ABSTRACT

The OSL (optically stimulated luminescence) dating method exploits dosimetric properties of grains of minerals naturally occurring in sediments and man-made materials.

In archaeology the OSL method is used to date pottery and other heated materials (e.g., bricks, stones, earth) or sediments related to archaeological finds. The significant improvement of the OSL dating method in recent years makes it applicable to objects ranging in age from 0 to 150 000 years (in some cases to 300 000 or more) with a typical accuracy between 5 and 10%. When compared with the radiocarbon method it makes possible dating objects containing no organic matter or originating in periods for which the radiocarbon method is less accurate due to the shape or lack of the calibration curve.

This paper discusses the details of recent advances in the method and several examples of its application to material from archaeological excavations of Medieval to Palaeolithic sites.

Key words: chronology, luminescence, dating, radioactive dose, archaeology, pottery

INTRODUCTION

The OSL (optically stimulated luminescence) dating method exploits dosimetric properties of grains of minerals naturally occurring in sediments and man-made materials (Huntley et al., 1985; Aitken, 1998). Energy of ionising radiation released by natural radioisotopes is absorbed and stored in the crystal lattice of minerals. It may be released in the form of light (luminescence) upon heating or excitation with visible or infrared light. The amount of luminescence depends on the absorbed dose of radiation and thus enables assessment of the dose. In certain circumstances the dose absorbed per year is stable through time and may be estimated based on spectrometric measurements of radiation emit-
ted from the dated object and, if necessary, from the soil surrounding it. Thus it is possible to calculate the time during which the absorbed dose was accumulated. The time calculated in this way equals an age of a dated object if mineral grains were reset at the time of the object’s origin. The most important factors resetting the crystal lattice of mineral grains, that is zeroing the measured luminescence and absorbed dose, are elevated temperature higher than ca 450 – 500°C, and exposure to sunlight. It practically means that the OSL method dates the last heating or the last light exposure of mineral grains, narrowing the range of datable objects to ceramic (or similarly fired materials) or sediments containing grains that were exposed to light during or prior to sedimentation.

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**PHENOMENON OF LUMINESCENCE**

Light emitted by any source is either incandescence or luminescence. This is due to the definition of these physical terms. Incandescence is the emission of light by a hot object. On the contrary, luminescence is the emission of light by sources other than a hot, incandescent body. For this reason it is sometimes referred to as cool light. It is caused by transitions of electrons within a substance from more energetic states to less energetic states. Several types are quite common: chemiluminescence, electroluminescence, and triboluminescence, which are produced, respectively, by chemical reactions, electric discharges, and the rubbing or crushing of crystals.

Incandescence is thermal radiation, and is emitted at the expense of internal (thermal) energy of the hot body, and obeys the general principles of thermodynamics.

Luminescence is radiation emitted through entirely different mechanisms and its spectrum reflects electronic properties of the emitter. For example, spectrum (colour) of light emitted by popular electroluminescence diodes (LED) depends on the semiconductor material and on impurities it was doped with during manufacturing. Energy emitted as luminescence comes from sources other than thermal energy of the emitting body. Depending on the type of energy converted into light we may refer to luminescence under different names. Table 1 gives the most common types of luminescence.