Paper ID: 30092
oral

66th International Astronautical Congress 2015

SYMPOSIUM ON TECHNOLOGICAL REQUIREMENTS FOR FUTURE SPACE ASTRONOMY AND SOLAR-SYSTEM SCIENCE MISSIONS (A7)
Space-Agencies Long-Term Views (1)

Author: Mr. Brent Sherwood
Caltech/JPL, United States, brent.sherwood@jpl.nasa.gov

STRATEGIC MAP FOR EXPLORING THE OCEAN-WORLD ENCELADUS

Abstract

Introduction: Cassini discovered tidally-modulated jets emitting salty water from the interior of Saturn's moon Enceladus, measured salts and organic species in the plume, and gravitationally inferred a large water reservoir in contact with the rock core over geologic time. Enceladus meets today's textbook conditions for habitability and is one of the best places to search for direct evidence of biomarkers. **Exploring an ocean world:** Enceladus also allows direct access to telltale molecules, ions, isotopes, and poten-tial cytofragments in space, via the plume. Plume mass spectroscopy, sample return, in situ investigation of surface fallback deposits, direct vent exploration, and eventually ocean submarining can all be envisioned. However, build-ing consensus to fund in situ exploration hinges on acquiring key new data. A roadmap is pivotal. Two early mission concepts are obvious: 1) flythrough plume analysis using gas and particle mass spectrometers, re-making the Cassini measurements with modern, high-resolution instruments; 2) sample return of plume ice particles, dust, and gas. **Strategic map:** These and other mission concepts each need unique capabilities, address unique science ques-tions, and yield results important for subsequent decisions. Affecting a logical sequence are mutually competing programmatic constraints: other astrobiology pursuits including exoplanet spectroscopy, cadence of mission-selection opportunities and science-community planning cycles; programmatic impatience to await interim results; and alignment of US exploration strategies with international partner goals. As with Mars, the anticipation of even-tual results may be able to drive strategic intent for many years absent deep evidence. Synergy among international partners may prove key for establishing and sustaining programmatic intent and momentum. Key enabling elements for long-term exploration of the ocean-world Enceladus include: coherent sequence of science questions; technologies that mature at the right time to enable mission performance and approval (e.g., plan-etary protection); integrated concepts that survive cost reviews; lessons learned from analog exploration (e.g., terres-trial oceanography and extremophile research), and community momentum and international partnerships. **Decision levers:** Analysis of these elements of the strategic map yields a short list of decision pressure points for the next two decades. Using these opportunities the community may systematically find and explore an alien ecosys-tem within the working lifetime of today's graduate students. Without such a map, progress toward an age of com-parative ocean exploration will be haphazard and slow. The windows for significant advance are sparse, and much remains to be done to prepare to take advantage of them.