DRILL SITE SELECTION PROCESS USING GEOPHYSICAL (SEISMIC, EM, MAGNETIC)AND REGIONAL GEOCHEMICAL URANIUM DEPOSIT VECTORS IN THE ATHABASCA BASIN

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SUPPORT:

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LANDMARK, SCHLUMBERGER-GEOQUEST-PETREL, OPENSPIRIT, HAMPSON RUSSELL, GEDCO, ADVINCED RESAERCH TECHNOLOGY

OBJECTIVE:
RECOGNIZE SEISMIC SIGNATURES OF PRIMARY INDICATORS OF MINERALIZATION

- STRUCTURAL CONTROL

  All U Deposits are associated with fractures at all scales

- ALTERATIONS

  Significant alterations all around the known U Deposits, Trace elements

- UNCONFORMITY INVOLVED

  Contact between sandstone and basement anomalies (Paleo-valleys ?)

- HIGH GRADE

  Richest Deposits

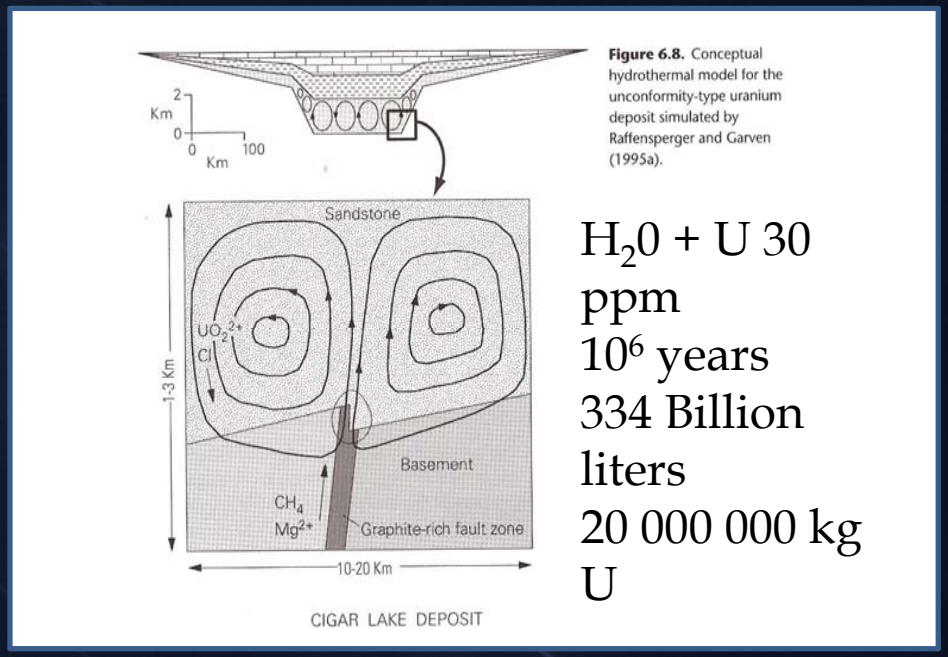
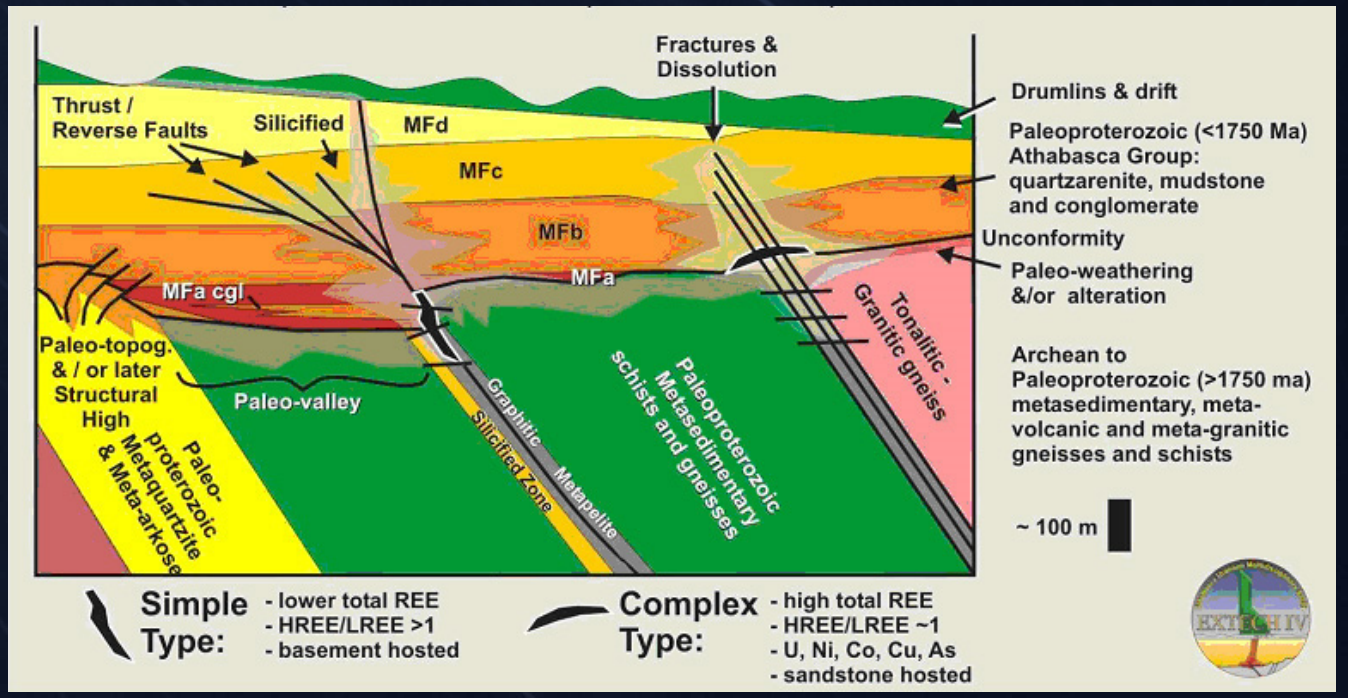
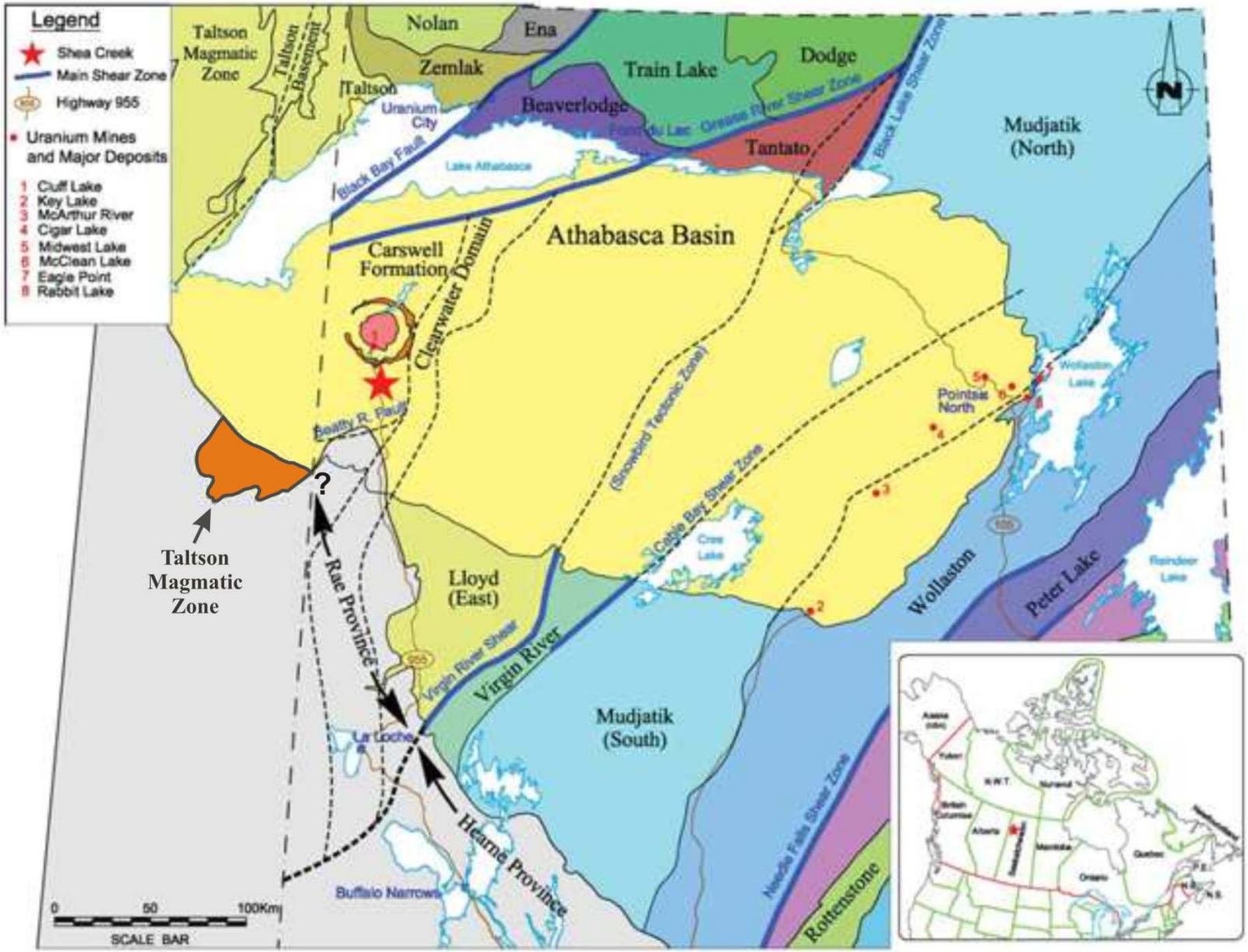
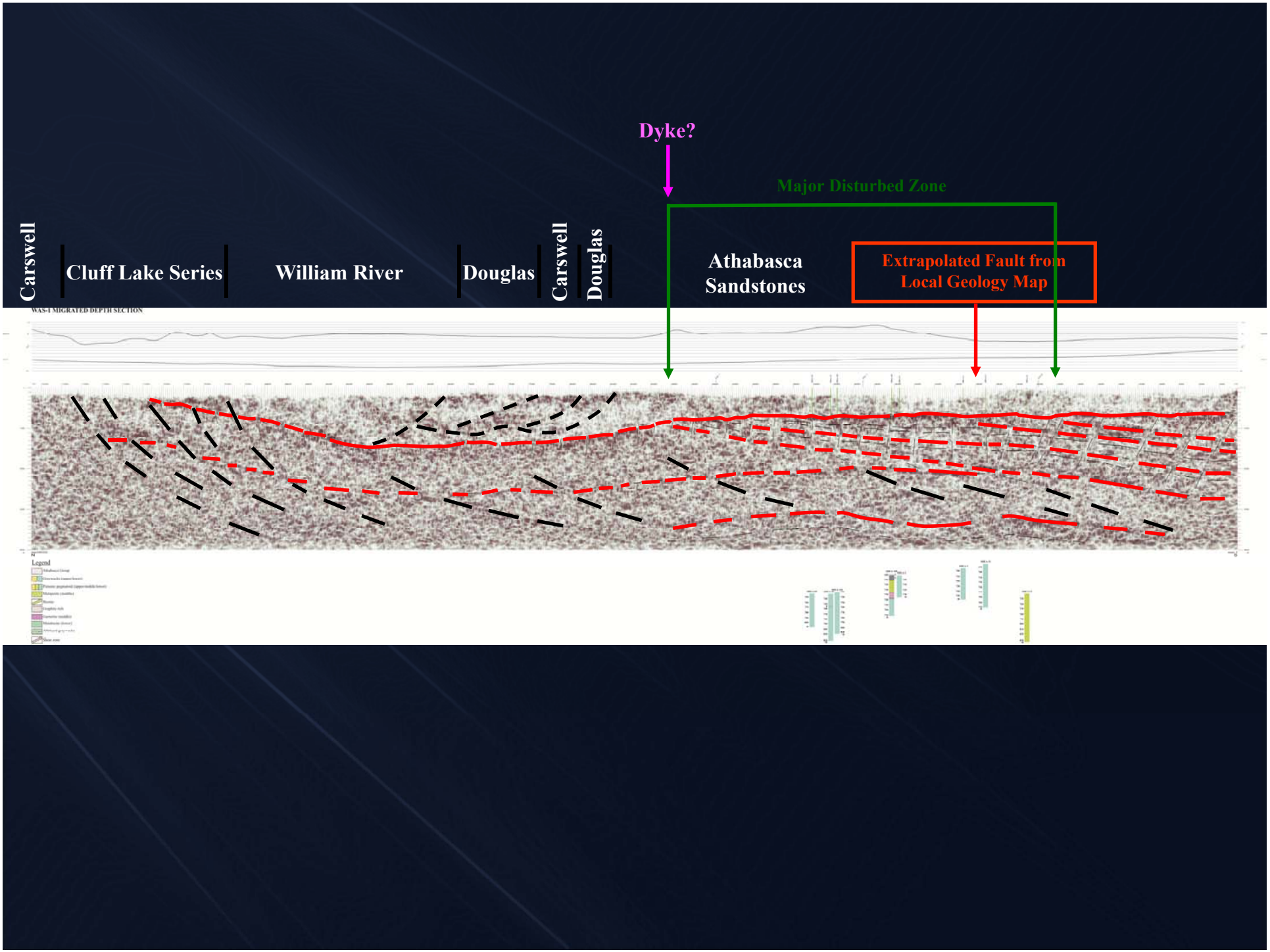


Figure 6.8. Conceptual hydrothermal model for the unconformity-type uranium deposit simulated by Raffensperger and Garven (1995a).

