Reconstruction of the paleoclimate at the time of formation of fluvial terraces based on phytolith analysis

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Uplift rates in inland area are generally estimated based on relative height of fluvial terraces (e.g., Yoshiyama and Yanagida, 1995). This method is based on a model that fluvial terraces are formed through interaction between tectonic process and the cyclic fluctuations of fluvial process controlled by climatic changes (the terrace development model; e.g., Kaizuka, 1969). Consequently, it is necessary to confirm the validity of the model in each study areas in order to apply this method. In this study, as a method to confirm the validity of the model, we tried to reconstruct paleoclimate using phytolith analysis in the Kaburakawa River basin, a tributary of the Tonegawa River.

Fluvial terraces are well developed in the Kaburakawa River basin, and these terraces are roughly classified into three categories (Q1˜Q3; Sugai, 1996). Based on 14C dating and tephrochronology, Q3, Q2, and Q1 terraces are correlated to Marine Oxygen Isotope Stage (MIS) 2, MIS 6, and MIS 8, respectively (Tajikara et al., 2008).

In this study, we reconstructed paleoclimate based on the phytolith analysis using samples from terrace deposits and aeolian deposits of Q2 and Q3 terrace. Marker tephras such as Iz-Kt, K-Tz, Aso-4, and AT are recognized in the aeolian deposits covering the terrace deposits of Q2 terrace (Tajikara et al., 2008). We estimated cool climate at AT and Aso-4 horizon, modestly warm climate at K-Tz horizon, and warm climate at top of the aeolian deposit. Iz-Kt, K-Tz, Aso-4, and AT tephras are dated as MIS 5/6 boundary, immediately after peak of MIS 5c, MIS 5b, and the first half of MIS 2, respectively (Machida and Arai, 2003). Since paleoclimate reconstructed from phytolith analysis is roughly consistent with that of estimated from tephra horizon, we judged that reconstruction of paleoclimate base on phytolith analysis is valid in the Kaburakawa River basin.

We inferred that the upper part of terrace deposits of Q2 and Q3 terraces are deposited under cool climate based on phytolith analysis. In addition, Q3 terrace gravels are considered to deposit under cool climate based on genus of wood fragment taken from the upper part of the Q3 gravels (Tajikara et al., 2008). These fasts indicate that Q2 and Q3 terrace are formed under cool climate, and that the terrace development model is valid in the Kaburakawa River basin. Consequently, we concluded that tephrochronology and phytolith analysis are available as a method to examining validity of the terrace development model.