

DEEP SUBGLACIAL LAKE EXPLORATION VIA RECAS SONDE INTEGRATED WITH HOT-WATER DRILLING SYSTEMS

The exploration of subglacial lakes plays a pivotal role in deciphering the life characteristics within extreme environments. Currently, the drilling techniques used mainly include hot water drilling technology, deep ice core drilling technology, and RECoverable Autonomous Sonde (RECAS) . Compared to the other methods, RECAS offers distinct advantages for subglacial lake detection: compact equipment size, high automation, minimal external contamination, and ease of deployment.

Pavel et al. (2014) initially introduced the design concept of RECAS. Subsequently, in 2022, they successfully completed the research and development of the RECAS-500 prototype, which boasted a drilling capacity of 500 meters. Drilling and retrieval verification experiments were conducted on the Dalk Glacier in Antarctica. The cumulative drilling depth reached 517 meters, with a maximum drilling depth of 200.3 meters. Notably, the meltwater within the borehole froze and sealed it effectively, validating the working principle feasibility of RECAS (Sun et al. 2022). However, for subglacial lakes buried deeper than 3000 m, the RECAS drilling duration exceeds six months, making long-term reliable operation at Antarctic sites challenging. Consequently, integrating RECAS with hot-water drilling represents the optimal approach.

Jilin University is currently developing a RECAS-3000 system compatible with hot-water drilling. The system comprises four main components: a surface winch system, a relay cable, a relay module, and the RECAS probe. To minimize cable power loss, the relay cable employs conductors with a larger diameter and lower resistance. High-voltage power transmission is implemented between the surface and the relay module. Within the relay module, this high-voltage power is rectified and transformed before being supplied to the RECAS probe via dedicated RECAS cables.

Furthermore, to achieve clean exploration of subglacial lakes, four distinct deployment schemes combining hot-water drills and RECAS probes were proposed. The advantages and disadvantages of each scheme were comparatively analyzed.

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