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Selection of Ice Core Drilling Sites in the Grove Mountains Blue ice Area, East AntarcticA

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Deepening our understanding of million-year-scale climate evolution, particularly unraveling the mystery of the Mid-Pleistocene Transition (MPT), urgently requires obtaining older ice core records extending beyond current limitations (approximately 800,000 years), especially continuous climate archives reaching back 1.5 million years. While deep-sea sediments reveal the dominance of 40,000-year glacial cycles in the Early Pleistocene and the shift towards 100,000-year cycles during the MPT, they lack the precision to resolve crucial atmospheric greenhouse gas concentrations. Shallow ice core drilling in Blue Ice Areas (BIAs) with exposed old ice offers an efficient complementary. These areas often form where bedrock topography is highly variable; unique ice flow dynamics can bring million-year-old ice to shallow depths, as evidenced by the discovery of ice core record over 2.7 million years old in the Allan Hills region, demonstrating their potential. In this study, we focus on the Grove Mountains area of Antarctica (approximately 100 km from China's Taishan Station), characterized by nunataks, highly variable bedrock topography, and complex ice layers disturbance, where BIAs with the potential for exposing older ice have formed. To support China's 2025-2027 Grove Mountains BIA drilling program aimed at obtaining high-resolution climate and environmental records extending back millions of years, we comprehensively utilized multi-source remote sensing data and high-resolution airborne radar data. Our study precisely revealed ice thickness, internal layering structures, and bedrock topography features. Through in-depth analysis of the impact of ice flow-bedrock interactions on the uplift and exposure processes of ancient ice, we successfully identified and determined three high-potential ancient ice core drilling sites within the Grove Mountains. This site selection strategy significantly enhances the probability of successfully drilling to retrieve ultra-long-scale paleoclimate records of major scientific value. This study holds the promise of filling the gap in direct climate records prior to the MPT and underpinning million-year-scale climate reconstruction.

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