Micro-Computed Tomography applied to the study of Japanese pottery

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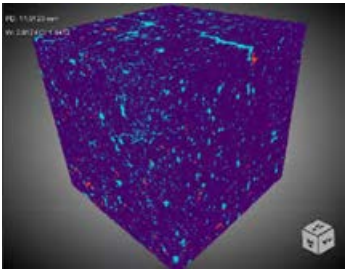
M. Magalini [(1)], L. Guidorzi[(1)], L. Vigorelli[(1,2)], R. Quaranta[(1)], E. Fissore[(1)], T. Nozaka[(3)], A. Seike[(4)], J. Ryan[(5)], J. Mitsumoto[(4)], N. Matsumoto[(5)], M. Gulmini[(6)], A. Lo Giudice[(1)] and A. Re[(1)]

(1) Physics Department, University of Torino & INFN - Sezione di Torino, via Giuria, 1, 10125 Torino, Italy
(2) DET, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129, Torino, Italy
(3) Department of Earth Sciences, Okayama University, 3-1-1 Tsushima-naka, Kita-ku, 700-8530 Okayama, Japan
(4) Faculty of Humanities and Social Sciences, Okayama University, 3-1-1 Tsushima-naka, Kita-ku, 700-8530 Okayama, Japan
(5) RIDC - Okayama University, 3-1-1 Tsushima-naka, Kita-ku – 700-8530 Okayama, Japan
(6) Department of Chemistry, University of Torino, via Giuria, 7, 10125 Torino, Italy



In the framework of the BeArchaeo European project, X-ray imaging has been applied to characterise pottery fragments from several Japanese archaeological sites: radiography for a first screening and Computed Tomography (CT) for a complete volume reconstruction, 3D rendering and segmentation. CT revealed to be useful to distinguish and visualize different characteristics of the sample, such as internal porosity (voids size and their directionality) and principal mineral components, that can give valuable information on manufacturing and execution techniques of the artifact. Usually, these results are obtained with a high spatial resolution in an invasive way by means of a Scanning Electron Microscope (SEM), while using CT similar results can be obtained non-invasively, even if with a lower resolution. For this purpose, tomographic acquisition of the central part of every sample was performed (Local Tomography) to reach the maximum possible resolution in the final CT reconstruction. A methodology for data processing has also been developed and tested, with a particular focus on the correction of the artifacts that could afflict CT analysis, the so called "ring artifacts". In the reconstructed volume, the various ceramics components are clearly visible with different grey levels according to the material density and composition. The grey level variations are in fact due to the different X-ray attenuation coefficient of the present elements and their atomic packing, giving an indication of the chemical composition. Higher density areas, composed of more heavy chemical elements, are visible as brighter areas, while dark areas indicate the presence of voids and porosity that extends over the entire investigated volume. Areas with an intermediate grey level represent medium density material, such as other types of minerals or inclusions and the ceramic matrix. The 3D visualization of the CT images is usually performed to qualitatively characterise the microstructure of the sample. In this case, threshold-based method for segmentation was used: grey levels correspondent to the different materials are separated and different colours are virtually assigned to each of them. Linking this information with the one obtained by the invasive techniques (petrographic examination, SEM-EDS, XRF, XRD etc..), it is possible to propose some correlations with different inclusions inside the fragments.

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