What Can Plumes Tell Us About Sub-Surface Oceans?

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Introduction: The well documented Enceladus plumes create a dusty, asymmetric exosphere in which electrons can attach to small ice particles - forming anions, negatively charged nanograins and dust - to the extent that cations can be the lightest charged particles present and, as a result, the dominant current carriers. Several instruments on the Cassini spacecraft are able to measure this environment in both expected and unexpected ways. Cassini Plasma Spectrometer (CAPS) measures ions, electrons and photo-electrons and also measures the energy/charge of charged nanograins when present. When the plasma is sufficiently dense the Cassini Radio Plasma Wave Sensor (RPWS) and Magnetometer (MAG) data can be used to derive electron density and RPWS also detects dust impacts. Langmuir Probe (LP) measures the electron density and temperature via direct current measurement. The Magnetospheric Imaging Instrument (MIMI) measures energetic particles as well as energetic neutral atoms produced during charge exchange interactions in and near the plumes. The Ion Neutral Mass Spectrometer (INMS) measures ions and neutral molecules and the Cosmic Dust Analyser (CDA) measures down to micron sized dust. By consolidating data from these Cassini sensors we are able to produce a fairly complete picture of the near Enceladus environment. Here we extend the analysis using theoretical considerations and models to discuss what properties are evolved (not produced at the moon) versus what properties are preserved features that could be due to the presence of a sub-surface ocean.