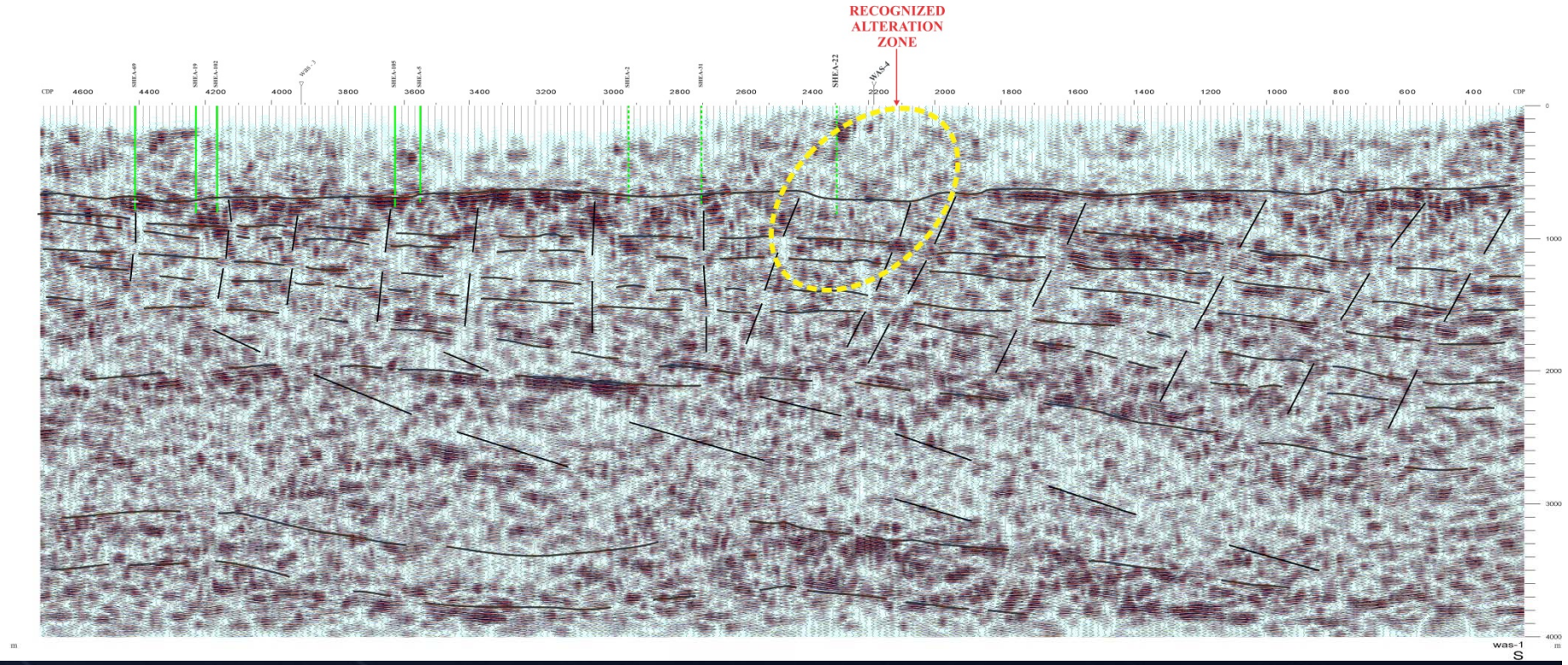
H_20 + U 30 ppm
10^6 years
334 Billion liters
20 000 000 kg U



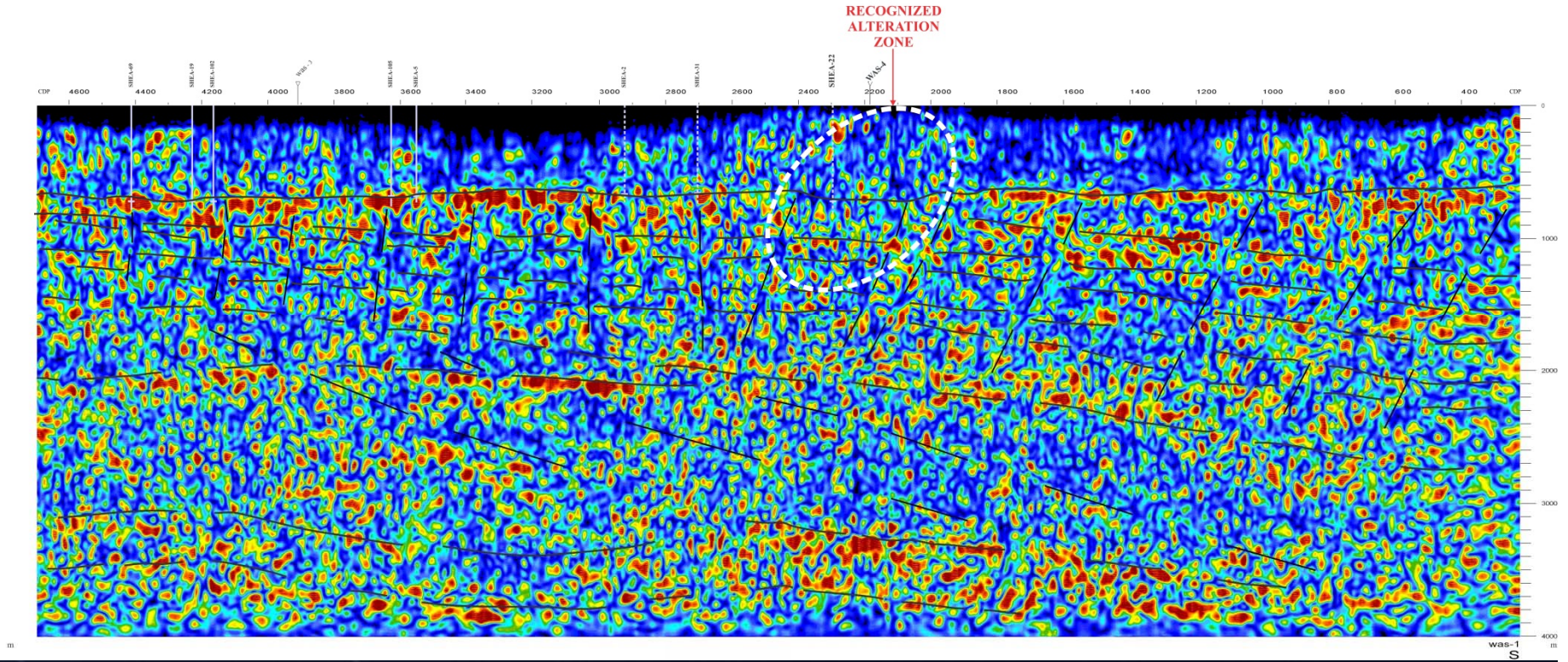

Legend
Shea Creek
Main Shear Zone
Highway 955
Uranium Mines and Major Deposits
1 Cluff Lake
2 Key Lake
3 McArthur River
4 Cigar Lake
5 Midwest Lake
6 McClean Lake
7 Eagle Point
8 Rabbit Lake
Taltson Magmatic Zone
Taltson Basement
Nolan
Ena
Zemlak
Taltson
Uranium City
Beaverlodge
Train Lake
Dodge
Tantato
Black Lake Shear Zone
Mudjatik (North)
Athabasca Basin
Carswell Formation
Clearwater Domain
Black Bay Fault
Lake Athabasca
Beatty R. Fault
(Snowbird Tectonic Zone)
Pointsett North
Wollaston Lake
Cable Bay Shear Zone
Cree Lake
Lloyd (East)
Rae Province
Virgin River Shear
Virgin River
Wollaston
Peter Lake
Reindeer Lake
Mudjatik (South)
Hearne Province
Buffalo Narrows
Nowdle Falls Shear Zone
Rottenstone
0 50 100Km
SCALE BAR
Taltson Magmatic Zone
?


Dyke?
Major Disturbed Zone
Carswell
Cluff Lake Series
William River
Douglas
Carswell
Douglas
Athabasca Sandstones
Extrapolated Fault from Local Geology Map
Legend

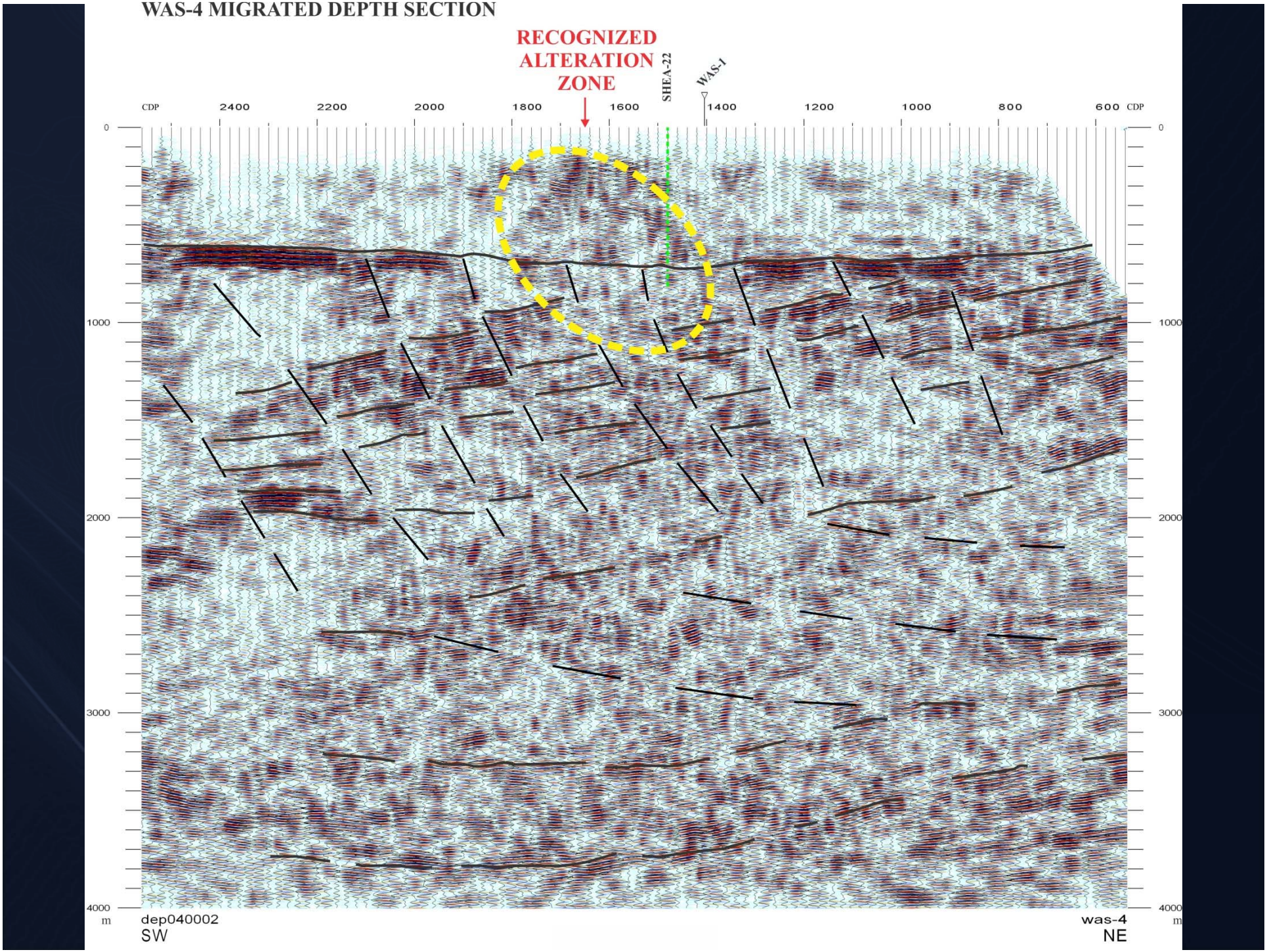
WAS-1 MIGRATED DEPTH SECTION
(SOUTHERN END OF THE PROFILE)



