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OPEN FILE 7987**

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at Lac Kinojévis, Quebec**

G.R. Brooks

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Abstract

As part of a reconnaissance sub-bottom acoustic profiling (SAP) survey, 22 SAP were collected from Lac Kinojévis, Quebec, on July 11, 2014. The eight profiles with the best penetration were located in the southeastern, narrower area of the lake. Two depositional facies can be identified within the SAP returns that represent lacustrine-fluvial and glaciolacustrine deposits. No obvious mass movement deposits are present in the profiles.

Introduction

Large areas of northwestern Quebec-northeastern Ontario were inundated by a succession of glacial lakes, known as Barlow, Barlow-Ojibway and Ojibway, that evolved within the Timiskaming and Hudson Bay basins between 10 570 and 8470 ± 200 cal BP (Vincent and Hardy 1979; Veillette 1994; Breckenridge et al. 2012). A legacy of these glacial lakes is the regional occurrence of glaciolacustrine deposits that form the Great and Lesser clay belts areas, as has been described in early geological reports (e.g., Coleman 1909, 1922; Wilson 1918; James 1923). Studies in the 1920s by Antevs (1925; 1928) interpreted that the rhythmically laminated couplets composing the deposits are varves which represent annual accretions. He recognized that the varves form a time series that can be correlated throughout the region, based on varve thickness patterns, as subsequent research has verified (Hughes, 1959; 1965; Breckenridge et al., 2012). Many reports mention the presence of beds of “contorted”, “deformed”, “disturbed” and “slidden” varves within the glaciolacustrine deposits (Wilson 1918; Antevs 1925, 1928; Hughes, 1959; Breckenridge, 2012). Some of these disturbed deposits have been interpreted or inferred to be stratigraphic evidence of paleoearthquakes that occurred during local deglaciation (Adams 1982, 1989; Doughty et al. 2011, 2013).

Recent literature indicates that lake basins are promising areas for investigating paleoseismicity, by identifying stratigraphic levels that contain the deposits of multiple, synchronous, submarine landslides and/or turbidity currents (e.g., Moernaut et al. 2007, 2009; Upton and Osterberg, 2007; Bertrand et al. 2008; Anselmetti et al. 2009; Beck 2009, 2011; Maloney et al. 2013; Morey et al. 2013; Strasser et al. 2013). Mass movement deposits have been recognized within the deposits of lake basins in eastern Canada, including northwestern Quebec-northeastern Ontario, that are attributed to both modern and prehistoric earthquakes (e.g., Shilts, 1984; Shilts and Clague, 1992; Shilts et al., 1992; Ouellet, 1997; Normadeau et al., 2013; Doughty et al., 2010; 2014). Brooks (2015) advocated applying an integrated seismo- and chrono-stratigraphic approach to investigating mass movement deposits as evidence of paleoseismicity preserved in lake basins.

To identify the occurrence of disturbed deposits (i.e., landslide, turbidity currents and/or soft sediment deformation) preserved in the sub-bottoms of lakes, reconnaissance sub-bottom acoustic profiling (SAP) surveys were collected by the Geological Survey of Canada in July 2014 at eight lakes in the Rouyn-Noranda-Kirkland Lake area, northwestern Quebec-northeastern Ontario (Fig. 1). The results allow an assessment of the extent and character of disturbed deposits in the region and can be used to identify lake basins (or portions thereof) for more detailed SAP surveys to investigate regional paleoseismicity.

This report contains the results of the reconnaissance SAP survey undertaken at Lac Kinojévis, Quebec, on July 11, 2015 (Figs. 1 and 2). It summarizes the SAP methodology, includes a map of the profile lines, provides a generalized overview of the deposits contained in the sub-bottom, and a brief notation of the content of the individual profiles. The report contains digital data of the SAP profiles in .keb and .sgy formats, and raster images of the profile returns (bmp). It also contains .kea files that list the date and time of collection, water depth, and geographical coordinates for the profile routes. This report is one of eight that summarize the results of the July 2014 reconnaissance SAP surveys, as listed in Table 1.

