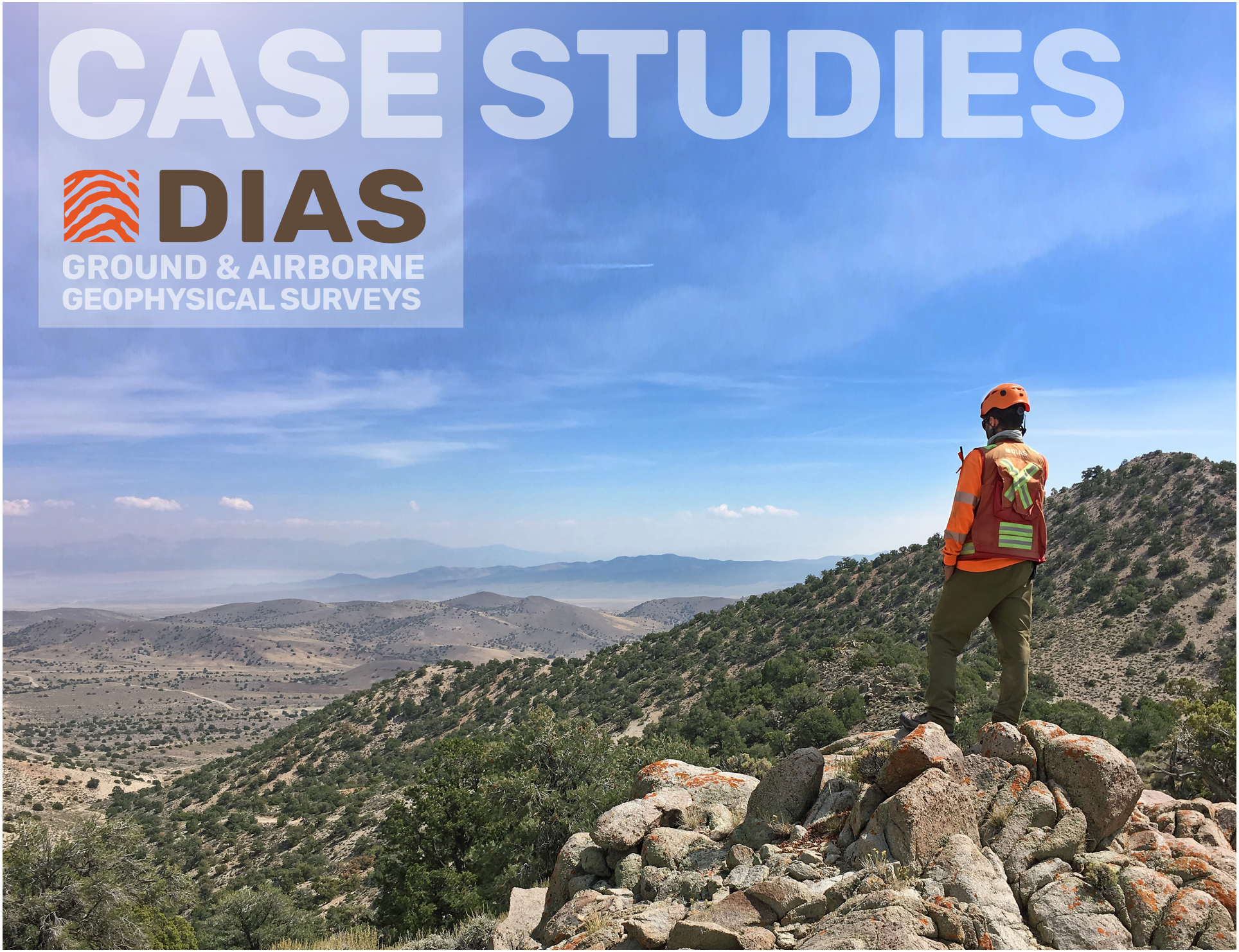
CASE STUDIES

DIAS

GROUND & AIRBORNE
GEOPHYSICAL SURVEYS



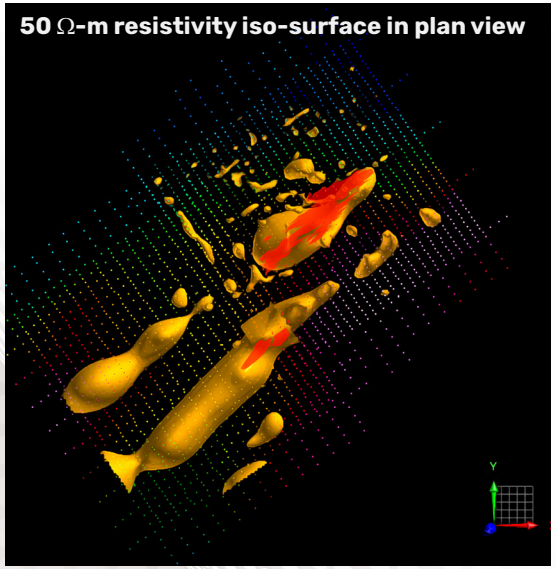
ARROW URANIUM DEPOSIT

DIAS CASE STUDY

NexGen Energy - Saskatchewan, Canada

OVERVIEW

Dias Geophysical successfully imaged alteration related to a known uranium deposit from 100 m depth to over 600 m depth. A similar conductive response 400 m south of the known deposit led to the discovery of the South Arrow uranium deposit.



DIAS32 SOLUTION

A full 3D resistivity survey was completed across a 1.4 by 1.4 km area centered over the known deposit. A portion of the survey was completed over a large open-water lake. The multi-azimuth, and multi-scale data set was processed and inverted to generate a high-resolution 3D resistivity model of the survey area from surface to 600 m depth.

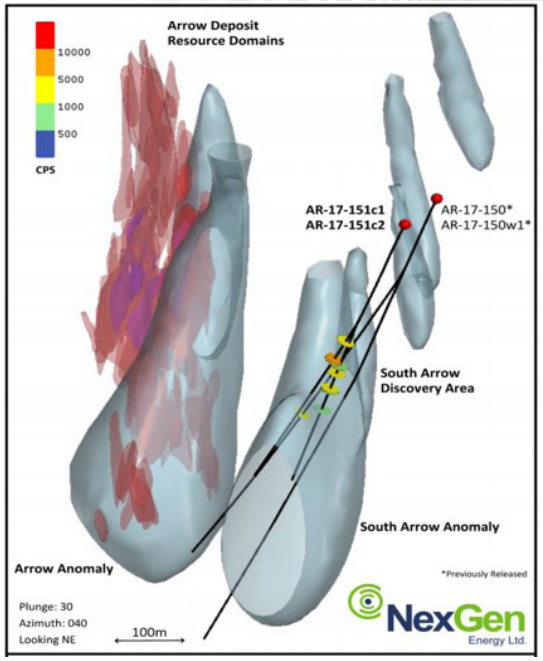
OUTCOME

The DIAS32 3D survey successfully imaged the alteration related to the Arrow high-grade uranium deposit with a high degree of correlation. A similar response in the data, 400 m south of the Arrow Deposit was drill tested and high-grade uranium mineralization was discovered. This discovery of the South Arrow deposit **confirms the effectiveness of the resistivity method in the exploration** for basement-hosted unconformity-related uranium deposits in and around the Athabasca basin.

SITUATION

Canada's Athabasca Basin hosts the vast majority of high-grade uranium deposits. NexGen Energy's Arrow deposit in Saskatchewan, Canada, is the largest undeveloped uranium deposit in the world. Direct detection of unconformity uranium deposits is virtually impossible with conventional geophysical exploration techniques. The DIAS32 DCIP survey was designed to image the alteration related to the high-grade uranium mineralization at Arrow, and by integration with other geologic and geophysical data sets, improve exploration efficiency.

- ✓ **Unconformity-related uranium deposit**
- ✓ **Imaged alteration related to a high-grade, basement-hosted uranium deposit to 600 m depth**
- ✓ **The South Arrow deposit was discovered from the DIAS32 data set**



"The ground 3D resistivity survey conducted by Dias Geophysical was key in elevating South Arrow as a high priority target that has now returned off-scale radioactivity associated with a large and robust alteration system."