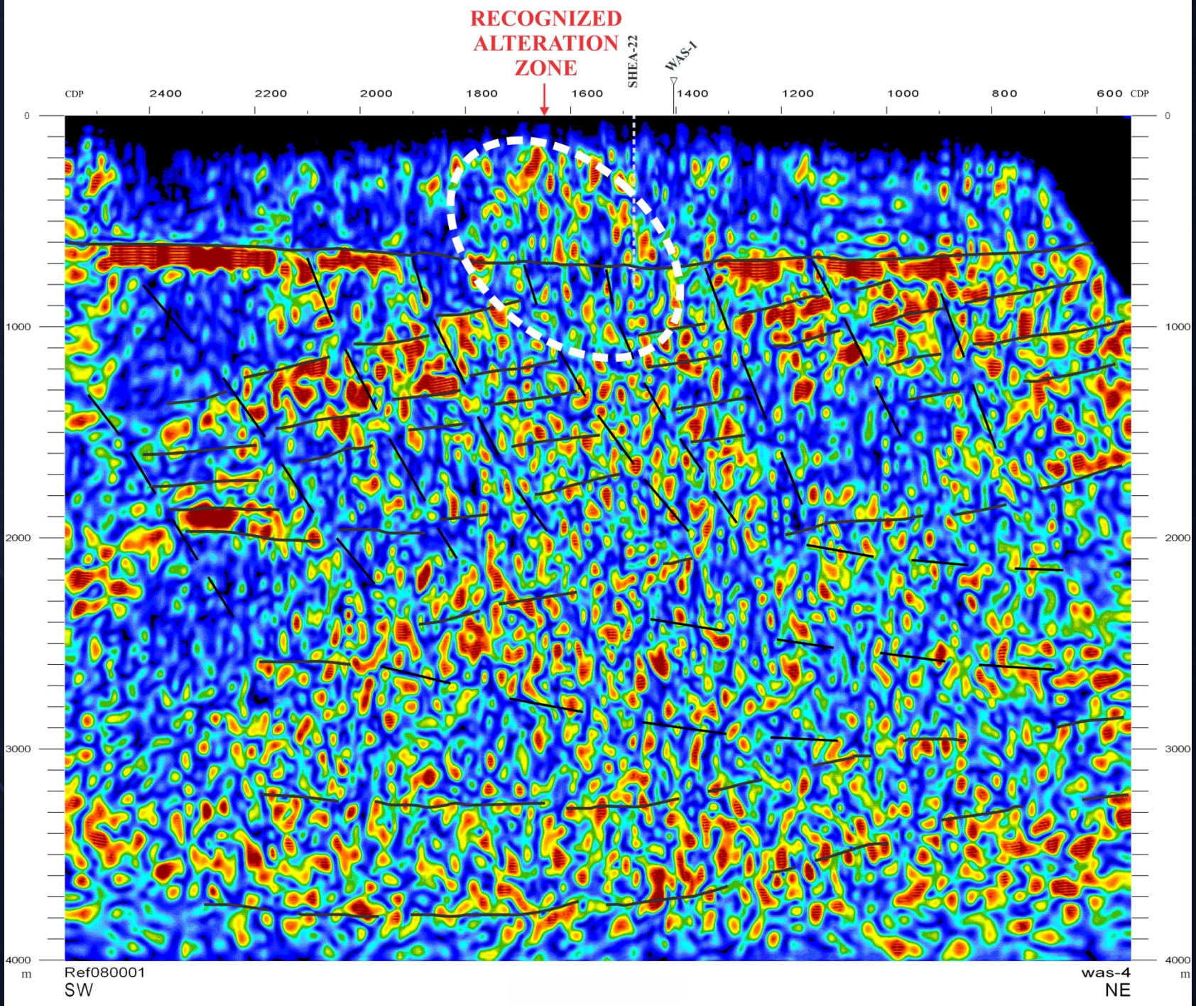
WAS-1 REFLECTION STRENGTH SECTION
(SOUTHERN END OF THE PROFILE)

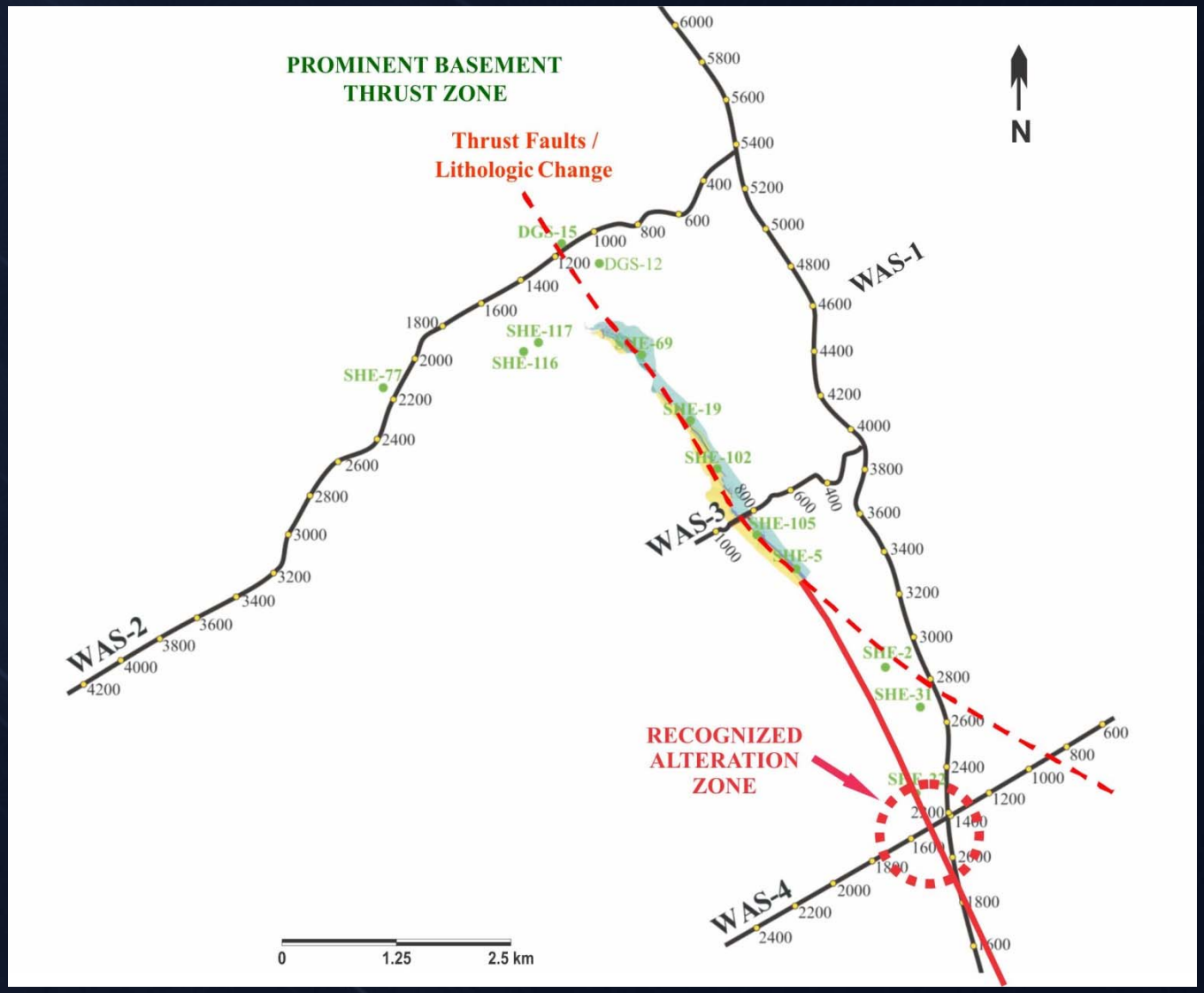


WAS-4 MIGRATED DEPTH SECTION



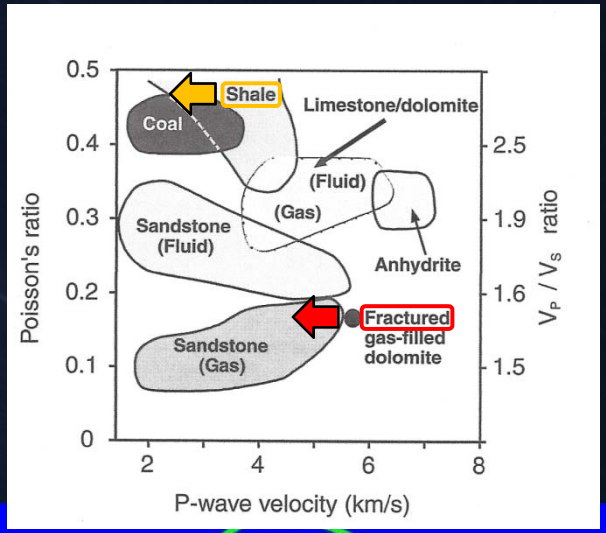
WAS-4 REFLECTION STRENGTH SECTION



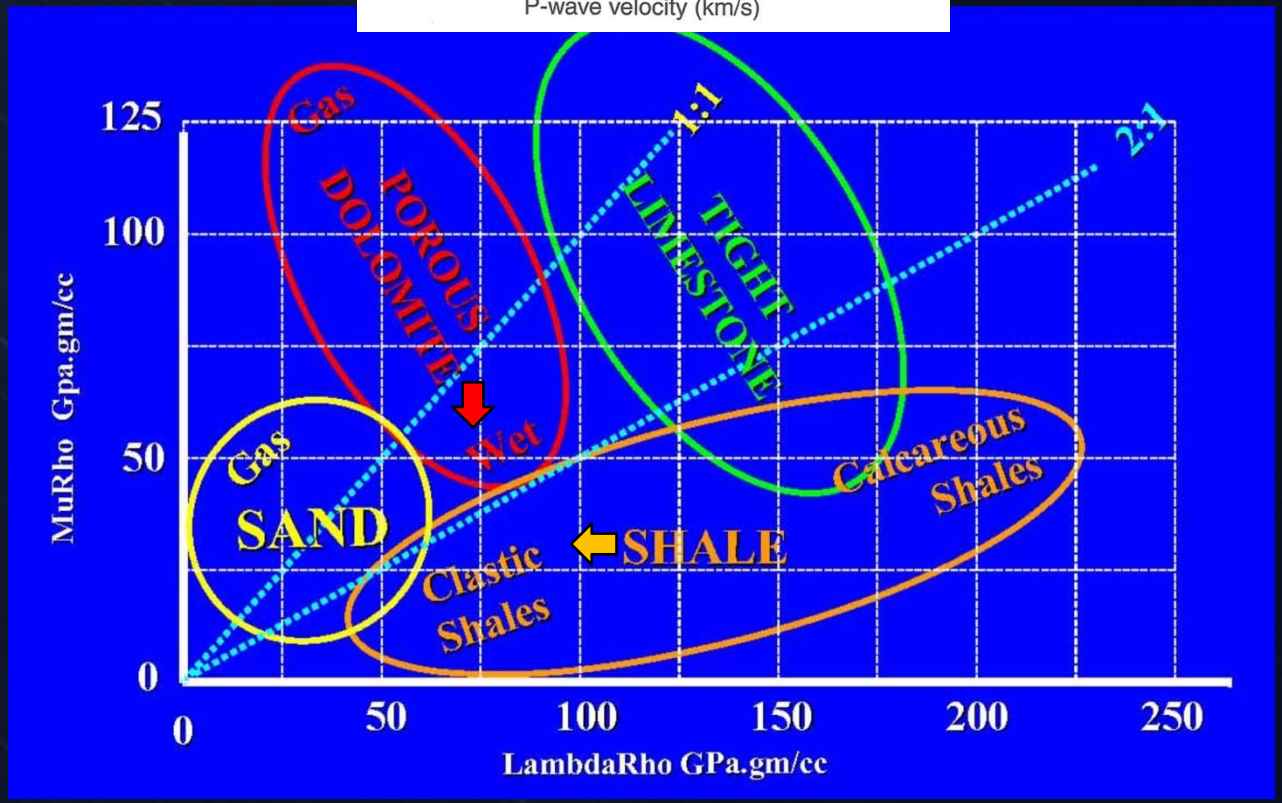

PROMINENT BASEMENT
THRUST ZONE
Thrust Faults /
Lithologic Change
N
WAS-1
WAS-2
WAS-3
WAS-4
DGS-15
DGS-12
SHE-117
SHE-116
SHE-77
SHE-69
SHE-19
SHE-102
SHE-105
SHE-5
SHE-2
SHE-31
RECOGNIZED
ALTERATION
ZONE
0
1.25
2.5 km

P-wave velocity vs. Poisson's ratio and Lambda*Rho vs. Mu*Rho cross-plots.

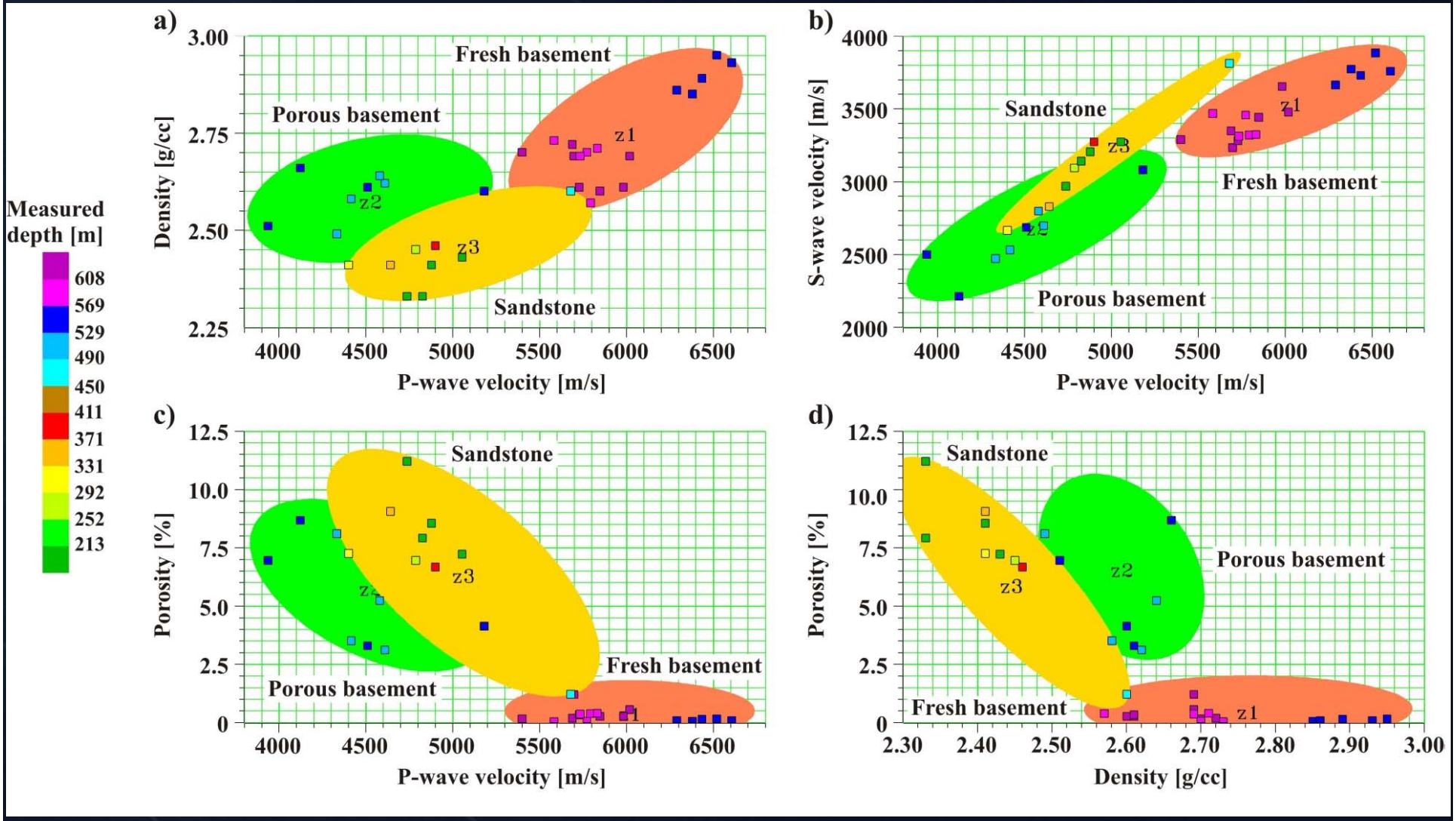
Poisson's ratio, Lambda*Rho, and Mu*Rho are more characteristic for the lithology than the P or S-wave velocity in itself.

