The Cryosphere Discuss., 7, C2465–C2469, 2013
www.the-cryosphere-discuss.net/7/C2465/2013/

The Cryosphere
Discussions
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Interactive comment on "Tectonic and oceanographic controls on Abbot Ice Shelf thickness and stability" *by* J. R. Cochran et al.

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Received and published: 22 November 2013

Summary

This paper describes the use of the Operation IceBridge topographic mapper, radar and gravimetry data, plus some ancillary data sets, to describe the tectonic setting underlying and surrounding Abbot Ice Shelf (AbIS) and the oceanographic conditions which combine with the bathymetry to determine basal melting.

The paper is well written and is a valuable contribution to the literature on Amundsen Sea ice shelves. While I have a large number of comments, I don't think it will take long to revise this paper.

Comment IDs are page/line numbers.

– Laurie Padman

MAJOR COMMENTS

1) Maybe for the journal, not the authors: Figure sizes on "printer friendly format" are inadequate. I needed to view the figures greatly expanded on the computer, especially Figs. 1-3.

5513/7-10: Can you tell us briefly here, why the base could not be imaged by radar in this region?

5513/16: A standard error of 12 m seems high when the full range is 1-26 m.

5519/25: As a non-geologist, I was a bit confused by what was meant by "an en echelon set of faults". Also 5520/3, "half graben". You don't need to teach us geology, but a quick and simple explanation of these terms might be useful.

5520/8: I don't really know what I'm meant to see in Fig. 1 and Fig. 3b to confirm the existence of "ice rises and rumples on the ice shelf surface". For Fig. 1, it may just be that the figure is too unclear, even magnified on the screen.

5521/19: See extensive comments below re Figure 4. In particular, given that your thesis is about circulation of CDW through poorly defined troughs, you need the IBSCO data points marked, and the RSS Shackleton 2012 cruise near the western ice front marked.

5522/3: Give actual "x" coordinates for the locations of "footwall rims" in Fig. 3 for us to focus on. I think one of these is near x=37 km, yes? Others?

5522/6-8: Comparison of mean depth of AbIS needs to specify here (in main text) that the means are evaluated from Bedmap2 points at the same locations (along the OIB lines). This is clear in Figure 8 caption but the impression, at this point in the text, is that you're comparing an "OIB mean ice shelf elevation" with the Bedmap2 total ice shelf mean value, so that sampling might explain the difference.

5522/13-16: I was surprised that any marine ice is expected on Abbot. Usually requires strong basal slopes and sources of supercooled water (so, a fairly strong vertical velocity of meltwater).

5522/19-23: This long sentence is very difficult for me to parse. Break in two, or otherwise rewrite?

MINOR COMMENTS

In general, I'd use "Abbot Ice Shelf" instead of "the Abbot Ice Shelf". Also, consider whether it is reasonable to abbreviate it to, e.g., "AbIS" (not "AIS", which is ambiguous).

5510/6: comma after "balance"

5510/10: capitalize "Shelf"

5511/4: comma after "Embayment"

5513/3-6: don't need quotation marked around instrument names.

5513/9: space after "axis"

5514/4: comma after "island"

5517/29-30: Where do I see "Peter I Island" and "De Gerlache seamounts" on a figure?

5520/17: Explicitly mark and identify the BGA on Figure 2.

5520/18: Not sure what is meant by "which LATER marked the ..."

5521/3: Clearer, I think, if you say "extends NORTHWARD along ..."

5522/28: "Wilkens" => "Wilkins"

5523/1-2: I think it is not just that the "winter water" layer cools and deepens seasonally that matters, but that the upper ocean responds dynamically much more easily (and quickly?) than CDW inflows forced by larger-scale atmospherics. E.g., at Wilkins we see frontal upwelling and downwelling responses to *local* winds. You get to some of

this in the next para, but I'd bring this up here.

5523/5: I don't recall anything about "the August 2007-2008" period as being special. This is not your survey period, so it has something to do with Rignot et al. (2013)? However, I also don't recall seeing a statement of *when* the AbIS OIB data set was acquired.

5523/10: I don't know why you say that AbIS "is NOW sensitive to". The studies you quote suggest it isn't thinning so, unlike Wilkins, it hasn't become more exposed to surface processes with time. It IS reasonable to assume that its thinness makes it sensitive to fracture processes by surface meltwater, but the "NOW" really requires you to tell us how its exposure to upper-ocean processes has changed. Since it isn't by ice draft, the only other option is a trend in Amundsen Sea surface properties. If that's what you're implying, you'll need a citation.

FIGURES

Figure 1: Unclear, even when greatly expanded on-screen. There are a lot of things, and some *very* small text labels, that don't help the story. A better approach (IMO), is to build your own map, e.g., using the MODIS MOA or Landsat backgrounds, contouring a recent DEM and, maybe, adding IBSCO depth, then only labeling the features that matter.

Figure 2: Identify and label the BGA.

Figure 3: Axis numerical labels are too small.

Figure 4: (a) Limit of rifting is shown as a red line on the map itself, but purple in the legend panel. (b) Extend map so it gets to the shelf break along all or most of the northern boundary, so you can see where a trough leading out from between Dustin and McNamara islands might go. (c) Add IBSCO track lines. I really don't like this figure as-is: it leaves the impression that there *is* a sill between the CTD stations and the western ice front, which you tell us really isn't there based on new data. And it

doesn’t show the trough that you postulate might lead north between D and M islands but I can’t tell, from the present Fig.4, whether that is a reasonable hypothesis.

Figure 6: Minor comment: using solid line for Bedmap2 mean and dashed for your own mean draft suggests that Bedmap2 is the "preferred" value. Since the histogram in B is Bedmap2, this is probably okay.

Figure 7: Would like to see a second panel showing proposed *map* of seafloor depth, and maybe a third showing "water column height".

Interactive comment on The Cryosphere Discuss., 7, 5509, 2013.