NexGen Energy Press Release, July 27, 2017

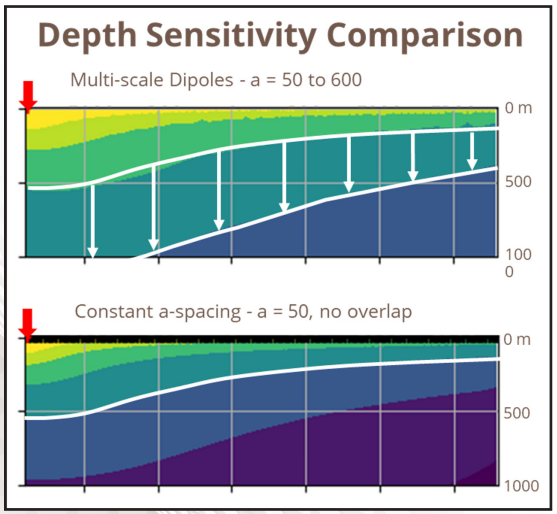
VIRGIN RIVER URANIUM

DIAS CASE STUDY

Saskatchewan, Canada

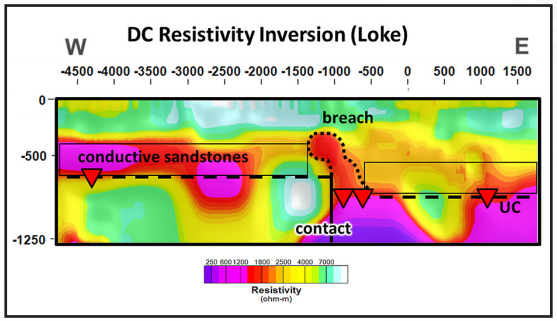
OVERVIEW

Dias Geophysical successfully imaged the geological structure, lithology and alteration related to a known mineralized structure at a depth of 700 m to 900 m. The survey identifies an alteration plume emanating up from a mineralized basement fault structure.



DIAS32 SOLUTION

A 12.5 km 2D line was surveyed with the DIAS32 system across the Virgin River structure. The A receiver spacing of 150 m and a current injection spacing of 75 m produced a relatively high data volume of 2D data with a- spacings of 150 m, 300 m, 450 m, etc. up to 1,200 m. This multi-scale data set was processed and inverted with the UBC-GIF and Loke RES3DINV codes to generate high- resolution 2D resistivity sections from surface to a depth of 1.2 km.

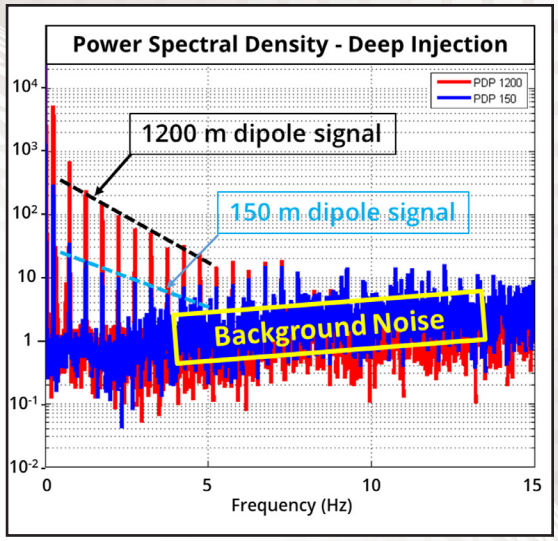


SITUATION

Canada's Athabasca Basin hosts the vast majority of high-grade uranium deposits. The Virgin River Uranium project occurs along a major structural corridor which hosts several world-class uranium deposits. The 2D survey line was completed to demonstrate the depth capabilities of the DIAS32 system in the Athabasca Basin environment. While direct detection of uranium deposits is not possible with geophysical methods, it is possible to image associated features such as the conductive graphite common in the host structures and the alteration plume that often emanates upward into the overlying sandstones.

OUTCOME

The DIAS32 2D test survey successfully imaged the alteration related to potential uranium mineralization in an area of the Athabasca basin where the unconformity lies at a depth of 700 m to 900 m. The survey mapped variation in the bedrock beneath the unconformity and hosted unconformity-related uranium deposits.



- ✓ **High-grade, unconformity-related Uranium**
- ✓ **Imaged alteration plume related to uranium mineralization**
- ✓ **Imaged basement lithologies below 900 m depth**

WEEDNANNA GOLD DEPOSIT

Alliance Resources Limited - South Australia

OVERVIEW

Dias Geophysical successfully imaged geological structure, lithology and mineralization at the Weednanna Gold Deposit in South Australia. A rolling 3D DIAS32 survey images the sulphide mineralization beneath ubiquitous surficial sediments with great clarity and to a depth of over 300 m. The survey generated several high priority targets.