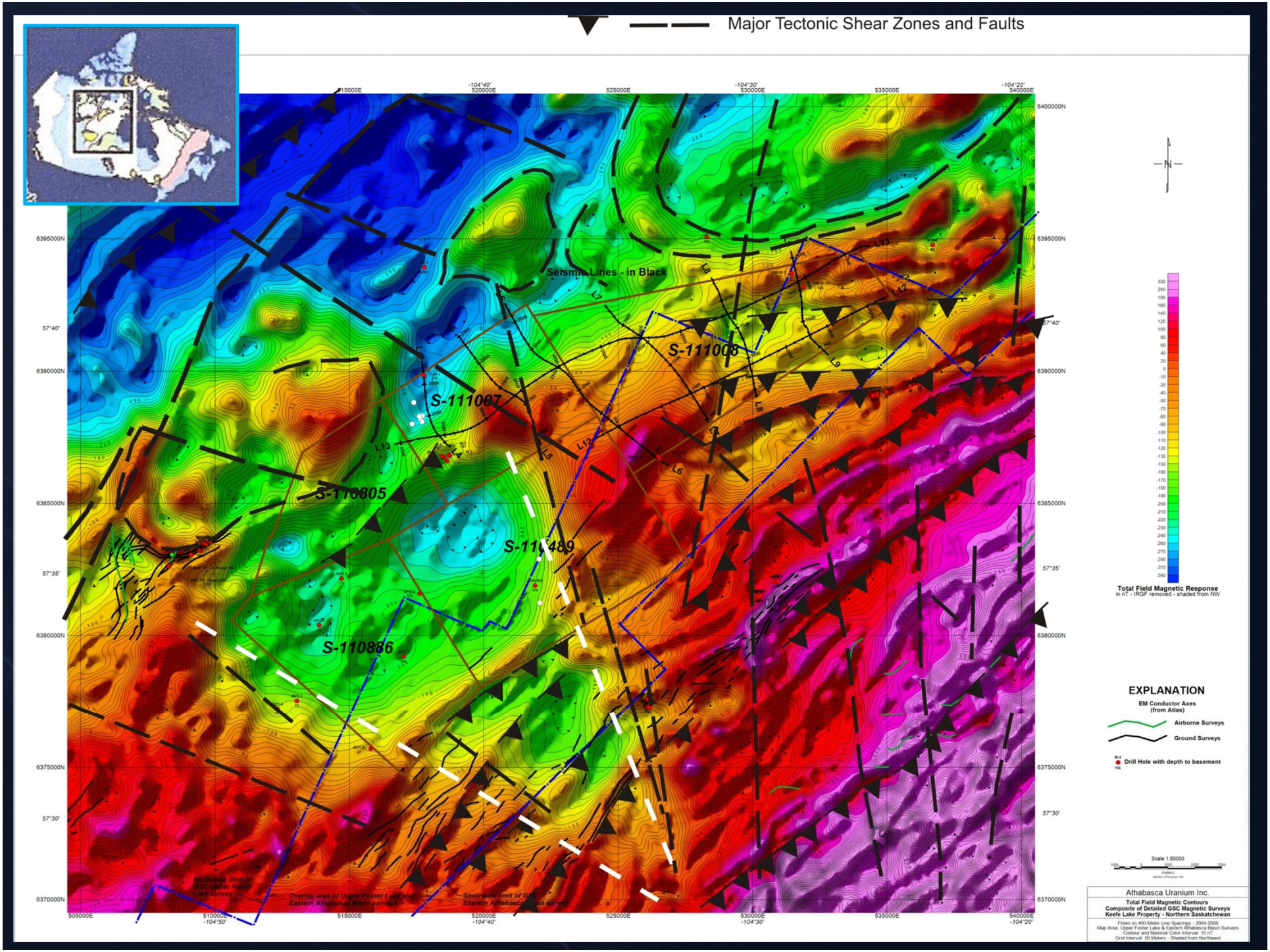


After
Ikelle and Amundsen, 2005
(sedimentary environment)

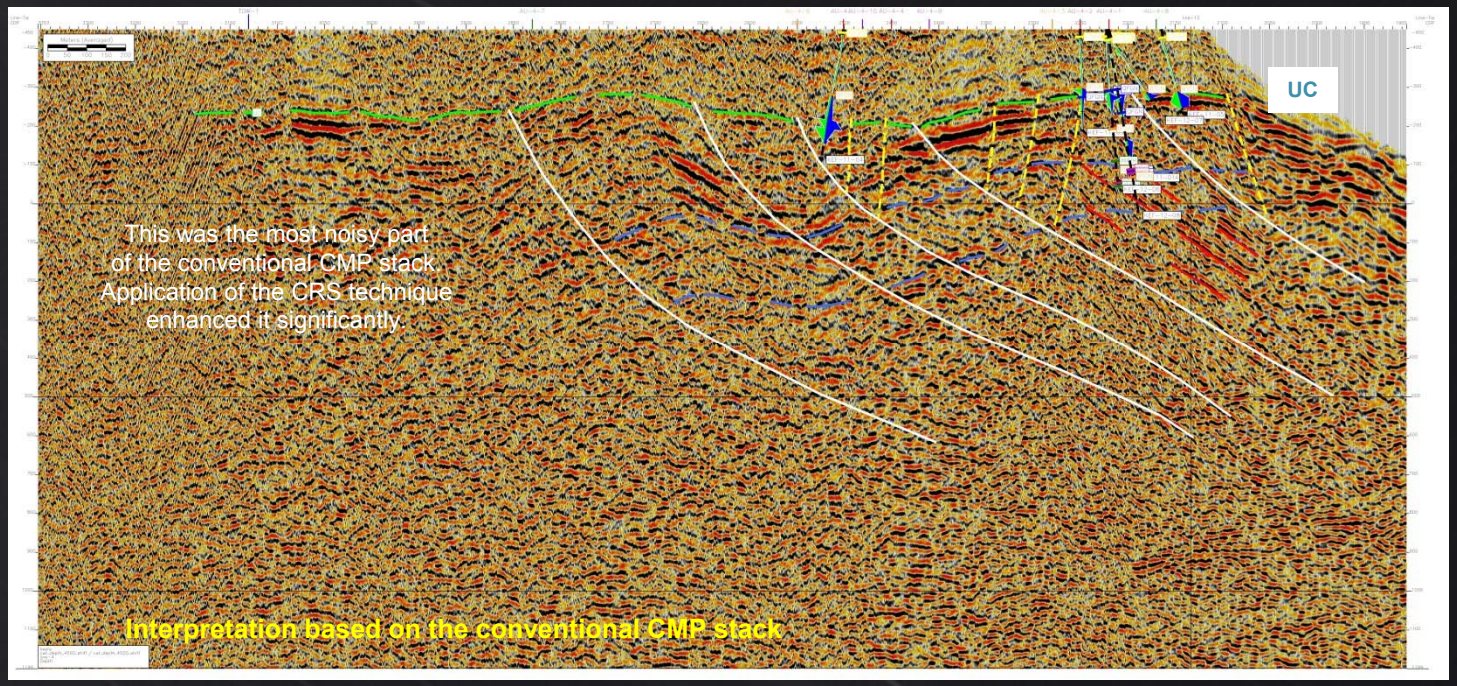


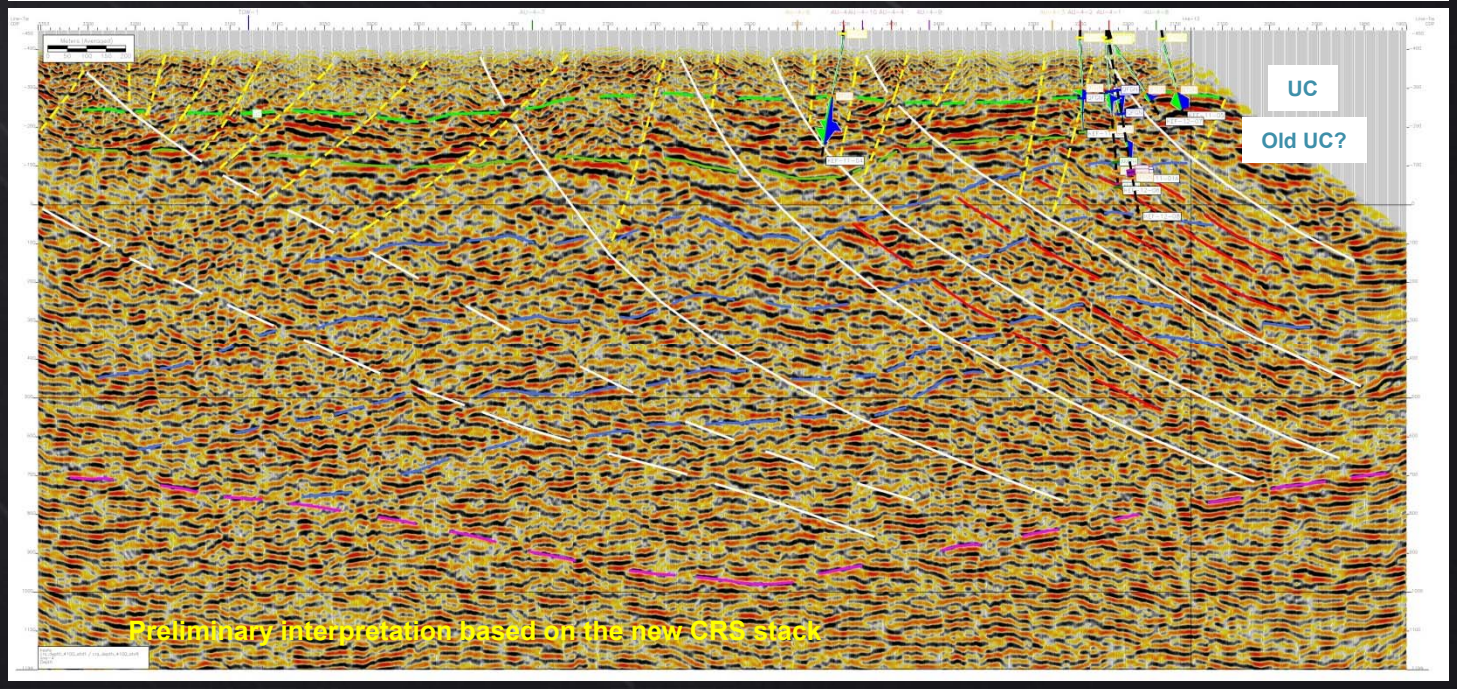
After
Goodway, 2007
(sedimentary environment)


Measured depth [m]
608
569
529
490
450
411
371
331
292
252
213
a)
Density [g/cc]
P-wave velocity [m/s]
Fresh basement
Porous basement
Sandstone
z1
z2
z3
b)
S-wave velocity [m/s]
P-wave velocity [m/s]
Sandstone
Fresh basement
Porous basement
z1
z2
z3
c)
Porosity [%]
P-wave velocity [m/s]
Sandstone
Fresh basement
Porous basement
z1
z2
z3
d)
Porosity [%]
Density [g/cc]
Sandstone
Porous basement
Fresh basement
z1
z2
z3


Major Tectonic Shear Zones and Faults
Seismic Lines - in Black
S-111008
S-111007
S-110805
S-110889
S-110886
L1
L2
L3
L4
L5
L6
L7
L8
L9
L12
L13
Total Field Magnetic Response
in nT - IRGF removed - shaded from NW
EXPLANATION
EM Conductor Axes
(from Atlas)
Airborne Surveys
Ground Surveys
Drill Hole with depth to basement
Scale 1:50000
Athabasca Uranium Inc.
Total Field Magnetic Contours
Composite of Detailed GSC Magnetic Surveys
Keefe Lake Property - Northern Saskatchewan
Flown on 400-Meter Line Spacings - 2004-2009
Map Area: Upper Foster Lake & Eastern Athabasca Basin Surveys
Contour and Nominal Color Interval: 10 nT
Grid Interval: 50 Meters - Shaded from Northwest
Overlap area of Upper Foster Lake and Eastern Athabasca Basin surveys
Southeast limit of GSC Upper Foster Lake survey
Southeast limit of GSC Eastern Athabasca Basin survey
515000E
520000E
525000E
530000E
535000E
540000E
505000E
510000E
-104°40'
-104°30'
-104°20'
-104°50'
6400000N
6395000N
6390000N
6385000N
6380000N
6375000N
6370000N
57°40'
57°35'
57°30'

Geological / structural interpretation based on the conventional CMP and the new CRS stacks





Inserted logs:
green – boron
blue – potassium

DATASETS UTILIZED
for studying Uranium Deposit Vectors within the KEEFE LAKE Uranium Property and its vicinity

1) Regional LITHOLOGY data

Observations of ***structural***, ***alteration***, ***pelitic***, ***pegmatitic***, and ***graphitic*** features obtained from historic and new boreholes.

