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TITLE: Astrobiological Journeys to and from the South Polar Sea of Enceladus - Bidirectional Interactions with the Saturn Magmetosphere

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ABSTRACT BODY: The spectacularly cryovolcanic moon Enceladus is a major source of plasma for the Saturn magnetosphere via ionization of the ejected molecular species and ice grains. Field-aligned plasma flows from the Enceladus environment visibly impact the moon's magnetic footpoint in Saturn's polar auroral region, while water group and other ions from the moon emissions diffuse radially throughout the magnetosphere and may be the dominant source of oxygen for Titan's oxygen-poor upper atmosphere. But the moon-magnetosphere interaction is bidirectional in the sense that the moon surface is globally exposed to constant irradiation by the returning magnetospheric ions and by energetic electrons from the field-aligned and radially diffusing populations. The returning ion source operates both on global scales of the magnetosphere and locally for highly reactive species produced in the ejecta plume. All of these sources likely combine to produce a highly oxidized global surface layer. Since plasma electrons and ions are cooled by interaction with neutral gas and E-ring ice grains from Enceladus, the moon emissions have a governing effect on the seed populations of energetic particles that irradiate the surface. The proposed subsurface polar sea and transient crustal overturn in the south polar region could bring the polar surface oxidants into contact with hydrocarbons and ammonia to make oxidation product gases contributing to the cryovolcanic jets, a process first proposed by Cooper et al. (Plan. Sp. Sci., 2009). As has been previously suggested for Europa, the oxidants could contribute to enhanced astrobiological potential of Enceladus, perhaps even higher than for Europa where organic hydrocarbons have not yet been directly detected. Unlike Europa, Enceladus shows no sign of an oxygen-dominated exosphere that could otherwise be indicative of extreme surface and interior oxidation inhibiting the detectable survival and evolution of complex organics.

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