

Object Number	K565	Description	Pyramid-fitting in gold with garnet and glass cloisonné decoration. Catalogue no. 577.
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Sample Description and location.

Sample K565-1 collected from material attached to inside wall of pyramid. Material is an off white crusty translucent material.

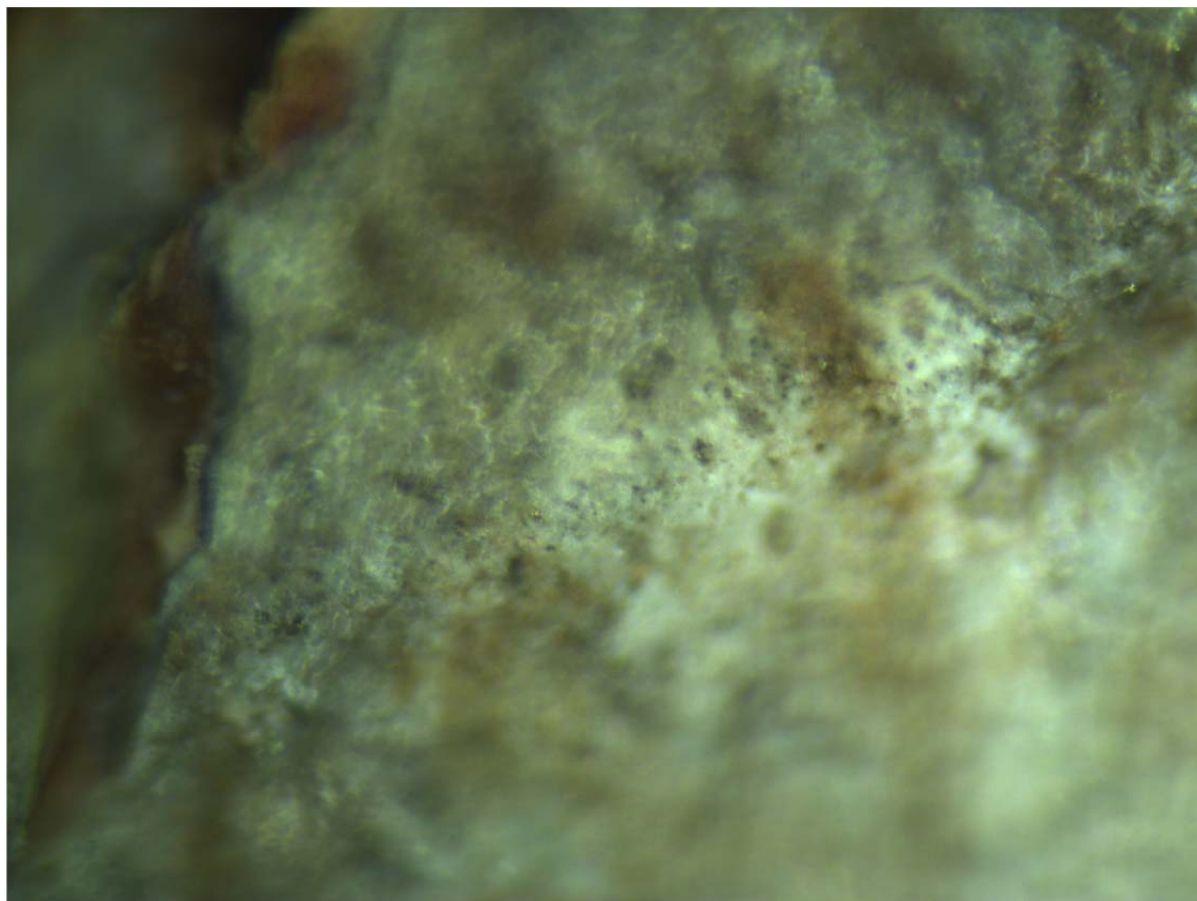


Figure 1. FTIR analysis point for sub-sample K565-1-3

FTIR Analysis

Comments: Spectrum K565-1-3 (top, red) is a close spectral match with the reference sample for calcium carbonate based lime plaster, (bottom, blue). Calcium carbonate is a complex inorganic compound that contains a calcium (Ca^{2+}) cation, and a carbonate (CO_3^{-2}) anion. Whereas most simple anionic compounds do not produce any vibrations in the mid-IR range, the carbonate ion is a covalently bonded functional group in itself, and undergoes internal molecular vibrations that occur within the mid-IR range. The attached cation has a slight impact on the position of the absorption bands for the complex anion, with heavier cations shifting the bands to a lower frequency, particularly at lower wavenumbers (Derrick et al 1999). Peak shifts to slightly higher wavenumbers than those known for calcium carbonate may indicate therefore the presence of magnesium carbonate within a sample.