2) Regional UC depth map

UC depth created from borehole and available seismic data.

3) Regional GEOCHEMISTRY data

U3O8, ***Co***, Cu, Ni, Pb, Zn, As, and ***B*** distribution maps compiled from borehole data.

4) Regional CLAY MINERAL maps

Illite and kaolinite distribution.

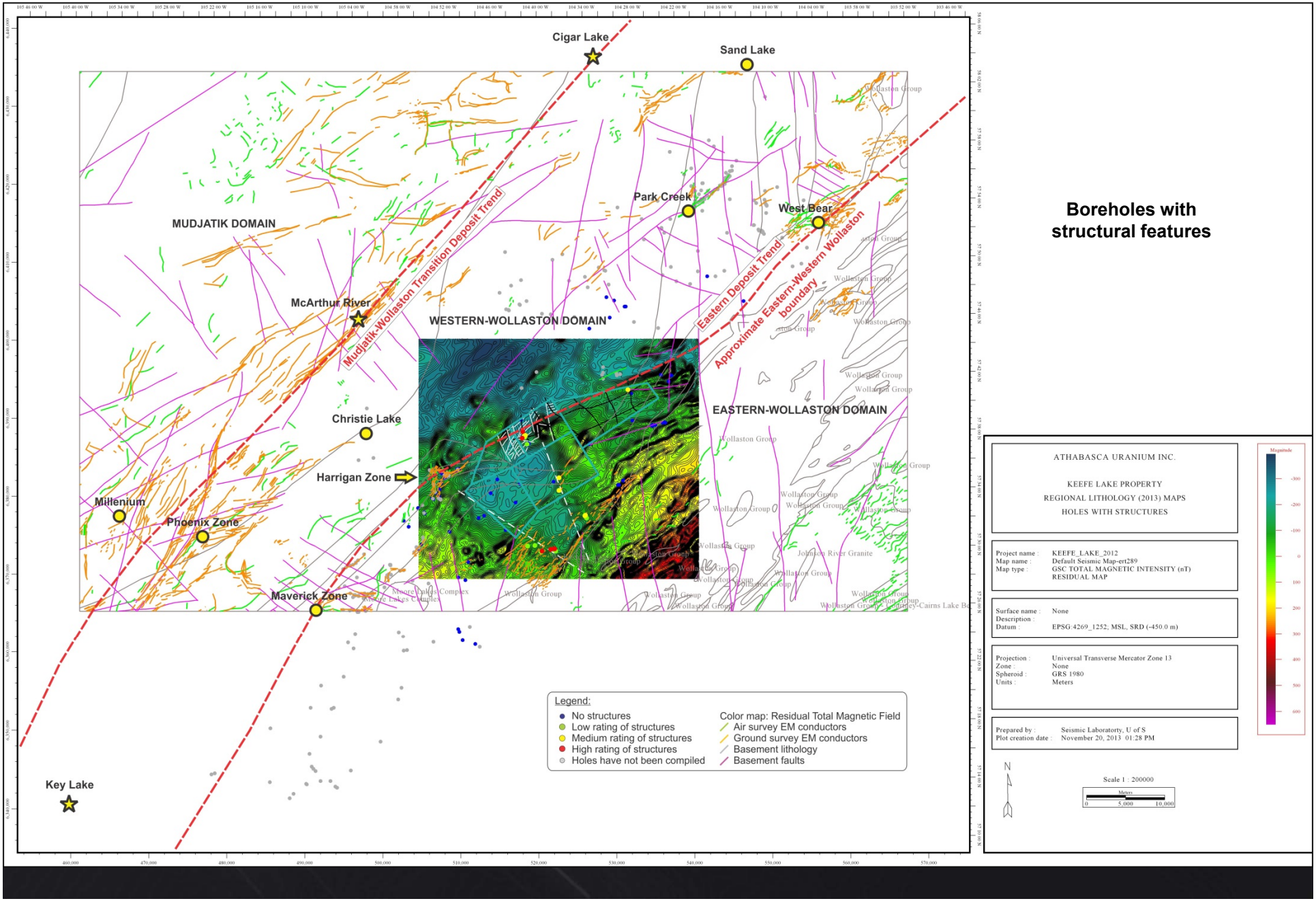
5) Local SEISMIC data

To identify faults, deep seated shear zones, disturbances of the unconformity, and alteration zones along the 2D ***seismic profiles***.

6) Local MAGNETIC and VTEM data

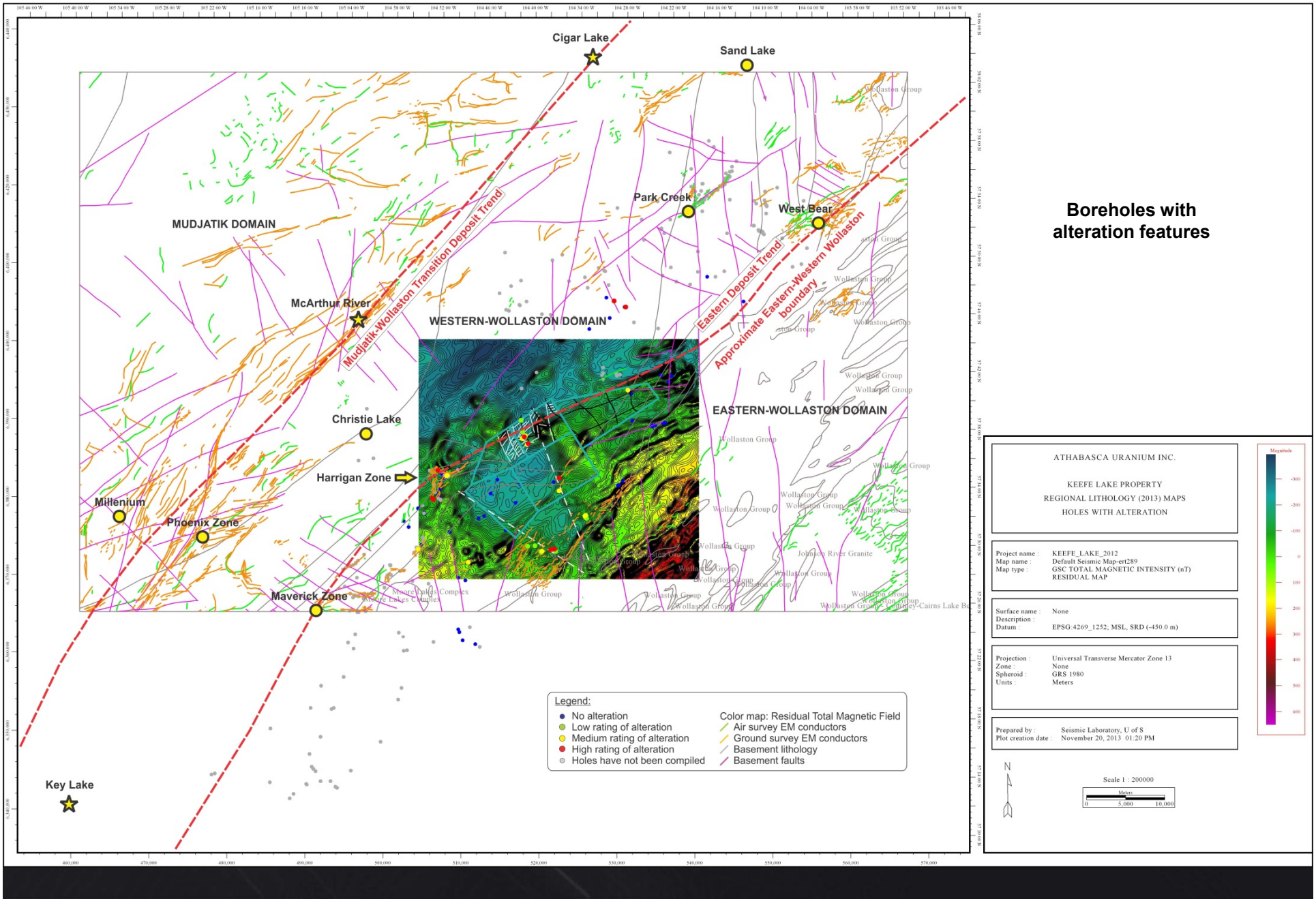
To extend the 2D seismic interpretation - ***Total Magnetic Intensity***, Magnetic Vertical Gradient, Magnetic Total Horizontal Gradient, ***Magnetic Tilt-Angle Derivative***, VTEM dB/dt Z Component (Channels 14, 20, 30), ***VTEM dB/dt Z Component Calculated Time Constant*** (tau *conductivity*), and ***Resistivity Depth Images*** (RDI) data were utilized.

Fig. 4: Boreholes with **structural** features displayed in the vicinity of the Keefe Lake property. GSC Total Magnetic Intensity, EM conductors (air and ground surveys), bedrock faults and geology, as well as structural interpretation (white continuous lineaments) based on available seismic, AEROTEM, and VTEM data (Keefe Lake property) is also shown (Scale=1:200,000).



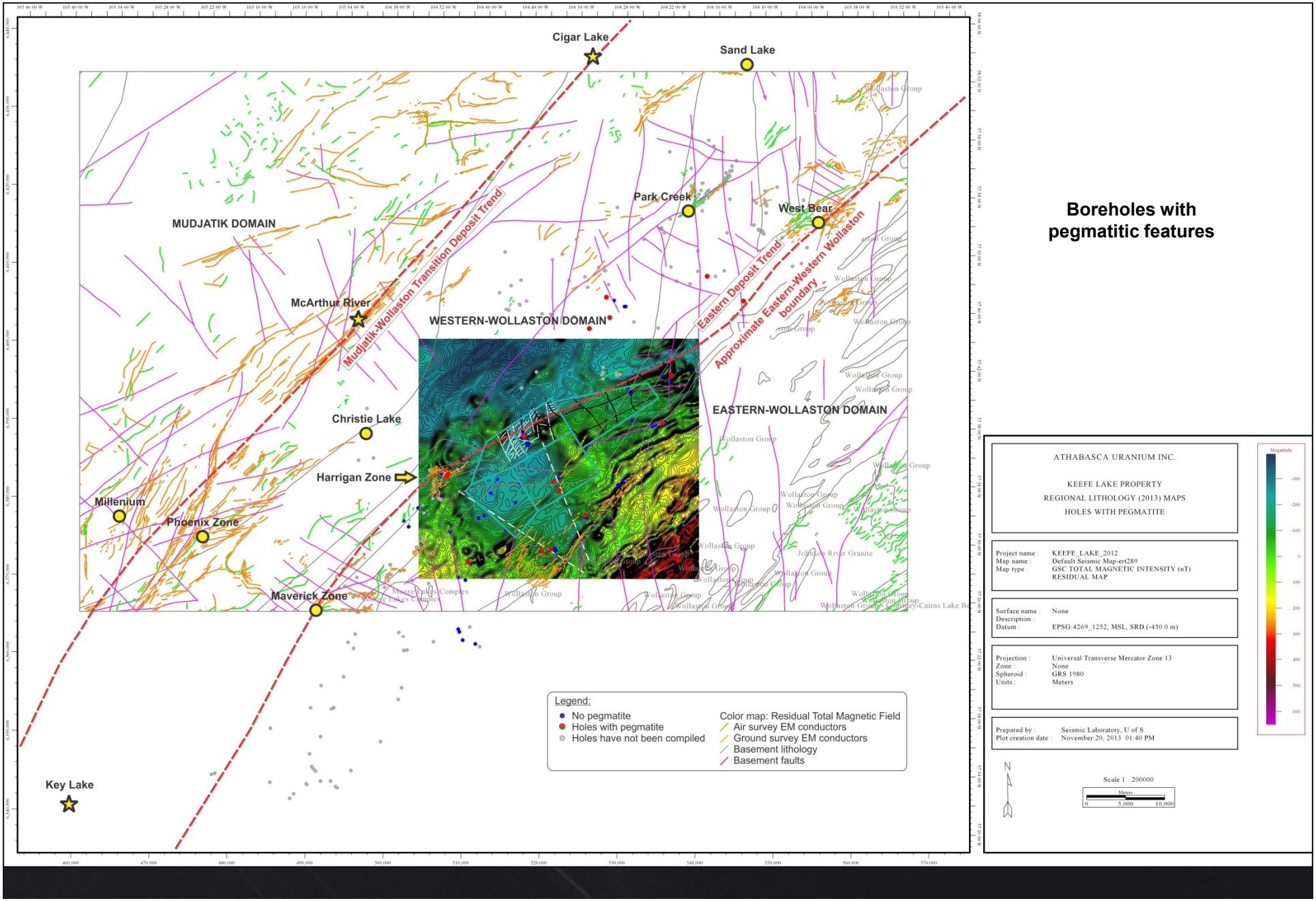
Boreholes with structural features

Fig. 2: Boreholes with **alteration** features displayed near the Keefe Lake property. GSC Total Magnetic Intensity, EM conductors (air and ground surveys), bedrock faults and geology, as well as structural interpretation (white continuous lineaments) based on available seismic, AEROTEM, and VTEM data (Keefe Lake property) is also displayed (Scale=1:200,000).



Boreholes with alteration features

Fig. 7: Boreholes with **pegmatitic** features displayed near the Keefe Lake property. GSC Total Magnetic Intensity, EM conductors (air and ground surveys), bedrock faults and geology, as well as structural interpretation (white continuous lineaments) based on available seismic, AEROTEM, and VTEM data (Keefe Lake property) is also displayed (Scale=1:200,000).



Boreholes with pegmatitic features

Fig. 5: Boreholes with **pelitic** or **semi-pelitic** features displayed near the Keefe Lake property. GSC Total Magnetic Intensity, EM conductors (air and ground surveys), bedrock faults and geology, as well as structural interpretation (white continuous lineaments) based on available seismic, AEROTEM, and VTEM data (Keefe Lake property) is also displayed (Scale=1:200,000).

