SENIOR PROJECT

Integration of Surface Seismic with Geo-electric Data

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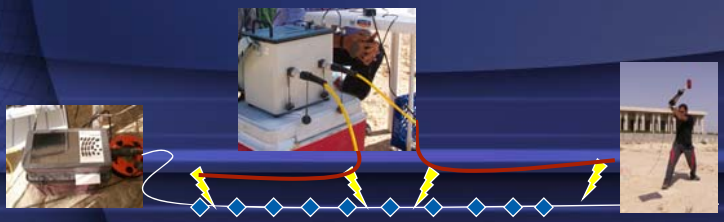


Outline

- INTRODUCTION
- LOCATION
- GEOLOGY

(Seismic Part)

- SEISMIC EQUIPMENT
- FIELD GEOMETRY
- NOISE ANALYSIS
- PRE-PROCESSING
- PROCESSING
- INTERPRETATION

(Geo-electric Part)

- BACKGROUND
- INSTRUMENTAL USED
- GEOMETRY PARAMETERS
- PARAMETERS AND MEASUREMENTS
- PROCESSING
- INTERPERTATION

- INTEGRATION
- CONCLUSION

- INTRODUCTION
- LOCATION
- GEOLOGY

Ahmed Al Zawwad

INTRODUCTION

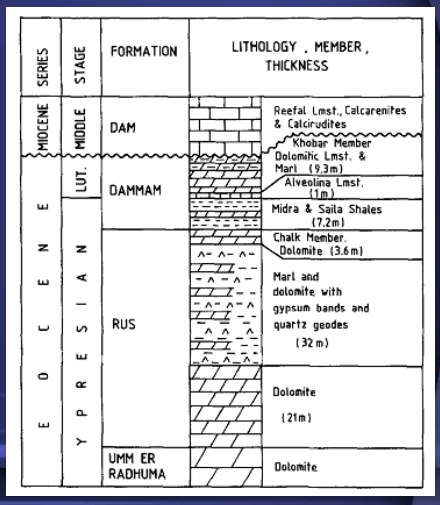
- With the help of Schlumberger we were going to make our senior project an “Integration of Surface Seismic with Geo-electric data”
- From this we would like to accomplish:
  1. Acquiring as much knowledge about the subsurface.
  2. See the relation between Refraction and Geo-electric method.

LOCATION

- The area that we agreed on doing the experiment in, is Dhahran Techno Valley.
- It lies over the proven Dammam reservoir.
- By knowing the weathering layers properties over this region it could help in reflection seismic " static correction".

Geology

- Generally the geology expected to be encountered is either of the Dammam Formation or Rus Formation.



M. NAMIK CAGATAY 1990.

SIESMIC PART

- SIESMIC EQUIPMENT
- FIELD GEOMETRY
- NOISE ANALYSIS

Ali Al Halal

Seismic Equipment

- 3 days field work
  - Day 1:
    - Decision of receiver and shot locations.
    - Flags determined the locations.
    - Digging to place the geophones.

Seismic Equipment

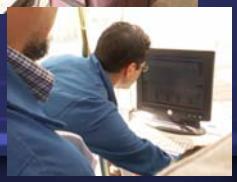
- 3 days field work
  - Day 2:
    - 3D Geophones were put in.
    - Cable connected.
    - 3 geodes were used.
    - Noise analysis.



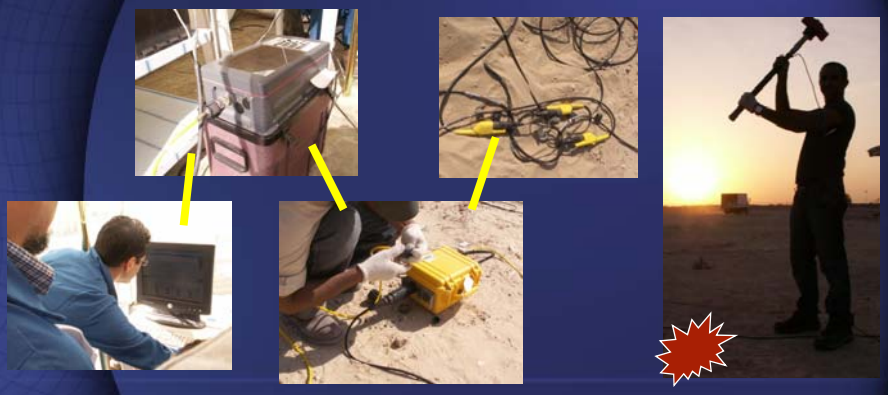
Seismic Equipment

- 3 days field work
  - Day 3:
    - Hammer source.
    - 9 shots were recorded with a stack of 7.
    - Using the Seismic acquisition machine “Geometrics” the shots were recorded.



