Contribution ID: **2085** Type: **Oral**

Structural Analysis of Ancient Ceramics Using X-Ray Computed Tomography

Friday 31 October 2025 14:00 (15 minutes)

The work is devoted to the results of using X-ray computed tomography (CT) in studying the spatial arrangement, size distribution and shape of internal inclusions in several ceramic fragments from the Urysay complex in the Zhambyl district of the Almaty region of the Republic of Kazakhstan.
To study the internal structure of the samples, the X-ray computed tomography (CT) method was used. Measurements were carried out on a specialized IMAX microtomograph (PRODIS Compact), which is a shielded box 100 × 60 × 60 cm^3 with a Spellman XRB011 microfocus X-ray source. The tomograph operates both in 2D real-time fluoroscopy mode and in 3D tomography mode with a spatial resolution of up to 1 μm.
Based on the data obtained, segmentation of internal inclusions was carried out and the grain size of ancient ceramic samples was calculated. The analysis of the structural tomography data showed that the ceramic materials contain a large number of relatively small grains with an average diameter of less than 0.8 mm, while some ceramics had larger inclusions or grains with a diameter of more than 1 mm. In addition, large, small pores and cracks of different sizes exist in ancient ceramics. It was suggested that these large pores were formed as a result of temperature changes during the firing of ceramic ware. The relative shift of the Raman peaks in the carbon group in amorphous carbon, as an indicator of the firing temperature of ceramic materials, confirms this suggestion.

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Session Classification: Applied Innovation Activities

Track Classification: Applied Innovation Activities