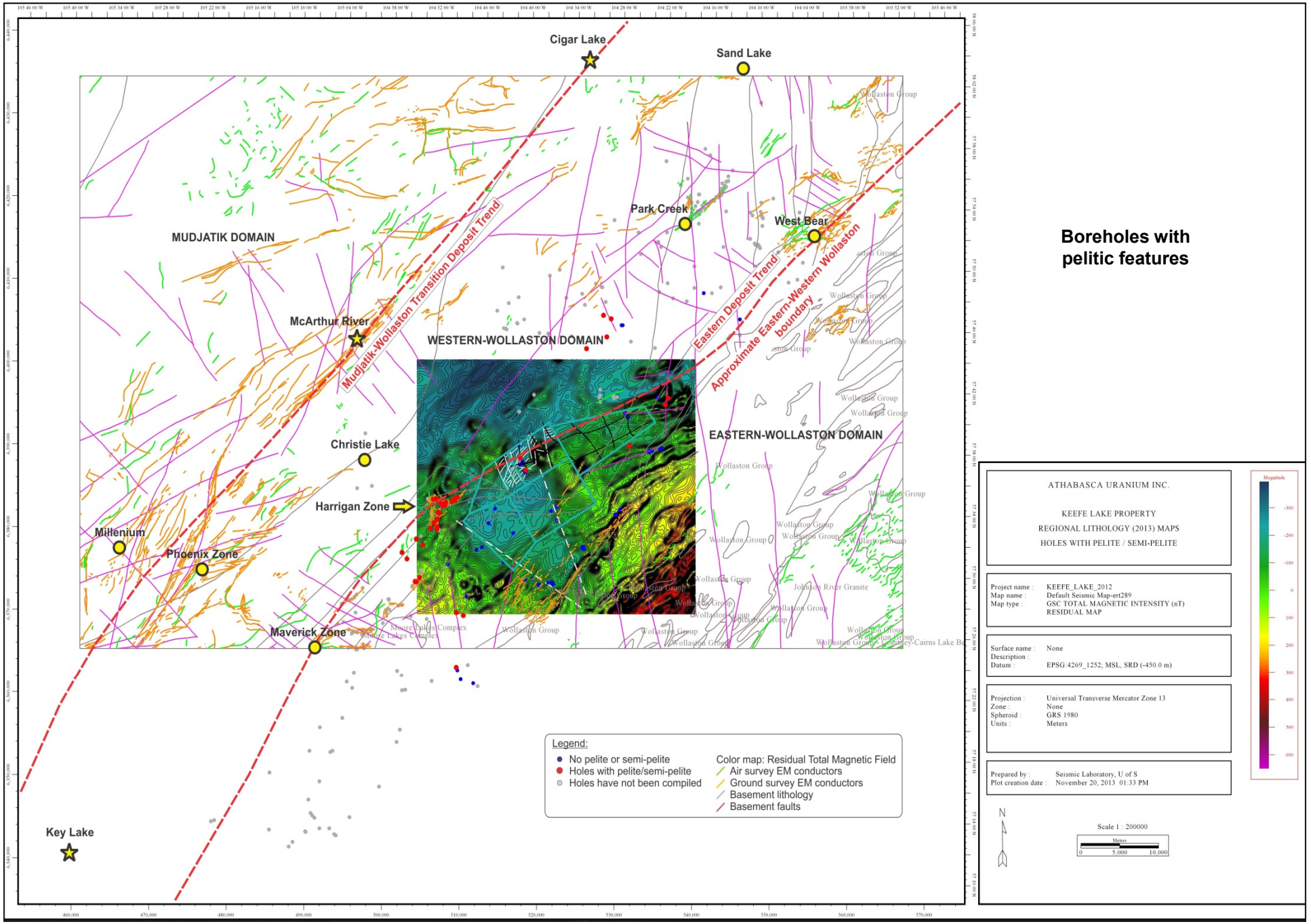


Fig. 9: Regional **unconformity depth map** created from borehole (450 holes) and available seismic data at the Keefe Lake property. EM conductors (air and ground surveys), bedrock faults and geology,as well as structural interpretation (white continuous lineaments) based on available seismic, AEROTEM, and VTEM data (Keefe Lake property) is also presented (Scale=1:200,000).

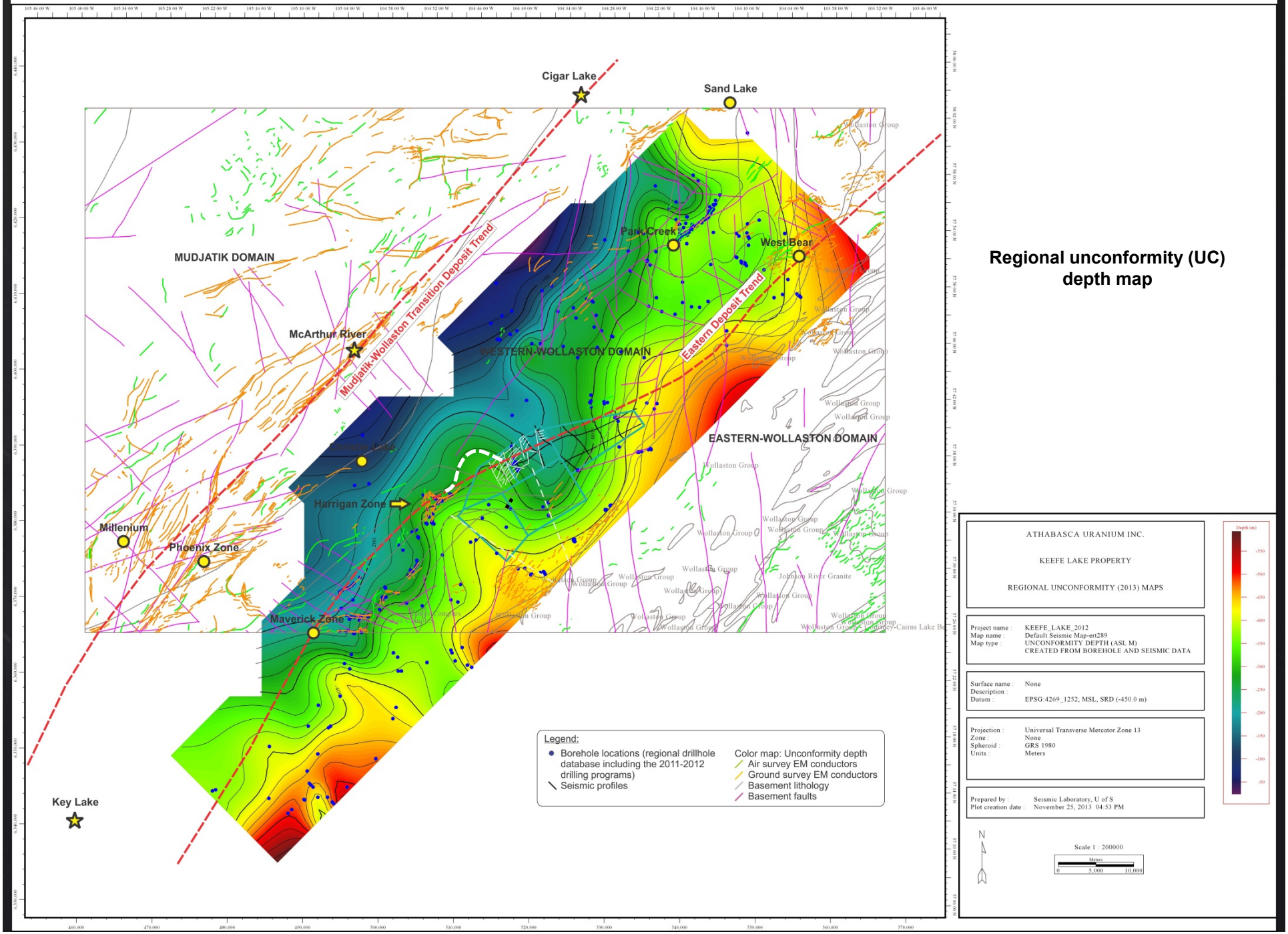


Fig. 10: Regional **uranium-oxide** (U3O8) log-normal distribution map in the area surrounding the Keefe Lake property. EM conductors (air and ground surveys), bedrock faults and geology, as well as structural interpretation (red continuous lineaments) based on available seismic, AEROTEM, and VTEM data (Keefe Lake property) are also displayed. Black dots mark the processed holes involved in the mapping (Scale=1:200,000).

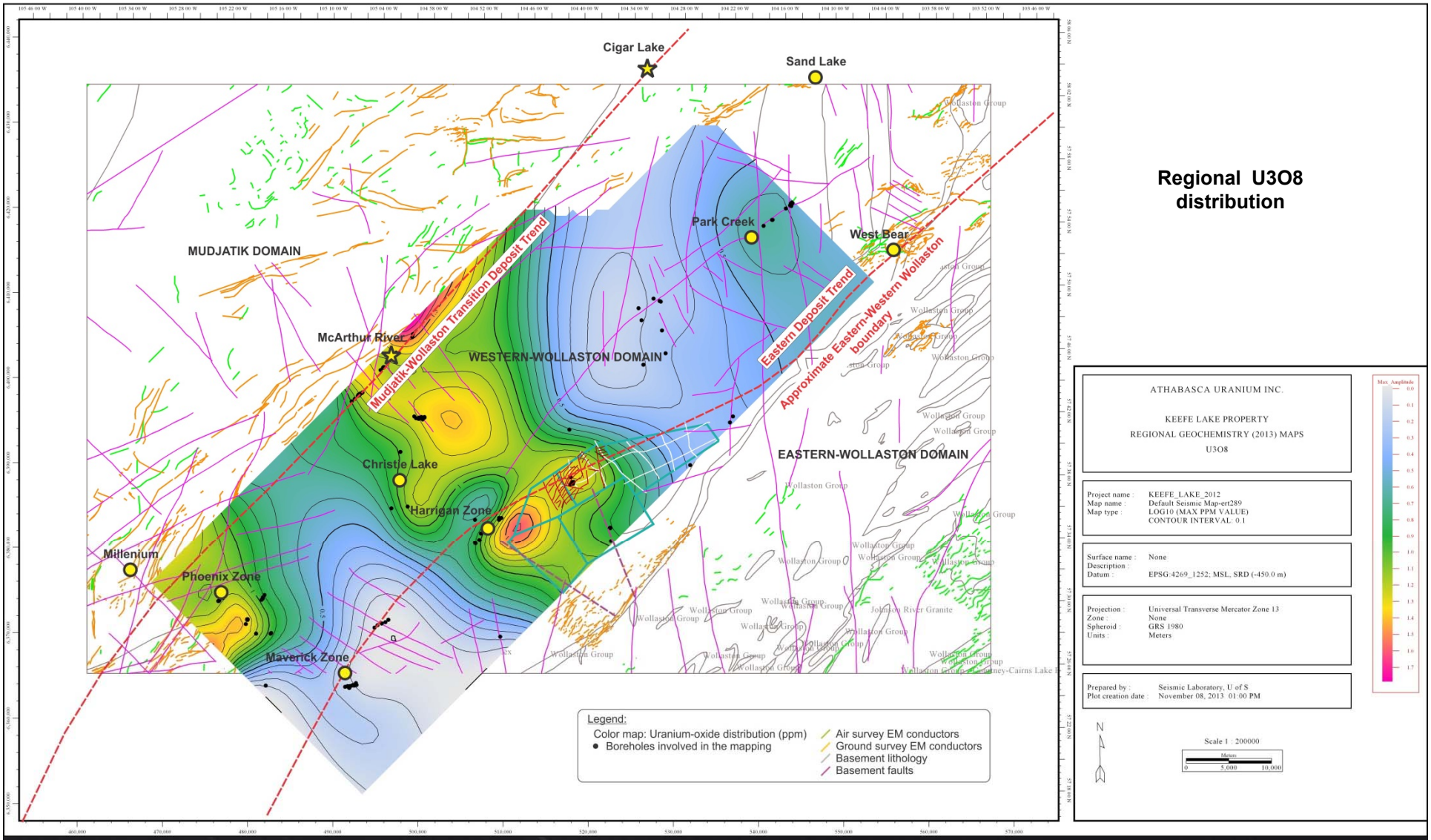


Fig. 11: Regional **cobalt** (Co) log-normal distribution map featuring the vicinity of Keefe Lake property. EM conductors (air and ground surveys), bedrock faults and geology, as well as structural interpretation (red continuous lineaments) based on available seismic, AEROTEM, and VTEM data (Keefe Lake property) are also displayed. Black dots mark the processed holes used in the mapping (Scale=1:200,000).

