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Interactive comment on "Archaeal Intact Polar Lipids in Polar Waters: A Comparison Between the Amundsen and Scotia Seas" *by* Charlotte L. Spencer-Jones et al.

Anonymous Referee #2

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This study attempts to assess the distribution of core GDGTs and intact polar lipid (IPL)-GDGTs in the waters of the Scotia Sea and Amundsen Sea in the Southern Ocean. GDGTs are membrane spanning isoprenoidal lipids that make up a significant portion of the membrane bilayer of a variety of Archaea. Modifications to these core membrane lipids, including the addition of 1-8 cyclopentane rings, 1 cyclohexane ring, or hydroxylations, or changes to the polar head groups, are thought to represent physiological responses to environmental factors, such as changes in temperature, pH, or redox. Because of this physiological connection between GDGT modifications and environmental conditions, an because GDGTs can be well preserved in ancient sediments, these molecules have been employed as paleotemperature proxies. In addition,

some of these modified GDGTs have also been proposed to be restricted to certain archaeal groups and, thus, have been utilized as diagnostic markers for specific archaeal group in a environmental settings. However, the utility of GDGTs and IPL-GDTGs as proxies and/or diagnostic markers requires an understanding of a variety of factors – confirming the correlation between environmental factors and the specific modifications made on the GDGT structures, determining the distribution of various GDGT structures in different ecosystems, and assessing the occurrence of specific GDGT structures in different cultured archaeal groups. In this study, the authors investigate the occurrence of the core GDGT structures, which are most relevant for paleotemperature proxies, as well as the occurrence of the GDGT structures with various polar headgroups in the Scotia Sea and Amundsen Sea.

The analyses performed in this study are well done and provide an interesting picture of the distribution of GDGTs in the Southern Ocean. In particular, they show limited cyclization of GDGTS in their samples with the majority of core GDGTs having zero rings. In addition, they see a significant amount of hydroxylated GDGTs which have been proposed to function in helping maintain membrane fluidity at low temperatures. The authors infer that both observations may reflect the cold environment of the Southern Ocean which their specific sites can range from -1 to 8 degrees Celsius. The occurrence of IPLs is a little more difficult to parse. Although I agree that IPLs can represent the occurrence of living archaea in the water column, I am not convinced that the intact IPLs are useful as diagnostic markers specifically for the Thaumarchaeota as I believe other archaea are known to produce head groups with 1 or 2 hexose groups. Nonetheless, the authors are able to demonstrate some interesting IPL-GDGT patterns that may reflect temporal changes in archaeal communities. For example, in the surface samples form the Amundsen Sea (collected within the euphotic zone), there was an absence of IPL-GDGTs. Previous studies have shown the absence of archaea in the surface waters of the Southern Ocean (and large abundance of bacteria) and this lack of IPL-GDGTs corresponded well with that larger seasonal variation in archaeal populations. Overall, this study is well-designed and well-written and contributes some

significant knowledge into the environmental distribution of both core GDGTs and IPL-GDGTs.

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