ST. FRANCIS XAVIER UNIVERSITY

Physics Colloquium

Friday, September 24, 2010, 4:00 pm, PS 1072

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Europa, Jupiter's Ocean Moon: Tides and the Prospects for Life

Europa's global ocean contains twice the liquid water of all Earth's oceans combined and may be the most likely place for the first detection of extraterrestrial life, all a consequence of an orbital resonance with Jupiter's other satellites. The resonance drives tides, which in turn heat Europa's interior, stress its icy crust, and cause rotational torque and orbital evolution. The heat maintains the liquid water ocean, and keeps the surface ice thin. Europa's icy crust records active resurfacing by tectonic and thermal processes over tens of millions of years, a rapidity demonstrated by a paucity of craters. Tidal stress can explain distinctive crack patterns, as well as shear displacement features. The characteristic ridges that cover tectonic terrain are likely built by tidal pumping of oceanic water and slush through cracks to the surface on a daily basis. Nearly half the surface is chaotic terrain, with ice rafts and other characteristics indicative of melt-through from below. All these processes were recent, and thus most likely continue today. Connections between the surface and the underlying ocean through the cracks, melt sites, and occasional impacts provide a variety of evolving environmental niches. The permeability of the crust allows exchange of materials, including delivery of enough radiogenic oxygen from the surface to support macro- as well as micro-organisms in the ocean. A habitable biosphere might extend from the ocean up to within a few centimeters of the surface, so life on Europa might be relatively accessible to spacecraft exploration, but at the same time vulnerable to contamination.