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Research on the key parameters of structure and morphology of drill bit for ice core drilling in polar ice sheet

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Ice core drilling in polar ice sheet is an important technical means to study the process of global climate change, and find paleontological life forms, as well as explore the formation and evolution of ice sheets and the geological evolution of glacial continents. For a long time, various drilling methods have been developed for ice drilling. Until now, some kinds of mechanical drill have been widely used in a variety of polar ice core drilling, such as auger drills, cable-suspended electro-mechanical drills, and so on. The core is formed with cutting the ice in rotation by annular drill head. The working process of ice core drilling is composed with three interrelated steps: ice sheet cutting, ice chips cleaning and ice core obtaining. The structure and morphology of drill bit are the key factors that influence the success of rapid ice core drilling, for example, they have a great impact on the rate of penetration, cutting torque and power consumption but also straightly affect the ice core surface quality, particle size, ice chip shape and quantity. Therefore, according to the urgent need of rapid drilling and coring in polar ice, this study has been made of the key parameters of structure and morphology of drill bit under different working conditions (i.e. depth of ice and temperature, cutting pitch, load on bit, rotation speed, etc.). During the research, the stress state and characteristic of ice and cutters were firstly analyzed. After a test-bed was established, the experiment of ice cutting had been carried out by different drill bit under different ice temperature, drilling pressure and turning speed. Then those influence laws were gained, and the mechanism of ice cutting was revealed. Finally, the optimal structure and morphology of drill bit and cutters were determined under the different working conditions.

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