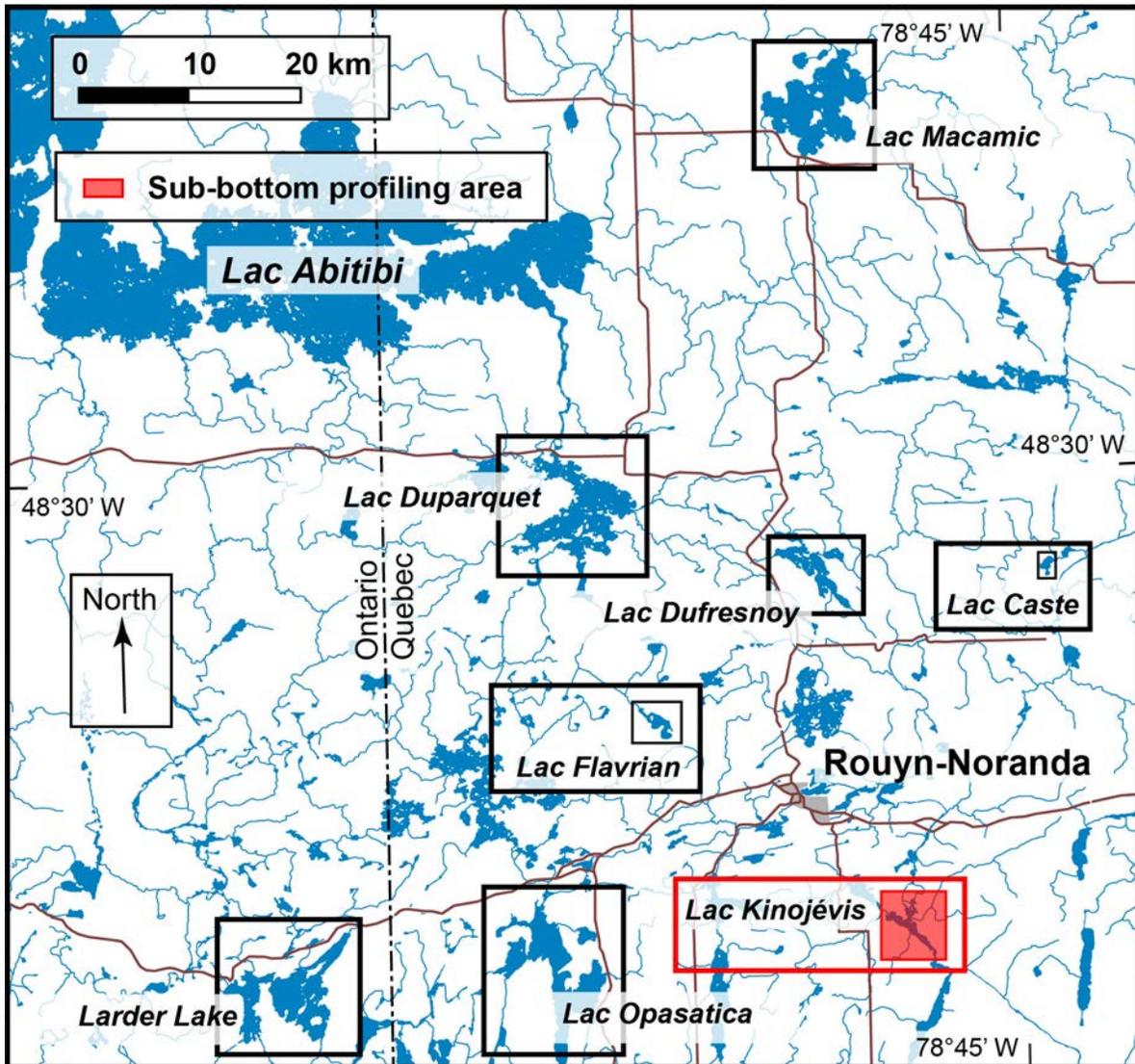


Fig. 1 Map showing the locations of Lac Kinojévis and the other seven lake basins in the Rouyn-Noranda area, Quebec, where reconnaissance sub-bottom profiling surveys were conducted in July, 2014.

