# Horn River basin

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**Summary**

Airborne EM methods remain the most cost-effective and preferred configuration, when it comes to assessing groundwater setting with high level of accuracy, which allows monitoring of mine tailings, finding any type of contaminate transport and modelling plumes. In our current study we present groundwater mapping over Horn River basin (British Columbia, Canada)

**Introduction**

This case study is a revised model of SkyTEM data flown in 2012 over the Horn River basin at request of Geoscience BC (Figure 1).

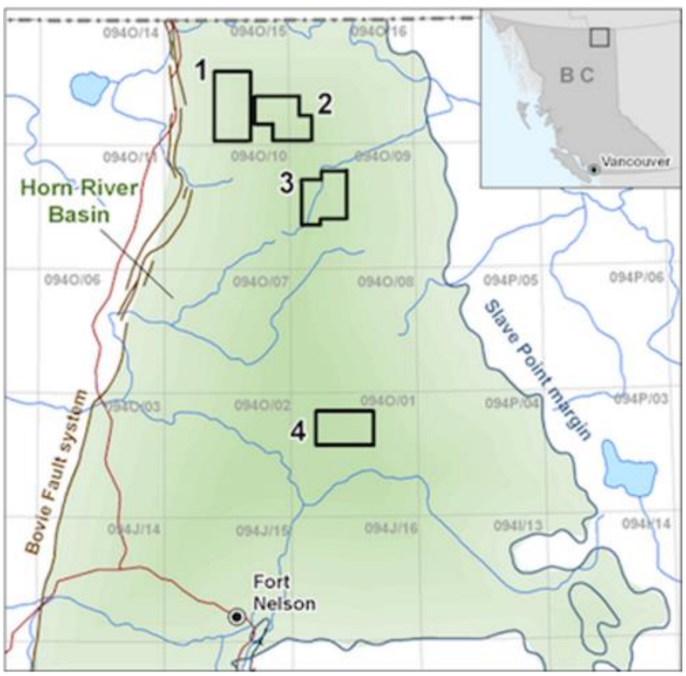


*Figure 1. Location of SkyTEM survey (adapted from Geosceince BC, 2012).*

The survey was aimed at investigating groundwater quality in order to facilitate groundwater management over the selected areas of the basin and data were inverted by Aarhus Geophysics using smooth and blocky inversion techniques in order to extract accurate information about location of aquifers controlled by Dunvegan formation.

**Approach**

SkyTEM (Sorensen and Auken, 2004) is a dual moment system, combining near surface and deeper penetration. Originally developed for groundwater mapping, it has been successfully used for this application in many projects around the world.

The data presented here had been originally acquired and processed by SkyTEM Aps, applying automated data editing and imaging techniques (Christensen, 2003). The standard procedures and protocols for AEM data processing and inversions, which were purposely designed for groundwater mapping in Denmark, are described below:

a) automated and manual editing of the raw navigation (e.g., altimeters, tilt meters) and EM data to remove artifacts that might arise from cultural features (coupling with metallic structures) or natural ones (e.g., canopy effects, surface water surfaces)
b) automated and manual assessment of noise and bias levels, to improve signal to noise ratio without smearing results, and to avoid artifacts in the models
c) if needed, application of calibration factors to the EM data
d) full non-linear inversion (Viezzoli et al., 2008) of the EM data, based on exact (1D) solution, both multi (smooth) and few layered (blocky)
e) strong integration with GIS to evaluate inversion results, and refine step a)

**Results**

The results presented were obtained by virtue of re-processing and re-inverting of SkyTEM dataset, which had been acquired as part of a collaborative project aimed at undertaking baseline research on water resources in the Horn river basin and investigating groundwater quality in selected areas.

The simplified geological setting of the Horn river basin consists of the following units (Figure 2):

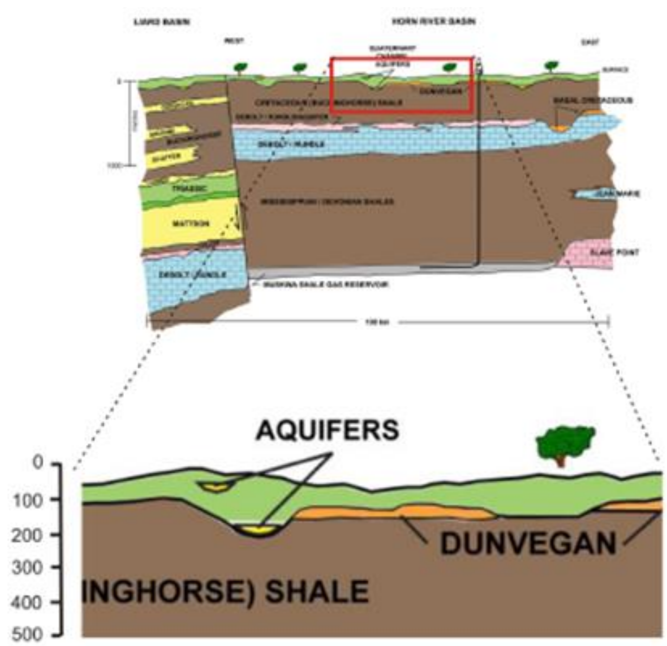


*Figure 2. Generalized geological cross-section of the Horn river basin.*

a) Quaternary glacial deposits: thickness= 100-150 m (generally conductive) with

b) Possible aquifers within buried glacio-fluvial channels (sands and gravels): conductive response due to highly mineralized water (more than 5 g/l)

