2D Resistivity / IP Data Release for Placer Mining and shallow Quartz Mining – Yukon 2010

Los Angeles Creek, Wolf Creek, Ladue River, and Rice Creek

Basic Survey Information

PERFORMED BY
Arctic Geophysics Inc.

FOR
Yukon Geological Survey
Yukon Government

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FIELD WORK
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1. Introduction
This geophysical exploration, conducted by Arctic Geophysics Inc., focuses on the discovery of subsurface conditions in remote wilderness areas in the Yukon, where little or no prospecting information for mining is available.

The data should be of value for placer mining and shallow quartz mining.

The study was initiated by Yukon Geological Survey as an incentive for investors, prospectors and miners to develop promising new areas for mining in the Yukon.

Target areas are Los Angeles Creek, Wolf Creek, Ladue River and Rice Creek.

For the investigation of the ground 2D Resistivity and Induced Polarization (IP) were employed. As a result 10 975m of measuring line have been produced in this exploration.

2. Goal
The geophysical exploration focuses on the determination of the following subsurface characteristics that are of interest for the placer mining industry:

1. Depth and topography of bedrock (main goal)
   - Paleochannels
   - Bedrock benches
   - Bedrock terraces
2. Sedimentary stratification
3. Permafrost conditions
4. Groundwater table

For the exploration of these placer mining related subsurface properties 2D Resistivity was used. The Resistivity imaging system simultaneously measured IP data being of interest for shallow quartz mining. These IP data covering the upper 100m of the subsurface might be of help for the advanced prospecting of primary deposits.

Furthermore this survey provides a contribution to the geosciences about the Yukon.
3. Exploration Area

The exploration project has been carried out in the following areas:

<table>
<thead>
<tr>
<th>Stream</th>
<th>Flowing into...</th>
<th>Mining District</th>
<th>Map</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles Creek</td>
<td>Yukon River</td>
<td>Whitehorse</td>
<td>115O/04</td>
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<tr>
<td>Wolf Creek</td>
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<td>Whitehorse</td>
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<tr>
<td>Ladue River</td>
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<td>Dawson</td>
<td>115N/01, 02</td>
</tr>
<tr>
<td>Rice Creek</td>
<td>Ladue River</td>
<td>Dawson</td>
<td>115N/07</td>
</tr>
</tbody>
</table>

Yukon Map
4. Crew

Leader: Stefan Ostermaier
Scientific Director
Arctic Geophysics Inc.

Prospecting Assistants: Eloi Mayano-Vinet
Alexandre Duhamel Gingras
5. Choice of Geophysical Method

5.1. Placer Prospecting

Ground Penetrating Radar (GPR)
Radar is not an appropriate method to prospect unknown ground for placer in the Yukon, since the radar waves are rapidly absorbed in water saturated sediments such as clay and Klondike-typical black muck. Even in good conditions radar waves can usually not penetrate deeper than 25m into sediments. For ground with discontinuous permafrost, which is common in the Yukon, the reflection lines in the radargram are significantly deformed; thus GPR data taken on changing frost are quite vague. Additionally the 12 feet antennas, needed to reach maximum depth penetration, are hard to move and use in the bush.

Seismic
Seismic soundings have difficulties detecting very shallow layer interfaces. Even by including refraction seismic the technology reaches the limits of what the instruments can measure. Measuring shallow interfaces for a long distance is not very economic. Discontinuous permafrost extensively changes the velocity of the sound waves and thus makes any interpretation difficult. The reflection and refraction on decomposed bedrock below gravel might be indistinct. Difficulties also arise when a survey has to be done on soft ground such as moss, tussocks, or over creeks. Furthermore a bigger crew is required because there is no light weight seismic system available at the moment.

Resistivity
In this survey 2D Resistivity was used. Resistivity is a reliable geophysical method for the detection of very shallow and deep layer interfaces in nearly all surface and subsurface conditions in the Yukon. Measuring shallow interfaces for a long distance is more economic than with seismic. Data taken in discontinuously frozen ground often provide a plausible interpretation since the profile matrix is consistently filled with data representing a material property. There are no “blind zones” in a resistivity profile like they appear in other geophysical methods purely based on signal reflection. A lightweight system is available for flexible use with a small crew.

5.2. Mineral Prospecting

Induced Polarization (IP)
IP data are simultaneously taken when measuring Resistivity, with the same equipment and staking. So these data are automatically at hand when using Resistivity. IP is an industry proven standard method for the detection of primary mineral deposits in hardrock mining.
6. Use of Geophysical Methods

6.1. Instrumentation

For this survey a lightweight, custom-built 2D RESISTIVITY and INDUCED POLARIZATION (IP) imaging system with rapid automatic data acquisition was used. The system includes:

- “4 POINT LIGHT” EARTH RESISTIVITY METER\(^1\)
- 100 ELECTRODE CONTROL MODULES\(^2\)
- 100 STAINLESS STEEL ELECTRODES\(^3\)
- 500m MULTICORE CABLE 100x5m\(^4\)

This system weighs approximately 60 kg which is about one third of regular standard equipment. It can be run with a 12V lead battery charged by 60 Watt solar panels. The equipment facilitates high mobility and rapid data acquisition with a small crew.

6.2. Data Acquisition

The data acquisition is carried out by the automatic activation of 4-point-electrodes. Thus several thousand measurements are taken, one every 1-2 seconds. The AC transmitter current of 0.26 to 30 Hz is amplified by the electrode control modules, up to a maximum of 100mA and 400V peak to peak. The voltage measured at the receiver electrodes (M, N) is also amplified.

In this geoelectrical survey the Schlumberger array was used. This array is appropriate to image horizontally running layers as is needed for placer prospecting.

