Plans for the *in-situ* detection of biomarkers in subglacial Lake Ellsworth

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Medium-sized subglacial lake Ellsworth has been identified by radio-echo sounding and is being considered for exploration and characterisation. It is anticipated that the initial characterisation of subglacial lake Ellsworth will consist of measurements made *in-situ* by a small probe lowered into the lake. Although a small quantity of sediment and water will also be returned to the surface for a more detailed analysis.

The *in-situ* detection and characterisation of life within subglacial lake Ellsworth will be accomplished using biosensor arrays that are small enough to fit within a probe that will be lowered downhole to the subglacial lake. The biosensor arrays will include the use of compound-specific-antibodies that bind to target molecules - biomarkers. This makes it necessary to identify target molecules prior to the development and deployment of a biosensor. If inappropriate target molecules and their complementary antibodies are selected, the biosensor may fail to detect the biomolecules that are present in the target environment with the potential for a negative detection outcome, even though evidence for biological activity may be present.

We have identified a number of molecular biomarkers as being useful for the exploration of subglacial lake Ellsworth. These include cell membrane constituents that are ubiquitous within one of the three domains of life: Ester bound C18:0 unsaturated fatty acids will be used as biomarkers for prokaryotes; isoprenoids present as di- and tetraethers will be used as biomarkers for Archaea; polyenoic fatty acids will be used as biomarkers for Eukaryotes. When biosensor data corresponding to these compounds are compared to measurements of the potential sources of primary productivity it should be possible to infer the domains of life that are present and their niche within the ecosystem.

Biomarkers that have less or more specific associations are also being considered. These include molecules like ATP that can be used as an indicator for biological activity, as well as molecules that are more specific like hexosamine, a component of chitin, that could be a marker for zooplankton.

The *in-situ* exploration of subglacial lake Ellsworth using biosensor technology presents a problem that is similar to that encountered during astrobiological exploration: How is it possible to know which compounds to look for prior to performing the analysis? In the case of subglacial lake Ellsworth the risk can be mitigated considerably because we would expect the subglacial lake to contain biology from one of the three domains of life that are already identified on earth. In the case of astrobiological exploration it is probably preferable to use antibodies that target a broad range of compound types – *e.g.* class specific – that are associated with biological activity on earth, as opposed to second guessing what the chemical composition of an unknown biology might be.