

# **Seismic surveys of the Amery Ice Shelf, East Antarctica: An investigation of meteoric and marine ice, the ocean cavity and the anisotropic crystalline structure of strained ice**

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## Abstract

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A multipurpose seismic study of the Amery Ice Shelf (AIS), East Antarctica, was undertaken between 2002/03 and 2005/06 with the aim of expanding glaciological knowledge of the structure of the AIS.

Seismic reflection surveys were carried out at localities G2A, AM01, AM04, and CT. CT is situated across the Lambert Glacier (LG)-Mawson Escarpment Ice Stream (MEIS) flow boundary. The results show ~722 m total ice at G2A, and a sharp 15 m decrease from 672 m to 657 m at the LG-MEIS ice boundary at CT. Strong reflections just under the ice base correspond to cooler water temperatures, mapping an 18-36 m layer of basal melt. A pycnocline is present in most seismic records, showing the boundary between Ice Shelf Water (ISW) and High Salinity Shelf Water. ISW thicknesses are 137-140 m at G2A and CT, and 75-95 m at AM01. At sites of marine ice accretion (AM01 and AM04) seismic data reveals the meteoric-marine ice boundary at 277 m and 394-401 m respectively. This matches depths measured by the Amery Ice Shelf Ocean Research (AMISOR) hot-water drilling project. Interestingly, the ice shelf base depth as measured by AMISOR produced no reflection in the seismic data at AM01 and AM04. A reflection from the hydraulic connection depth instead appears at 376 m at AM01 and 533-544 m at AM04. Seafloor depth below the surface is ~1317-1357 m around G2A, 975-992 m around AM04, 814-824 m at AM01 and 1120 m at the CT Line, although here the seismic data also shows a hill with its crest at 1083 m depth.

Perpendicular refraction surveys across major flow unit boundaries revealed negligible to weak azimuthal differences in P wave ice velocities, with no significant variation found within the upper ~100 m of ice shelf ice. The results showed a general range of 0.1-2.2 % variation, with only one site displaying a 4.3 % variation which may or may not indicate an anisotropic ice fabric.

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## Declaration

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This thesis contains a reviewed interpretation and discussion of processed data that was the basis of my own Honours thesis undertaken at Macquarie University in 2003, entitled “Seismic Reflection Studies of the Amery Ice Shelf, East Antarctica”, published in August 2006 as:

McMahon & Lackie (2006), Seismic reflection studies of the Amery Ice Shelf, East Antarctica: Delineating meteoric and marine ice, *Geophysical Journal International* **166**: 757-766.

Other than the above stipulated cases, this thesis entitled “Seismic surveys of the Amery Ice Shelf, East Antarctica: An investigation of meteoric and marine ice, the ocean cavity and the anisotropic crystalline structure of strained ice” contains no material which has previously been submitted or accepted for a higher degree, as part of the requirements for a degree, or for a diploma to Macquarie University or to any other institution. To the best of my knowledge, this thesis contains no material previously published or written by another person except where due acknowledgement has been made in the text. Further, I certify that this thesis is an original piece of research written by myself, and any help I have received for this research and in preparing this thesis has been appropriately acknowledged.

Kathleen L. McMahon

08/02/2012

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