

Improving Resource Definition in Critical Industrial Minerals Using ERT

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Sand and gravel are the most widely used industrial mineral in Canada and accounted for roughly \$2 Billion in value to the Canadian economy in 2022. Alberta is the second largest aggregate producer in Canada and as an equivalency, each Albertan uses about 10 Tonnes (1 truckload) per year. Canada supplies roughly 50% of all gravel imported by the United States. As a commodity with narrow margins, the usefulness of any deposit is a function of its proximity to the end user, the magnitude of the resource and the associated operating conditions and costs.

The predominant use of sand and gravel has been to supply the construction industry. Recently however, the petroleum industry has required increasing volumes of sand as a proppant for well stimulation. Much of this has been imported from the United States. Petroleum producers are using “in-basin” sources of sand where the meets spec as it offers a lower cost option. Several Alberta sand sources are in production and more are in the development stream.

Traditionally, exploration for and delineation of sand and gravel deposits has been done utilizing multiple shallow test pits and drill holes. These are often widely spread across a prospect, have depth limitations and may be invasive on the landscape. An ERT survey can “connect the dots” provided by pits and drilling and can provide additional information below the potential depth limits of drilling. ERT surveys can also provide a connection between an active pit operation and the poorly sampled potential pit extension limits. Lastly, as a non-invasive acquisition method, ERT requires only limited surface access.

Utilizing case studies, the value of an ERT survey will be demonstrated.

Electrical Resistivity Tomography

Electrical Resistivity Tomography (ERT) measures the spatial distribution and contrast of electrical resistivity in the subsurface. The data are used to produce a two-dimensional (2-D) electrical image (a “cross section” or “plane”) or three-dimensional (3-D) distribution of subsurface resistivity values.

ERT, for our purposes, can be used to

- Estimate depth, thickness, and resistivity of subsurface layers.
- Estimate depth to the water table.
- Develop a broad, low-resolution cross section of the site.

- Reconcile boring logs from multiple drilling efforts over time and identification of data gaps requiring further investigation.

ERT can reliably distinguish the upper four layers of discrete rock or soil types, with sufficient electrical resistivity contrast down to 100 meters (m), depending on the survey configuration. ERT is best applied in areas without common sources of signal interference or noise, including:

- Buried pipes, culverts, and cables.
- Metal fences and powerlines.
- Metal from nearby vehicles and buildings.
- Highly resistive ground (i.e., bedrock).

However, this property of interference makes ERT useful for determining any areas/volumes of aggregate that may be sterilized by near-surface infrastructure.

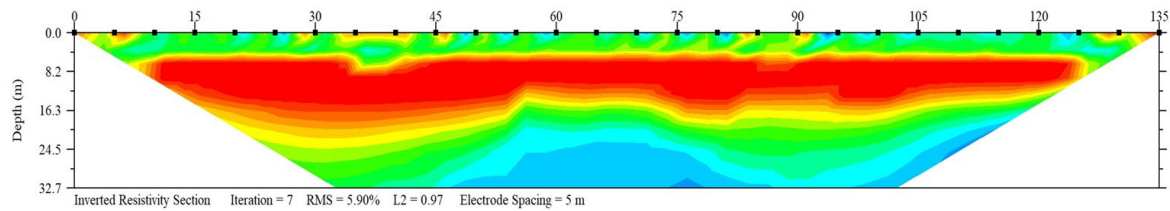
Results, Observations, Conclusions

Program examples will be shown to demonstrate the validity of the method and the variety of information that can be obtained. These will include a gravel pit extension, an in-basin sand program and drilling reconciliation opportunity.

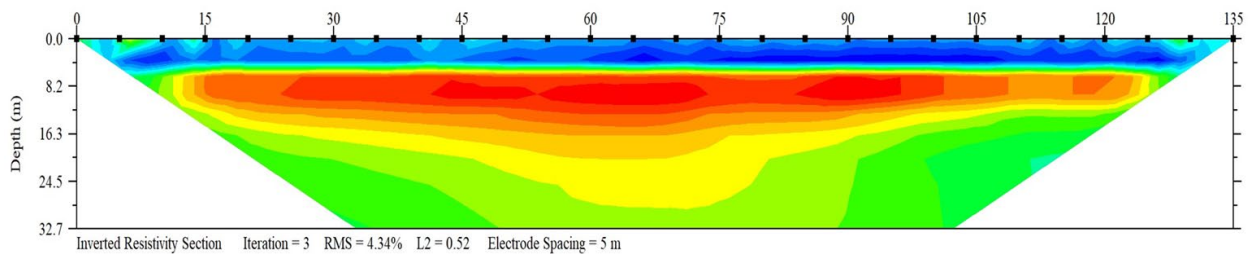
Pit Extension Example



Parallel to pit face



Perpendicular to pit face



ERT surveys can be used to assist with pit design. For example, identifying areas of uneconomic overburden thickness can allow an operator to optimally place stripped material or infrastructure.

Acknowledgements

References

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[https://clu-in.org/characterization/technologies/default2.focus/sec/Geophysical Methods/cat/Electrical Resistivity Tomography/#:~:text=Electrical%20Resistivity%20Tomography%20\(ERT\)%20is,electrical%20resistivity%20in%20the%20subsurface.](https://clu-in.org/characterization/technologies/default2.focus/sec/Geophysical%20Methods/cat/Electrical%20Resistivity%20Tomography/#:~:text=Electrical%20Resistivity%20Tomography%20(ERT)%20is,electrical%20resistivity%20in%20the%20subsurface.)

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