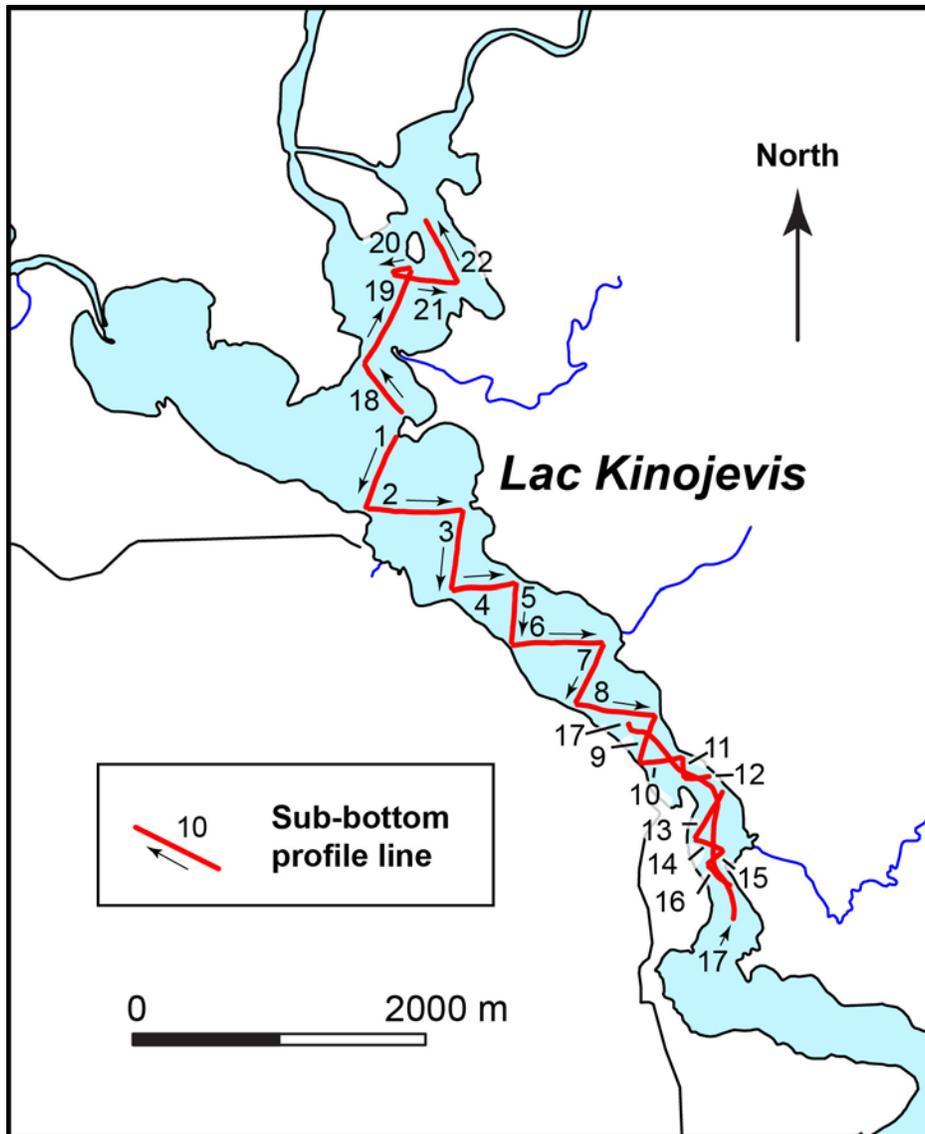


Fig. 2 Map of Lac Kinojévis showing the locations and numbering of the 22 sub-bottom profile lines.