Calcium carbonate shows a smooth symmetrical and broad absorption band from C-O stretching at about 1414cm^{-1} . Additional peaks at about 872cm^{-1} and 712cm^{-1} relate to C-O out of plane and in-plane bending within the carbonate ion respectively. Because few organic compounds have strong absorptions in this region, these sharp bands are very useful for confirmation and identification of carbonates in a spectrum (Derrick et al. 1999, Clark 1999, Trinkūnaitė-Felsen et al. 2012, Adler & Kerr, 1963). Splitting of the two lower wavenumber peaks indicates the presence of the aragonite crystalline phase in the calcium carbonate sample, whereas non-splitting indicates the calcite phase (Trinkūnaitė-Felsen et al. 2012). As aragonite transitions to the calcite crystalline phase at elevated temperatures (Balmain et al. 1999, Oates 1998) or over time in the presence of water (Oates 1998), the aragonite crystalline phase is not normally associated with heat processed calcium carbonate materials such as quick lime, lime putty or milk of lime. Additional bands such as the sharp band at about 1000cm^{-1} likely relate to Si-O stretching in silicates relating to clay mineral additives to the plaster mix.

Representative Spectrum

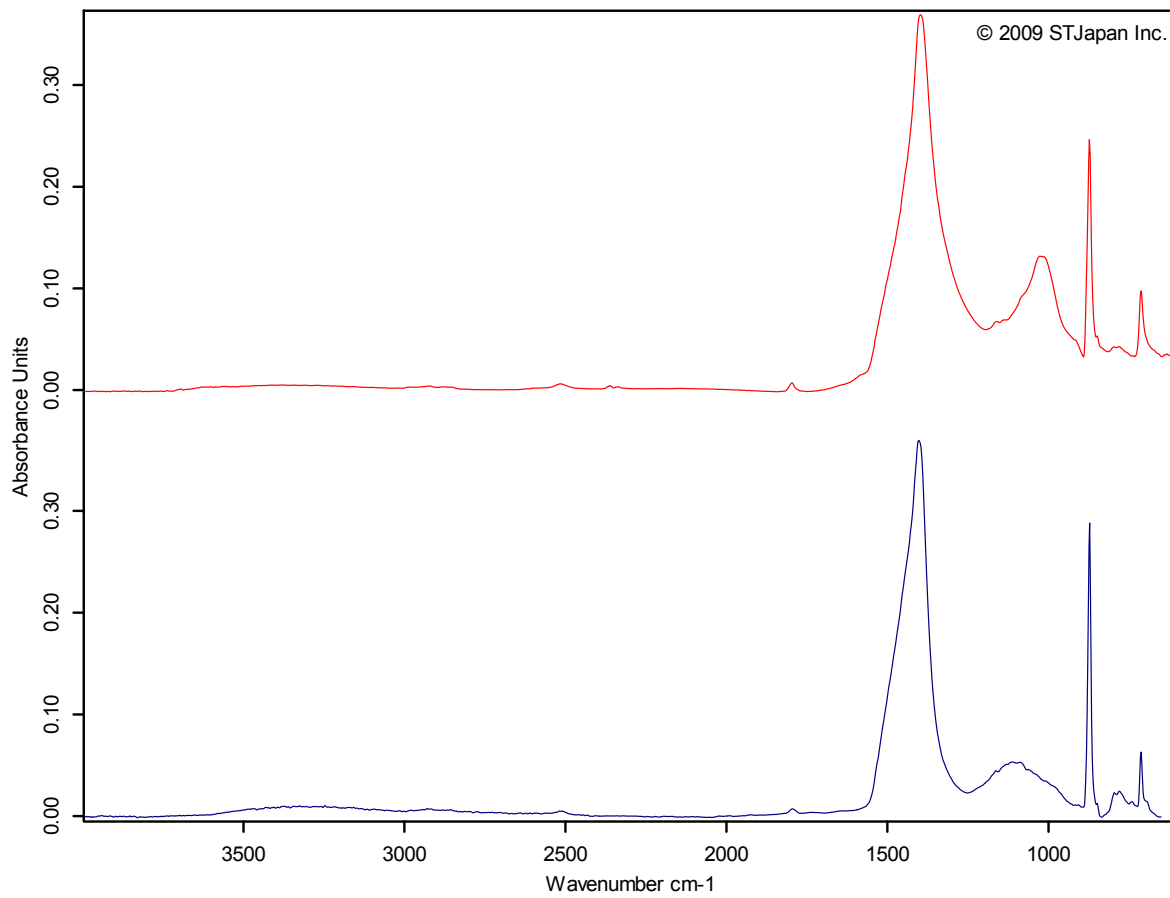


Figure 2. Top (red) K565-1-3. Bottom (blue), Lime plaster MVJ-1 Extra reference sample, ST Japan 2009.