EGU2020-11609
https://doi.org/10.5194/egusphere-egu2020-11609
EGU General Assembly 2020

Fossil plant remains preserved as charcoal within proximal ejecta blankets of impact craters reveal the influence of asteroid collisions with the Earth's surface

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Impact craters are formed when an asteroid strikes the surface with the hyper-velocity (usually higher than ~1km/s). The kinetic energy of the impactor is released as an explosion, a crater is formed, and target material is deposited outside, forming a proximal and later distal ejecta blanket. This consists of rocks, the surface soil layer and numerous plants remains (Cassidy et al. 1965, Khryanina 1981, Herd et al. 2008), including remains of trees directly killed by the asteroid (Losiak et al. 2016, Losiak et. Al. 2020). We have found a number of charcoals that we suggest are related to the formation of the following confirmed impact craters: Kaali Main, Kaali 2/8 (Estonia, Losiak et al. 2016), Morasko (Poland, Szokaluk et al. 2019), Whitecourt (Canada, Herd et al. 2008) and Ries crater (Buchner and Schmieder 2009). Three of these locations represent small (30-100 m in diameter) impact craters developed primarily in unconsolidated materials such as glacial tills and fluvioglacial sands. Whereas, Ries is a much larger and older crater: it is 24 km in diameter and 14.5 Ma old.

Here we present the results from a set of experiments that reproduce the process of formation of charcoals within the proximal ejecta blankets of small impacts. Firstly, charring experiments were achieved using the iCone Calorimeter that recreated a range of heating possibilities that might results from small impact cratering processes. The iCone allows samples to be heated, with or without ignition at a range of radiant heat fluxes for given durations; these heat fluxes can be static or transient, both of which may be relevant to different impact formation mechanisms. Secondly, we buried leaves and fragments of different woods in heated sand over a range of temperatures durations and cooling regimes to assess the potential for relatively cool ejecta to cause transformations of organic material to char in situ. All the chars created in the experiments were analysed via reflectance microscopy and compared with the charcoal that have been produced by modern wildfires. Our aim being to better understand the environmental effects of differently sized impact craters, but also to study the mode of preservation of plants killed during such extraterrestrial impact events.

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