Shock-darkening in ordinary chondrites: impact modelling

J. Moreau[1]*, T. Kohout[1,2] and K. Wünnemann[3]

[1]*Department of Physics, University of Helsinki, P.O. Box 64, 00014 Helsinki University, Finland*
*(*correspondence: julien.moreau@helsinki.fi)*
[2]*Institute of Geology, The Czech Academy of Sciences, Prague, Czech Republic*
[3]*Museum für Naturkunde, Berlin, Leibniz Institute for Evolution and Biodiversity Science, Invalidenstraße 43, 10115 Berlin, Germany*

LL ordinary chondrites of the Chelyabinsk meteorites show characteristics of shock-darkening in the retrieved samples (Kohout *et al.*, 2014) associated with partial melting of iron metal and sulphides. Our aim is to come up with a model to map the pressure-temperature (p-T) conditions under which Fe-Ni metals and iron sulphide begin to melt, leaving olivine grains in a solid state. To do so we use the iSALE-2D shock physics code (Wünnemann *et al.*, 2006). Fig. 1 shows theoretical peak-pressures, post-shock temperatures and melt distribution after a 5 km/s impact shock-wave, through a sample made of forsterite and iron grains, from the top. These observations rely on strength models as well as chosen equations of state.

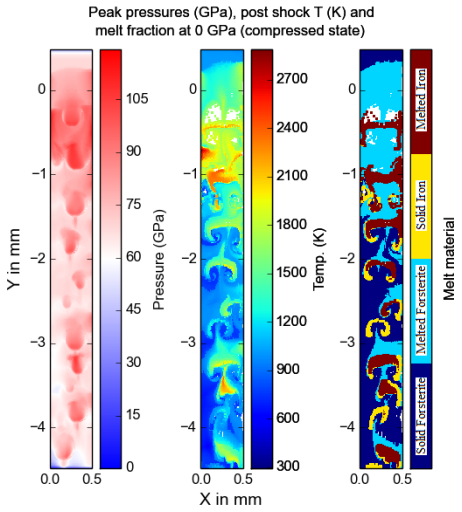

Figure 1: Section of a mesoscale simulation after a 5 km/s impact shock-wave on a sample made of forsterite with iron inclusions. Peak-shock pressures, post shock temperature and resulting melt fraction are shown.

References:

Kohout T., et al., 2014. Mineralogy, reflectance spectra, and physical properties of the Chelyabinsk LL5 chondrite – Insight into shock-induced changes in asteroid regoliths. Icarus, Vol. 228, pp. 78-85.

Wünnemann, K., et al., 2006. A strain-based porosity model for use in hydrocode simulations of impacts and implications for transient crater growth in porous targets. Icarus, vol 180, pp. 514-527.