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In Situ Observations of the Erebus Glacier Tongue Grounding Zone by the Icefin HROV

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Dynamics and interactions of marine terminating glaciers and ice shelves at the grounding zone are both critically important to the health of ice sheets and difficult to constrain. Few direct observations of grounding zone and grounding line processes exist due to their remote nature and technological limitations. To target these vulnerable parts of the cryosphere, we developed Icefin, a hybrid AUV-ROV (HROV) vehicle to be able to deploy through small boreholes and navigate within the narrow confines of the grounding zone. Icefin carries instrumentation similar to that found on oceanographic moorings, including CTD, dissolved oxygen, current and other scientific sensors for measuring oceanographic properties. Icefin also carries a suite of mapping sensors including sonars, altimeters, and cameras that allow us to define the cavity geometry below the ice and survey the properties of the ice and sea floor. During the austral summer 2018, we deployed Icefin through boreholes in the sea ice adjacent to the Erebus Glacier tongue under the NASA-funded RISE UP program based out of McMurdo Station with support from USAP. We completed 3 radials with <1-1.5 km penetration below the glacier, in which Icefin gathered data in areas under the 300m thick ice with less than 1m water depth, and imaged with sonar regions where the ice made direct contact with the seafloor. We observed a dynamic system: parallel sets of lateral linear deposits of material sculpted by the glacier, basal fractures and channels carved at the glacier base, and a variety of indications of ocean interactions. Additional missions surveyed the face of the glacier and its margin. We report our initial findings of the geometry of the cavity below the ice, and evidence for several kinds of dynamic interactions, and preliminary lessons for how grounding zone dynamics can be observed to form future models. In the next few years, Icefin will be deployed near the grounding zones of Kamb (through the ANZ Ross Ice Shelf Programme) and Thwaites glacier (through the NSF-NERC International Thwaites Glacier Collaboration) through hot water drilled access holes to achieve similar measurements of these critical systems.