Contribution ID: **37** Type: **Poster preference**

Study on Sediment Coring Techniques in Antarctic Subglacial Water Environment

Monday 15 September 2025 15:20 (5 minutes)

Antarctic subglacial sediments preserve important geological and ecological records, including paleoenvironmental changes, glacier melting processes, and subglacial ecosystem dynamics. However, current coring technology is difficult to cope with heterogeneous formation sediments containing hard particles (such as gravel, granite pebbles) and viscous clay matrix, which have high shear strength (2-22kPa). This study focuses on developing advanced sediment coring techniques for complex structural formations in the Antarctic ice water environment, aiming to address key challenges such as insufficient penetration depth (<3m), severe sample interference, and difficulty in recovery in existing sampling methods. This study employed multiple methods: Studies include: (1) reconstructing subglacial sedimentary layers through laboratory simulations, incorporating mineral composition and particle size distribution based on actual samples; (2) using energy dissipation models to study the infiltration mechanism under impact loads, in order to analyze crack propagation in hard particles and stress response in clay layers; (3) develop low interference sampling technology with innovative tool design to minimize interference with the water sediment interface layer; (4) Research on reducing the pulling force of sampling tubes through pressure compensation and core tube structural optimization. The penetration mode mainly focus on hammering and vibration sampling, which are expected to achieve deeper footage in these complex sedimentary formations. Laboratory coring tests, load analysis, and sample recovery were also studied through relevant experiments. These results will provide technical support for sediment sampling under the Antarctic ice shelf, glacial lakes, and subglacial lakes.

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Session Classification: Poster sessions oral introduction

Track Classification: Subglacial drilling and sampling