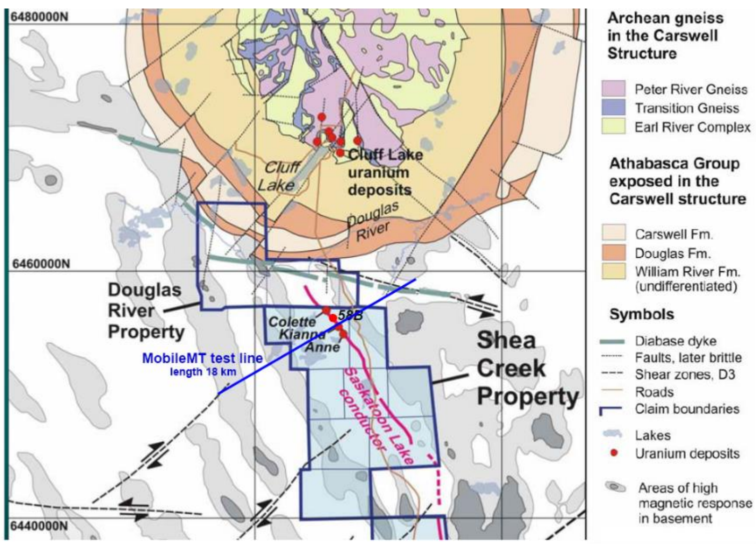
MobileMT: The next level of Airborne Electromagnetic Exploration in the Athabasca Basin

In August, 2018, Expert Geophysics Ltd flew a MobileMT test line over the Shea Creek uranium deposits area in the western Athabasca basin, just south of the former Cluff Lake mine site (Figure 1).

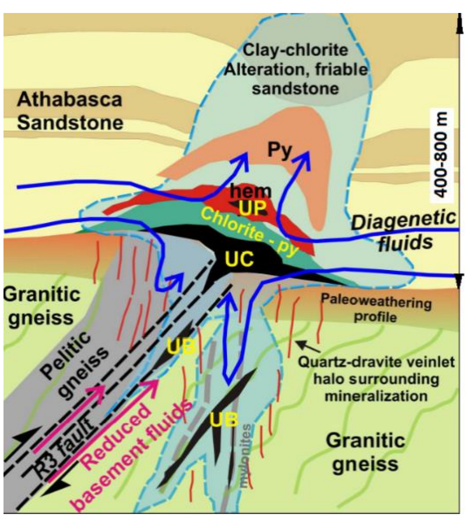


The area is underlain by 400 to 800 m of Athabasca sandstone cover.

Shea Creek deposits display full range of mineralization styles in the Athabasca basin (Rhys et.al., 2010):

- unconformity mineralization along the Saskatoon Lake conductor (UC);
- basement mineralization (UB) localized mainly in footwall of conductor;
- alteration plume developed above and surrounded by clay-chlorite alteration in sandstone (UP)

Figure 1 Position of the MobileMT test line over geology of the area (after Rhys et.al., 2010)



The schematic cross-section (Figure 2) shows the mineralization styles and their relative position in the Shea Creek area.

Figure 2 Typical schematic Shea Creek geological cross-section (after Rhys et.al., 2010)

MobileMT airborne EM technology brief description

MobileMT (Mobile MagnetoTelluric) is a passive airborne electromagnetic technique that records magnetic (in the air) and electric (on the ground) fields generated by natural sources in the frequency range from 25 Hz to 20 kHz. The exploration system includes two pairs of grounded electric wire lines, one of them is for reference signal, and moving three-component inductive coil system softly suspended and with low-noise signal amplifiers for magnetic field measurements (dB/dt) in three orthogonal directions (Figure 3).

Figure 3 MobileMT three component magnetic sensor in the air (Wawa, Ontario)

The MobileMT system features are:

- Frequency range 25 Hz – 20,000 Hz
- Advanced noise processing on both electronic and signal levels ensures high data quality
- Lightweight, aerodynamic bird is ideal for surveys with small helicopters in rough terrain
- Resistivity contrast in geologic structures of any shape due to total field measurements
- Broad frequency range provides excellent resistivity discrimination for both deep and shallow geology
- High data quality even at low natural field signals
- Second pair of ground electrodes provide an electrical reference signal for removing noise bias
- High signal to noise ratio; all three orthogonal components of the magnetic field are measured at the receiver in the air, as opposed to a single vertical component measurement
- High spatial data resolution due to high digitizing rate (in-line resolution) and optimal splitting time series data into frequency windows (in-depth resolution)

MobileMT Shear Creek test results

The range of frequencies less than 1000 Hz used for the case study, with 11 extracted frequency windows. MobileMT apparent conductivity profiles over the test line, for each frequency window, are presented in the Figure 4.

