Geophysical Research Abstracts
Vol. 12, EGU2010-12186-2, 2010
EGU General Assembly 2010

Spectroscopic Evidence for the Asteroidal Nature of the July 2009 Jovian Impactor

Carey Lisse (1), Glenn Orton (2), Padma Yanamandra-Fisher (2), Leigh Fletcher (3), Imke dePater (4), and Heidi Hammel (5)

(1) Applied Physics Laboratory, Johns Hopkins University, Laurel, MD, USA (carey.lisse@jhuapl.edu), (2) Jet Propulsion Laboratory, Caltech, Pasadena, CA, USA (go@scn.jpl.nasa.gov), (3) University of Oxford, Oxford, UK (fletcher@atm.ox.ac.uk), (4) University of California, Berkeley, CA, USA (imke@astron.berkeley.edu), (5) Space Science Institute, Boston, MA, USA (hbh@alumni.mit.edu)

The collision of a large object with Jupiter on July 19, 2009, heated its atmosphere, modified its composition and generated a prominent field of deposited particulate debris. Low-resolution 7-24 μm spectroscopy of the impact field obtained using the T-ReCS mid-infrared camera/spectrometer on Gemini/South on 24 July 2009 has revealed an excess 9-μm absorption in the impact debris in addition to that supplied by hot ammonia created in the impact.

We have searched for candidate materials that would best fit the spectral feature near 9 μm, and find that the feature cannot be matched with candidate materials in Jupiter's atmosphere. A search through a large suite of gaseous and solid absorption spectra (c.f Lisse *et al.* 2008, 2009) revealed that the major competent matches were for (a) obsidian, a glassy silica, and (b) quartz and cristobalite, crystalline silicas, kinetic alteration products of primitive body ferromagnesian silicates formed at high pressures and temperatures over 1500 K. There are also weak features at 10 – 11 um consistent with olivine absorptions. While the high temperatures required to create silicas are also high enough to destroy the non-refractory water and organics dominating icy cometary bodies, and thus destroy their spectral signal, there was no detectable absorption due to pyroxene materials, which, along with olivines in roughly equal measure, comprise the majority of refractory silicaceous species found in comets (Lisse *et al.* 2007). This suggests that the impacting body was not a comet, but an olivine-rich differentiated body similar to asteroids that are abundant in the outer regions of the main asteroid belt **(**Lodders and Fegley 1998**).** We speculate that the weak structural strength of bulk cometary material causes a comet impactor to catastrophically disrupt at higher altitudes and lower temperatures than a strong, dense asteroidal body, so that the cometary refractory dust component remains relatively cold and unaltered through blowback and Jovian surface deposition, while asteroidal dust is heated enough to be transformed from silicates to silicas.

Ancillary evidence for the asteroidal nature of the impactor arises from the singular nature of the impact site, the existence of asteroidal orbits consistent with the observed geometry (Chodas 2009, Orton *et al.* 2010), and the differences between the observed 2009 opacity spectra of the debris and the observed debris opacity created in July 1994 by the SL9 fragments. Nicholson *et al.* (1995) noted the presence of a non-gaseous component of their spectrum of the SL9 R fragment impact, which they fit with the "astronomical silicate" of Draine (1985). Griffith et al. (1997) also required an opacity source besides NH_3 gas in order to explain the spectral continuum associated with debris from the L fragment, inferring that it was most likely the result of a silicate feature similar to those in comets (Hanner *et al.* 1994). Both of these are consistent with increased opacity in the 10-12 μm region due to a mix of stratospheric debris consisting of olivines and pyroxenes, typically found in comets, without any additional opacity at $\sim$9 um due to silica.