Geophysical Research Abstracts
Vol. 14, EGU2012-2260, 2012
EGU General Assembly 2012


# JUpiter ICy moons Explorer (JUICE): AN ESA L-CLASS MISSION CANDIDATE TO THE JUPITER SYSTEM

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The overarching theme for JUICE is: The emergence of habitable worlds around gas giants. Humankind wonders whether the origin of life is unique to the Earth or if it occurs elsewhere in our Solar System or beyond. To answer this question, even though the mechanisms by which life originated on Earth are not yet clearly understood, one can assume that the necessary conditions involve the simultaneous presence of organic compounds, trace elements, water, energy sources and a relative stability of the environment over time. JUICE will address the question: Are there current habitats elsewhere in the Solar System with the necessary conditions (water, biological essential elements, energy and stability) to sustain life? The spatial extent and evolution of habitable zones within the Solar System are critical elements in the development and sustainment of life, as well as in addressing the question of whether life developed on Earth alone or whether it was developed in other Solar System environments and was then imported to Earth. The focus of JUICE is to characterise the conditions that may have led to the emergence of habitable environments among the Jovian icy satellites, with special emphasis on the three ocean-bearing worlds, Ganymede, Europa, and Callisto.

Ganymede is identified for detailed investigation since it provides a natural laboratory for analysis of the nature, evolution and potential habitability of icy worlds in general, but also because of the role it plays within the system of Galilean satellites, and its unique magnetic and plasma interactions with the surrounding Jovian environment. For Europa, where two targeted flybys are planned, the focus will be on the chemistry essential to life, including organic molecules, and on understanding the formation of surface features and the composition of the non water-ice material, leading to the identification and characterisation of candidate sites for future in situ exploration. Furthermore, JUICE will provide the first subsurface observations of this icy moon, including the first determination of the minimal thickness of the icy crust over the most recently active regions.

JUICE will determine the characteristics of liquid-water oceans below the icy surfaces of the moons. This will lead to an understanding of the possible sources and cycling of chemical and thermal energy, allow investigation of the evolution and chemical composition of the surfaces and of the subsurface oceans, and enable an evaluation of the processes that have affected the satellites and their environments through time. The study of the diversity of the satellite system will be enhanced with additional information gathered remotely on Io and smaller moons. The mis-sion will also focus on characterising the diversity of processes in the Jupiter system which may be required in order to provide a stable environment at Ganymede, Europa and Callisto on geologic time scales, including gravitational coupling between the Galilean satellites and their long term tidal influence on the system as a whole. Focused stud-ies of Jupiter's atmosphere, and magnetosphere and their interaction with the Galilean satellites will further enhance our understanding of the evolution and dynamics of the Jovian system. The circulation, meteorology, chemistry and structure of Jupiter will be studied from the cloud tops to the thermosphere. These observations will be attained over a sufficiently long temporal baseline with broad latitudinal coverage to investigate evolving weather systems and the mechanisms of transporting energy, momentum and material between the different layers. The focus in Jupiter's magnetosphere will include an investigation of the three dimensional properties of the magnetodisc and in-depth study of the coupling processes within the magnetosphere, ionosphere and thermosphere. Aurora and radio emissions and their response to the solar wind will be elucidated.