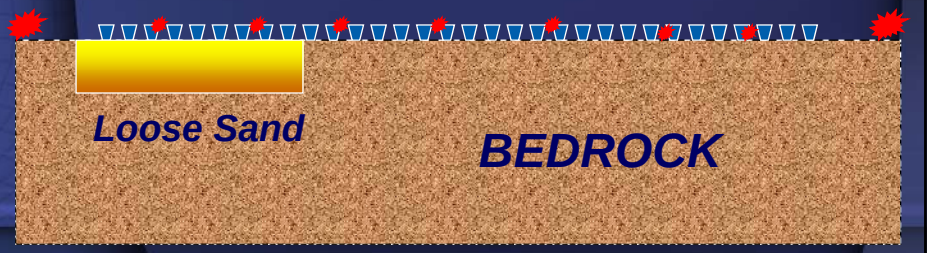


Seismic Equipment



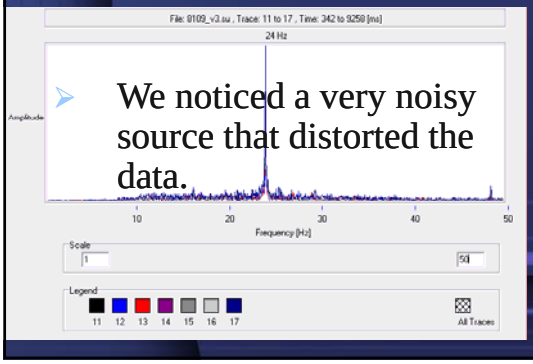
Field Geometry

160m (32 Geophones 5m apart)

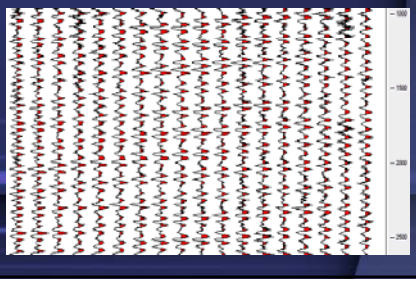


Noise Analysis

- Before any shots are recorded noise analysis has to be done for QC.



- We noticed a very noisy source that distorted the data.



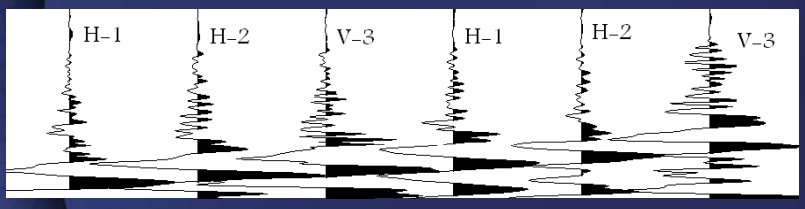
Noise Analysis

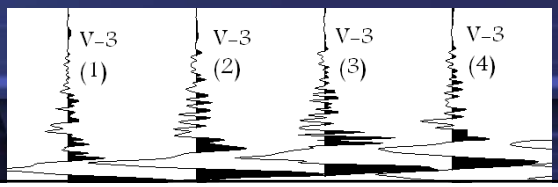
- PRE-PROCESSING
- PROCESSING
- INTERPRETATION

Abdulrahman Al-Shuhail

Pre-Processing

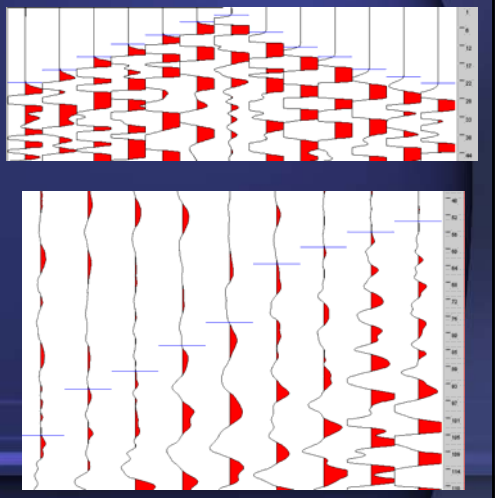
- The 3 component data was recorded using 1 profile, hence we got 96 traces in each record.
- Before any processing could take place we had to separate the H-1 and H-2 components.
- Using VISUAL SUNT we successfully separated the components and got only the V-3 component.





