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Analysis of radiocarbon dates of an archaeological site in the Russian Far East: The marine reservoir effect as seen on charred remains on pottery

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Abstract

In order to obtain precise and accurate calibrated radiocarbon chronologies for archaeological sites, it is necessary to determine the provenance of the carbon material being dated. Of particular note is determining the provenance and radiocarbon age of charcoal remains on pottery. In this context, we discuss the decipherment of dates on the Ustinovka-8 site in the Russian Far East. Using $\delta^{13}C$, $\delta^{15}N$ and C:N it is possible to ascribe charcoal provenance to terrestrial and marine origins. Our data show radiocarbon age difference that are clearly associated with carbon origin, and a maximum estimated ΔR of approximately 400 years during the Zaisanovskaya culture, 4400 cal BP. A combination of pottery analysis and ^{14}C dating at this site determined the Zaisanovskaya cultural period to be 4000–5000 cal BP, the Boismanskaya and the Late Rudninskaya cultural period 5800–6500 cal BP, and the Early Rudninskaya cultural period of 6800–7100 cal BP.

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Keywords: Radiocarbon dating; Carbon and nitrogen stable isotopes; Charred remains on pottery; Russian Far East

1. Introduction

In the Russian Far East, thin occupational layers coupled with variability and complexity of physically mixed artifacts often yield ambiguous ^{14}C results from nearby material but not intrinsic to the artifact. To avoid this, charcoal residues on pottery remains are being increasingly utilized to provide direct dating of artifacts [1]. However, owing to the possibility of different carbon provenance for the charred residues, this by itself does not guarantee an accurate calibrated date on the artifact. Radiocarbon ages on charred remains are often older or younger by several centuries or more than the ages expected by archaeological context and or cultural period and likely reflect different origins (e.g. marine versus terrestrial) of the carbon contained in the charred material or material that is not truly contemporaneous with the artifact.

In this study, we have determined the radiocarbon ages of charcoal and charcoal remains on the surface pottery from the Ustinovka-8 site. The relationship between

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archaeological/cultural context and radiocarbon ages derived from these types of analyses are likely to provide more accurate timing of cultural complexes than those studies based on charcoal associated with artifacts from thin occupational layers. The combination of radiocarbon dating, $\delta^{13}C$ and $\delta^{15}N$ allow us to determine the provenance of the charred remains between marine and terrestrial origins. Where there are the equivalent of "paired" terrestrial and marine data, we are able to estimate past variations in ΔR.

2. Site and samples

The Ustinovka-8 site is located at 44°14′52″ North and 135°12′45″ East on a plateau 135 m above sea level north of the Zerkal'naya River (Fig. 1). The headwaters of the Zerkal'naya River is at Sihote-Alin and it finishes running its course in the Sea of Japan about 50 km away. In the central portion of the site, there is a round depression with diameter of 10 m in which seven (7) distinct occupational layers were recognized. It was possibly used as a trash abandonment space or as a settlement space, the primary deposits were relatively intact. Artifacts of the early Neolithic Rudninskaya and Boismanskaya cultures, Zaisanovskaya of the Late Neolithic and the Bronze Age Lidovskaya cultures are found in layers three through six [2]. The spatial distribution and relationships of all of the artifacts and charcoal/wood samples found in the depression are shown in Fig. 2.

The excavation of the Ustinovka-8 site was performed by a joint Russian and Japanese expedition. We participated in the international excavation of the site in 2004. Our contribution was excavation of one quarter of the round depression. From the ninety-two (92) total samples taken comprised of 66 wood charcoal, 20 charred carbon on pottery remains and six soil samples, we report initial radiocarbon results on 54 different carbon samples.

