

Ocean coupling limits the rupture velocity of the fastest observed ice shelf rift propagation event

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The Antarctic ice sheet is buttressed by floating ice shelves that calve icebergs along large fractures called rifts. Yet rift dynamics are not well understood due to a scarcity of in situ observations of rift propagation. Here, we report the first-ever seismic recording of a multiple-kilometer rift propagation event. Remote sensing and seismic recordings reveal that a rift in the Pine Island Glacier Ice Shelf extended 10.53 km at a speed of 35.1 m/s, the fastest known ice fracture at this scale. We simulate ocean-coupled rift propagation and find that the dynamics of water flow within the rift limit the propagation rate, resulting in rupture two orders of magnitude slower than typically predicted for brittle fracture. Using rift seismograms, we estimate that ocean water flows into the rift at a rate of at least 2,300 m³/s during rift propagation and causes mixing in the subshelf cavity. Our work supports the hypotheses that large ice shelf rifts can propagate as hydrodynamically-limited brittle fractures and demonstrates how seismology can enhance study of cryospheric processes.