

Object Number	K673	Description	Strip-mount in gold with garnet cloisonné decoration and one pointed end. Catalogue no. 553.
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	Sample Description and location.
	K673-1 collected from the bottom of an empty cell. Grey brown coloured crusty material.



Figure 1. Sample K673-1 collected from empty cell in top right corner.



Figure 2. Sample K673-1

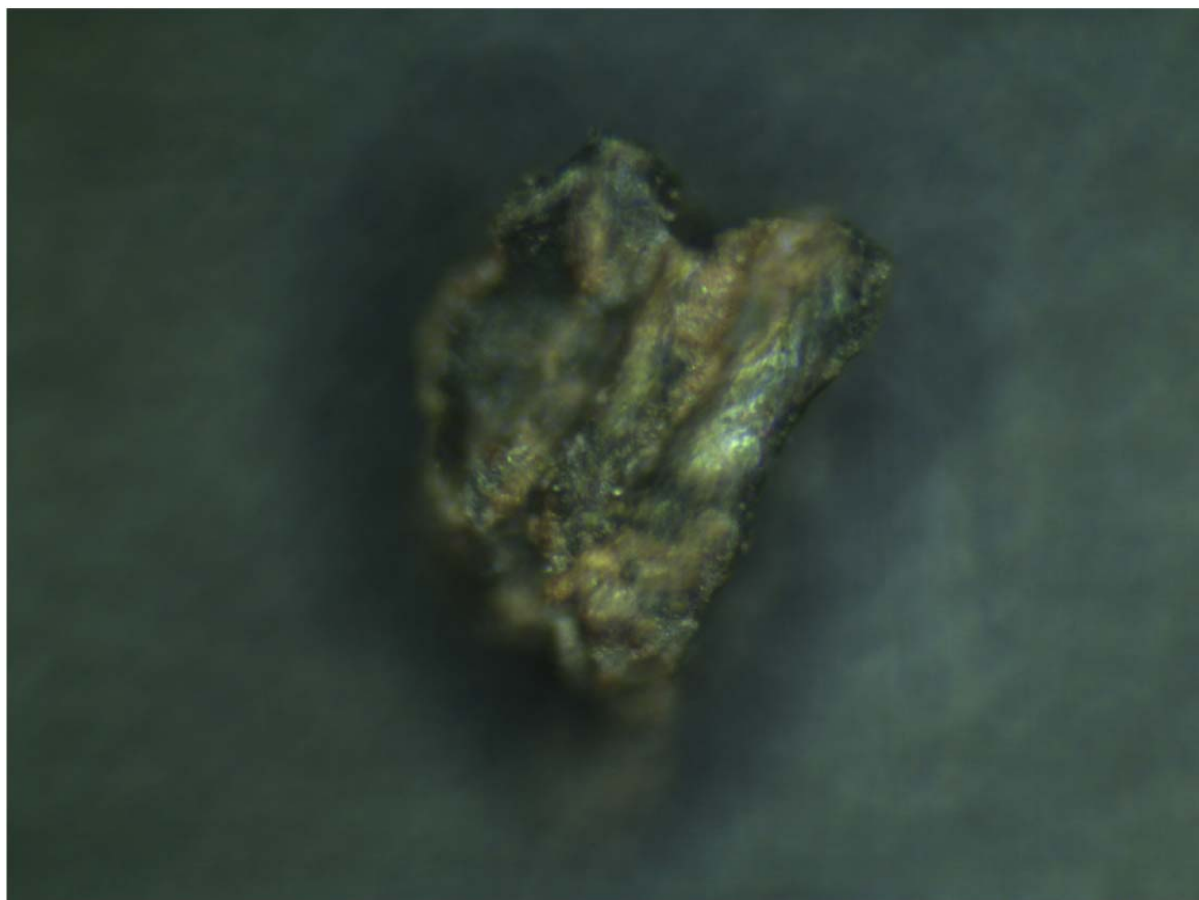


Figure 3. Detail showing FTIR analysis point for sub-sample K673-1-2

## FTIR Analysis

Comments: Spectrum K673-1-2 (top, blue) appears to be a deteriorated keratin based material such as horn or hoof glue. The FTIR spectra for keratinous materials exhibit characteristic bands for amide I (C=O stretching) between 1700 and 1600  $\text{cm}^{-1}$ , and amide II (CN stretching and NH bending) between 1560 and 1500  $\text{cm}^{-1}$ , and a broad band centred at around 3300 $\text{cm}^{-1}$  related to N-H stretching. A doublet between 3000 and 2800 $\text{cm}^{-1}$  relating to C-H stretching of methylene groups are characteristic of keratinous proteinaceous materials. (Welsch et al. 2012, Kennedy et al. 2013, Mansilla et al. 2011, Derrick et al. 1999). In oxidised keratinous materials such as the oxidised horse hair spectrum shown in Fig.4, an intense peak at about 1030 $\text{cm}^{-1}$  is attributable to S=O bonding in cysteic acid. (Welsch et al. 2012, Kennedy et al 2013, Mansilla et al. 2011). This peak should be interpreted with some caution in this sample however as silicate based material such as is found in earth minerals also exhibit a sharp band at approximately 1000 $\text{cm}^{-1}$  which relates to Si-O bonding. The peak at 1030 $\text{cm}^{-1}$  may derive from cysteic acid in oxidised keratinous tissue, silicate based earth minerals deliberately added to the paste or from the burial environment, or a combination of both.

