Artemis Testing Lab

THERMOLUMINESCENCE REPORT

February 10, 2021

Item 162730

Results of Analysis:

Estimated age: 1050 years old (+/- 200)

686 S Taylor Ave, Ste 108, Louisville, CO 80027 / USA --- 303.325.5203, info@artemistestinglab.com --- **www.ArtemisTestingLab.com**

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Report on Thermoluminescence Authenticity (TL) Test - Item 162730

Object: Pottery Shard w/ Corrugated Pattern

Origin: Iowa, USA

Drill Sampling:

Sampling conducted by Artemis Testing Lab

Sample 1: Flat side

Sample 2: Side with lines

Analysis Results:

Based on the testing results, we conclude this object was last fired 1050 years ago (+/- 200).

The enclosed graphs form a constituent part of the expertise and reflect only excerpts from the complete catalogue of measurements. While the results are given in good faith, Artemis Testing Lab assumes no responsibility or liability for any financial loss incurred through erroneous results.

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Serge Fayeulle, PhD

The expertise is only valid if accompanied by the signature of Serge Fayeulle. Only the original report may be considered valid. If you are presented with a copy, please contact Artemis Testing Lab at 303.325.5203 for confirmation of its contents.

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Thermoluminescence method

Samples of pottery, when heated to temperatures between 250°C and 500°C, emit a small amount of light. This physical effect is known as thermoluminescence (TL). The amount of light is directly proportional to the age of the piece: the older the pottery, the more light that is emitted. Thermoluminescence provides a scientific method with which the art community can authenticate ancient pottery and give a rough estimate of the age of the artifacts.

The physical mechanism responsible for the light emission is the release of energy trapped in the pottery material. This energy results from the absorption of radiation by the pottery material and its environment (mainly uranium-238, thorium-232, and potassium-40). The initial heating (the firing of the clay when the pottery was fabricated and subjected to heat for the first time) brings the energy level present in the artifact down to zero. From the moment of that reset, the pottery begins to accumulate energy again. The amount of this energy, directly proportional to the time until the next heating occurs - in our laboratory - creates the thermoluminescence effect that we measure with specialized equipment.

The thermoluminescence measured as a function of the temperature is called the glow curve. Typically, to convert the TL signal to equivalent radiation energy, the samples are exposed to a calibrated radioactive source and the glow curve of the irradiated samples is compared to the glow curve of the non-irradiated samples. The calibration sources are an alpha source (americium-241 or curium-244) and a beta source (strontium-90). An approximate age of the sample can be calculated from the equivalent radiation dose and the amount of radiation the pottery received each year after the initial firing.

Additive method
The thermoluminescence is measured as a function of the temperature, from room temperature up to 500°C, for a first sample before irradiation (this is called the natural state). Other samples from the same piece and same sampling location are exposed to a calibrated radioactive source and the glow curve of the irradiated samples is also measured. It can then be compared to the natural state glow curve to calculate the age of the piece. Typically, three irradiation doses are used in the range 0 to 50Gy. The uncertainty on the calculated age is generally around +/- 20%.

Sampling:
Our sampling procedure is informed by the latest scientific literature. Multiple (usually two, but dependent on source) sample sites on each piece are chosen after careful examination of the surface for signs of repair or restoration. These surface sites are gently cleaned using H2O and then sampled in a room with a light source between 555-630 nm. Approximately 50-200mg of sample material are extracted from each sample site using a 2mm carbide drill bit operated at low speeds. The sample material is immediately sealed in aluminum foil and the drill bit is thoroughly cleaned after each sample site extraction.

Artemis Testing Lab Environment:

TL-System:
Freiberg Lexsyg Smart

Filter:
Schott BG39-BG25-KG3

Beta-Source
Sr90-40 mCi – 0.115 Gy/s

Alpha-Source
Cm244 – 0.5 mCi

Working Method
Fine Grain Sedimentation after treatment in methanol
Multi Aliquot Aging Determination
Measurements carried out in nitrogen