Table 1 List of Open Files containing reconnaissance sub-bottom profiling of eight lakes in the Rouyn-Noranda-Kirkland Lake area, northwestern Quebec-northeastern Ontario.

Profiled lake basin	GSC OF number
Lac Caste	7991
Lac Dufresnoy	7990
Lac Duparquet	7989
Lac Flavrian	7988
Lac Kinojévis	This report
Lac Macamic	7985
Lac Opasatica	7984
Larder Lake	7986

Lac Kinojévis

Lac Kinojévis is located ~16 km southeast of Rouyn-Noranda, Quebec (Fig. 1). The lake is elongated in shape with the long-axis is oriented in a northwest-southeast direction. Lac Bruyere is located ~1 km northwest of Lac Kinojévis; the two water bodies are separated by a wetland. Lac Caron is a narrow basin, ~22 km long, which extends towards the south-southwest from the Kinojévis River just downstream of Lac Kinojévis.

Lac Kinojévis forms a wide section of the Kinojévis River. It covers ~5.3 km², is ~6 km long and up to 1 km wide; a bay, ~2 km long, extends to the northeast into which the bifurcated mouth of the Kinojévis River flows. The river exits Lac Kinojévis towards the southeast.

Access to the lake was obtained using a private boat launch at the northwest end of the lake, near the start of profile 2.

Methodology

The SAP survey on Lac Kinojévis was undertaken on July 11, 2014, using a Knudsen 320MTM profiler coupled to low (28 kHz) and high (200 kHz) frequency transducers. The pole-mounted transducers were attached on the side of a 4.9 m (16 ft) aluminum boat powered by a 30 hp motor. Traversing speed during profiling ranged between 5 to 7 km.hr⁻¹. Profiling routes were mapped using streamed differentially-corrected GPS coordinates collected with a Novotel Smart-V1 antenna-receiver and recorded in combination with the digital SAP data. The active window depth of the profiler was set to 0-20 m. The profiling routes are depicted in Fig. 2.

Profiler and GPS data for each profile were recorded digitally on a notebook computer as .keb and .kea files. A .keb file is a Knudsen proprietary format that can be opened with Knudsen PostSurveyTM v1.61¹ software, which is included with the download of this Open File. In the .keb format, the profile returns include a depth scale and vertical line stamps which display time

¹ PostSurvey v1.61 is proprietary property of Knudsen Engineering Ltd.TM and is intended for authorized use only. Any use, other than the specific purpose of playback/displaying Knudsen data is prohibited. PostSurvey v1.61 has been included in the download of OF-7987 with the permission of Knudsen Engineering Ltd.TM. The software has been provided for the convenience of the OF-7987 user. A user of this software does so entirely at their own risk.

and geographical coordinates (degree-decimal minutes). The vertical line stamps are made at the start/end of the profiles as well as at 20 sec intervals during profiling (Fig. 3).

To further facilitate profile viewing, the .keb file of the 28 kHz channel returns for each profile has been converted to a .sgy format file as well as a .bmp raster image. The .kea file contains the date and time of data collection, water depth, and geographical coordinates of the profile routes. The .kea files are an ASCII format and can be opened through a spreadsheet software, such as Microsoft Excel®. Depths on the profiles in the .keb and .kea files are based on a sound velocity in water of 1500 m.s⁻¹.

The .keb, .sgy, .bmp and .kea files for each profile are contained in designated profile folders. The folders form a digital Appendix that accompanies the download of this report.

