

## **Ancient Japanese glass imported from Eurasia as revealed by on site XRF analysis.**

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Since glass is a synthetic material made by mankind, its chemical composition contains archeologically important information such as manufacturing period, manufacturing area, and manufacturing method *etc.* Glasses can be divided into several types depending on their chemical composition and information on the origin of the glass can be obtained by analyzing the glass. Since ancient glass is a valuable cultural property, a non-destructive analytical methods are often required in the analysis of glass such as X-ray fluorescent (XRF), EPMA, and LA-ICP-MS analyses. The authors developed a portable XRF spectrometer capable of quantitative analysis of Na and Mg, which are important composition of glass, and have analyzed a large number of glass at museums and excavation sites.

The origin of the glass was known as West Asia ca. 4000 years ago, and then gradually spread the Eurasian Continent. In particular, after the glass blowing technique was invented in Syria in the 1st century BC, glass was produced in large quantities as living necessities, and along with the expansion of the Roman Empire, it spread throughout the Asia through the Silk Road. It is said that glass spread to Japan around BC 3 C, and a large amount of glass beads are excavated as burial goods from the ancient tomb. Japan is geographically located at the end point of the Silk Road, and by examining the glass in Japan, you can learn the transition of glass in East Asia. The authors continue to analyze ancient glasses excavated in various parts of Japan from Hokkaido in the north to Kyushu in the south with the portable XRF spectrometer. In addition, we brought the XRF to China, Vietnam, India, Russia, Kyrgyzstan, Tajikistan, Turkey, Egypt etc., and analyzed the excavated glass to know the compositional change.

In overview of ancient glass distribution in Japan, around BC 3 C, lead barium (silica) glass and lead glass originating in China circulated, and potassium (silica) glass originating in Southeast Asia also circulated. After that, high alumina soda lime glass originating in Southeast Asia was excavated from the beginning of AD, and then soda lime glass was widely distributed to 7 C, all of which are imported. In Japan, high-lead glass containing 60-70% PbO was produced in the latter half of 7C when glass production from raw materials began. After that, in the Song Dynasty in China, a lead potash glass was developed and delivered to Japan. After that, Japanese glass is predominantly made of potash lead glass, and it continues to the Edo period.

Meanwhile, potash lime glass produced in China in Song Dynasty were distributed in medieval Japan. It is noted that due to the influence of isolation policy there was little variation of chemical composition of glass in the Edo period. However, in Hokkaido, glass is appreciated in the Ainu culture, so the distribution of potassium lime glass and potassium lead glass is observed characteristically. In the lecture, we will discuss the distribution of glass in East Asia while comparing these glasses excavated in Japan with the glasses in various regions of Eurasia.