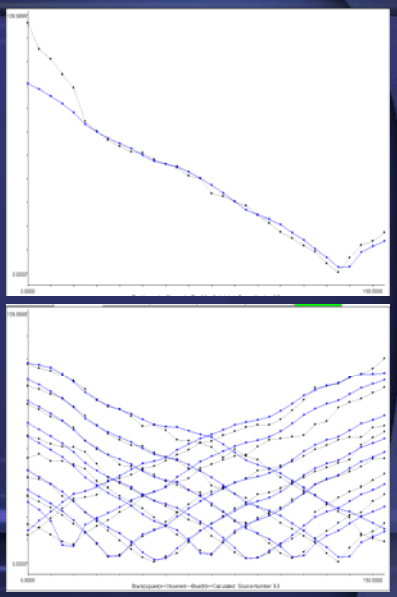
Processing

- Then next was to pick the first breaks.
- Using SeisOPT Picker we were able to get the first arrivals.
- It was difficult to find the first break when the shot was furthest from the sand.



Processing

- For modeling we used SeisOPT@2D.
- Before modeling the data we had to check the first arrivals with respect to the other shots.



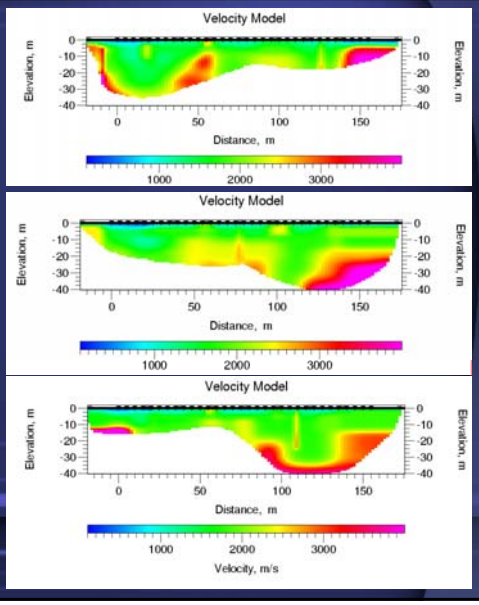
Interpretation

- First model that we obtain has its parameters automatically calculated.
- Then we run it ten more times while changing one of the parameters.
- Finally we take the 3 least error models.

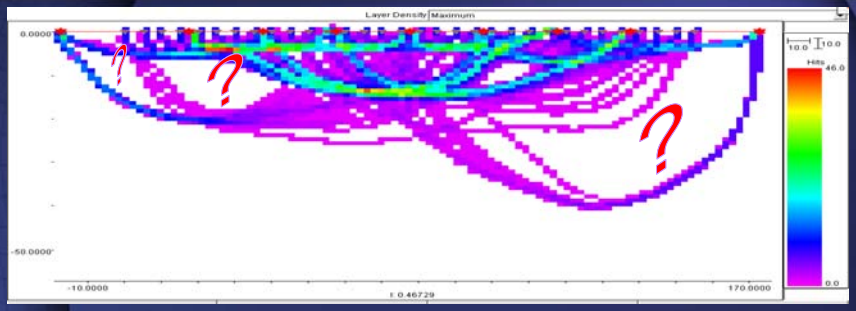
Interpretation

Best Models

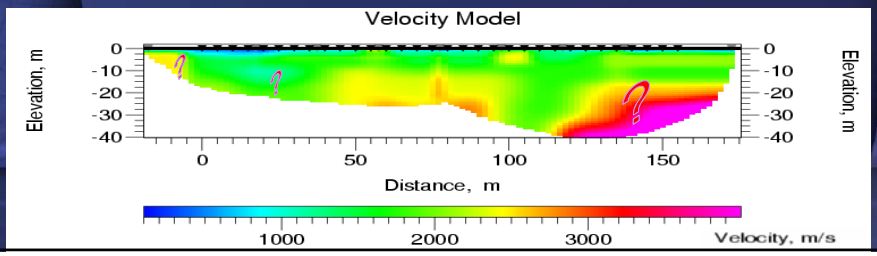
- (a) Error: 4.872072e-006
- (b) Error:5.523698e-006
- (c) Error:4.934083e-006



