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The Influence of Mantle Rheology on the Early Differentiation of Icy Satellites

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Icy materials form the bulk of Neptune and Uranus and the major satellites orbiting the outer planets. These satellites, which are believed to have mainly accreted before the dispersal of the solar nebula, have withstood differing internal processes leading, for example, to varying degrees of differentiation of their interiors. In order to accurately model early dynamic processes, detailed constraints on the viscosity of icy materials are needed. Currently such data are not available for the range of conditions and compositions encompassed by the icy satellites. The aim of this project is to study the mechanical properties of ice and icy compounds at pressures and temperatures compatible with the entire range of conditions within icy satellites. A proposed novel experimental approach will be used to determine structural and elastic data and to extract stress and strain relations for constructing flow laws for icy materials. These properties will then be integrated into models to constrain factors which led to some satellites differentiating into silicate cores surrounded by ices, while others remained mainly undifferentiated.

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