. The lead isotope ratios of the Kamoiwakura Bells No. 31, 32, and 34, produced from the same mold, diverge between Bell No. 31 and Bells Nos. 32 and 34. However, ICP analysis shows their copper concentrations are similar, ranging from 82.35% to 85.14%. Therefore, it is unlikely that the difference in lead isotope ratios stems from copper concentration; rather, it can be considered a difference in origin within Area A. Furthermore, while the figure also shows the copper concentration for the Kamoiwakura bronze bells, no correlation was observed between copper concentration and lead isotope ratios. It can be inferred that the effect of copper concentration differences on lead isotope ratios was small.

This presentation demonstrates that variations in lead isotope ratios are observed among groups of bronze bell artisans. This suggests that in the Kinki region, the procurement activities for metal raw materials may have differed among the various bronze bell-making artisan groups.

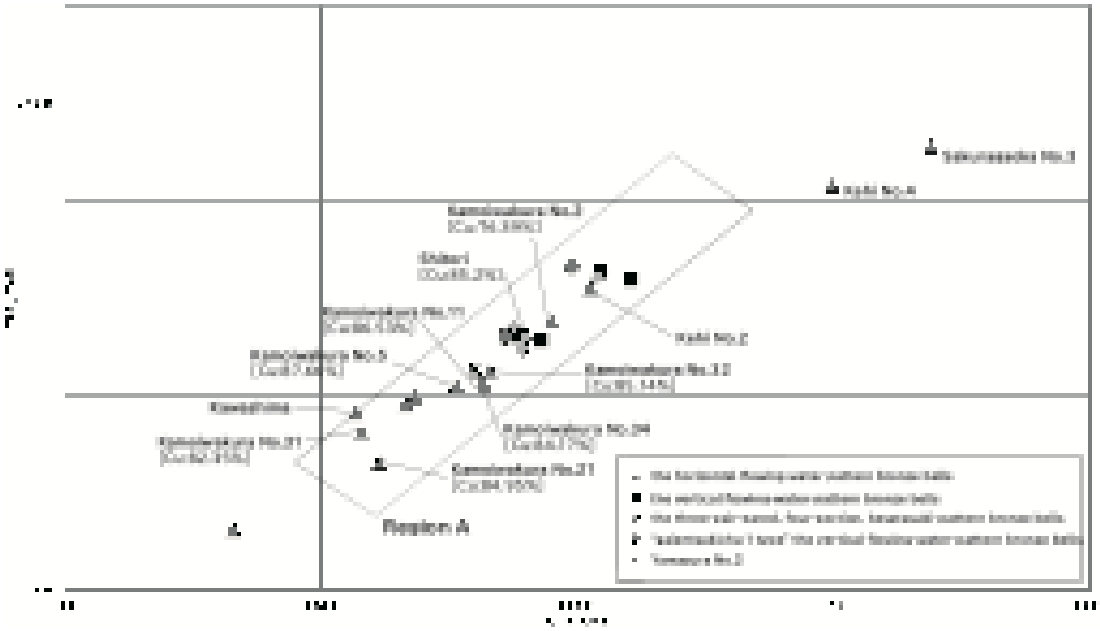

Fig. 1. Lead isotope ratio of "gaientsukichu 2 type".

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