SITUATION

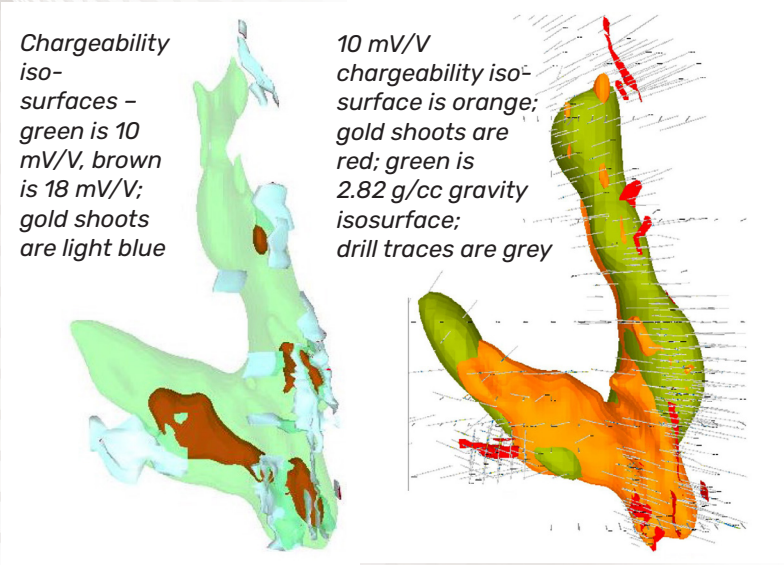
The Weednanna deposit is a magnetite breccia in carbonate altered rocks forming a skarn near the contact with a granite intrusion and containing elevated gold, bismuth, tin, uranium, lead and zinc. High grade gold is associated with sulphide replacement of magnetite. The survey area is covered by a veneer of transported sediments that makes exploration challenging. Prior to the DIAS32 survey little was known about the potential for mineralization below 200 m. The strong association of gold with sulphides makes the IP method an effective tool for imaging potential mineralization.

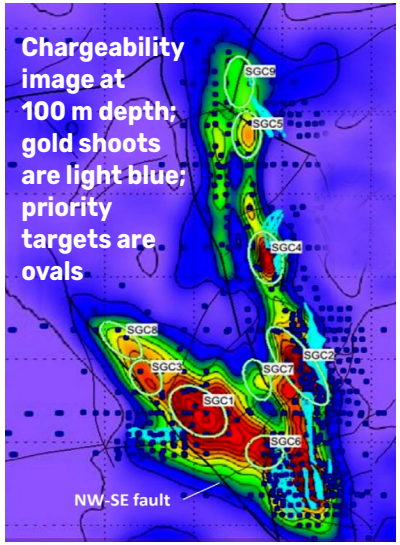
DIAS32 SOLUTION

A rolling 3D survey with CVR was completed over the 1.1 km by 1.5 km survey area with the DIAS32 system. A line spacing of 50 m and a receiver spacing of 25 m provided for detailed 3D imaging of the subsurface. The CVR data set provided multi-scale and multi-azimuth data for 3D inversion. The final 3D models of resistivity and chargeability were resolved to 5 m.

OUTCOME

The DIAS32 3D survey successfully imaged the mineralized system to a depth of approximately 300 m. The final 3D models of resistivity and chargeability provided insight into structure, lithology and mineralization, and several high priority targets were interpreted from integration of the survey results with other geophysical, and geological data sets.





- ✓ **High-grade, intrusion-related gold (skarn)**
- ✓ **Imaged sulphides associated with gold mineralization to a depth of 300 m**
- ✓ **Identified several high priority targets for further exploration**

