REVISITING FIRES AT THE K-Pg BOUNDARY.

J. Morgan[1], N. Artemieva[2,3], C. Belcher[4], T. Goldin[5] and Elisabetta Pierazzo[2]. [1]Imperial College London. E-Mail: j.morgan@imperial.ac.uk [2]Planetary Science Institute. [3]Institute for Dynamics of Geospheres, Moscow. [4] Univ. of Vienna. [5] Univ. of Edinburgh.

Introduction: The discovery of large amounts of soot in K-Pg boundary clays led to the hypothesis that there were major wildfires at the K-Pg boundary [1,2]. Impact generated fires could be ignited in two ways: through the fireball for distances of up to 3000 km [3] and globally through the re-entry of hypervelocity ejecta [4]. Models of the latter have assumed a particular velocity and mass flow for the re-entering ejecta [4, 5]. In our new simulations we model the entire process, starting with the ejection of material from Chicxulub and ending with these ejecta re-entering the Earth's atmosphere. We have also reviewed the evidence that has been used to argue against the global wildfire hypothesis [6,7], including the lack of charcoal and relative abundance of uncharred material in K-Pg boundary sites in North America.

Method: We simulate the Chicxulub impact with the 3D hydrocode SOVA [8] complemented by the ANEOS equation of state for geological materials [9]. With SOVA, we model: 1) the impact and initial ejection of material and 2) the ballistic continuation of ejecta on a spherical earth until the ejecta arrives at the top of the atmosphere [10]. We then use the 2D two-phase fluid flow code KFIX-LPL to model the atmospheric re-entry of ejecta [5] and the thermal pulse delivered to the Earth's surface. We have modeled the ejection of material for two impact angles, 45° and 60°, and calculated the associated thermal pulse at 2000-2500 km and 7000-8000 km from Chicxulub. These distances correspond to the southern USA and Europe – locations where there is a wealth of observational data.

Results: When sedimentation rates and dilution of charcoal with other ejecta material are taken into account, the K-Pg boundary record in North America may be consistent with local wildfires. Some fires at, or shortly after, impact appear to be required to explain the large mass of soot in the global K-Pg layer. The thermal pulse delivered to the surface depends on radiating temperature of the ejecta and the opacity distribution of the atmosphere and thus is strongly dependent on re-entry velocity, spherule size and mass flow of ejecta, and these change with angle of impact and direction (downrange, uprange, etc.). The thermal pulse (> 20 kW/m^2) in the downrange direction at sites up to a few thousand kilometers from Chicxulub may be sufficient to ignite fires, but is less severe (< 20 kW/m^2) for distal sites and in other directions. Our results suggest that ejecta re-entry ignited some wildfires, but did not instantaneously ignite fires globally.

References: [1] Wolbach W. et al. 1985. *Science* 230: 167-170. [2] Wolbach W. et al. 1990. *GSA special paper* 247: 391-400. [3] Shuvalov V. and Artemieva N. 2002. *GSA special paper* 356: 695-703. [4] Melosh H. et al., 1990. *Nature* 343: 251-254. [5] Goldin T. and Melosh H. 2009. *Geology* 37, 1135-1138. [6] Belcher C. et al. 2005. *Geol. Soc. London* 162: 591-602. [7] Belcher C. et al. 2009. *PNAS* 106: 4112-4117. [8] Shuvalov V. 1999. *Shock Waves* 9:381-390. [9] Thompson S.L. and Lauson H.S. 1972. *SC-RR-61 0714*. Sandia Nat. Lab. 119 p. [10] Artemieva N. and Morgan J. 2009. *Icarus* 201:768-780.