Prioritized Technology: Ice Penetration and Sampling – Sample Handling and Transport

Technical Goal

- Develop process for sample handling and hardware transport system for samples from the point of extraction taking into account
    - forward contamination constraints,
    - ensuring Earth life is not ingested into instruments, and
    - specific sample preparation requirements for each instrument.
    - method to handoff sample to instrument or sample return

Technical Status

- Sample handling and transport has not been attempted at cryogenic temperatures by robotic spacecraft.
- Biomolecule detection may be done at liquid water temperatures, so cyrogenic handling may not be required for all (or any) instruments.

Mission Applications

- Discovery of macromolecules indicating extant life may exist can be looked-for in water that periodically erupts onto the surface and freezes, or in convecting ice, or in the liquid water ocean. Intermediate depths (Class 2) may also be of interest, e.g. if Titan has layered deposits. Also, Enceladus plume vents may be explored, including down to liquid water.
- Low probability of contamination of the sample during mission to meet COSPAR and eliminate chance misinterpreting earth life as alien life
- Class 1 enables sampling of pristine material, e.g. almost entirely unaffected by the radiation environment of Europa.
    - Significantly deeper than the planned Europa lander at ~10 cm.
- Class 2 enables sampling of possible layered terrain on Titan, and completely unaffected by radiation (including Galactic Cosmic Rays)
    - At the limit of depths that might be achieved using techniques that "line the hole" to prevent collapse all the way to the desired depth.
- Class 3 enables sampling of liquid water from the oceans or in convecting ice that has been in contact with the liquid oceans in the relatively recent past
    - Convection zone on Europa likely to be at least one or a few km depth.

Development Cost and Schedule