Marine controlled source electromagnetic inversion data from a field at Campos basin SE-Brazil, post-salt reservoirs constrained by seismic and well log

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Sharing is encouraged

Agenda

- **INTRODUCTION**
- **CSEM DATA SET**
- **PRACTICAL ASPECTS IN THE 3D CSEM INVERSION**
- **RESULTS AND VALIDATION**
- **INCORPORATING PRIOR INFORMATION**

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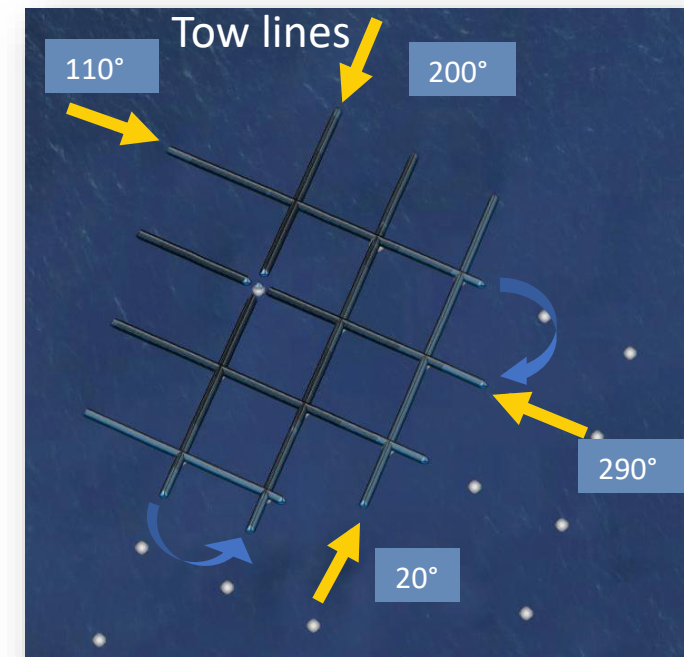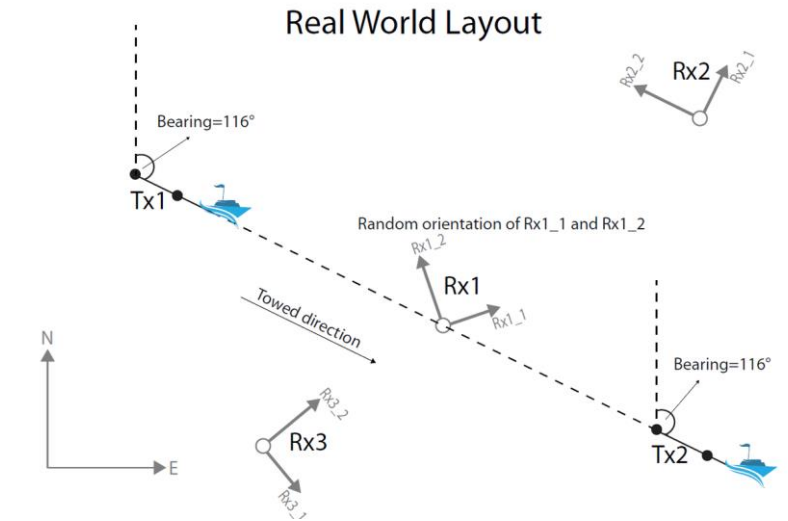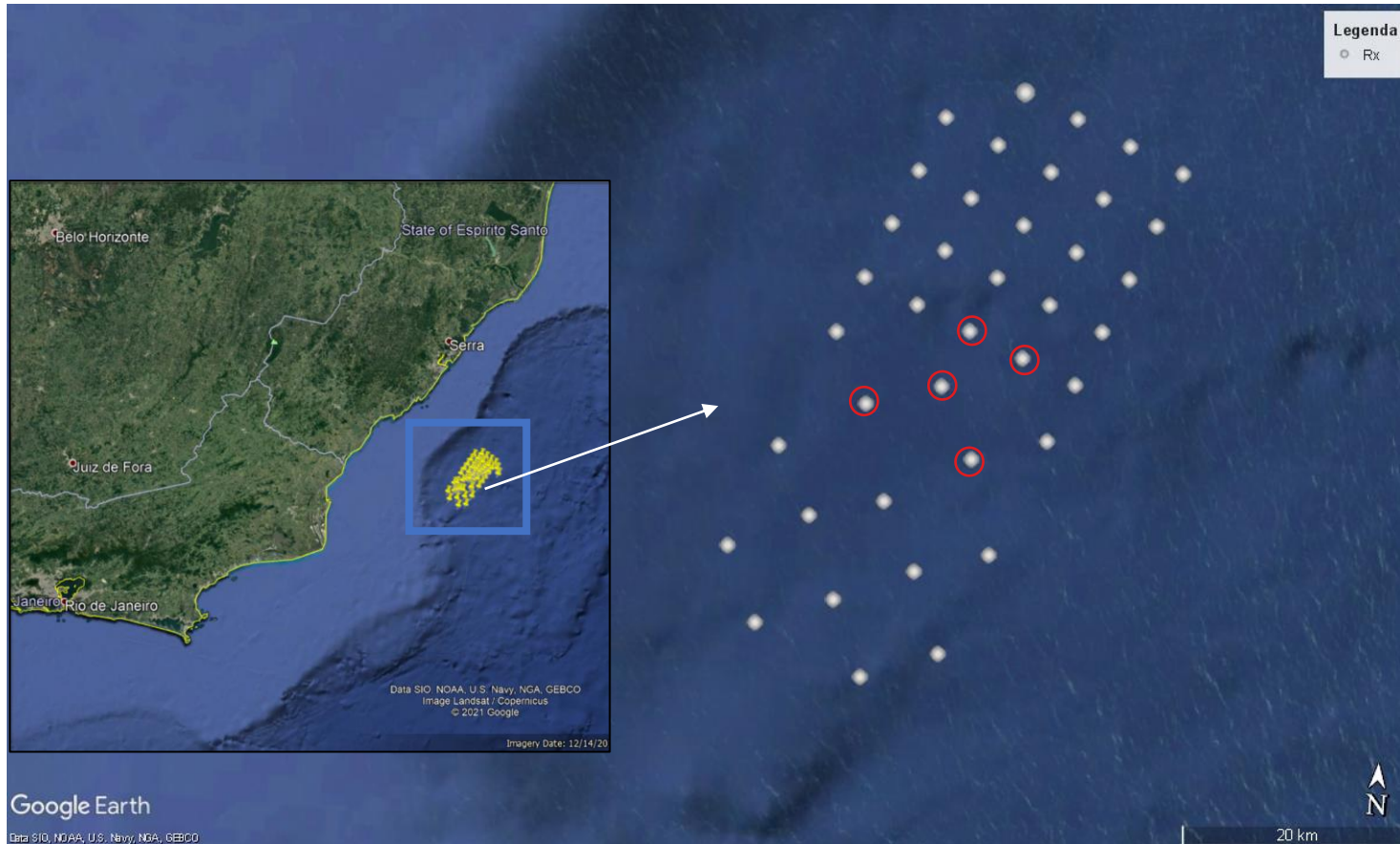
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Introduction