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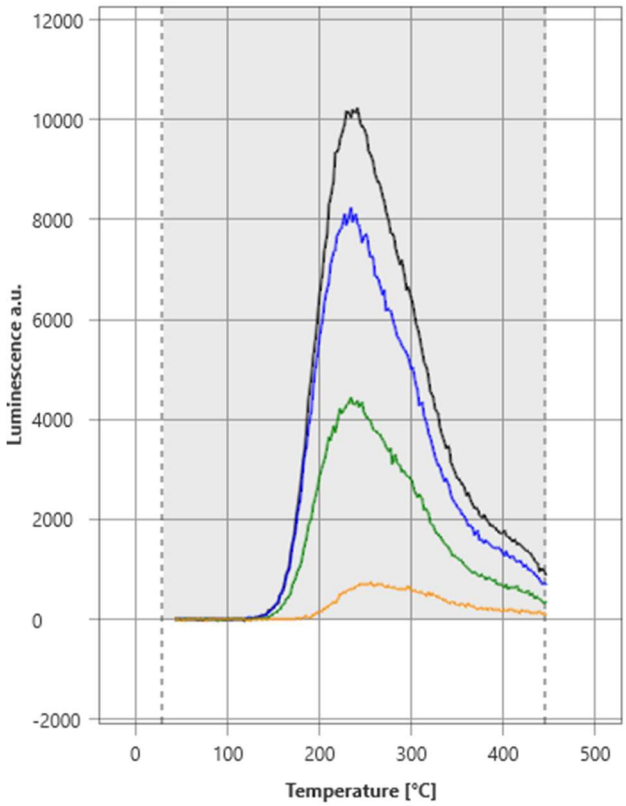
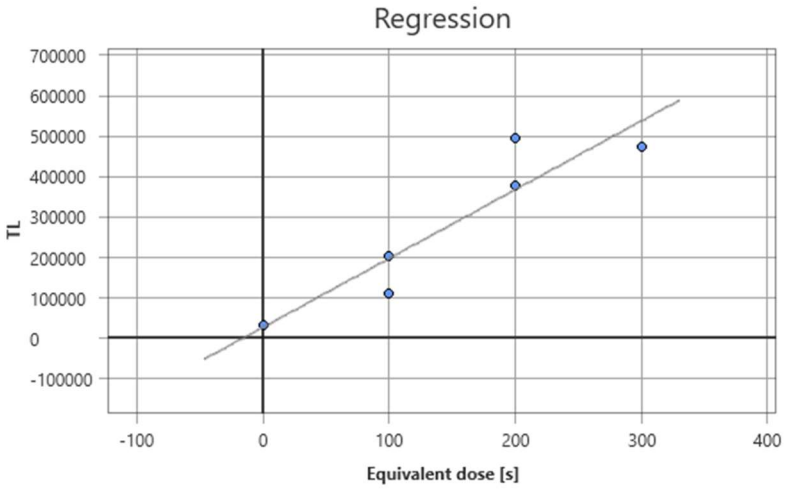
Data and analysis for Item 162730



Glow curves for Natural Sample (orange curve), and after irradiation for Sample 1
Green: 11.5 Gy, Blue: 23 Gy, Black: 34.5 Gy



Additive growth curve for Sample 1:
Equivalent dose is given as 1.8 +/- 0.4 Gy

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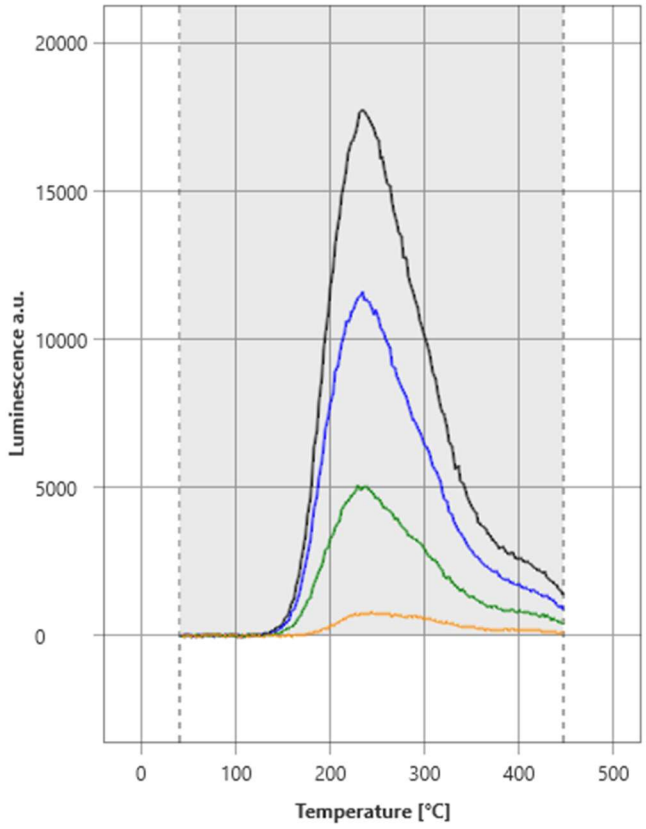
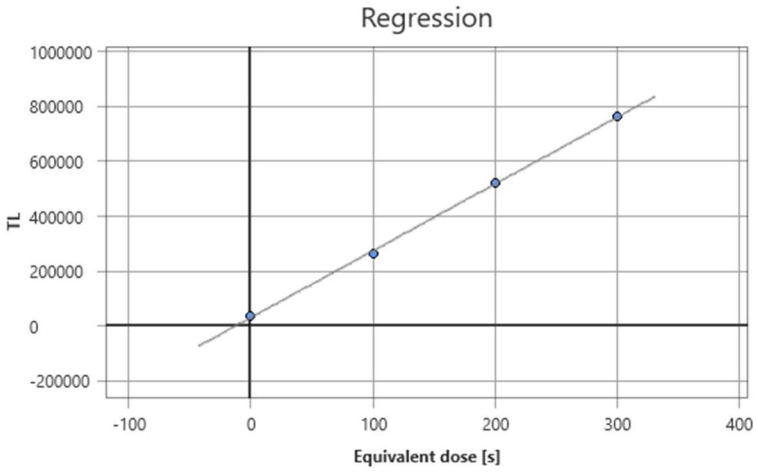