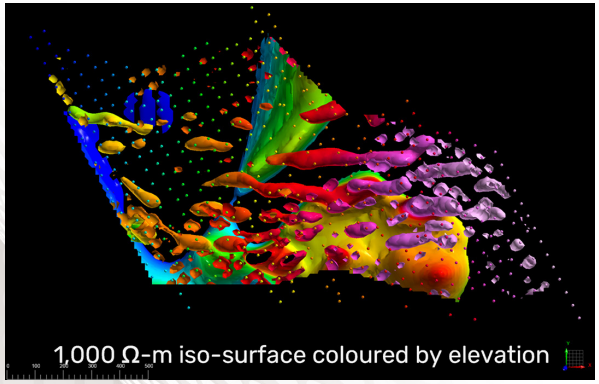
QUARTZ RISE PROJECT

DIAS CASE STUDY

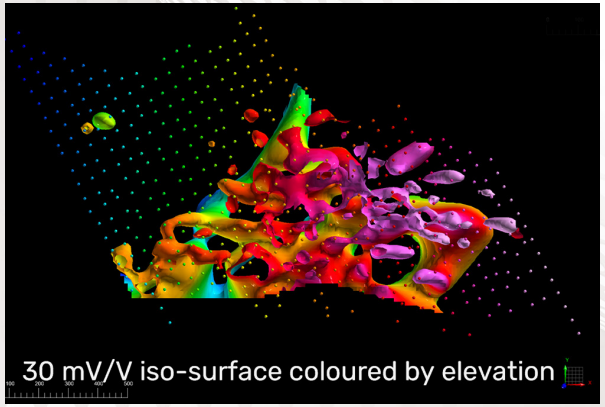
Seabridge Gold Inc. - Northern BC, Canada

OVERVIEW

Dias Geophysical successfully imaged geological structure, lithology and mineralization at the Quartz Rise project in British Columbia's Golden Triangle region. A rolling 3D DIAS32 survey images the epithermal vein systems in the near-surface, and when combined with geology and magnetic data, identifies a potential porphyry source at depth.



1,000 Ω-m iso-surface coloured by elevation



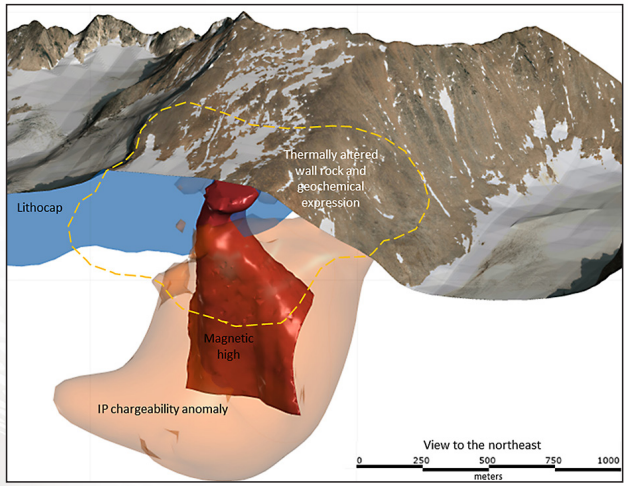
30 mV/V iso-surface coloured by elevation

SITUATION

Three years of exploration work at Quartz Rise have isolated a promising source of the lithocap above the old, high-grade Johnny Mountain Mine. Further geophysical, geochemical and geological mapping surveys have been completed, and an initial drill program totaling up to 8,000 meters has been designed to test the large intrusive system that is likely responsible for the lithocap and elevated gold and copper concentrations. This area has a geological environment astonishingly similar to KSM.

OUTCOME

The DIAS32 3D survey imaged the vein system and identified an unexpected east-west trend. Targeting of the high resistivity features was successful, and analysis of the core identified a breccia vein, which suggests a proximal porphyry source. A successive DIAS32 survey was completed in 2019 to close out the chargeability anomaly, and integration of this data with geology, geochemistry and magnetic data, a priority target for a porphyry source was interpreted and is currently being drill tested.



DIAS32 SOLUTION

A rolling 3D survey with CVR was completed over the 1.5 km by 0.8 km survey area with the DIAS32 system. A line spacing of 50 m and a receiver spacing of 25 m provided for detailed 3D imaging of the subsurface given the epithermal vein target. The CVR data set provided multi-scale and multi-azimuth data for 3D inversion. The final 3D resistivity and chargeability models were resolved to 5 m.

- ✓ **Imaged resistive features that were successfully tested for epithermal vein mineralization**
- ✓ **Imaged a deep conductive and chargeable feature currently being tested as a possible porphyry source**
- ✓ **The DIAS32 data set assisted in upgrading the geologic knowledge of this project, moving from epithermal to porphyry**

Comparing DIAS32 3D Surveys with Conventional 2D

OVERVIEW

Dias Geophysical's DIAS32 3D induced polarization and resistivity (DCIP) system is unique in its ability to deliver high volume data sets that include both multi-azimuth and multi-scale dipoles. These data sets support highly resolved and accurate 3D models of resistivity and chargeability.

OUTCOME

In the figure below, note the significant resolution difference between the DIAS32 3D resistivity survey model (left) and the 2D model (right). In several places the apparent geologic features and trends differ significantly.

