

Drilling at Lake Vostok by the Russians

After two decades of hardwork, on 5 February 2012, a team of Russian scientists began drilling at Lake Vostok, the largest of more than 140 sub-glacial lakes and the most deeply buried of the lakes hidden under the Antarctic ice cap. The Russian team plans to send a robot into the lake to collect water samples and sediments from the bottom of the ice well at the end of 2012, when the new Antarctic summer starts. Unusual forms of life could be found in the water layer of the lake as an ecosystem has been sealed off-below the ice for millions of years and atmospheric conditions, which could resemble those of the hypothesized ice-covered ocean of Jupiter's moon, Europa. The lake water is supported on a bed of sediments which is 70 m (230 ft) thick, offering the possibility that they contain a unique record of the climate and life in Antarctica before the ice cap formed. Geothermal heat from the earth's interior may warm the bottom of the lake and allow the melting of ice, and the ice sheet itself insulates the lake from cold temperatures on the surface¹.

The presence of ice sheets on earth is a temporary event in geologic history marking the ice age. The modern ice sheets are several million years old; the Antarctic sheet, probably 10–20 m.y. old. Russian scientist, Peter Kropotkin first proposed the idea of freshwater under the Antarctic ice sheets at the end of the 19th century. He theorized that the tremendous pressure exerted by the cumulative mass of thousands of vertical metres of ice could increase the temperature at the lowest portions of the ice sheet to the point where the ice would melt. Kropotkin's theory was further developed by Russian glaciologist I. A. Zotikov, who wrote his PhD thesis on the subject in 1967. Russian geographer Andrey Kapitsa used seismic soundings in the region of Vostok Station during the Soviet Antarctic Expedition in 1959 and 1964 to measure the thickness of the ice sheet. Kapitsa was the first to suggest the existence of a sub-glacial lake in the region

and subsequent research confirmed his hypothesis.

Under about 3.7 km of the ice sheet of Antarctica, a large, deep, freshwater lake was found in 1974–75. An airborne radio-echo survey of ice depths over central East Antarctica led to the discovery of a sub-ice lake of unknown depth and composition, with an area of about 10,000 sq. km and lying beneath ~4 km of ice. This sub-ice lake probably occupies a rift valley where water is 125 m deep or more, and the lake is comparable in dimensions to Lake Ontario. The residence time of the water in the lake is of the order of tens of thousands of years, and the mean age of water, since deposition as surface ice, is about one million years. Steady-state theory predicts basal melting of ~1 mm/year for the ice sheet above this lake². In 1993, altimetric data from satellite measurements provided independent evidence of the areal extent of the lake, thus confirming it to be the largest known sub-ice lake by an order of magnitude³.

In 1990, scientists began drilling at Vostok Station (Borehole 5G), their Antarctic base and have returned every summer to continue the task. At first the team was drilling to remove ice cores to obtain data on climate, but by the mid-1990s, scientists realized that a huge lake existed deep below the surface and speculated that sampling its water might yield signs of ancient life. The drilling project has been opposed by some environmental groups. However, the scientists argue that hot-water drilling would do less environmental damage as they were using unsterile kerosene and freon to lubricate the borehole and prevent it from collapsing and freezing; more than 60 tonnes of these chemicals have been used thus far on the ice above Lake Vostok⁴. The Russian scientists have explained that hot-water drilling requires more power than they could generate at their remote camp. According to the United States National Research Council, microbial life exists in Lake Vostok and

after such a long period of isolation, any life forms in the lake require protection from contamination. Sediments on its floor should give clues to its long-term climate, and isotopes in its water are expected to help geologists determine how and when sub-glacial lakes such as Lake Vostok formed. Meticulously documented decontamination procedures will be required to establish the credibility of the scientific data obtained⁵.

Though the Russians claim to have improved their operations, they continue to use the same borehole, which has already been filled with kerosene. According to Valery Lukin, Head of Russian Antarctic Expeditions, new equipment has been developed at the St. Petersburg Nuclear Physics Institute that would ensure the lake remains uncontaminated upon intrusion⁶. Lukin has repeatedly reassured other signatory nations to the Antarctic Treaty System that the drilling will not affect the lake, arguing that on breakthrough, water will rush up the borehole, freeze and seal the chemical fluids out.

The Antarctic and Southern Ocean Coalition has argued that this manner of drilling endangers Lake Vostok and other sub-glacial lakes in Antarctica, as some scientists believe that these sub-glacial lakes are inter-linked with Lake Vostok.

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