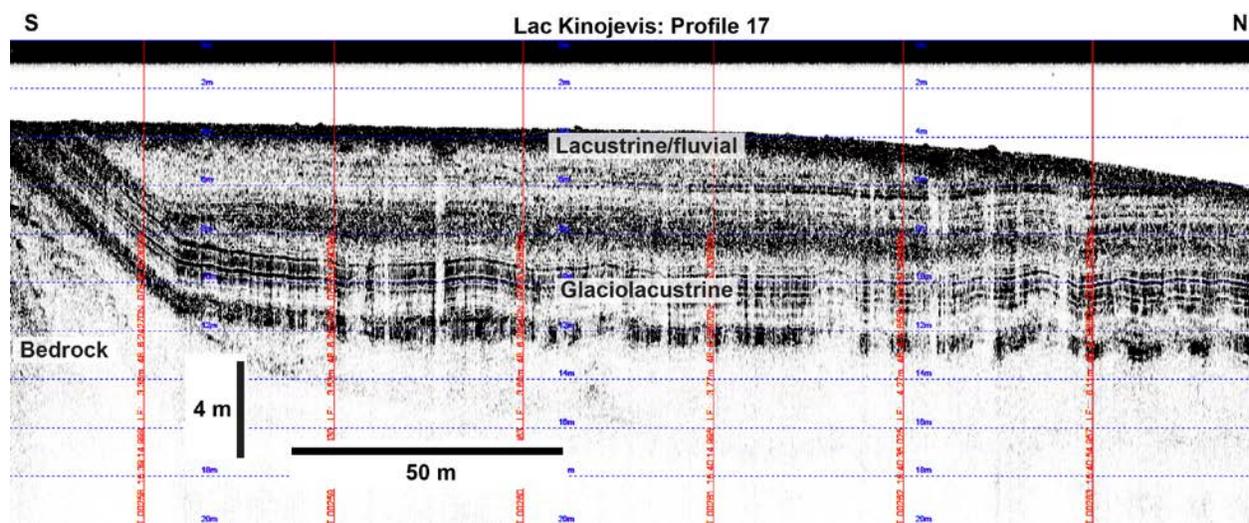


Fig. 3 Example of a sub-bottom acoustic profile from Lac Kinojévis, showing the lacustrine/fluvial and glaciolacustrine facies. The deposits onlap bedrock on the far left of the profile above which the glaciolacustrine deposits are erosively truncated at the modern lake bed. These returns are from the southern portion of profile 17. See Fig. 2 for the location of the profile. The horizontal dashed lines show depth at 2 m intervals and the vertical lines are time-geographical coordinates stamps.

Results

Twenty-two SAP profiles were collected at Lac Kinojévis, as shown in Fig. 2 and summarized briefly in Table 2. Profiles 1 to 16 zig-zag back and forth across the lake towards the general southeast direction. Profile 17 follows the long axis of the basin and cuts across profiles 16 to 9 in the general north and then north-northwest direction. This profile ends where a large zone of no penetration was encountered in the central area of the lake. Profiles 18 to 22 were collected in the northern arm of the lake (Fig. 2).

Quality of the returns is variable in different parts of Lac Kinojévis. The best results were obtained along profiles 10 to 17 in the southeastern, narrower section of the lake. Little to no

penetration of sub-bottom was obtained in the middle and northern portions of the lake along profiles 1 to 9 and 18 to 22.

From the profiles 10 to 17 and the faint returns in profiles 6 to 9, two depositional facies are present in Lac Kinojévis, as exemplified in Fig. 3. The depositional facies are summarized as follows:

Lacustrine-fluvial facies – consists of transparent to weakly bedded deposits (Fig. 3); bed spacing is variable. The basal boundary is conformable and commonly well defined by a strong impedance layer. Deposits of this facies are interpreted to have aggraded in the post-glacial basin of Lac Kinojévis. The deposits are interpreted to be lacustrine-fluvial sediments reflecting the presumed influence of riverine processes in the lake basin.

Glaciolacustrine facies – consists of multiple, decimetre-scale, parallel reflectors that are draped on the underling topography (Fig. 3). Deposits exhibiting this facies are common to many lakes on the Canadian Shield and reflect sedimentation within a glaciolacustrine depositional environment. The deposits of this facies in Lac Kinojévis deposits are inferred to have aggraded within glacial Lake Ojibway.

