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Multi-analytical characterization of archaeological ceramics. A case study from the Sforza Castle (Milano, Italy).

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The aim of this work was the characterization, using several analytical techniques, of a sample of ancient pottery found during archaeological excavations in the 14th century
ś Sforza Castle in Milano.
The use of a multi-analytical approach is well established in the study of archaeological materials (e.g. Tite et al. 1984, Ribechini et al. 2008).
The chemical composition of the sample was determined with X-ray fluorescence spectroscopy. The chemical composition is: SiO2 61.3(±3)%, Al2O3 22.5(±2)%, Fe2O3 7.19(±6)%, K2O 3.85(±1)%, MgO 1.6(±1)%, Na2O 1.6(±4)% (probably overestimated), TiO2 1.02(±2)%, CaO 0.93(±1)%, MnO 0.15(±1)% and P2O5 0.06(±2)%. The K2O content, important when dealing with TL dating, was determined also with atomic absorption spectrophotometry. The K2O content determined with atomic absorption is 3.86(±3)%, in agreement with X-ray fluorescence analysis.
The mineralogical composition of the sample was determined with X-ray powder diffraction: quartz 59.6(±1) wt%, mica 37.8(±3) wt% and feldspar (plagioclase) 2.6(±2) wt%.
The sample homogeneity was assessed with X-ray computerised tomography (CT), which is a very powerful non-destructive analysis tool for 3D characterization (Sèguin, 1991). CT images show differences in materials with different X-ray absorption (mainly depending on different densities) and 3D reconstruction has many interesting archaeological applications (e.g. study of sealed jars). CT images of the studied sample showed the presence of angular fragments (probably quartz) few millimetres wide immersed in a fine grained matrix.
Moreover, before and after the CT analysis, some ceramic powder was sampled to perform thermoluminescence analysis (TL, the powder used for this analysis can not be recovered). It was thus possible to evaluate the dose absorbed by the material due the X-ray irradiation. The dose absorbed after 3 hours of irradiation, the time needed for a complete scan of a 7 x 5 x 1 cm, is about 100 Gy, which is a very high value compared to those usually measured in TL analysis of non-irradiated samples. This has to be taken into account when planning CT and TL analyses on the same sample.

References

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