

# Re.S.Artes

Le Regard de la Science sur les Arts et le patrimoine culturel

## Thermoluminescence authenticity test for objects of Art: some elements of understanding

Thermoluminescence analysis of terracotta objects (ceramics, earthenware,...) allows to evaluate when was performed the last firing of the material at a temperature of about 500°C or more. This information corresponds, *a priori*, to the time of manufacturing of the object.

**For authentication purpose, it is possible to know the maximum age of an object and to assess its compatibility with the presumed antiquity of its shaping.**

This is a complementary approach to the stylistic study of works: it provides objective information that comes support (or refute) the point of view of the expert.

In some cases it will be also necessary to perform a CT scan or an X-ray imaging in order to confirm the homogeneity of the piece and to extrapolate the thermoluminescence results to the whole object.

### Principle

Thermoluminescence analysis of terracotta is based on the ability of crystals to emit light (luminescence) when heated (thermo-). The intensity of this emission depends on two parameters: the radioactivity of the environment in which the crystals are kept and the time during which they are subjected to this irradiation.

The timer is reset each time the crystals are heated (typically at a temperature of over 500°C). Then this technique allows to estimate the time of the last firing.

**To measure the natural thermoluminescence of the terracotta allows to determine the time interval elapsed since the last heating.**

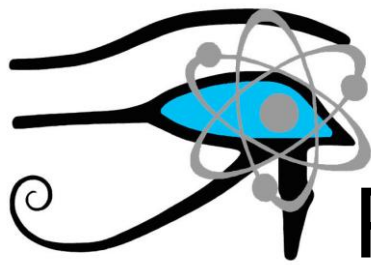
### Measurements

Two terracotta samples are extracted from the piece by drilling. After chemical treatment, the samples are in the form of a polycrystalline powder deposited on metal discs.

Thermoluminescence experiments consist on heating the crystals to 500°C and recording the intensity of the luminescence thus released. Then by comparison with signals generated by known radiation doses, in the field of homothety of curves so-called "plateau", we obtain an estimate of the irradiation dose accumulated in the crystals since their last heating (ED value).

For objects out of archaeological context, for which the burial or conservation environment is unknown, we proceed by hypothesis concerning the intensity of the suffered radioactivity, from values most commonly measured on site. We obtain an estimate of the age of the last heating, which is considered as consistent or not with that presumed for the studied object.





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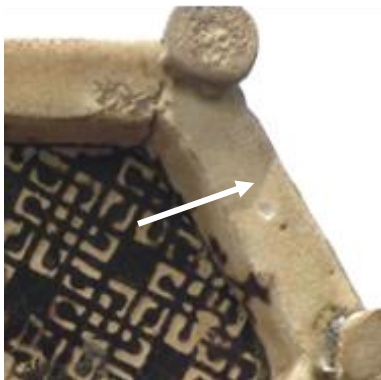
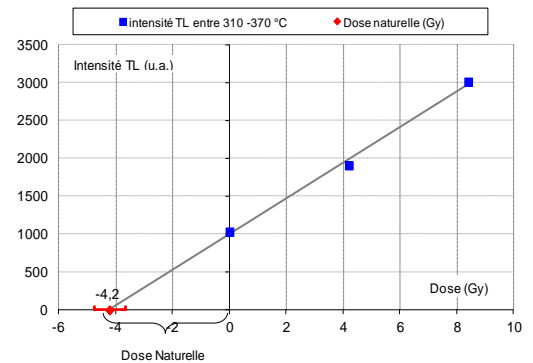
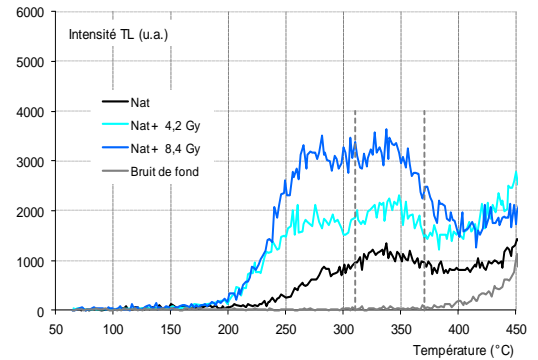
## Two examples



**Terracotta sculpture, Africa  
presumed from 11<sup>th</sup> – 16<sup>th</sup> centuries AD**

The intensity of the natural thermoluminescence (black curves) and the material behavior towards irradiation (blue curves) indicate that it was anciently fired. The age of the last heating can be estimated at **900 ± 100 years old, corresponding to the range [1010 – 1210] AD.**

*This result confirms the attribution style of the sculpture.*



**Glazed terracotta sculpture, Europe,  
presumed from 16<sup>th</sup> century AD**

The constituent terracotta of the object has a thermoluminescence signal of very low intensity (black curves). This is characteristic of a recently heated material.

*The object was shaped during the 20<sup>th</sup> century AD.*