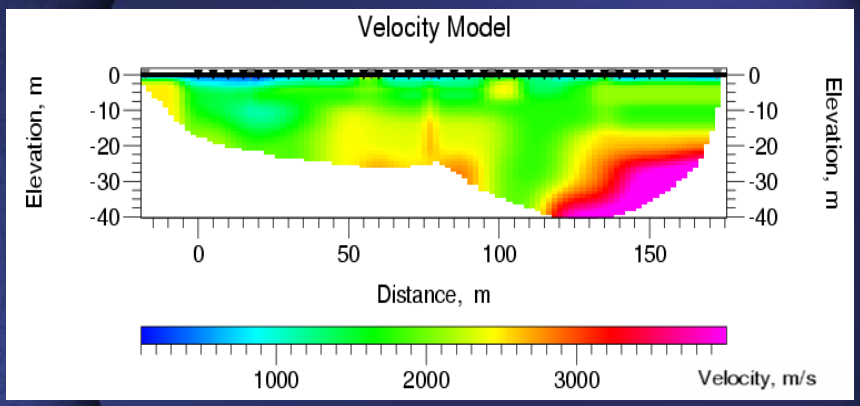
Interpretation



- ✓ Each model defines a certain area bounded by the ray paths.



Interpretation



GEO-ELECTRIC PART

- BACKGROUND
- INSTRUMENTS USED
- GEOMETRY PARAMETERS
- PARAMETERS AND MEASUREMENTS

Hassan Al Ramadhan

BACKGROUND

- Principle: transmitting a DC current “I” through two electrodes and measuring a voltage “V” with two other electrodes
- Apparent resistivity: $\rho_a = k V / I$, K depending on the electrode separation
- Detects many kinds of features
  - layering
  - folds, faults
  - bedrock
  - voids and cavities

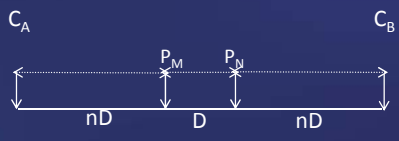
SURVEY STRATEGY

- Resistivity mapping, constant separation traversing (CST)
  used to determine lateral variations of resistivity. The current and potential electrodes are maintained at a fixed separation and moved along profiles
- Vertical electrical sounding (VES):
  used in the study of near-horizontal interfaces. The electrode spread is progressively expanded about a central point
- Resistivity tomography (ERT):
  is a mix between CST and VES. Also named electrical imaging

Dr. Laurent Marescot, 2007

WENNER-SCHLUMBERGER ARRAY

- Sensitive to both horizontal & vertical changes



C_A & C_B = current electrodes

P_M & P_N = potential electrodes

n = the ratio of the distances between the C_A- P_M and P_M- P_N

The IRIS instrument (Syscal R1 Plus):

Specifications:

- Measures both resistivity and chargeability (IP)
- Two strings of cable with 24 electrode
- DC current of 2.5mA, 200 watts

Applications:

- environmental studies,
- groundwater investigation,
- civil engineering,
- Archaeology.
- geotechnical investigations

A current electrode

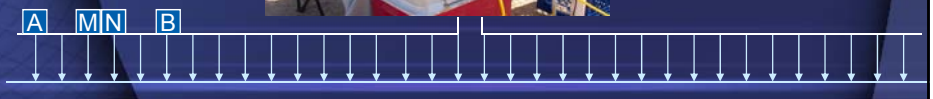
Syscal R1 PLUS

GEOMETRY PARAMETERS

- Number of electrodes= **34**
- A constant electrode spacing "a" = **5 meters**
- Spread length " **L**"= **170 meters**
- Depth of investigation= **34 meters**

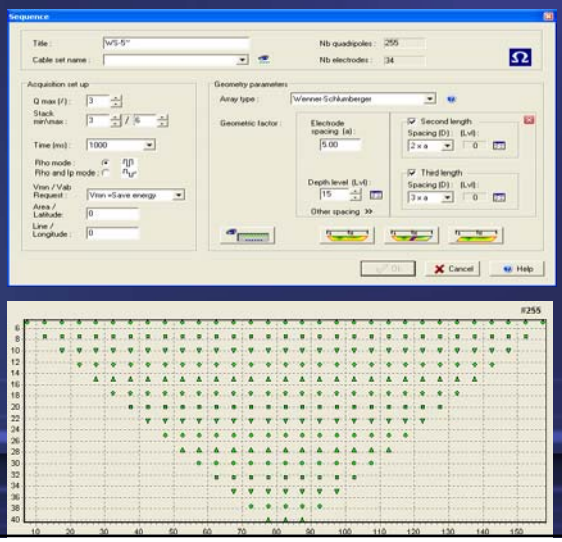
Wenner-Schlumberger Array

Depth: about 0.2 x L



PARAMETERS AND MEASUREMENTS

1) CREATE A SEQUENCE OF READING WITH ELECTRE II SOFTWARE.