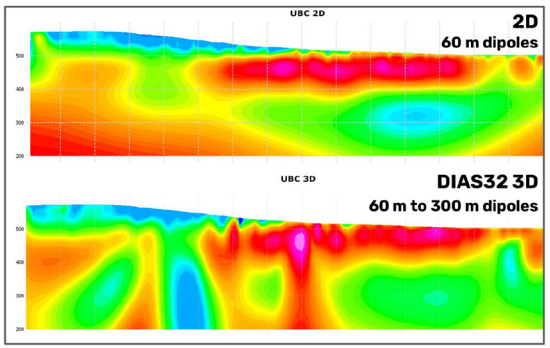
In the image to the right, note the significant differences between the 2D and 3D models. The vertical sources at depth are known vertical conductive basement units. DIAS32 CVR data sets provide accurate, high resolution models for confident interpretation and follow-up.

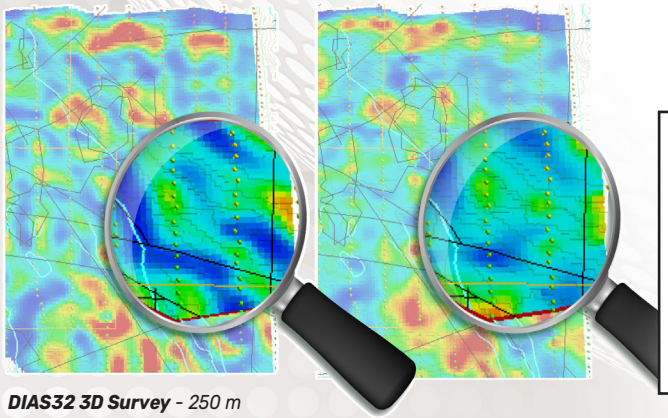
SITUATION

In many environments, conventional 2D DCIP surveys image the geology with a high degree of uncertainty. 2D surveys generally produce a relatively low data density and lack the ability to confidently image sources between the survey lines. As a result, there is significant risk in targeting drill holes in complex geologic environments and the ability to accurately image deep sources is limited.

DIAS32 SOLUTION

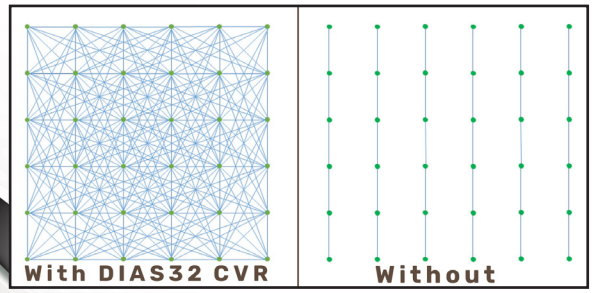
Dias has patented a completely new mode of acquiring IP and resistivity data called CVR. The DIAS32 system measures the response from individual electrode sensors relative to a common voltage reference (CVR) wire. DIAS32 provides advantages in safety, operational efficiency, data volume and data quality. The DIAS32 system can be deployed in any array configuration at any scale, both in 3D and 2D. CVR allows for the computation of a dipole from any two electrodes across the survey area. This yields a rich, high volume data set that contains multi-azimuth and multi-scale dipoles. Most DIAS32 surveys yield data sets of several million possible dipoles.





DIAS32 3D Survey *- 250 m line spacing, 100 m to 800 m dipole spacing - 3D inversion model at 100 m depth*

2D Survey *- 250 m line spacing, 100 m dipole spacing - 3D inversion model at 100 m depth*



- ✓ **In DIAS32 surveys, dipoles are built in-line and cross-line and with varying azimuths for dense, rich data sets**
- ✓ **DIAS32 data sets combine high resolution and depth sensitivity for robust and accurate 3D models**
- ✓ **Accurate models reduce exploration risk**

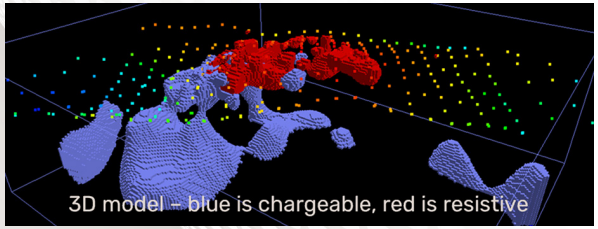
BIG TEN – AMSEL PROJECT

VR Resources Ltd. - Nevada, USA

SITUATION

The Big Ten caldera is a Tertiary-aged volcanic complex approximately 20 km in diameter in west-central Nevada. It occurs in an extensional rhyolite volcanic centre, which is analogous in age and setting to the Round Mountain Mine.

