Investigations of near-vertical subsurface structures near Swiss Camp, Greenland

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Processed Radio Echo Sounding (RES) data reveal vertical subsurface structures near the equilibrium line close to Swiss Camp, Greenland. Moulins, or englacial conduits that extend from the surface to unknown depths within the ice, may allow summer meltwater to drain into the ice sheet and contribute to increased basal lubrication. Moulins that are actively draining meltwater have been observed during ground-based investigations in the ablation zone near Swiss Camp [Behar, Steffen, pers. com.]. While these features have not been directly observed as high upstream as the equilibrium line, they have been inferred as an explanation for observed ice-sheet speed-up events recorded near Swiss Camp [Zwally, 2002; Parizek & Alley, 2004]. Testing this hypothesis is crucial because the location of such moulins may help determine whether they are responsible for changes in elevation that are too large to be caused by surface melt and decreased snowfall alone [Krabill, 1999].

RES profiles collected in spring 2006 reveal a vast number of potential moulin features. To interpret RES data for this investigation, it is necessary to collapse the corresponding diffractors to their approximate original shape using a migration algorithm and to confirm the orientation of the resulting structure. In doing so, it may be possible to determine whether the imaged feature is vertical, similar to a moulin or not vertical, similar to an englacial drainage pathway. A focused investigation was carried out during the following field season in spring 2007 on one feature ~1 km from Swiss Camp and another ~11 km north. Both sites were relatively isolated from other major features, making them ideal for clean data migration. Radar sounding for both sites was collected using a ‘race-track’ grid pattern analogous to a marine seismic survey to enable the use of 3D seismic migration algorithms in addition to 2D migration that are possible with data from a single profile. Data migration was accomplished using the Paradigm Focus seismic data processing package by appropriately scaling the wave speed and travel times for use with radar data. Post-migration results indicate that both sites have vertical features but different depth penetration. The feature closer to Swiss Camp does not appear to reach the bed while the more distant feature may. Neither of the features appear to be accompanied by dipping layers or those of varied brightness which would be indicative of water content as seen in RES profiles collected over other similar features.