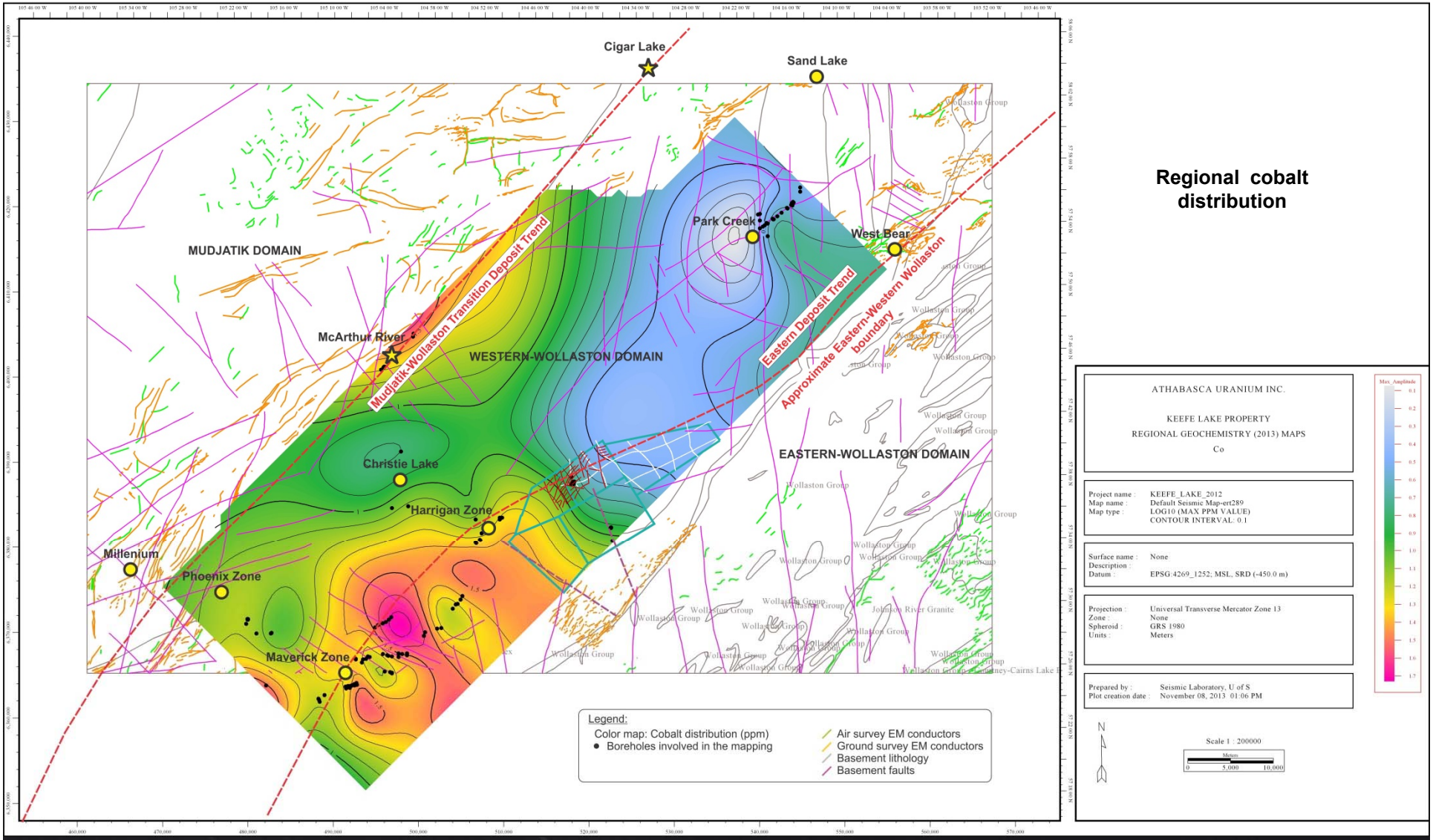
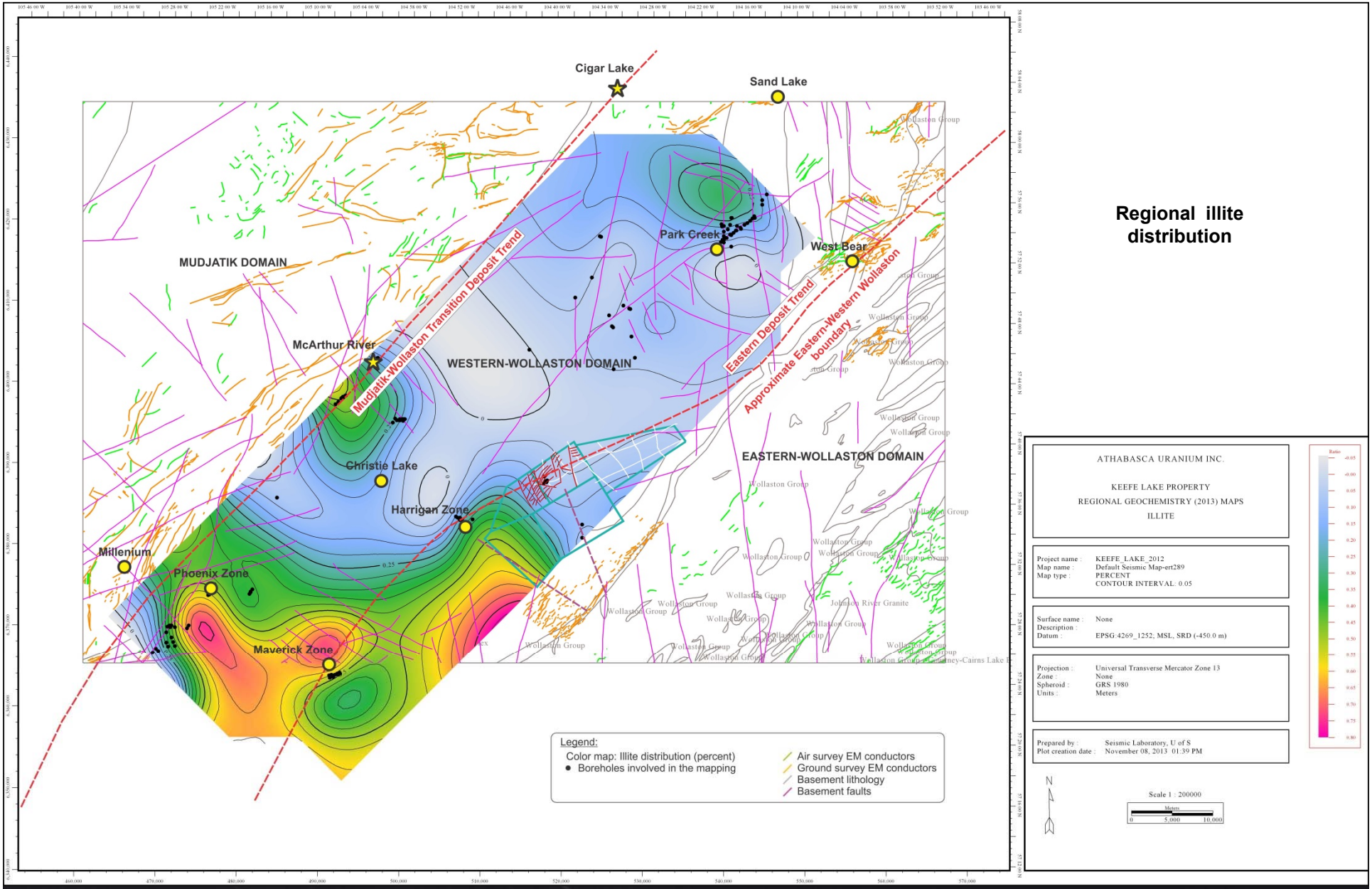
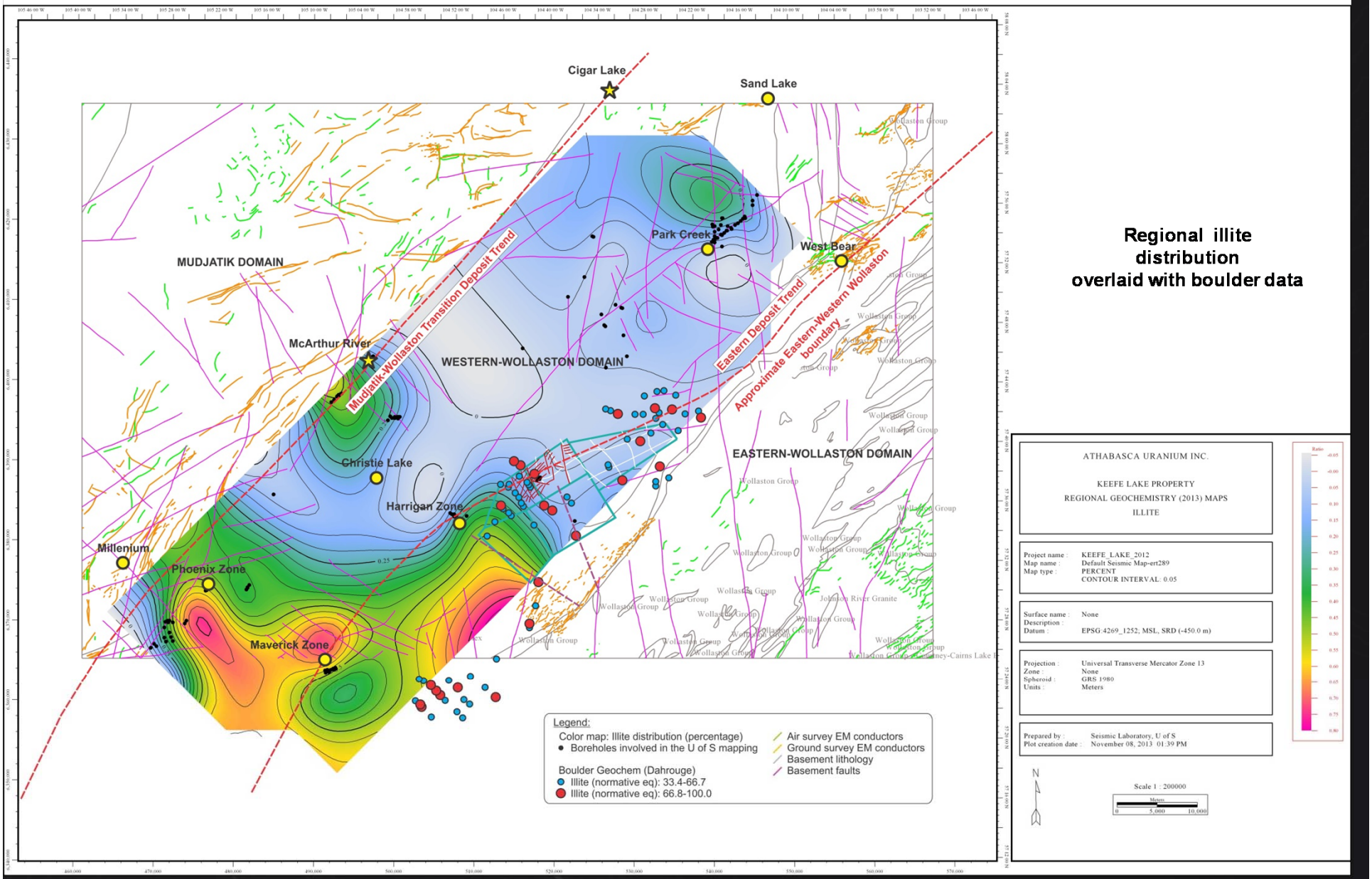


Fig. 18: Regional **illite** normal distribution map around the Keefe Lake property. EM conductors (air and ground surveys), bedrock faults and geology, as well as structural interpretation (red continuous lineaments) based on available seismic, AEROTEM, and VTEM data (Keefe Lake property) are also displayed. Black dots mark the processed holes involved in the mapping (Scale=1:200,000).



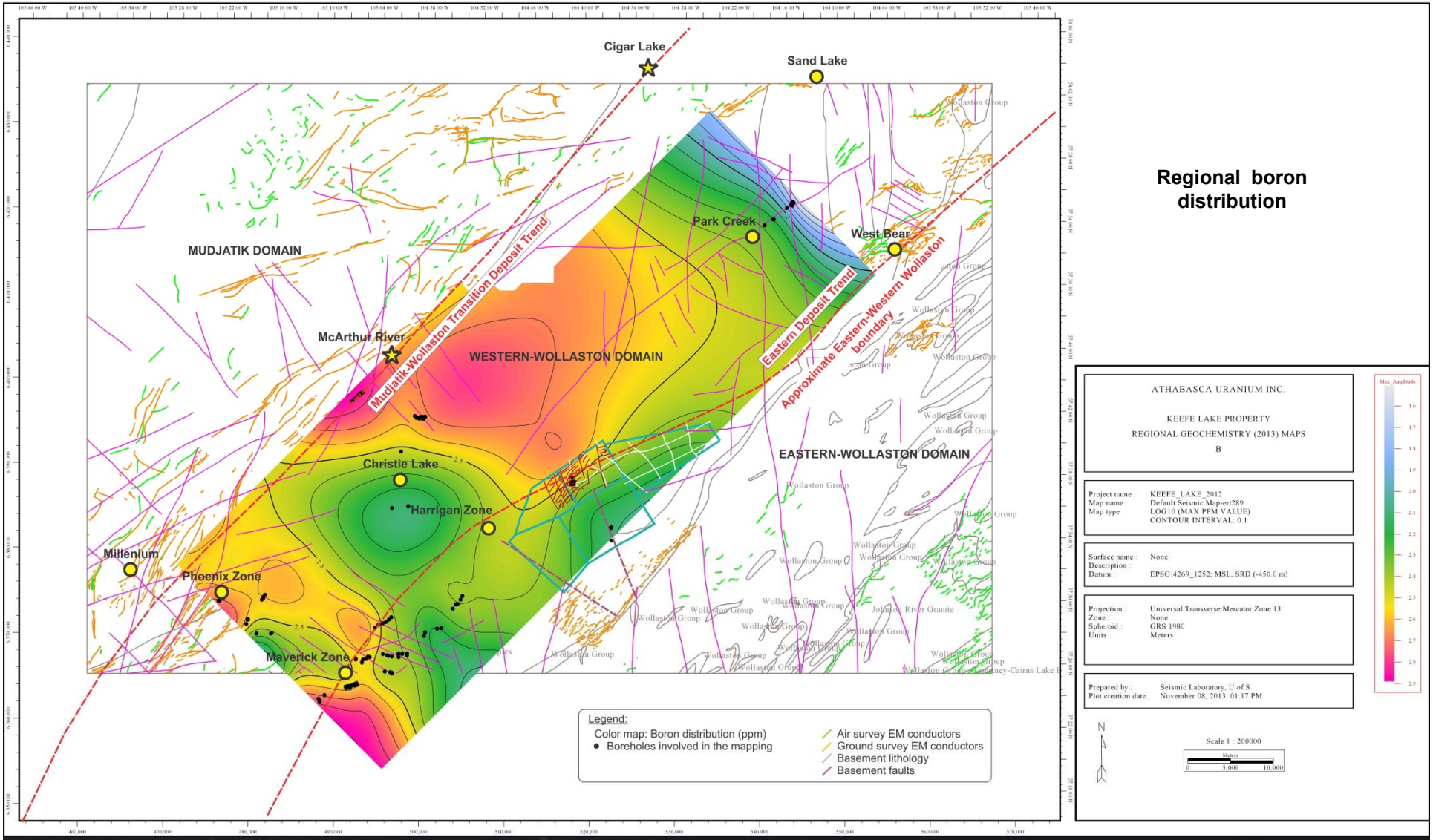
Regional illite distribution

Fig. 18.a: Illite values in boulders over Athabasca Uranium claim areas compiled by Dahrouge Geological Consulting and overlaid on the regional illite distribution map (U of S) around Keefe Lake.
Note that regional values are shown in percent (Scale=1:200,000).

