The Origin of Palimpsests

J. M. Moore (NASA Ames); D. Korycansky (SETI Institute); V. Bray (Univ. Ariz.); O. L. White (SETI Institute)

Palimpsests are the most enigmatic impact features observed on icy worlds of the Solar System. Palimpsests are large impact features which are bright, old, mostly flat, and roughly circular. They range from >150 to ~350 km in diameter and sometimes exhibit recognizable associated radial secondary ejecta crater strings beyond their rims. Curiously, among all the Solar System's icy worlds, palimpsests are exclusively seen on the icy Galilean moons.

Palimpsests are obviously different than similarly sized impact features seen on other icy satellites. For example, Evander, a 350 km diameter peak-ring impact basin on Saturn's moon Dione, has a very low depth/diameter ratio of 0.008, indicating significant viscous relaxation. Nevertheless, it still retains short wavelength topography including a prominent central peak, peak ring, and a continuous rim, none of which are seen at palimpsests. Palimpsests display an approximately circular, and dominating, expanse of undulating plains, which is level with surrounding terrain and shows no recognizable rim. At the center of palimpsests are smooth central plains that are enclosed by a low scarp. Central plains material superposes the surrounding undulating plains and is littered with small blocks reminiscent of "small chaos" on Europa.

Palimpsests have yet to be explored using modern impact simulation tools. We have begun to investigate two competing hypotheses: (A) Palimpsests form on targets which have a preexisting near-subsurface layer that is liquid or solid but very weak, and is excavated as proximal ejecta; or (B) They form in a solid ice target underlain by a steep thermal gradient that strongly influences the resulting impact feature, including the production of impact-induced melting at depth that is then a major component of proximal ejecta. Our results will have profound implications for the early thermal history of the icy Galilean satellites.

We will test our two hypotheses for the formation of palimpsests on Ganymede (where they are both best observed and preserved) by means of 2D iSALE hydrodynamic simulations of impacts into ice targets that will be structured according to the scenarios for each hypothesis**,** with select runs in 3D. We have already conducted a pilot study using 2D iSALE that has yielded promising results, which we will report out at the meeting.

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Sessions:

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