c) Dunvegan sandstones-conglomerates: resistive lenses

d) Buckinghorse shales: conductive

e) Debolt/Rundle aquifer: limestones (too deep for AEM).

The inversion was aimed at improved imaging of the acquirers present in glacio-fluvial channels. In Figure 3, a resistivity depth slice is shown at depth of approximately 90 m below surface (320 – 330 m absolute elevation) with aquifers clearly mapped as conductive targets (yellow).

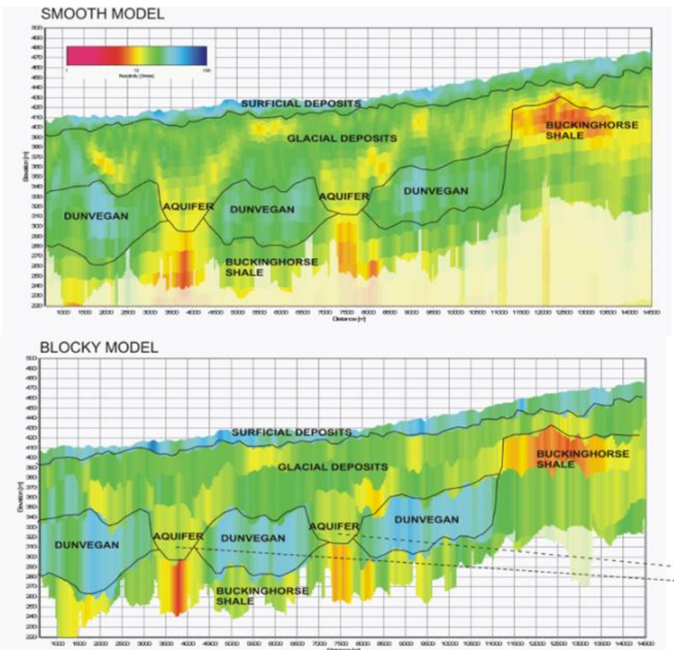


***Figure 3****. "Smooth" inversion model (top) vs "blocky" model (bottom).*

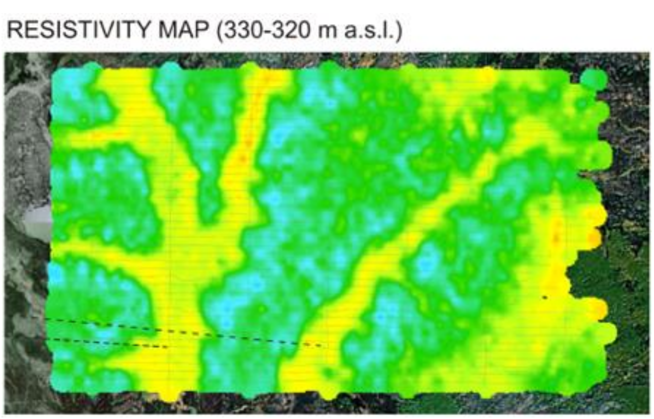


***Figure 4.*** *Resistivity slice at 90 m depth (320 – 330 m absolute elevation.*

In general, there appears to be very good resolution of the conductive aquifers, saturated by mineralized waters, at the bottom of the buried fluvio-glacial valleys (clearly imaged in plain view on the resistivity depth slices). In addition to the "smooth SCI inversion", there was a "blocky" inversion carried out over the area of study (Figure 4).

In Figure 4 it can be seen, that blocky model allows better resolution of the Dunvegan formation, which seems to be controlling the targeted aquifers and is characterized by electrical resistivity of 30-40 Ohm-m.

**Conclusions**

The shown example shine light on innovative approaches in inverse theory, such as "blocky" inversions and using a-priori information for advanced interpretation.

Ongoing development within the AEM world is increasing the value, relevance and applicability of suggested methodology in groundwater and environmental applications. This methodology can become a very effective tool in quantitative assessments of groundwater potential of area of interest, and also helps facilitate assessment of groundwater contamination and contaminant transport, as well as 3D mapping of contaminant plumes in the future if there is need for such study.

**Acknowledgements**

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**References**

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