Bathymetry and geological structures beneath the Ross Ice Shelf at the mouth of Whillans Ice Stream, West Antarctica, modeled from ground-based gravity measurements

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New gravity data reveal important geologic controls on the location and behavior of the grounding zone of Whillans Ice Stream (WIS), West Antarctica. Grounding zones of ice sheets and contiguous ice shelves are important for understanding ice-sheet dynamics, as key processes that influence the grounded ice and its discharge into the ocean occur in these regions. Here we model the bathymetry and shallow geological structures beneath the Ross Ice Shelf in an embayment of the WIS grounding zone using gravity data collected on the ground, in conjunction with seismic and radar data. We find that the region of shallow ocean water (<~50 m) is extensive; oceanographic models suggest grounding zones exhibiting thin ocean cavities with gently sloping ice-ocean interfaces are likely to be tidally well-mixed, leading to slower basal melting than would occur in a thicker, stratified water column. Beneath the ocean water column, we model a fault and a sedimentary basin in a half-graben, filled with two layers of sediments. The total thickness of the sediment layer is 900 to 1250 m in the half-graben, and 600 to 800 m on the upthrown block, and the basement depth is no more than 2000 m. We observe that the upper, softer sediment is thinnest near the modern grounding line and may possibly pinch out near our grid, and that the modeled fault is roughly parallel to part the grounding. We therefore hypothesize that the WIS grounding line stabilized in its current location in part due to the subglacial geology.