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Interactive comment on "Sensitivity of airborne geophysical data to sublacustrine permafrost thaw" *by* B. J. Minsley et al.

Anonymous Referee #2

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Comments to the Authors

This paper demonstrates the ability of airborne geophysical techniques (AEM) to characterize subsurface physical properties associated with talik formation beneath lakes. The results of this work can help to improve techniques to both identify and delineate taliks beneath lakes and also to monitor their evolution over time. This is important for development of ground water models which are required for example, for planning mining developments and the assessment of their environmental effects. Identification of hydraulic connections between mining project components such as open pit/underground mines and tailing impoundments and surrounding water bodies is a key consideration in planning mining projects.

The paper is appropriate for publication in The Cryosphere. A few comments, from a

permafrost perspective, are offered for the authors' consideration.

Methods, Section 2.1 Additional information would be useful regarding the initial study conditions such as the initial ground temperature conditions and permafrost thickness.

Results/Discussion For fine-grained sediments such as silt and clay, a significant amount of unfrozen water may exist below 0°C. The unfrozen water content curve (unfrozen water vs temperature) for fine-grained material therefore differs from that for coarser grained sands and gravels. Perhaps the authors could add a bit more about the range in temperatures for which the unfrozen water content may make it difficult to determine talik boundaries. For warm permafrost conditions where temperatures are close to 0°C one could delineate a talik from the AEM survey (due to lower resistivity) in finer grained material which is larger than that which would be defined based on only temperature (i.e. permafrost at temperatures below 0°C).

The authors mention (page 6097) that AEM data are most likely to be useful for baseline characterization of subsurface properties as opposed to monitoring changes in permafrost. Perhaps the authors could comment more on the effectiveness of delineating through taliks which is a key consideration in the identification of hydraulic connections between water bodies. What are the limitations of the technique regarding permafrost conditions as presumably the technique would not be as useful for identification of through taliks under colder conditions where permafrost is thicker.

I would agree with the authors that for the most part under natural conditions, changes in permafrost occur over a longer time period than is practical for repeat AEM surveys. However there are situations related to human activity where repeat surveys might be practical. One situation where use of AEM as a monitoring tool might be considered is where lakes are formed behind dams. This would be the case for water supply reservoirs and for mine tailing impoundments. Over several years a talik will form as there is a significant change in ground surface temperature conditions (rapid change from a mean ground surface temperature of several degrees below 0°C to temperatures

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above 0°C). There may also be situations either natural or related to human activity where (rapid) lake drainage may occur resulting in freezing of taliks beneath the former lakes and it is not clear whether AEM might be useful for monitoring these changes.

Interactive comment on The Cryosphere Discuss., 8, 6079, 2014.

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