PARAMETERS AND MEASUREMENTS

2) TAKING READINGS IN THE FIELD WITH Syscal R1 Plus

PARAMETERS AND MEASUREMENTS

Regular check steps during the survey

- Checking the internal transmitter battery of the SYSCAL.
- Checking the connection of these electrodes with the “RS CHECK” key, by spraying slight salty water around a disconnected electrode.

- PARAMETERS AND MEASURMENTS
- PROCESSING
- INTERPERTATION (RES2Dinv)
- INTERPRETATION (RES1D)

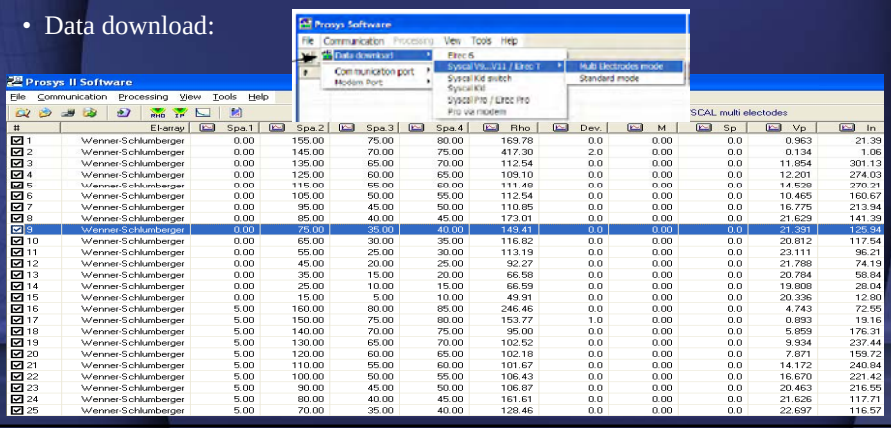
Omar Ba-wazir

PARAMETERS AND MEASUREMENTS

3) **Transfer And Process The Data With PROSYSII Software.**

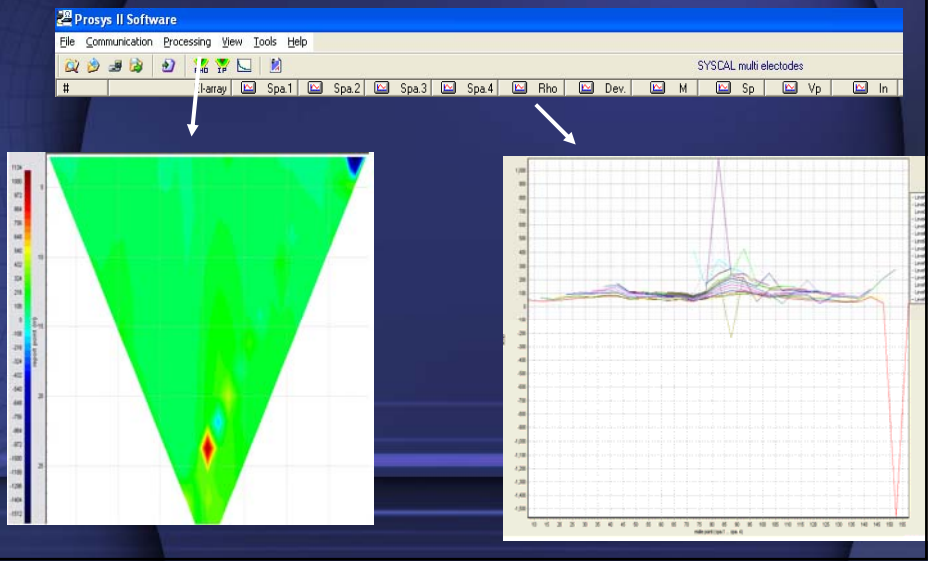
The main functions of the PROSYSII software are the following:

- Data download:



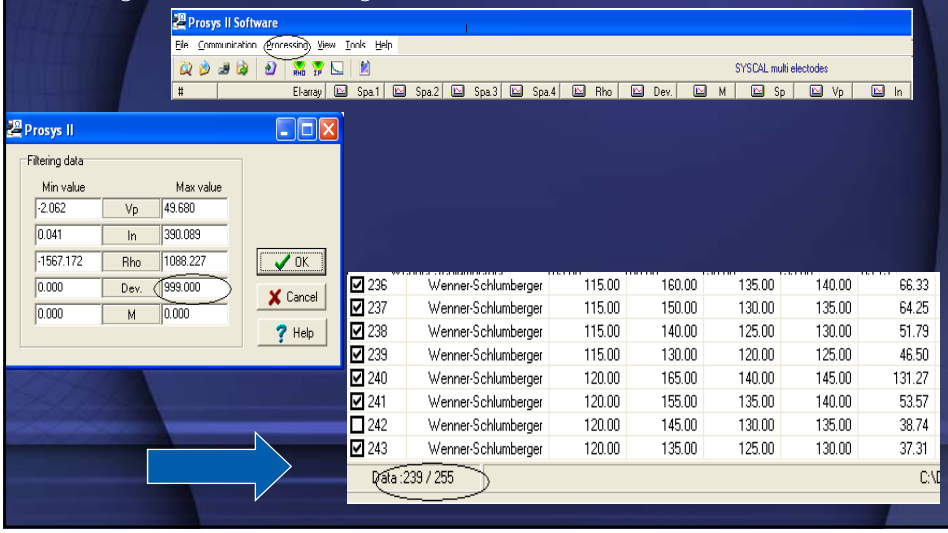
PARAMETERS AND MEASUREMENTS

•Numeric & graphic presentation:



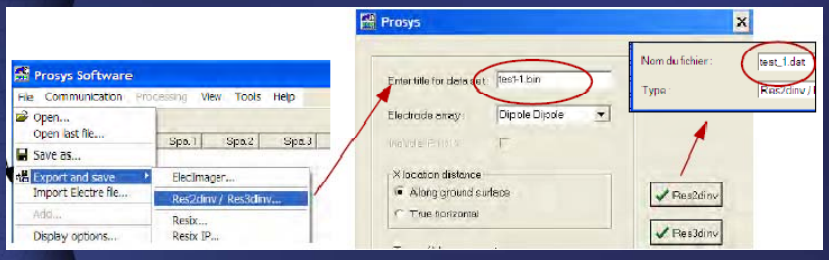
PROCESSING

• Processing ⟶ Filtering:



PROCESSING

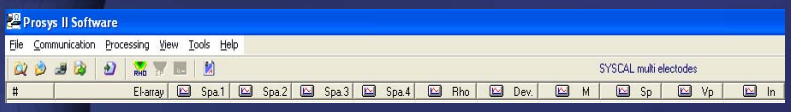
• Make a file readable by the interpretation software:



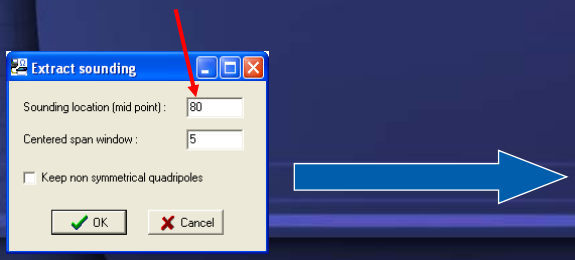
PROCESSING

Vertical Electrical Sounding (VES):

•Click on " File| Extract and Save", then "Spreadsheet Sounding".

