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Searching for the oldest ice in Antarctica using RES method: Review and Chinese contribution

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Oldest ice with a potential climate record over 1.2Ma on Earth has significance in revealing reasons of Middle Pleistocene Transition (MPT, occurred between ~0.9–1.2 Ma ago). The deep ice core at Dome C provided us the longest and high resolution record of paleo-climatic change in the past of 0.8Ma with eight glacial cycles, but it's not long enough to infer what caused the earth's glacial cycle changing from ~40ka to recent ~100ka during MPT. Searching for the oldest ice in Antarctica is now an international effort, and is also the main goal of International Partnerships in Ice Core Sciences (IPICS) established by SCAR. Modelling results show that the most likely places have oldest ice exist along ice divide of East Antarctic Ice Sheet, including Dome A, Dome C, Dome F and Ridge B. Radio-echo sounding (RES) is a well-established geophysical method to measure ice thickness, subglacial topography and internal ice layers. All these are critical parameters or boundary conditions for modelling.

In the past several years, Dome C was well surveyed by both airborne and ground-based RES with high-spatial resolution grid. Based on ice thickness and subglacial topography, as well as paleo-accumulation rate and basal conditions inferred from RES results, drilling site was almost selected, and two deep ice cores will be drilled soon by Australia and Europe respectively. In Dome F, airborne RES campaign has also been launched recently. Preliminary results show oldest ice may exist there. Anyway, ground-based RES is required in future. In Dome A, China conducted ground-based RES in 2004/05 and 2007/08. A 30km * 30km area was surveyed in a very high resolution grid. According to ice thickness, bedrock topography and internal layers, the deep ice core drilling site was located, and ice core was drilled soon after that. However, extensive airborne RES from AGAP project shows basal melting and refreeze-on ice developed in Dome A region. Modelling results with new data give a possible ice age of ~0.5Ma - ~0.7Ma at bottom, but large uncertainty exists because of unknown geothermal heat flux and ice fabrics. Anyway, Dome A is still a very likely place having oldest ice. To further evaluate ice age and search for the oldest ice in Dome A, ice fabric was studied using multi-polarization radar data, and other potential places, for example valleys with not that thick ice, are being studied. Last year, China surveyed the Ridge B area firstly using recently deployed airplane with ice penetrating radar. The RES data can help to search for the oldest ice in this region in future.

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