

Time dependent behavior and mechanisms of heating in the brittle and ductile regimes of icy satellites

Christine McCarthy

Laboratory experiments have long been used to define the rheological properties of Earth and planetary bodies with depth. Strength in the uppermost part of the lithosphere is defined by the applicable Byerlee's Law, which is the frictional Coulomb strength on preexisting faults; whereas at greater depth strength is controlled by temperature and pressure dependent viscous deformation. Both frictional and viscoelastic responses may play important roles in tidal heating and convection on icy satellites, but at different time and length scales. Understanding the dynamic, time-varying parameters for frictional heating and dissipation can improve estimates of long-term heat flux and planetary body evolution. I will share results from two different types of laboratory experiments on polycrystalline ice that reproduce tidally modulated behavior: (1) periodic velocity biaxial experiments that measure friction and (2) forced oscillation compression experiments that measure attenuation. The former provide the rate-and-state dependent friction parameters as a function of forcing amplitude and frequency to explore frictional stability on periodically loaded faults over a range of conditions. The latter inform us about the influences of frequency, temperature, grain size, and strain history on mechanical dissipation of tidal energy in deep interiors.