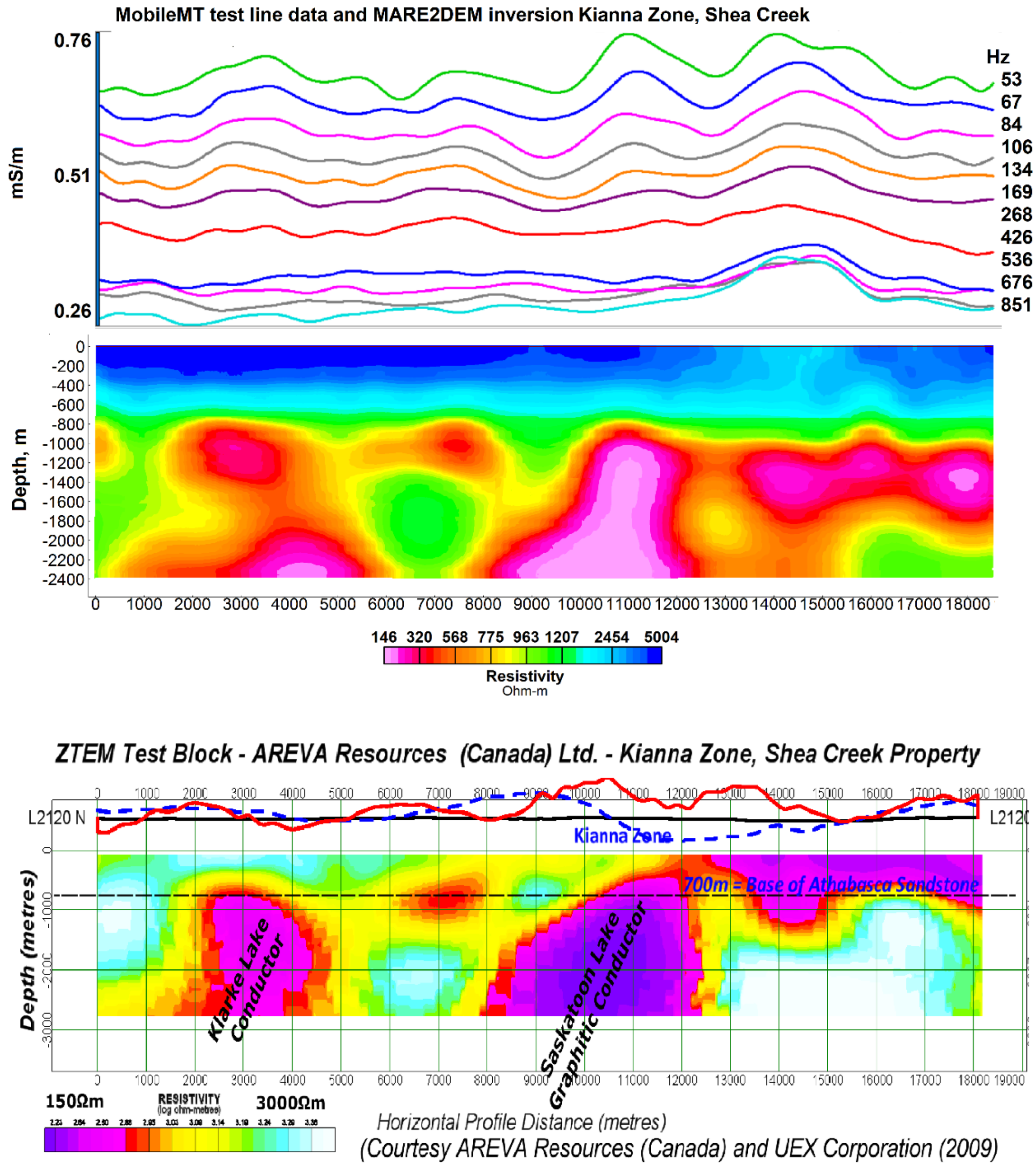


Figure 4 - The line over Kianna Zone, Shear Creek. From top to bottom:

- **MobileMT apparent conductivity profiles in 53-851 Hz frequency range;**
- **resistivity section derived by MARE2DEM inversion for selected 11 frequencies;**
- **2D inversion of ZTEM data (ZTEM section from Legault et al., 2009).**

The test line is crossing the Kianna unconformity style mineralized zone. Position of the zone at the unconformity between the sandstone underlying crystalline basement (~11000 m mark along the line). As seen from the comparison with AFMAG tipper (ZTEM) resulted section over the same line, MobileMT data 1) clearly shows the horizontal contact (unconformity) between Athabasca sandstones and the crystalline basement throughout the line (on the depth ~700 m); 2) capable to differentiate resistivity inhomogeneity in the highly resistive sandstones strata; 3) demonstrates comparatively high resolution in the geoelectric picture overall.

The resistivity distribution shows that MobileMT data is sensitive not only to highly conductive targets but to resistivity variations in the highly resistive sandstone unit. The shape of the anomaly at the 13000-15000m in the Figure 5 marks similar to clay-chlorite alteration (Figure 2).

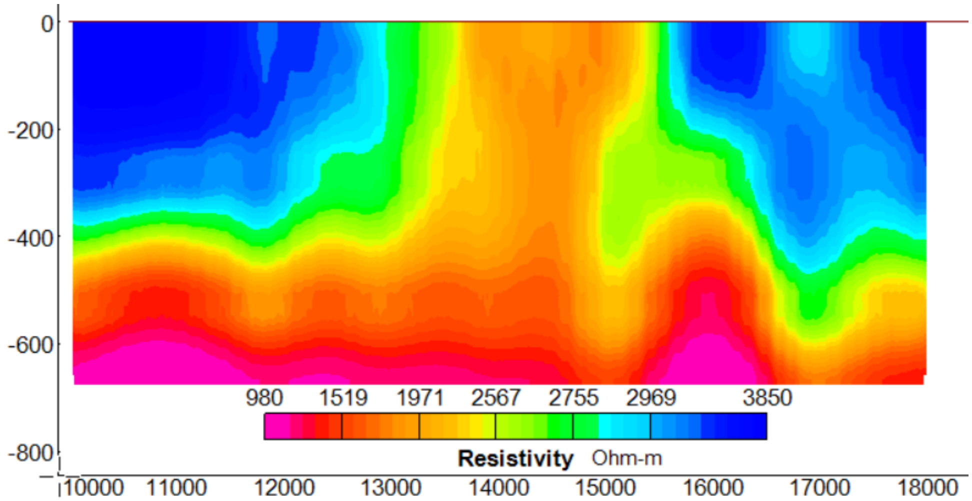


Figure 5 Zoomed-in resistivity section of possible clay-chlorite alteration in the sandstone cover. 10000-18000 m part of the full section in the 0-700 m depth range.

MobileMT is the first airborne electromagnetic system with ability of resistivity mapping in the full range of resistivities and depths of the Athabasca basin rocks, mineralization and alteration zones from the surface to 1.5-2 km depth. In comparison with other existing and historical airborne EM technologies, MobileMT is able to explore not only deep and highly conductive graphitic horizons but recover resistivity variations in the sandstone cover reflecting alteration zones which attribute sandstone-hosted uranium deposits. Due to very wide frequency broadband and total field measurement, MobileMT is applicable for the next main exploration tasks in the Athabasca basin:

- Identification mineralization potential trends;
- Targeting graphitic fault-conductor axis, markers and assemblages;
- Mapping possible alteration zones, sandstone breaches, desilicification and argillization of the sandstone and/or basement and lithostructural favor ore depositions in 3D in the full shallow-to-deep range.

Reference:

Legault, J., H. Kumar, B. Milicevi, and L. Hulbert, 2009, ZTEM Airborne tipper AFMAG test survey over a magmatic C0-Ni target at Axis Lake in Northern Saskatchewan: Saskatchewan Geological Open House.

Rhys D., Sierd E., Luke van der Meer (2010) Geology of the Shea Creek uranium deposits: an expanding uranium district in the Western Athabasca Basin. Saskatchewan Geological Survey Open House, Nov. 29, 2010.