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Establishing maximum temperatures attained during building fires with thermoluminiscence

Miguel Gomez-Heras (1,2) and Jorge Sanjurjo Sánchez (3)

(1) Universidad Complutense Madrid, Spain (mgh@geo.ucm.es), (2) Instituto de Geología Económica / Instituto de Geociencias (CSIC-UCM), Madrid Spain., (3) Instituto Universitario de Xeoloxía "Isidro Parga Pondal", Universidade da Coruña, Spain.

It is not uncommon when looking back at the weathering history of a building to find fires as a part of this history. Fire is not only one of the main catastrophic weathering agents for building stone, but it also has signification as it can be the result of relevant historic events, such as wars. Dating fires and knowing the maximum temperatures attained by rocks during them is important to understand the level of damage a fire could cause in the past and how it affected to the subsequent weathering history after the fire. This information is also useful from the historical/ archaeological point of view as it could offer insights on the causes that promote fire, possible sources, fuels, etc. Laboratory tests have been carried out for this communication to assess the maximum temperature reached by rocks during past fires. The thermoluminescence (TL) sensitivity of quartz has been measured for this purpose as it is strongly influenced by firing at high temperatures. Such property has been used to distinguish burnt from unburnt archaeological quartz pebbles and to measure the firing temperature of ancient pottery and concrete structures. The TL glow curve of quartz shows three main peaks located at 110, 250 and 350ºC. The sensitivity of such peaks can be increased if some temperatures are reached during the firing of quartz. Thus, maximum temperatures of fires can also been assessed in the case of stony building materials containing quartz. Tests were made on 'Uncastillo sandstone', which is a calcitic sandstone with a variety of quartz grain types (mono, policrystalline and chert). 'Uncastillo sandstone' has been used continuously from Roman times onwards in the region of Saragossa (Spain) and there are numerous examples of fired heritage buildings constructed with this stone type. This brown sandstone shows intense discolouration after fires and therefore facilitates to identify areas fired in the past. 5cm cubes were heated in an oven at different temperatures from 100ºC to 1000ºC (in 100ºC steps) for 3 hours. Quartz grains were obtained from cubes by crushing, sieving and chemical etching. After TL measurements to record the zero dose reading, quartz grains were irradiated with different beta doses and the TL curves were measured. The different sensitivity changes in the 110, 250 and 350ºC peaks of the TL curves were measured. The changes were compared considering the temperatures reached during heating in oven.

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