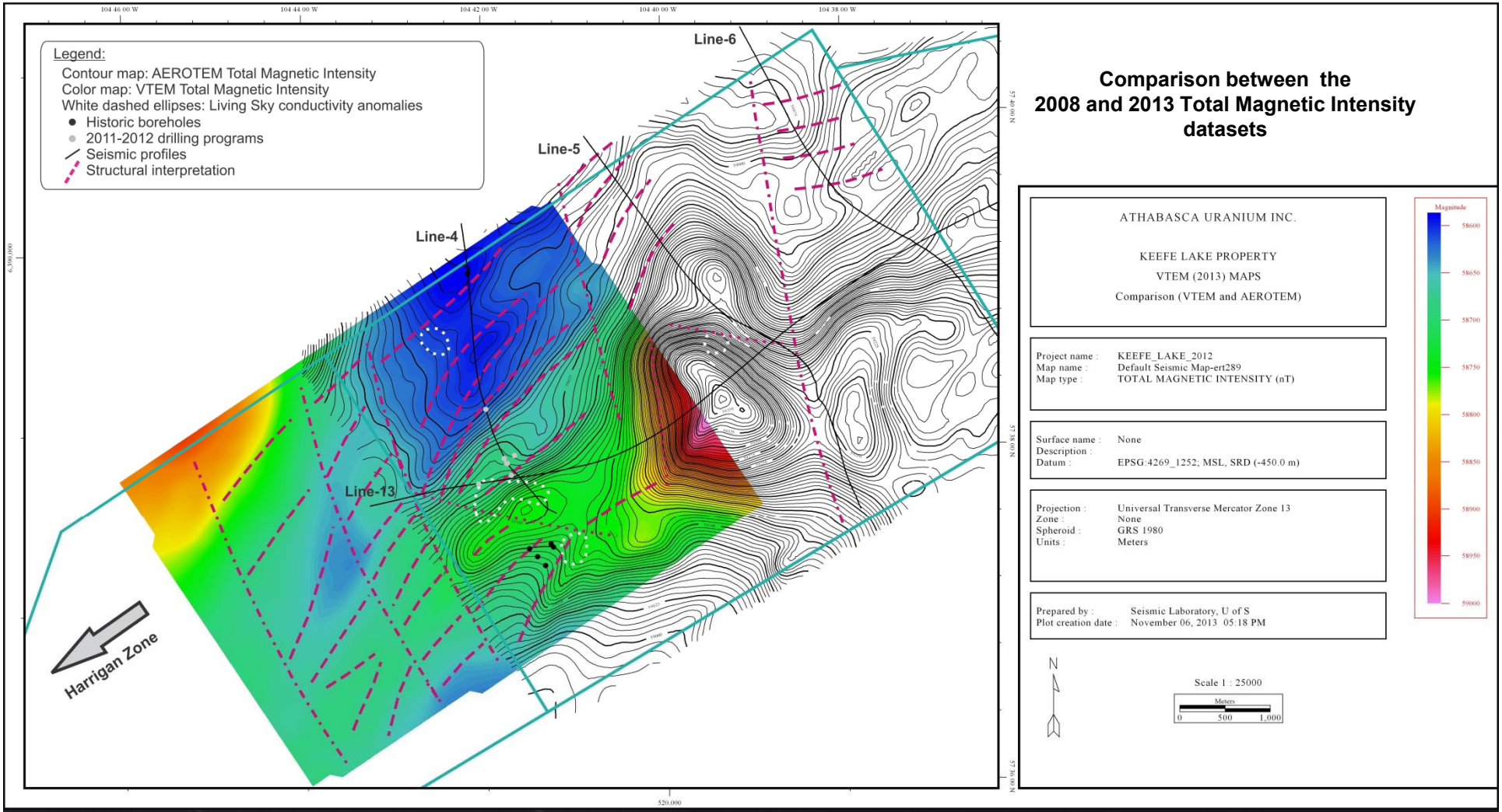


Regional illite distribution overlaid with boulder data

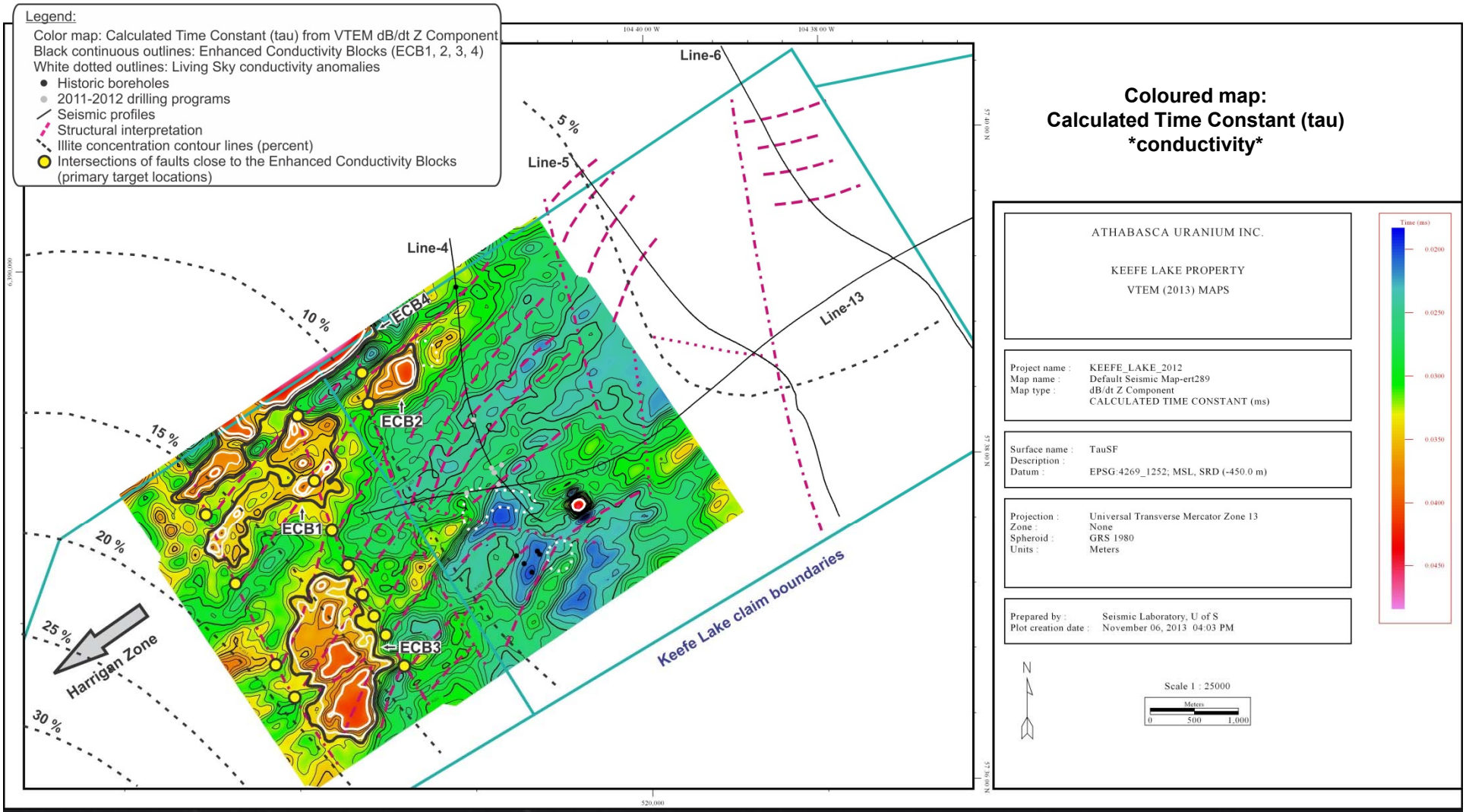
Fig. 17: Regional **boron** (B) log-normal distribution map in the vicinity of Keefe Lake property. EM conductors (air and ground surveys), bedrock faults and geology, as well as structural interpretation (red continuous lineaments) based on available seismic, AEROTEM, and VTEM data (Keefe Lake property) are also displayed. Black dots mark the processed holes used in the mapping (Scale=1:200,000).



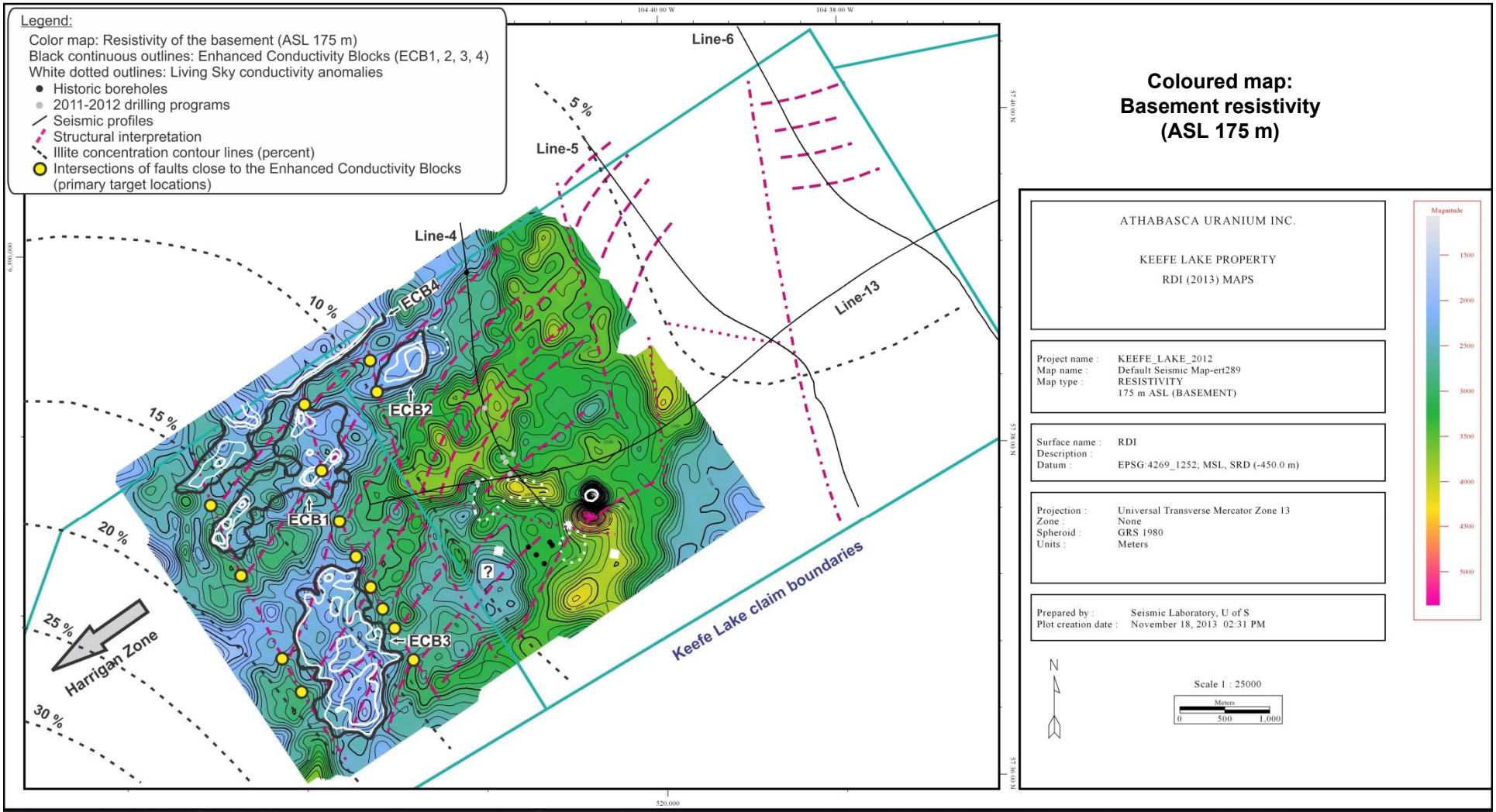
A comparison between the **2008 and 2013 Total Magnetic Intensity (TMI)** data. Black contour lines represent the 2008 data and the coloured map displays the 2013 data. The high correlation between the two TMI datasets confirmed our structural interpretation (2012) based on the seismic survey (Scale=1:25,000).



Enhanced conductivity blocks marked out on the **Calculated Time Constant (tau)** map around Keefe Lake (Scale=1:25,000).



Enhanced conductivity blocks displayed on the **resistivity** map of **basement** (175 m ASL) around Keefe Lake (Scale=1:25,000).



CONCLUSIONS

- High resolution reflection technique, in correlation with other indicative vectors, provides primary structural and alteration information, within the Keefe L. prospect.
- Several primary integrated attributes are indicative of mineralization within the SW.
- The anomalous zones are more accurately defined in depths than any other geophysical technique, reduce drilling cost significantly.