

# Dynamics of Subglacial Lake Whillans from WISSARD Radar, Seismic and GPS Surveys and Satellite Laser Altimetry

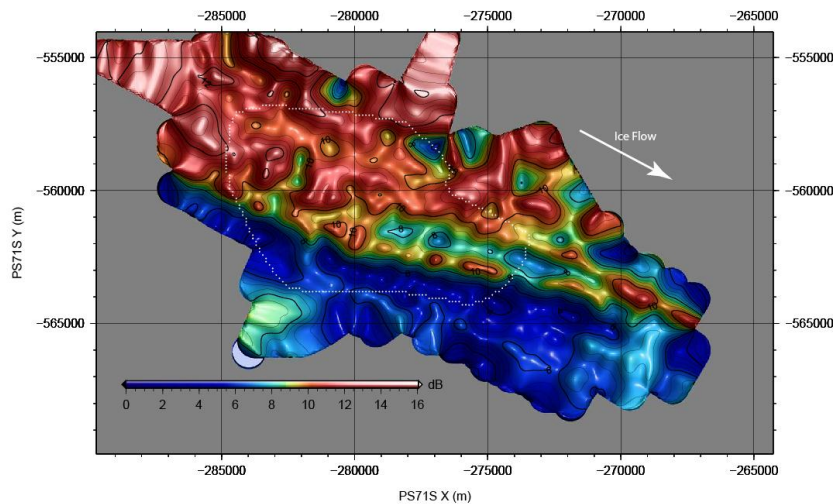
*Knut Christianson<sup>1,3</sup>, Robert Jacobel<sup>1</sup>, Huw Horgan<sup>2</sup>,  
Sridhar Anandkrishnan<sup>3</sup> and Richard Alley<sup>3</sup>*

*1. Physics Department, St. Olaf College*

*2. Antarctic Research Centre, Victoria University*

*3. Earth and Environmental Sciences, Penn State University*

We discuss the dynamic filling/draining cycle of Subglacial Lake Whillans using ice-penetrating radar, kinematic GPS, satellite laser altimetry, and active source seismics. High spatial density kinematic GPS and ice-penetrating radar surveys, 3 m along-track spacing and 500 m or 1 km line spacing, were interpolated to 100x100 m<sup>2</sup> grids of surface elevation, basal topography, subglacial hydropotential pressure, and relative basal reflectivity. A bed lination along the north side of the lake coincides with the area of strongest basal reflectivity gradient (high on the lake side), showing that water is likely confined by, and flows adjacent to, this ridge. Active source seismic profiles in the lake basin show high reflection amplitudes and portions of the survey depict a phase reversal that is consistent with the presence of several meters of water. We also seismically image a shallow water column (~6 m) in area of lowest hydropotential pressure indicating that lake drainage is likely primarily controlled by changes in surface topography such that a shallow water column remains at low stand. We use GLAS ICESat laser altimetry combined with measurements of basal topography to construct a time series of changes in hydropotential gradient. Ridges in basal topography along the edges of the lake act as barriers to changes in hydropotential pressure. Changes in hydropotential are greatest in the southwest corner of the lake, corresponding to the largest elevation anomaly, and may be partially confined here by a low amplitude central ridge in basal topography. Although the exact drainage mechanism remains unclear, troughs that run parallel to and merge with basal topography suggest confinement of water and sediment flow by subtle ridges in basal topography in the filling stage of the lake cycle.



Subglacial Lake Whillans relative basal reflectivity (South Polar Stereographic). The sharp bed lination corresponds to the marked change in reflectivity along the north margin of the lake basin indicated by the color change from blue to warmer colors at about 8 dB. Areas to the south are wet.