The FTIR spectrum for beeswax is characterized by dominant absorption bands around 2950 $\text{cm}^{-1}$  and 2850 $\text{cm}^{-1}$  that relate to C-H stretching of the methylene ( $\text{CH}_2$ ) groups, a band at 1740 $\text{cm}^{-1}$  that relates to C=O bonding characteristic of the ester groups, a band around 1460 $\text{cm}^{-1}$  relates to C-H bending, and a doublet between 720 and 730 $\text{cm}^{-1}$  relating to non planar skeletal deformation vibrations of long chain hydrocarbons (Derrick *et al* 1999, Birshtein and Tul'chinskii 1977). The bands in the region 1350 - 1180  $\text{cm}^{-1}$  may be assigned to a phenomenon known as a 'band progression' present in fatty acids and fatty acid esters which result in a series of evenly spaced bands in this region. These are due to wagging and twisting vibrations of successive carboxyl coupled methylene groups (Baeten et al. 2010).

## Representative Spectrum

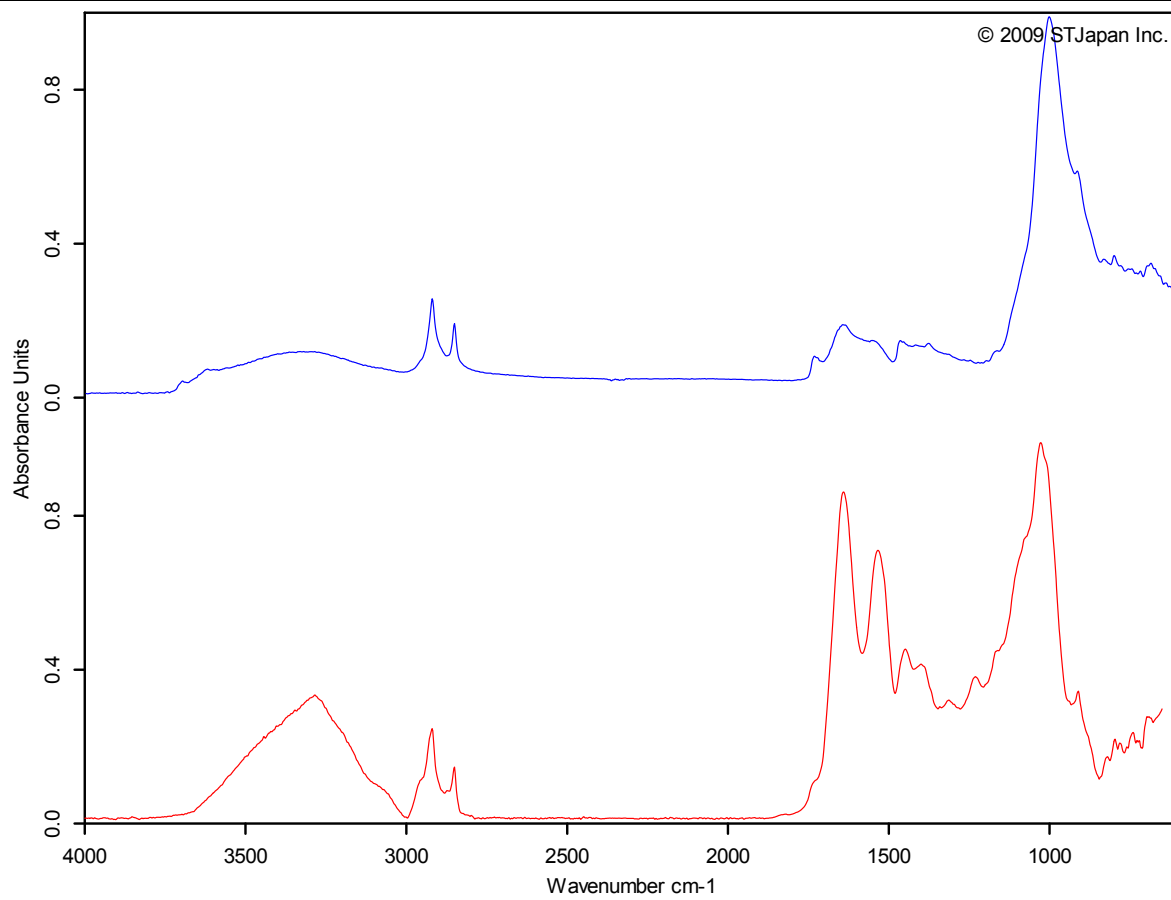


Figure 4. Top (blue) spectrum for K673-1-2. Bottom (red) Oxidised horse hair reference sample, ST Japan 2009.