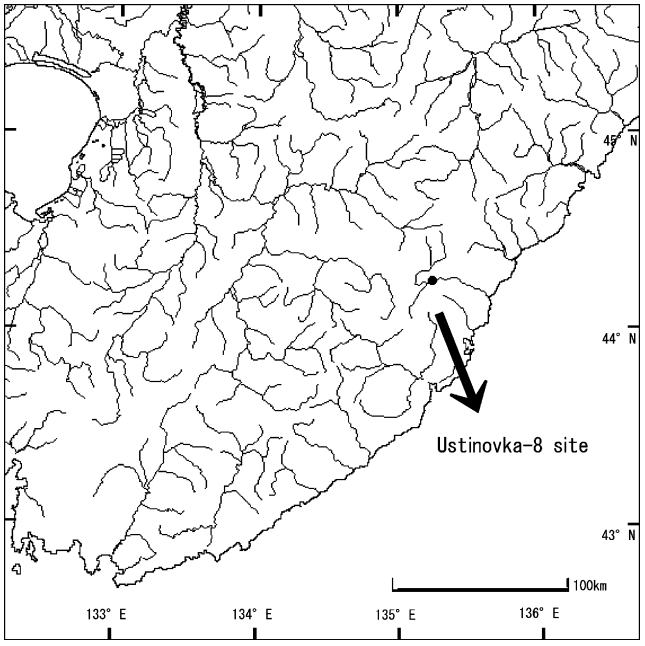

Fig. 1. Location of the Ustinovka-8 site.

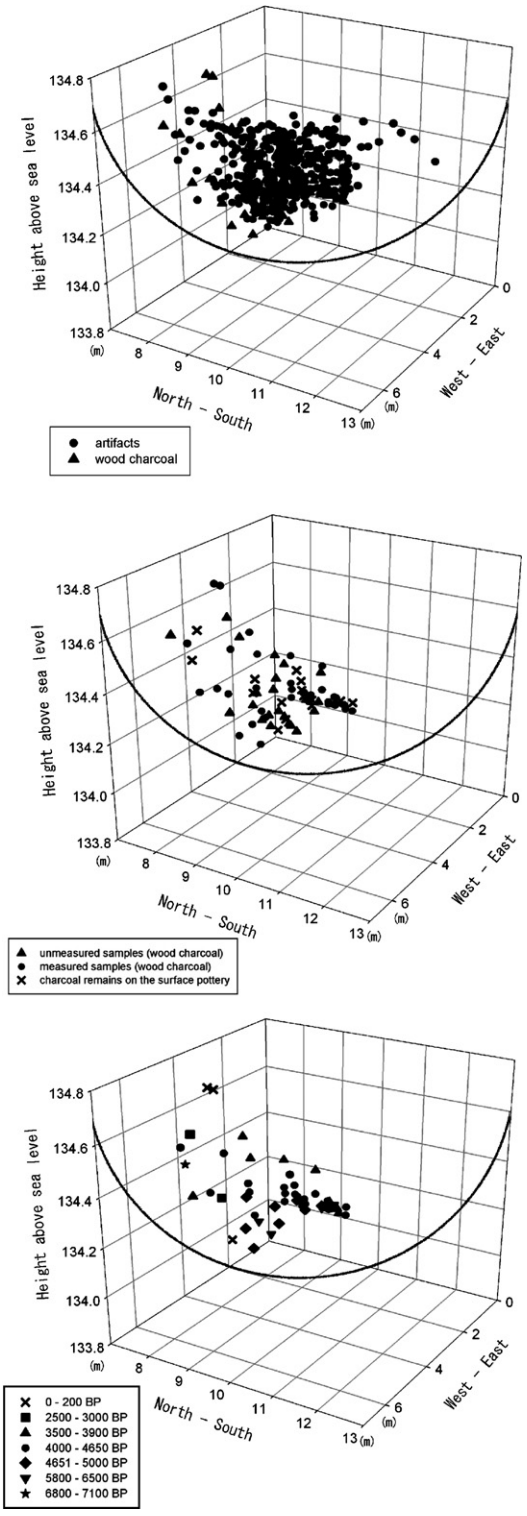

Fig. 2. Distribution of artifacts and charcoal of the Ustinovka-8 site.

3. Methods

Samples were examined under a microscope, and plant roots or other visible contaminants were removed with