Exploration of Subglacial Lake Ellsworth

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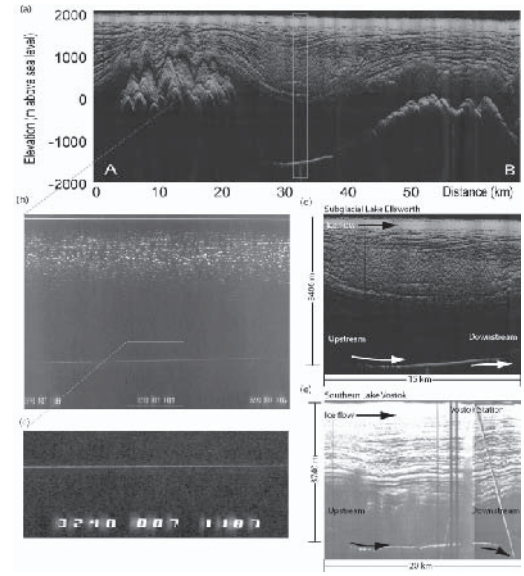
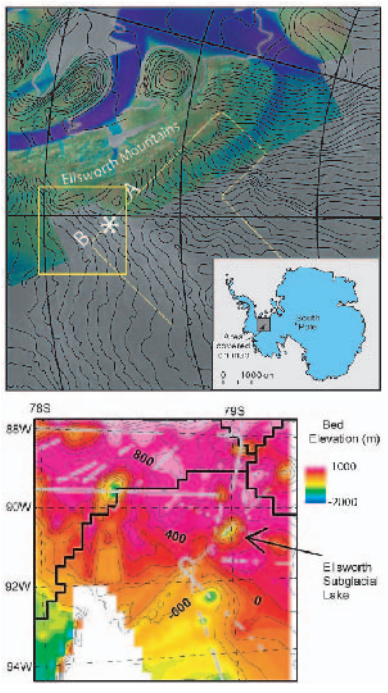
It is now an established hypothesis that Antarctic subglacial lakes house unique forms of life and hold detailed sedimentary records of past climate change. To test this hypothesis requires in-situ examination.

The direct measurement of subglacial lakes has been debated ever since the largest and best-known lake, named Lake Vostok, was identified as having a deep water-column. However, the Subglacial Antarctic Lake Environments programme, set up by the Scientific Committee on Antarctic Research to consider and recommend mechanisms for the international coordination of a subglacial lake exploration programme, state that prior exploration of smaller lakes would be a "prudent way forward". Of the 145 subglacial lakes known in Antarctica, one lake in West Antarctica, named Subglacial Lake Ellsworth, stands out as a prime candidate for first exploration. This is because:

- *Lake Ellsworth, is only 10 km long,*
- *The lake is logistically accessible by UK and US,*
- *Lake Ellsworth is representative of other lakes*
- *Subglacial access and sampling has precedent in West Antarctica*
- *The sediments contain a record of West Antarctic ice sheet history.*
- *The lake is located ~20 km from an ice divide*
- *The ice sheet surface over the lake is only 2000 m above sea level*



Radio-echo sounding transect over Lake Ellsworth (see other figure). The data show a bright, flat smooth reflector indicative of a subglacial lake. Lake surface morphology (right hand panels) is highly similar to Lake Vostok.



The location of Lake Ellsworth (upper panal) and its topographic setting (lower panel)

Lake Ellsworth will be accessed using hot water drilling. Although hot water drilling has yet to be undertaken to ice depths in excess of 2.5 km, in West Antarctica (where the ice is much warmer than in East Antarctica) the ice base has been sampled several times using this technique and drilling down to the 3.5 km is feasible. Prior to lake entry, 400 m of water will be taken from the hole, to ensure that the drill water does not enter the lake (a procedure used many times in glaciological studies).

The science experiment is simple. Once lake access is achieved, a probe will be lowered down the borehole and into the lake. The probe will contain series of instruments and chambers to measure and sample the lake water and sediments, and will be tethered to the ice surface through which power, communication and data will transmit. The probe will be dropped down the water column to the lake floor, where sediment will be sampled. The probe will then be pulled up and out of the lake, measuring its environment continually as this is done. Once at the ice surface, samples will be taken from the probe for laboratory analysis (to take place over subsequent years). The duration of the science mission, from deployment of the probe to its retrieval, is likely to take between 24 and 36 hours (maintaining hole access for this time is feasible).

Given that the comprehensive geophysical survey of the lake is planned for 2006-7, a two-year development phase from 2005 makes it possible that the exploration of Lake Ellsworth could take place during the International Polar Year (2007-9). The project is ideally suited to the ambition of IPY theme #4 "To investigate the unknowns at the frontiers of science in the polar regions". The exploration of Lake Ellsworth will be unique, interdisciplinary, will result in major findings concerning subglacial lake environments and, consequently, will have a sizeable public interest. The programme is challenging yet feasible given the expertise within the consortium of scientists involved.

Additional information on the Lake Ellsworth program can be found at www.ggy.bris.ac.uk/ellsworth