Multi-analytical non-destructive approach for the study of Iron Age swords from Torre Galli necropolis at UniCal STAR facility

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This work is focused on the diagnostic analysis of the collection of swords found among the grave goods of the Torre Galli necropolis (10th-9th century BCE), preserved at the National Archaeological Museum of Reggio Calabria.
In this site, the military organisation played a leading role in male society and swords were symbols of political power of few family heads. The Torre Galli necropolis is widely regarded as one of the most significant archaeological sites for understanding Iron Age civilization in the Italian Peninsula.
The main aim is to characterize the constituent materials of the analysed swords to determine their composition, manufacturing techniques, and state of preservation. The artifacts have been subjected to diagnostic investigations carried out using non-invasive and/or micro-invasive techniques such as μ-Raman spectroscopy**,** X-ray fluorescence (XRF)**,** X-ray tomography**,** 3D scanning and colorimetry.
The ongoing analyses have enabled the identification of both inorganic and organic materials, including iron, bronze, bone, and wood, along with the recognition of degradation phenomena.
The project also includes the development of innovative virtual restoration**,** exhibition**,** and integrated valorisation strategies for the artifacts.

Fig.1: A sword from the Torre Galli necropolis.

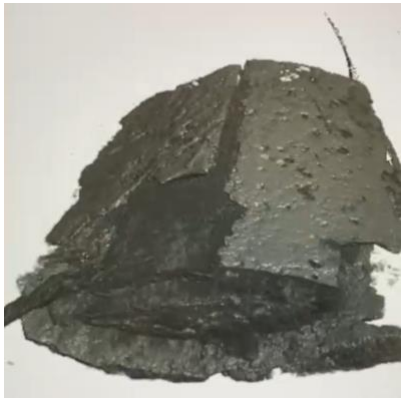
Fig.2: Volume rendering, obtained by X-ray tomography, of a portion of the sword shown in Fig. 1.

These research activities are carried out at STAR (*Southern Europe Thomson Backscattering Source for Applied Research*), a public national research infrastructure, with European projection, dedicated to advanced X-ray and non-invasive diagnostic technologies. This enables the application of analytical traditionally available only at large-scale facilities, while offering significantly lower costs and a more compact instrumentation.
At STAR, microtomography and X-ray microscopy systems, combined with non-contact 3D reconstruction techniques such as laser scanning and photogrammetry, provide non-destructive three-dimensional imaging of both the internal structure and external morphology of samples ranging from a few millimetres to several tens of centimetres, achieving spatial resolutions down to the sub-micrometre scale.