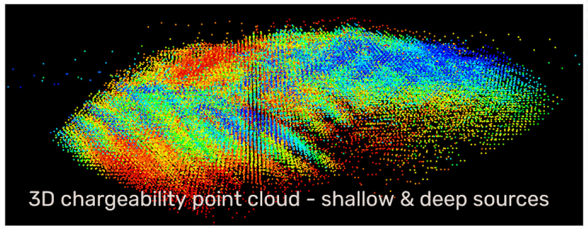
The Amsel project area lies within the Big Ten complex. Prior work has defined a 2 km X 3 km airborne radiometric potassium anomaly with a coincident robust Au-Ag-Sb-Mo soil anomaly. These anomalies plus a hilltop of silica-clay altered volcanic tuff with gold-bearing quartz veins indicates potential for a large epithermal gold system analogous to the Round Mountain deposit, where mineralization is found below an alteration cap in a welded tuff.



3D model – blue is chargeable, red is resistive

DIAS32 SOLUTION

The DIAS32 survey was designed to identify where sulphide-bearing quartz veins are concentrated within the large alteration cap and geochemical anomaly. The 3D CVR survey using 200 m line spacing and 100 m station spacing generated more than 225,000 data records from which a final data set of 95,000 data records were used for 3D inversion modelling. The survey was designed to image toover 600 m depth.



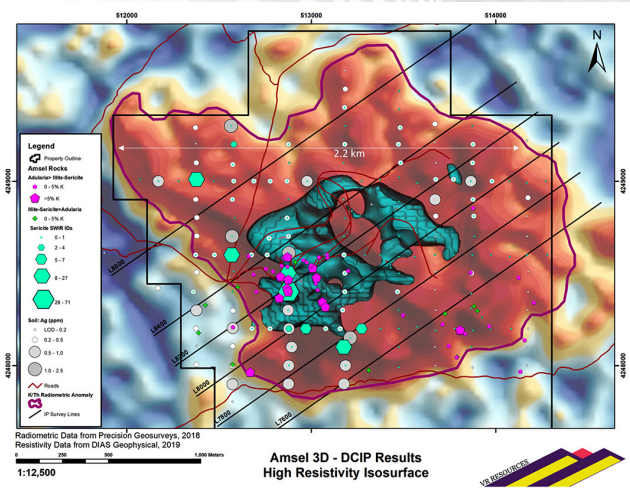
3D chargeability point cloud - shallow & deep sources

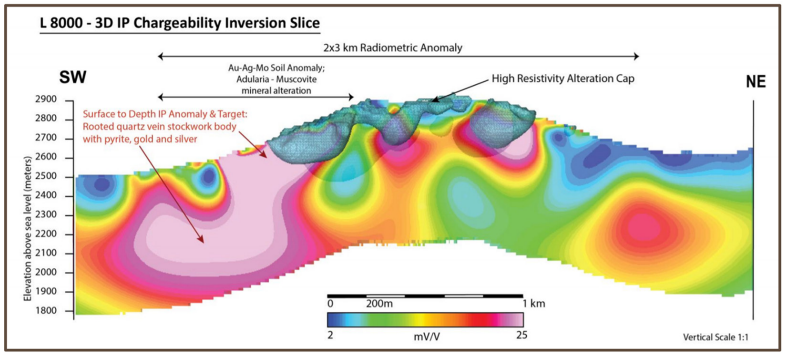
OUTCOME

The 3D resistivity model identifies a large, near-surface high resistivity anomaly covering a 700 m by 900 m area in the southwest quadrant of the radiometric anomaly and surface alteration zone. The high resistivity zone appears to form a cap directly above an underlying IP anomaly. The high resistivity correlates with high temperature adularia and muscovite alteration in rocks, and the strongest multi-element soil geochemical anomaly.

A section along line 8000 through the 3D IP model depicts the chargeability anomaly directly below the high resistivity zone interpreted as an alteration cap. The anomaly extends from surface to a depth of at least 600 vertical metres. The anomaly occurs below the main multi-element soil geochemical anomaly and below the area where muscovite and adularia alteration minerals are identified in rock samples.

The IP anomaly from the 3D inversion model correlates directly with the overlying high resistivity alteration cap. It is also co-spatial with the silver soil geochemistry anomaly, and with sulfur, because the IP is expected to relate to pyrite associated with secondary hydrothermal silica. The IP anomaly correlates with the strongest surface sulfur anomaly and is the principal target for pyritic quartz vein stockwork with gold and silver mineralization.





