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Looking for Astrobiological Signatures with Penetrators on Europa

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Europa, along with Mars and Titan, is considered a prime candidate for the presence of extraterrestrial life in the solar system. Although without a significant atmosphere, but which includes trace amounts of molecular oxygen, and very cold surface temperatures around 40-120K, it is widely believed that Europa hides a liquid salty water ocean kms under its icy crust warmed by enormous tidal forces from Jupiter, with a rocky mantle beneath (ref.1). Such a subterranean ocean, shielded from massive surface radiation, make it a good habitability candidate for indigenous life.

Furthermore, the Europan surface features a plethora of apparently young, colourful fissures consistent with the egress of potential astrobiological material upwelled from the ocean beneath, which could be investigated either remotely or in-situ for signatures of life. In particular, this material appears to be rich in sulphur which offers the opportunity for determination of the isotopic proportions of sulphur, either remotely or in-situ, capable of differentiating between inorganic and biological origin (ref.2). This is relevant to the search for life on exoplanets, since evidence of high external radiation need not be an excluder of the presence of life.

Penetrators proposed for Europa (ref.3) involve delivering small projectiles at high velocity to just beneath the surface ice, where the destructive effects of radiation are greatly reduced. This provide a means for both direct sampling, and remote sensing of potential astrobiological material with stand-off distances of the order of centimetres rather than interstellar distances as for exoplanets. However, since spectrographic signals are preserved through long space transits, this may offer the possibility for detection of common astrobiological signatures, though sensitivity may be an issue. Direct astrobiological investigations of samples collected by the penetrators will also be presented, to allow other potential insights for remote observations of life signatures from exoplanets.

R1: *Carlson, R. W., Johnson, R. E. and Anderson, M. S. 1999, Science, 286, pp. 97-99.*
R2: *Chela-Flores J. and Kumar N. 2008, International Journal of Astrobiology,* ***7,*** *(3), pp. 263-269.*
R3: *Penetrator website: http://www.mssl.ucl.ac.uk/planetary/missions/Micro_Penetrators.php*