The Resistivity data up to 100m depth require just about 25% of the device’s measuring capacity. The data acquisition was optimized for Resistivity: It was designed to get highest data quality at lots of line meters in shortest time possible. Therefore the quality of the Resistivity data is very good in all profiles.

The IP data were simultaneously taken with the Resistivity data while the data acquisition was optimized for Resistivity. Thus the quality of the IP data ranges from usable to good. Only the IP data at the Los Angeles Creek profiles 01-04 are getting noisy below 50m. – As this survey was designed for placer investigation no time was invested in optimizing the IP data in greater depth. To get less noisy IP data at 50-100m depth a more time-consuming way of data acquisition would have been required.\(^5\)

\(^1\) Constructed and produced by LGM (Germany)
\(^2\) Ditto
\(^3\) Constructed and produced by GEOANALYSIS.COM (Germany)
\(^4\) Constructed and produced by GEOANALYSIS.COM (Germany)
\(^5\) 1) Tuning the transition resistance between probes and ground below 1 Kilo*ohm. 2) Use of a more extensive data averaging mode compared to Resistivity.
6.3. Processing
The measured Resistivity/IP data were processed with the RES2DINV inversion program\(^6\).

Both data, Resistivity and IP, were processed using program settings individually fitted to the characteristics of each data set. Thus the data might sometimes vary for the same ground material in different profiles.

6.4. Interpretation
The geophysical data collected in this survey are “pioneering data”. They cannot be linked with other local geophysical information or technologically acquired data which were gained by drilling, trenching, shafting, or mining.

The Interpretation of the measured data is supported by:

- Experience - 5 years of measuring practice with Resistivity/IP in Yukon/BC
- Discussion - with governmental placer geologist William Lebarge et al.\(^7\)
- Comparison - between geophysical and technogenic information found in other surveys
- Observation - of surficial conditions in the field
- Sources - Bedrock Geology Map, Surficial Geology Map\(^8\),

The Resistivity profile is the foundation for the interpretation of the subsurface conditions for the placer prospection. It usually allows for good interpretation of depth, topography and rock type of the bedrock as well as the overburden consisting of humus, muck, mud, and different layers of gravel; permafrost and groundwater.

Besides the Resistivity reading can support the interpretation of the IP model.

The IP profile serves as basis for the interpretation of the mineral and petrologic conditions in hardrock. However, this study does not deliver a deeper analysis of the IP data since the interpretation of chargeability patterns of the subsurface requires much more geological background information than an interpretation of an Ohm meter mosaic for placer prospecting does require. Nevertheless the IP data might help in secondary studies.

Additionally the IP profile can help to interpret the bedrock and overburden for placer.

\(^6\) Produced by GEOTOMO SOFTWARE (Malaysia)
\(^7\) Lebarge, William; Placer Geologist, Yukon Geological Survey
6.5. Profile image
In the Resistivity profile the interpreted layer interfaces are marked with a black line. Please be aware: The profiles show ground-layers approximately 15% thicker than they are in reality. The thickening of the model layers is caused by the inversion software. The correction factor of 0.85 for the determination of the true layer thickness has been established by the Arctic Geophysics Inc. team on the basis of numerous geoelectrical profiles verified by drilling, trenching, and mining done by our customers.

The graphical markings showing the interpreted layer interfaces in the profiles (using the black lines) are done accordingly to the data structure in the profile itself. This means: the layers there will also show up approximately 15% thicker than they are in reality. In the interpretation text the layer thicknesses and depths have been recalculated to the expected real values.

7. Line Arrangement
The locations of the profiles show a linear pattern along the valleys:

The roughly equidistant pattern of the lines gives a suitable information base for a systematic analysis of the progression of the subsurface parameters along the valley.

The locations of the cross valley profiles do stay away from tributaries since they could falsify the recording of systematic parameters of the subsurface along the valley, for example bedrock depth and thickness of gravel. The discharge of side creeks could also interfere with the identification of the placer-creating features such as the channel system and bedrock benches in the investigated valley.

8. Measuring Results – see Scripts
Los Angeles Creek.pdf
Wolf Creek.pdf
Ladue River.pdf
Rice Creek.pdf
9. Addendum

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http://www.yukonminingrecorder.ca/PDFs: 115O/04, 115N/01, 115N/01, 115N/02, 115N/07, scale 1:30 000

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Qualification

**Philipp Moll**  
Managing Director, Arctic Geophysics Inc.

- Study of geology, University of Freiburg, Germany  
- Visit of geophysical field courses, University of Karlsruhe and University of Stuttgart, Germany  
- Geological Prospecting for precious metals and minerals in the Yukon, NWTs, and Alaska since 1989  
- Geophysical surveying for Mining Exploration in the Yukon since 2005  
- Study of biology and German language and literature, University of Freiburg, Germany  
- Apprenticeship of precision mechanic, Tools Factory Hermann Bilz, Zell, Germany

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- Study of geology, University of Tübingen, Germany  
- Visit of geophysical field courses, University of Karlsruhe and University of Stuttgart, Germany  
- Geological prospecting for precious metals and minerals in the Yukon and Alaska since 2001  
- Geophysical Surveying for Mining Exploration in the Yukon since 2005  
- Study of computer science, University of Stuttgart, Germany

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Stefan Ostermaier
Gallery

Rendezvous with the helicopter at confluence of Los Angeles Creek and Yukon River

Start of the exploration, Dawson City/Yukon, Stefan Ostermaier, AG
Hiking from Los Angeles Line 07 to Wolf Line 06

Processing at Los Angeles Line 07, Stefan, AG
Crew: Stefan Ostermaier, AG; Eloi Mayano-Vinet, Alexandre Duhamel Gingras