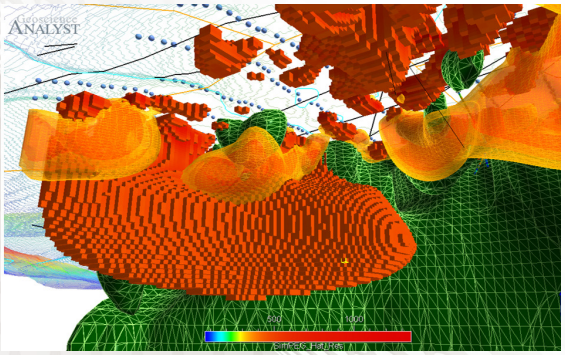
HAT PROJECT, Golden Triangle

DIAS CASE STUDY

Doubleview Gold - BC, Canada

SITUATION

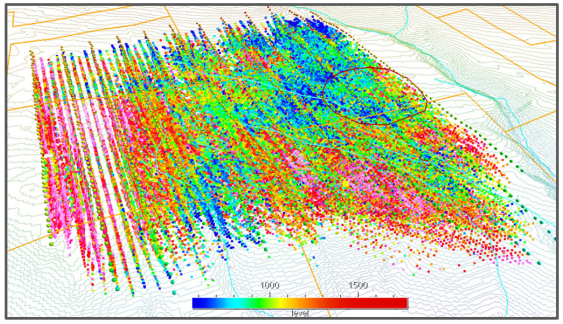
The Hat Property is situated in the prolific Golden Triangle of northern British Columbia, Canada, which hosts many significant gold and copper deposits. The Hat Property is thought to host an Alkalic Copper Gold porphyry. The property is structurally complex; generally, the southwestern portion of the property has a large dioritic intrusion which is interpreted to sit on top of Stuhini group volcanics. Soil sampling has outlined several zones of copper, gold and silver near the margin of the intrusion. Historical 2D geophysical surveys have shown the IP method to be effective in detecting mineralization, but limited depth and poor resolution have hampered drill targeting.



SOLUTION

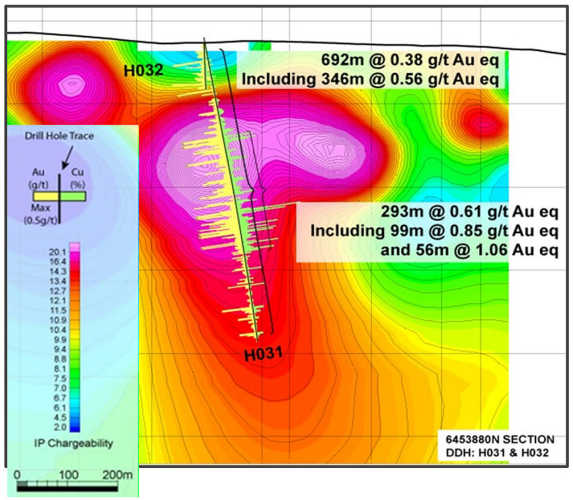
In 2018, Dias Geophysical was contracted to carry out a 3D DIAS32 survey across the priority portion of the property. The 9 sq. km. survey comprises 12 lines with a 250 m line spacing and 100 m station spacing. The survey was carried out in a pole- dipole configuration with common voltage referencing.

The depth of investigation was designed to be 500 m or more, and high resolution was achieved through multi-azimuth acquisition. During the QC process, approximately 10% of the DC data and 15% of the IP data were removed, leaving a high-volume data set of over 100,000 data points.



OUTCOME

Unconstrained 3D inversions for the resistivity and chargeability parameters produced robust 3D models with a near-surface resolution of 25 m. The DIAS32 survey identified an extensive chargeability high which occurs below the Lisle Zone, which had yielded encouraging drill results prior to the DIAS32 survey. The DIAS32 3D models were integrated with geological, geochemical and magnetic data sets to produce a prioritized list of targets. The subsequent drill program produced significant results in the Lisle Zone where mineralization was found to occur to depths of over 700 m. Visible gold was encountered in one hole. Drill testing of hole H036 revealed an occurrence of visible gold which was accompanied by chalcopyrite, bornite and magnetite.



- ✓ **The DIAS32 survey produced significantly higher resolution and deeper results than conventional surveys**
- ✓ **From the survey outcome, targeted drilling from 3D chargeability models to a depth of approximately 900 m**