Glow curves for Natural Sample (black curve), and after irradiation for Sample 2
orange: 11.5 Gy, Green: 23 Gy, Blue: 34.5 Gy



Additive growth curve for Sample 2:
Equivalent dose is given as 1.5 +/- 0.1 Gy

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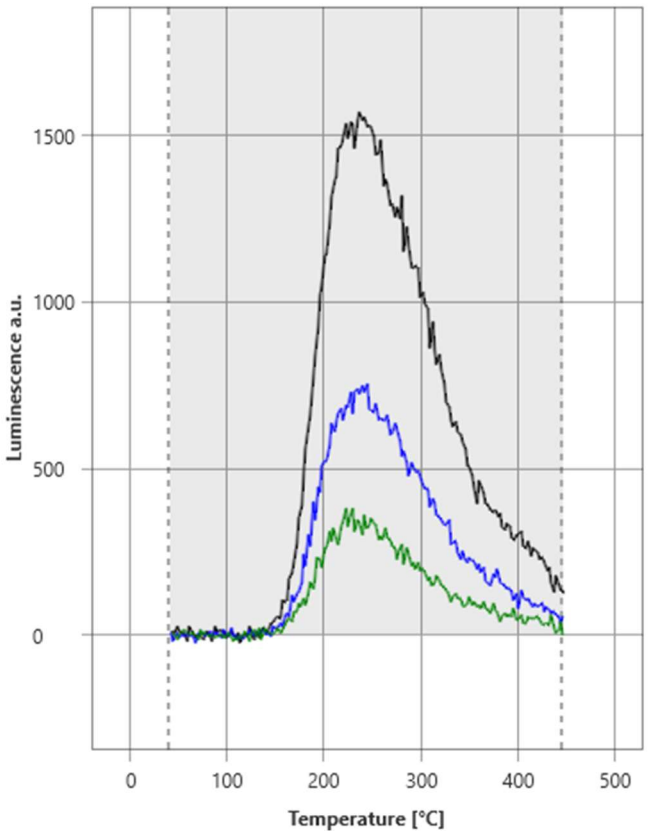
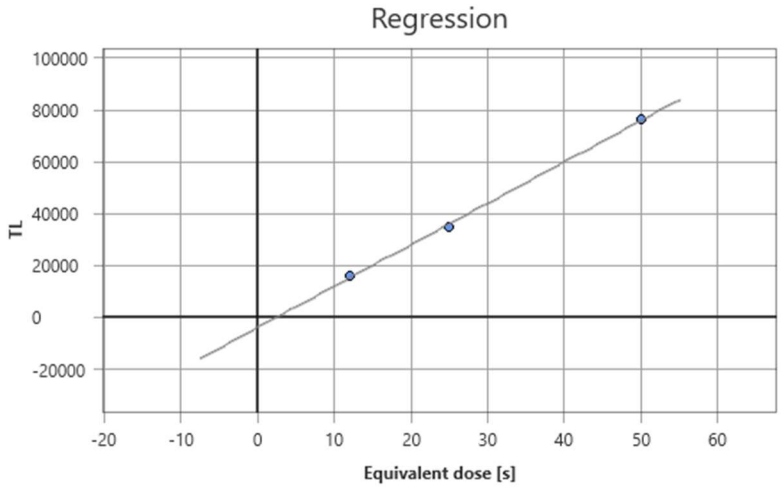


2nd glow curve for Item 162730
(green: 1.45 Gy, Blue: 2.8 Gy, Black: 5.75 Gy)



2nd glow curve:
Equivalent dose is given as 0.2 Gy

Based on the testing results, we conclude this piece was last fired 1050 years ago (+/- 200).

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