Geophysical Research Abstracts,
Vol. 10, EGU2008-A-10282, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-10282
EGU General Assembly 2008

The Chronology of the Early Outer Solar System

T. Johnson (1), J. Castillo-Rogez (1), D. Matson (1), A. Morbidelli (2, 3), J. Lunine (4)

(1) Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA 91109, (2) Observatoire de Nice, Nice, France, (3) Southwest Research Institute, Boulder, CO, (4) Lunar and Planetary Lab, University of Arizona, Tucson, AZ (Contact Email:Torrence.V.Johnson@jpl.nasa.gov)

We consider effects of the "Nice model" [1] in the outer Solar system. This model suggests that the "lunar cata-clysm" was not confined to the terrestrial planet zone or the inner solar system, but should have been a solar system-wide phenomena, distinct from the last stages of accretion of the planets and satellites themselves. We address the implications of the "Nice model" with respect to: (1) the geological history of outer planet satellites and (2) KBOs properties.

Cratering Record: During the LHB satellites in the outer Solar system should have been affected by intense bombardment. The oldest surfaces in the Saturnian system, especially Iapetus and Mimas, are expected to have re-corded that event. We are using models of the satellites' thermal histories to compute the capability of the satellites' lithospheres to retain craters, depending on assumptions about their initial conditions, and especially their time of formation with respect to the production of calcium-aluminum inclusions (CAIs). Heat from short-lived radioiso-topes (SLRI), especially 26Al, plays an key role in decreasing the porosity in the least dense satellites and in fully differentiating the densest ones. Thus, in turn, it affects the ability of the early crust to record large impacts. The comparison between the crater density on these surfaces with the current bombardment rate integrated over the age of the solar system will let us tell whether or not the outer solar system underwent the so-called late heavy bom-bardment (LHB), as evidenced on the Moon and the terrestrial planets.

Composition of the Kuiper Belt Objects: The idea that the Kuiper-Belt objects are

remnants of the population that formed the outer Solar System satellite systems has important implications. We [2] have pointed out evidence that the outer Solar system formed a few My after the production of calcium-aluminum inclusions (CAIs). This is a scenario that is consistent with recent observations by Spitzer of young protoplanetary disks that cleared "planet" lanes in as little as 1 My [3] and in about 3 My on the average. If the planets in the early outer Solar system indeed formed in a few My, it is likely that planetesimals were strongly affected by 26Al decay. We could expect that the icy planetesimals underwent differentiation, the smallest among them could even have been subject to water boiling and loss. The Kuiper Belt and trans-neptunian objects show a wide range of physical properties. The presence of 26Al would have resulted in early differentiation of these objects, and their disruption could have yielded objects enriched in rock or in ice (Cf. [4]). Thanks to the early accretion of 26Al, the conditions might have been suitable for hydrothermal activity to take place, similar to what is suspected to have occurred in Enceladus' early history, or in Ceres.

Acknowledgements: Part of this work was performed at JPL under contract to NASA.

References: [1] Gomes et al. (2005) Nature 435, 466-469. [2] Castillo-Rogez et al. (2007) Icarus 190, 179-202. [3] Espaillat et al. (2007) ApJ 670, L135-L138. [4] Brown, M. (2007) NASA Ames Planet Satellite Formation Meeting.