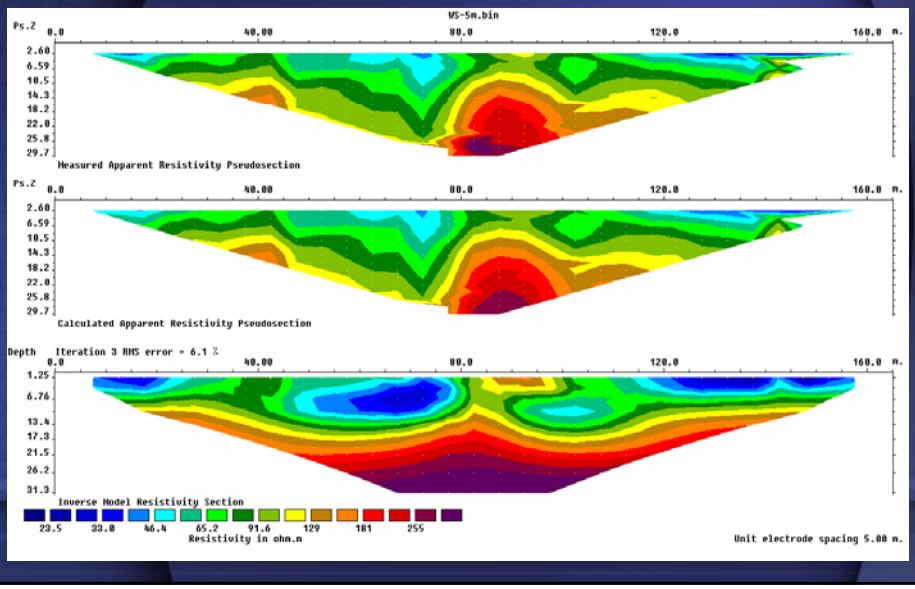


- Enter the X location (mid-point of the quadripoles, in meters).

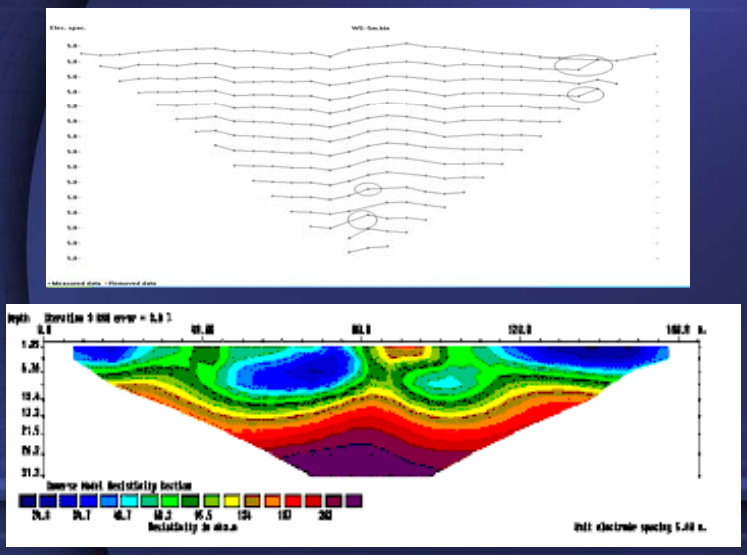


AB/2	ohm-m
7.5	74.95
12.5	67.12
17.5	67.15
22.5	78.58
27.5	93.17
32.5	107.46
37.5	120.62
42.5	130.44
47.5	140.37

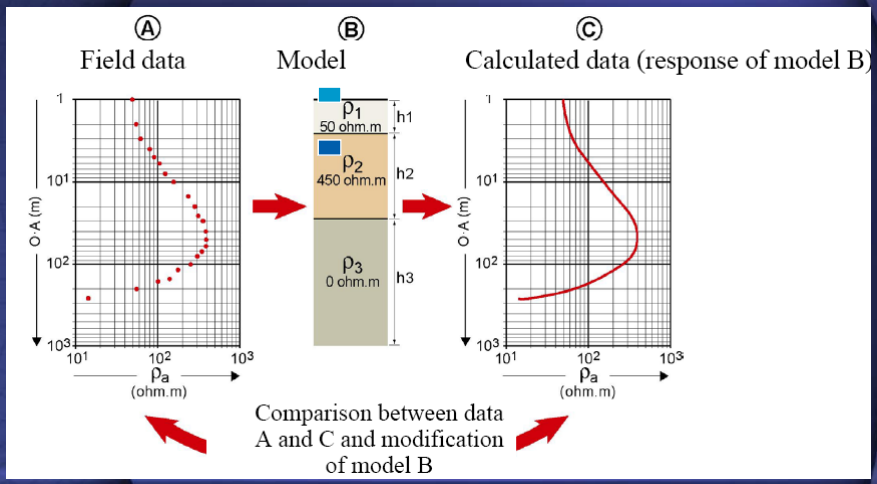
INTERPRETATION (*RES2Dinv SOFTWARE*)



