Constituent Material Analysis of the Bamiyan Buddhist Wall Paintings in Central Asia
(1) : Using Synchrotron-based µFTIR, µXRF/µXRD Analyses

TANIGUCHI Yoko

Approximately 50 caves at the Bamiyan site, once a vast Buddhist monastic complex, were decorated with wall paintings between the early 5th and late 9th centuries AD. These wall paintings reveal a variety of cultural, technical and material influences from China, Iran, the Mediterranean, India and northern nomadic cultures. Minute painting samples were analysed at the European Synchrotron Radiation Facility (ESRF) in a collaborative research project using synchrotron-based µFTIR and µXRF/µXRD analyses in order to identify constituent materials (both organic and inorganic) and alteration products. Results derived from three samples presented the newly-discovered use of drying oils as binding media. These results were then studied from wider cultural interactions between the West and East along the Silk Road. Synchrotron-based analysis carries the advantage of having a high S/N and small beam size. Simultaneous analysis of SR-µXRF/ SR-µXRD combined with SR-µFTIR analysis enabled the individual analysis of multiple layers within paintings, even where layers were only a few µm thick. It also enabled the identification of each particle within such thin layers.

The Bamiyan wall paintings were made using the a secco technique, which involves applying organic binding media mixed with pigments onto earthen rendering layers. Oil painting techniques with a lead white ground appeared in Bamiyan after the mid-7th century AD. Fatty acids, resins, amid acids, and polysaccharides were detected within each layer. At this point in time, the wall paintings stand as the oldest example of oil painting techniques in the world. Some layers containing drying oils have changed into lead soaps. The presence of some metal leaves with yellowed varnish, as well as the usage of artificial pigments such as lead white and minium, suggest links with the ‘mecca’ technique of medieval Mediterranean art and the ‘mitsuda-e’ technique of Shōsōin, which shall be addressed upon reviewing wider cultural interactions between the East and West in the 7th century AD.

Key Words: Painting materials, multi-layered structure, SR-µFTIR, SR-µXRF/µXRD, imaging