

Investigating the effects of lightning on cultural heritage: Characterization of the resulting fulgurite

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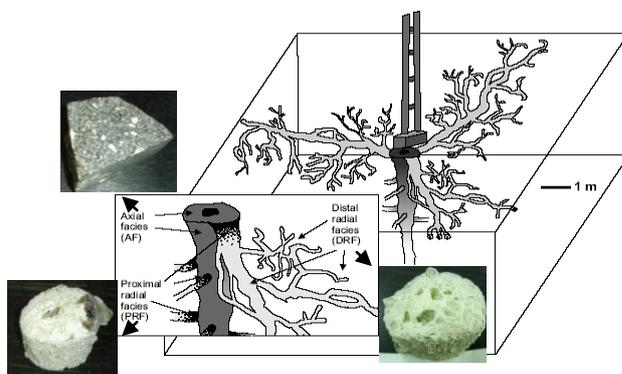
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On average, about 100 lightning discharges occur every second on the Earth. When lightning strikes soil, sand or rock, the high temperatures reached (about 30.000 °K) promote the formation of melted glass tubular structures known as fulgurites. In the case referred here, lightning stroked a soil (granitic sand plus angular stones of thick-grained two-mica granite) and allochthonous materials supporting the platform of an electric tower. The intense melting produced a cylindrical rod, from which, as if they were roots of a tree, several bifurcating horizontal and subhorizontal branches of decreasing thickness were attached (see figure below).

A macroscopic description of a sample of the so formed fulgurite allowed the definition of several vitreous facies: axial, proximal radial and distal radial. These different vitreous facies were examined with a range of techniques. Laser induced breakdown spectroscopy and X-ray fluorescence were used to assess the changes in the elemental composition of the original material; colorimetry was employed for the quantification of color changes and mercury intrusion porosimetry for differences in porosity (total, micro and macro-porosity). Other petrophysical properties were also determined such as bulk density and open porosity or porosity accessible to water. The obtained results indicate that the composition, based in that of the original material, varies from the center to the external area due to melting.

Although damage of lightning on built cultural heritage is frequent, fulgurites are no so frequent to find, therefore this study allows the investigation and characterization of the effects of this natural phenomenon on built of cultural heritage.



The benefit of this study, and in general, of the characterisation of fulgurites materials to curators, restorers and conservators, is on the one hand, to know the properties of these materials as museum objects, and on the other hand, to have an approach on the changes induced by lightnings on architectural heritage.

Scheme of fulgurite specimen with different bifurcating branches.