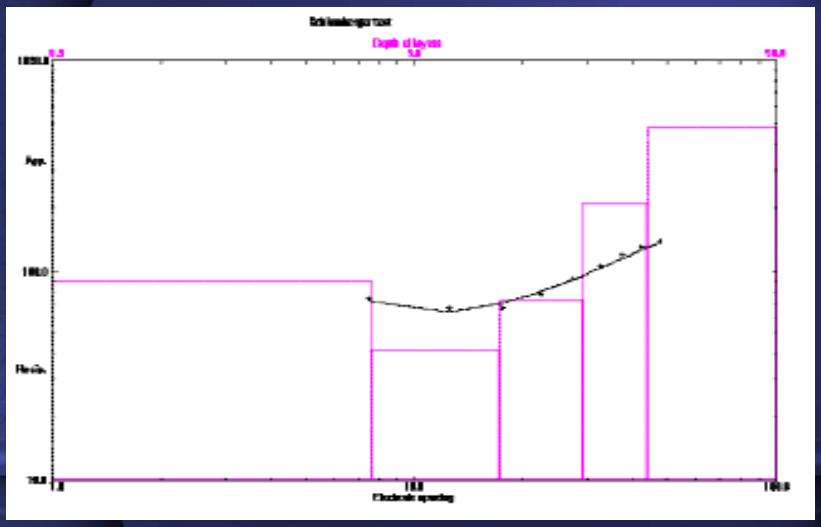
INTERPRETATION (*RES2Dinv SOFTWARE*)



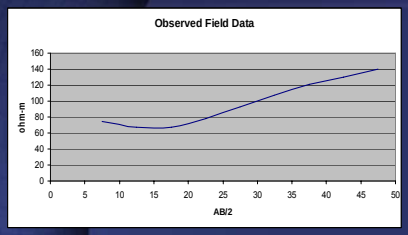
INTERPRETATION (RES1D)

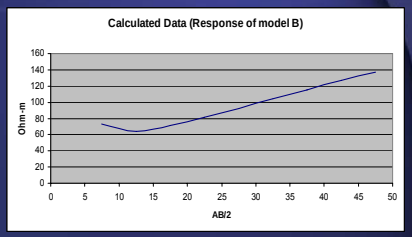


INTERPRETATION (RES1D)



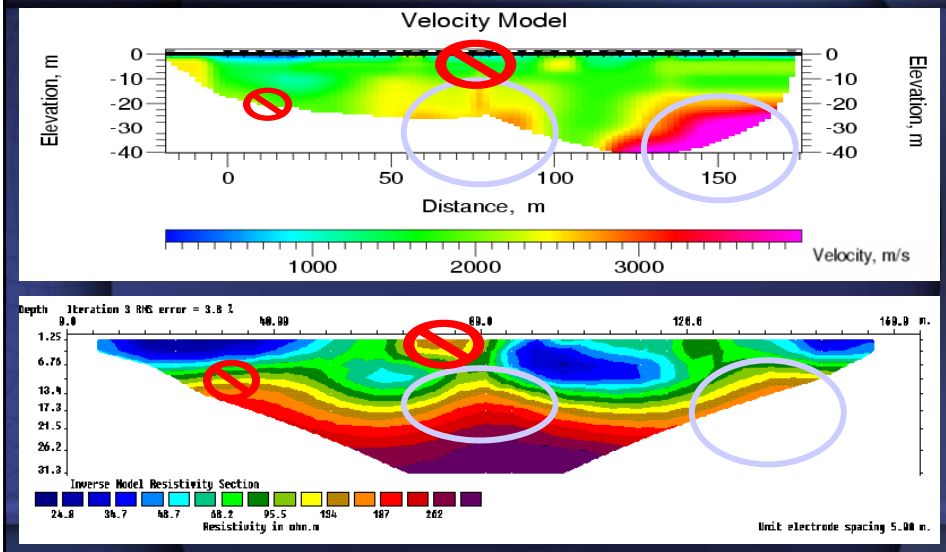
INTERPRETATION (RES1D)





Layer	Resistivity (Ohm-m)	Thickness (m)
1	91.095	3.825
2	41.663	4.781
3	73.141	5.977
4	208.799	7.471
5	484.053	

Integration



Conclusion

- Using two geophysical methods proves to be very useful in interpreting the subsurface.
- There were many models but we chose the one that agreed with real structures and the surface geology seen during the acquisition phase.
- The Seismic and resistivity models agreed in some aspects (bulging structure), but in other aspects they greatly disagreed (middle outcrop).

Acknowledgments

- We would like to thank Earth Sciences Department for giving us this opportunity.
- We would also like to thank Schlumberger Carbonate Research Center for all their help and support.
- Everyone that helped us accomplish this project.

Thank You