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Continuously Coring with Air Reverse Circulation by a Rapid-air-movement Ice Drill System: Key Parameters and Mechanism Research on Ice Core Autonomously Breaking

Content

In the past years, many scholars around the world have made many great contributions to developing ice-drilling technology, which has greatly promoted the research of polar science. However, due to some limitations of a typical electromechanical drill, the length of a core barrel is no more than 6.1 m. Whenever a core barrel is filled with ice after each run, it is necessary to stop drilling and lift drill for ice core and chips collection, which waste a lot of time and reduce drilling efficiency. In fact, the average daily footage of a cable-suspended electromechanical drill is no more than 20-30 m. In order to break through technical bottleneck of slow rate of penetration (ROP) of deep ice core drilling, it is necessary to perform research on rapid ice-core drilling technology under the harsh working environment and shortening working time under the complex subglacial conditions. Recently, a new ice-drilling method of Continuously Coring with Air Reverse Circulation (CCARC) with a rapid-air-movement (RAM) ice drill system has been put forward, which uses dual-wall aluminum drill pipe. CCARC ice drilling technology can effectively prevent compressed air circulation losses in snow-firn cover and it can continuously get ice core with air reverse circulation. It does not need to stop drilling to lift the drill to the ice-sheet surface to take out ice core from the drill, so it can greatly improve the rate of penetration. However, the prerequisite for the realization of CCARC ice drilling is that the core splitter set on the internal surface of the inner tube of drill bit can autonomously break ice core with equal length. In order to further improve CCARC ice drilling technology, it is necessary to study horizontal force and lateral displacement required to break ice core with different diameter and length during drilling, because these key parameters are important for ice coring drilling operation and drill design. Thus, in this study, based on the established ice-core splitting test-bed, mechanism and key parameters of ice-core breaking process under different conditions were theoretically calculated and experimentally measured. Then the influence of ice core temperature, diameter and splitting length on ice core breaking were quantified, and the feasibility of the ice-core breaking mode was also demonstrated.

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Submitted by **Prof. WANG, Rusheng** on **Tuesday, 26 April 2022**