

NEW JLU MULTI-ARM LOGGER AND FIELD TESTING AT THE BEDROCK BOREHOLE IN PRINCESS ELIZABETH LAND, EAST ANTARCTICA

operations were conducted, revealing significant borehole constriction at the bottom section under drilling fluid-free conditions. These observations provide valuable scientific guidance for drilling engineering practices.

This project focuses on the deep ice core borehole drilled during the 2023-2024 China-Russia joint Antarctic scientific expedition, utilizing a high-precision logging instrument independently developed by Jilin University to conduct comprehensive parameter measurements. By monitoring the dynamic changes in borehole diameter in real time, it evaluates the borehole closure effect under ice stress conditions, providing a basis for subsequent drilling process optimization. Simultaneously, the logger records borehole azimuth and deviation data to invert glacial flow characteristics. Combined with vertical temperature profile measurements, it allows to estimate subglacial geothermal heat flux, revealing the mechanisms of subglacial geological activity and ice-rock interactions.

The drilling site is located at 69°35′08.27″ S, 76°23′03.65″ E, about 28 km from China's Zhongshan Station. The ice thickness at this location is 541 m (Talalay et al. 2025). In 2024, a full-depth ice core was successfully drilled, reaching the bedrock and retrieving bedrock core samples. The logger enables measurement of borehole parameters, including diameter, temperature, pressure, and azimuth, providing critical data for ice core drilling and subglacial environment analysis.

The logger was deployed by first connecting the instrument to an armoured cable via the IBED cable termination, enabling both power supply and data communication. However, due to insufficient sensitivity of the built-in temperature sensor, real-time temperature profiling during tool retrieval was unreliable. As a result, supplementary sensors were later employed for thermal measurements, restricting the logging tool's primary function to borehole diameter and azimuthal deviation monitoring.

During operation, the tool was lowered to the borehole bottom using a winch-controlled descent. However, borehole closure near the base initially prevented penetration beyond 474 m. After reaching this depth, the spring-loaded caliper arms were activated, and the tool was gradually retrieved at a speed of 25–30 mm/s. This retrieval process allowed continuous, real-time acquisition of diameter variations and azimuthal orientation along the ice column.

The borehole logging tool successfully obtained diameter measurements and azimuthal orientation data down to the depth of 474 m. Following the completion of drilling fluid retrieval, multiple repeat logging operations were conducted, revealing significant borehole constriction at the bottom section under drilling fluid-free conditions. These observations provide valuable scientific guidance for drilling engineering practices.

References

Talalay, P.G., Leitchenkov, G., Lipenkov, V. et al. Rare ice-base temperature measurements in Antarctica reveal a cold base in contrast with predictions. *Commun Earth Environ* 6, 189 (2025). <https://doi.org/10.1038/s43247-025-02127-1>

Primary author: HAN, Bo (Polar Research Center, Institute for Polar Science and Engineering, Jilin University, Changchun, China)

Co-authors: ZHANG, Nan (Polar Research Center, Institute for Polar Science and Engineering, Jilin University, Changchun, China); LI, Yazhou (China University of Geosciences, Beijing, China); TALALAY, Pavel (Polar Research Center, Institute for Polar Science and Engineering, Jilin University, Changchun, China); FAN, Xiaopeng (Polar Research Center, Institute for Polar Science and Engineering, Jilin University, Changchun, China); GONG, Da (Polar Research Center, Institute for Polar Science and Engineering, Jilin University, Changchun, China)

Presenter: HAN, Bo (Polar Research Center, Institute for Polar Science and Engineering, Jilin University, Changchun, China)

Session Classification: Poster sessions oral introduction

Track Classification: Borehole logging and in-situ observatories