Observation of the boson peak in excavated amber.

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A large number of buried cultural objects made of amber have been found at archaeological sites from the Jomon, Kofun, Nara and Heian periods. In Japan, amber is found in a limited number of localities, and the physical properties of amber vary from region to region. Therefore, clarifying the provenance of excavated amber through scientific analysis is important information for studying ancient distribution and exchange networks. Previous studies have mainly used FT-IR and thermal analysis to estimate the origin of ancient amber. On the other hand, the provenance of ancient amber has been studied using archaeological approaches. However, there are differences between the results of archaeological and scientific research. In particular, the results of scientific analysis that amber was transported from the Tohoku region to the Kinki region are often negative. Therefore, establishing a more accurate scientific characterisation method of ancient amber through scientific research is an essential task in the study of ancient distribution and exchange networks.

In this study, we attempt to estimate the provenance study of ancient amber by inelastic neutron scattering. Inelastic neutron scattering experiments were performed at 5, 100 and 300 K. The samples were collected from each amber provenance at present (standard samples) and excavated from archaeological sites in the Jomon and Kofun periods (ancient amber). The boson peaks were observed in the 100 K spectrum. No significant differences were observed between the peak areas of the standards. However, the peak areas of ancient ambers were significantly reduced compared to the standard samples. The boson peak positions of the standard samples and ancient ambers are plotted against the geological age (Fig 1). Note that ancient ambers are plotted on an age axis of 0, and the plots are colour coded according to plant origin (red: *Araucaria*, blue: *Metasequoia*, green: *Dipterocarp*, black: unknown). The peak positions of the standards differed according to the amber provenance. However, no clear correlation with geological age was observed. In addition, the peak positions of the ancient ambers were found to be shifted to the higher energy side compared to the standard sample. The comparison was made between the intensity ratios of the boson peak and the quasi-elastic scattering in the inelastic neutron scattering spectra at 300 K. The results are shown in Figure 2. The proportion of boson peaks in all standard samples and ancient ambers were about 70%. It is cleared that the proportion of boson peaks and quasi-elastic scattering remained constant regardless of the region of origin and the collection, manufacture and use of the amber by the ancient people.

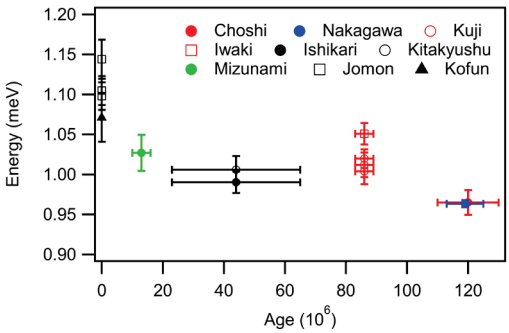

Figure 1. The boson peak positions relation to the geological age.

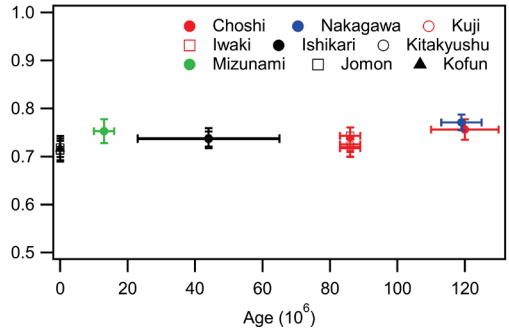

Figure 2. The ratio of boson peak area to quasi-elastic scattering.