



Science and Reconnaissance from the Europa Clipper Mission Concept: Exploring Europa's Habitability

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Europa is recognized by the Planetary Science Decadal Survey as a prime candidate to search for a pre-sent-day habitable environment in our solar system. As such, NASA has pursued a series of studies, facilitated by a Europa Science Definition Team (SDT), to define a strategy to best advance our scientific understanding of this icy world with the science goal: Explore Europa to investigate its habitability. (In June of 2014, the SDT completed its task of identifying the overarching science objectives and investigations.) Working in concert with a technical team, a set of mission architectures were evaluated to determine the best way to achieve the SDT defined science objectives. The favored architecture would consist of a spacecraft in Jupiter orbit making many close flybys of Europa, concentrating on remote sensing to explore the moon. Innovative mission design would use gravitational perturbations of the spacecraft trajectory to permit flybys at a wide variety of latitudes and longitudes, enabling globally distributed regional coverage of Europa's surface, with nominally 45 close flybys, typically at altitudes from 25 to 100 km. This concept has become known as the Europa Clipper.

The Europa SDT recommended three science objectives for the Europa Clipper: Ice Shell and Ocean: Characterize the ice shell and any subsurface water, including their heterogeneity, ocean properties, and the nature of surface-ice-ocean exchange; Composition: Understand the habitability of Europa's ocean through composition and chemistry; and Geology: Understand the formation of surface features, including sites of recent or current activity, and characterize high science interest localities. The Europa SDT also considered implications of the Hubble Space Telescope detection of possible plumes at Europa.

To feed forward to potential subsequent future exploration that could be enabled by a lander, it was deemed that the Europa Clipper mission concept should provide the capability to perform reconnaissance for a future lander. In consultation with NASA Headquarters, the SDT developed a reconnaissance goal: Characterize Scientifically Compelling Sites, and Hazards, for a Potential Future Landed Mission to Europa. This leads to two reconnaissance objectives: Site Safety: Assess the distribution of surface hazards, the load-bearing capacity of the surface, the structure of the subsurface, and the regolith thickness; and Science Value: Assess the composition of surface materials, the geologic context of the surface, the potential for geological activity, the proximity of near surface water, and the potential for active upwelling of ocean material.

The Europa Clipper mission concept provides an efficient means to explore Europa and investigate its habitability through understanding the satellite's ice shell and ocean, composition, and geology. It also provides for surface reconnaissance for potential future landed exploration of Europa. Development of the Europa Clipper mission concept is ongoing, with current studies focusing on spacecraft design trades and refinements, launch vehicle options (EELV and SLS), and power source (MMRTG and solar), to name a few. We will provide an update on status of the science and reconnaissance effort, as well as the results of trade studies as relevant to the science and reconnaissance potential of the mission concept.