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Regional Variations of Subsea Permafrost Development on the Arctic Continental Shelves: A comparative analysis of the Beaufort and East Siberian Seas

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The stability and spatial distribution of subsea permafrost across the Arctic continental shelves play a pivotal role in our understanding of global warming. Serving as a significant carbon store, this permafrost has the potential to release greenhouse gases when it thaws, significantly influencing the global climate. This study is dedicated to a comprehensive investigation of the extent and state of submarine permafrost within the Arctic, with a particular focus on the comparative analysis of subsea permafrost development along the continental shelves of the Beaufort and East Siberian Seas. This research enhances our grasp of Arctic subsea permafrost's current variability and its role in global warming processes. To map the extent of subsea permafrost, we utilized multichannel seismic data from the Beaufort Sea (2014) and East Siberian Sea (2016, 2019), collected by the IBRV Araon. Employing a full waveform inversion approach, we precisely determined the seafloor permafrost's velocity structure, offering insights into its depth and state. The research reveals pronounced regional variations in the development of subsea permafrost on Arctic continental shelves. In particular, the continental shelf of the Beaufort Sea is characterized by a densely concentrated distribution of subsea permafrost extending to depths of up to 600 meters. In contrast, the continental shelf of the East Siberian Sea is dominated by permafrost that has thawed significantly, reaching depths of around 400 meters. These different regional patterns may be influenced by a number of factors, including the proximity of the shelf to the coast, the influence of ocean currents, the geological composition of the seabed and the prevailing thermal conditions. These findings suggest that the highly variable nature of submarine permafrost across the Arctic shelf is crucial to understanding warming induced changes in Arctic submarine permafrost and the potential for greenhouse gas release through permafrost dissociation.