The glaciolacustrine facies deposits along profiles 16 and 17 are truncated erosively locally at the modern lake bed. This truncation undoubtedly reflects erosion for fluvial currents within a narrow area of the lake basin.

A facies representing bedrock is present in profiles 16 and 17. This facies forms a strong, opaque reflector with a smooth, curved, or irregular surface topography. In the area of both profiles, bedrock outcrops on the nearby shoreline either at the end or adjacent to the profile route.

There is no obvious occurrence of mass movement facies encountered in any of the profiles in Lac Kinojévis. A possible occurrence, however, is in the noisy returns in the limited portion of the profile 10 where there is penetration of the sub-bottom.

Summary and conclusions

Twenty-two SAP were collected from Lac Kinojévis , Quebec, on July 11, 2014.

The best penetration of the sub-bottom is along profiles 10 to 17 in the southeastern, narrower area of the lake. There was little to no penetration of sub-bottom elsewhere along profiles 1 to 9 and 18 to 22.

Two depositional facies are identified within the SAP returns that represent lacustrine-fluvial and glaciolacustrine deposits. No obvious mass movement deposits are present in the profiles.

Lac Kinojévis is deemed a poor basin for follow-up detailed profiling and core collection because of the apparent lack of the mass movement deposits within the sub-bottom.

Table 2 Summary listing of the Lac Kinojévis sub-bottom profile lines

Profile number	Direction	Length (m)	Comments
1	SW	522	- No penetration along entire profile
2	E	625	- No penetration along entire profile
3	SSW	524	- No penetration along entire profile
4	E	410	- No penetration along entire profile
5	S	390	- No penetration along entire profile
6	E	604	- Faint returns near end of profile but no penetration elsewhere - Returns show glaciolacustrine deposits
7	SW	426	- Faint returns at beginning and very end of profile, but no penetration elsewhere - Returns show glaciolacustrine deposits
8	ESE	527	- Faint returns at very beginning and near the end of profile, but no penetration elsewhere - Returns show lacustrine-fluvial and glaciolacustrine deposits
9	SSW	316	- Faint returns along first half of profile - Returns show lacustrine-fluvial and glaciolacustrine deposits
10	E	271	- Good penetration along last half of profile, but no penetration elsewhere - Returns show lacustrine-fluvial, glaciolacustrine and possible mass movement deposits
11	S	123	- Good penetration but noisy returns along most of profile - Returns show lacustrine-fluvial and glaciolacustrine deposits
12	E	157	- Good penetration but noisy returns along entire profile - Returns show lacustrine-fluvial and glaciolacustrine deposits
13	SW	358	- Good penetration but noisy returns along first third of profile but no penetration elsewhere - Returns show lacustrine-fluvial and glaciolacustrine deposits. Bedrock also present in profile.
14	ESE	185	- Good penetration but noisy returns along last two thirds of the profile, no penetration elsewhere - Returns show lacustrine-fluvial and glaciolacustrine deposits
15	SW	127	- Good penetration but noisy returns along first and last thirds of profile, no penetration in between - Returns show lacustrine-fluvial and glaciolacustrine
16	SE	194	- Good penetration along last half of profile, but no penetration elsewhere - Returns show lacustrine-fluvial and glaciolacustrine deposits. Bedrock also present in profile. - Glaciolacustrine deposits erosively truncated at lake bed.
17	N then NW	1695	- Good penetration along much of profile, zones of no penetration along last half - Returns show lacustrine-fluvial and glaciolacustrine deposits. Bedrock also present in profile. - Glaciolacustrine deposits erosively truncated at lake bed.

18	NW	410	-	No penetration along entire profile
19	NE	693	-	No penetration along entire profile
20	WSW	115	-	No penetration along entire profile
21	ESE	420	-	No penetration along entire profile
22	NW	468	-	No penetration along entire profile

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