

Seismic Studies of the Amery Ice Shelf, East Antarctica

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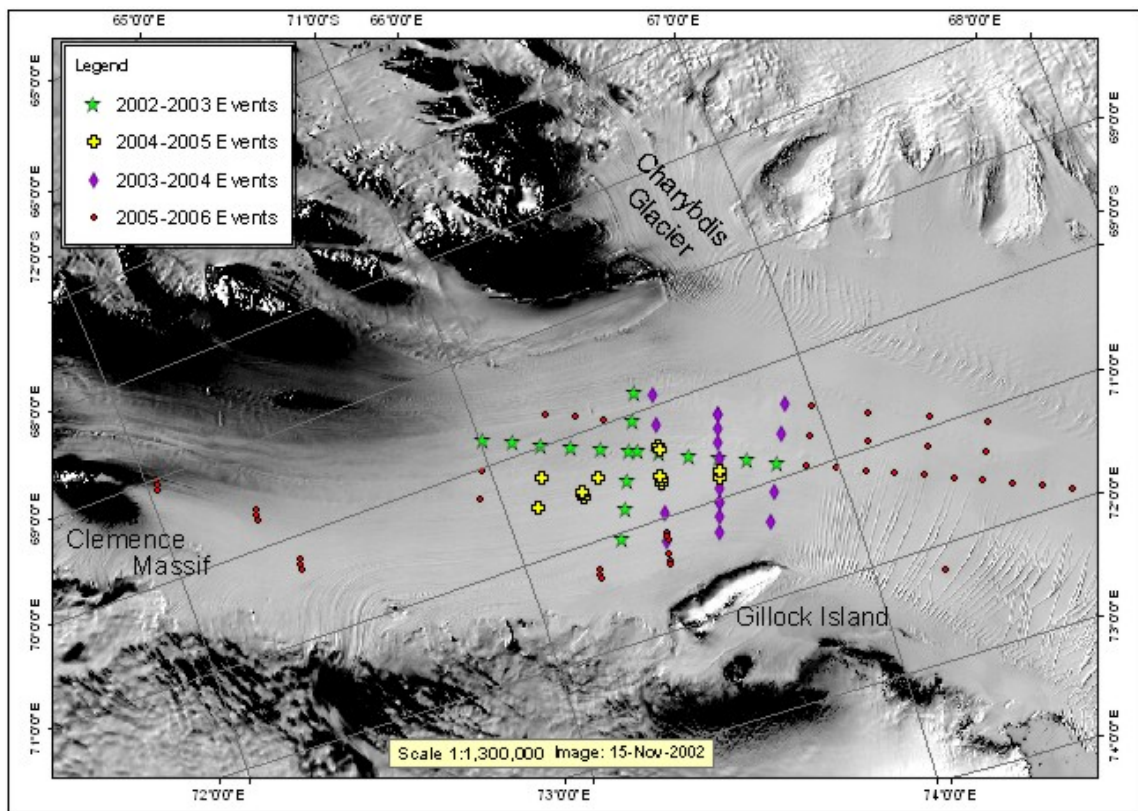
In the 2002/2003 and 2004/2005 Antarctic summer seasons, seismic research was carried out on the Amery Ice Shelf (AIS), East Antarctica. The AIS is located between Davis and Mawson Stations, on the coast of East Antarctica, at around 70°S, 70°E. It is the third largest embayed shelf in Antarctica, and the largest entirely in East Antarctica, and as such is one of the largest glacier drainage basins in the world. Due to this, and its thermal isolation, the AIS plays an important role in the global climate system (Allison, 2003). As such, the AIS is a very interesting site for study. The AIS has been the site for numerous glaciological surveys in the past, however seismic surveying had not been undertaken in a serious manner since the Soviet Antarctic Expedition (SAE) seismic surveys in the 1970s. These entailed about eighty seismic observations, none of these being taken south of 71°35'S (Hunter et al., 2004; Allison, 2003).

The initial aim of the research, beginning in the 2002/2003 season, was to undertake some regional mapping of the ice shelf, and to determine if marine ice could be differentiated from meteoric ice employing the seismic technique. Similar work was carried on in the 2003/2004 season by Hugh Tassell (UTas, GA). In 2002/2003, regional surveys were completed every 10 km along the north-south line running down the centre of the AIS (see Fig 1 for survey locations). A 50 km perpendicular line was carried out across the centre of the north-south line, and a 1 km detailed seismic reflection line was carried out just north of this intersection. This was done using overlapping spreads to maintain fold coverage. The resulting seismic stack showed two distinct reflections around the ice-water boundary, which results in a ~20 m thick marine ice layer here.

In the 2004/2005 season, the scope of the project was extended to include research into deformation and fracturing of the AIS. The major aim of the research was to ascertain whether the ice showed anisotropic properties, i.e. whether strain along stream margins had led to a realignment of ice particles, causing a difference in seismic ice velocity between the direction of flow propagation compared to the normal to the flow direction. For this season, this type of survey was initially proposed to be undertaken in regions close to Gillock Island on the eastern side of the AIS, along lines of high strain, seeing as these would be the areas most likely to show anisotropy. Sites to survey were picked from strain images of the ice shelf, produced from ice velocity images. Due to an inability to access these sites in 2004/2005, the anisotropy surveys were instead undertaken over flowline margins, as picked from Landsat images. It was hoped that the flowlines represented a margin which could possibly have undergone enough strain in the past to preserve a relict shear margin, to reveal anisotropic differences in the ice. Surveys were undertaken in sets of three, one survey spot in the middle of the "strained" area (i.e. on the flowline) and two spots either side of the flowline, approximately 1-2 km from the centre spot. This distance was used so as to be outside any influence of where strain had

occurred, resulting in what we hoped to be measurable difference in seismic velocity, with central anisotropic ice, and isotropic ice to either side. Processing is still being done on data obtained last season, and results so far are inconclusive as to whether the seismic velocity variations are great enough to be outside the error margin.

Next season, the 2005/2006 Antarctic summer, more anisotropy surveys will be carried out closer to Gillock Island, and regional surveys will be continued to improve the detail and extend the boundaries on the current subsurface map of the AIS. The plans for this season are to access the anisotropy survey locations within the strained area close to Gillock Island, as well as in an area in the south of the AIS. By undertaking surveys on the same ice stream in both regions, it can be discovered if there's a difference in anisotropy properties related to the age of the ice since deformation, comparing data from younger ice in the south with data from older ice near Gillock Island.



References:

Allison, I., 2003. The AMISOR project: ice shelf dynamics and ice-ocean interaction of the Amery Ice Shelf. Forum for Research into Ice Shelf Processes, Report (14). Web address: <http://www.gfi.uib.no/frisp/Rep14/allison.pdf> (accessed 15/06/05)

Hunter, J., Hemer, M., & Craven, M., 2004. Modeling the circulation under the Amery Ice Shelf. Forum for Research into Ice Shelf Processes, Report (15). Web address: <http://www.gfi.uib.no/frisp/Rep15/hunter.pdf> (accessed 15/06/05) Caption: Fig 1. Survey locations of recent seismic work on a satellite image of the Amery Ice Shelf.