Recent Results, new Approaches, Hypotheses, Riddles, and “Way to go?” in the Geophysics of Outer Planet Satellites

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Since the Voyager missions, Galileo and Cassini-Huygens have explored in detail the satellite systems of Jupiter and Saturn, respectively. In the same period, laboratory experiments have improved our knowledge of material properties (*e.g.*, thermal and rheological) relevant to the satellites. Advances in geophysical modeling have provided new views of the interior, exterior, and orbital evolution. Rheology, structure, and sources of heat play the lead roles in forging our understanding of the icy satellites.

An important new result is evidence in the Saturnian moons for short-lived radiogenic species being active in the outer Solar System. This opens the door to fine-scale radiochronometry (*e.g.*, 26Al) of satellites, that is, constraining in absolute time key events in their origin and evolution. Also, smaller satellites can be significantly more geologically-geophysically-dynamically active than previous thought. For example, on Enceladus an active geyser field offers a host of hydrothermal chemical possibilities, including pre-biotic compounds. Also, the intense, short, early, heating of satellites supports non-linear dynamical evolution. This facilitates new hypotheses for solving long-standing riddles (*e.g.*, Iapetus’ synchronous rotation, Mimas’ high eccentricity).

Geophysical models are key to using the data to constrain the environments in which the moons formed and evolved. As absolute ages become available each body will be seen as related to other satellites in their system, to their mother planet, and to the origin of the outer solar system in general.

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