- The Campos basin is located in the SE Brazilian margin.

- The tectonic and sedimentary evolution of the Campos Basin is linked to the Gondwana breakup at the start of the Cretaceous.

- It is one of the most important basins in the Brazilian economic panorama due to the large accumulations of Hydrocarbons.

- A set of public data is available in the area:
  - CSEM data, Seismic lines and Well logs.
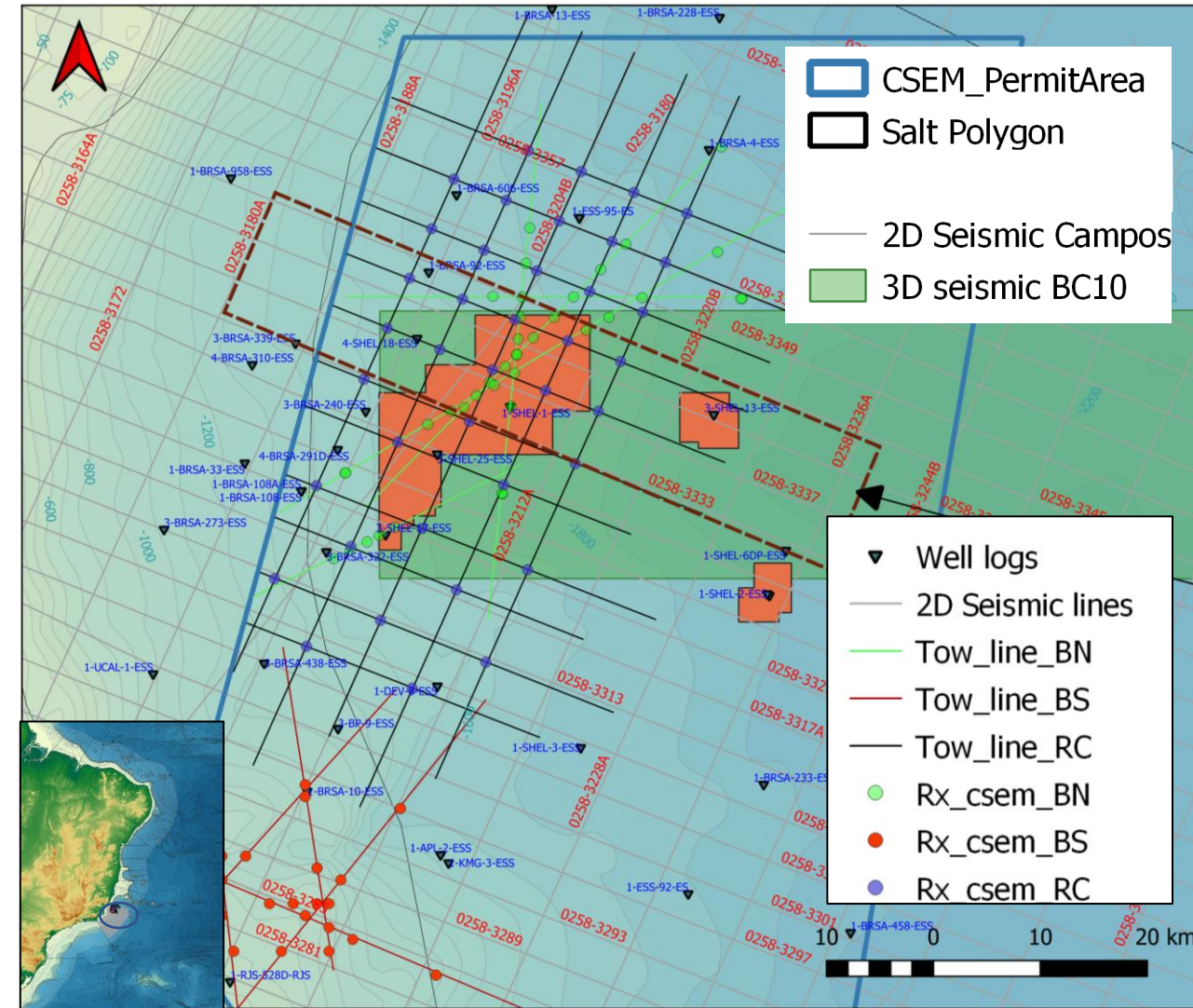
CSEM data

- Data from 5 EM receivers (Rx's) ;

- Electric field Pmax (amplitude and phase);

- Each transmitter (Tx) has 4 frequencies: 0.125, 0.25, 0.5 and 1.25 Hz.

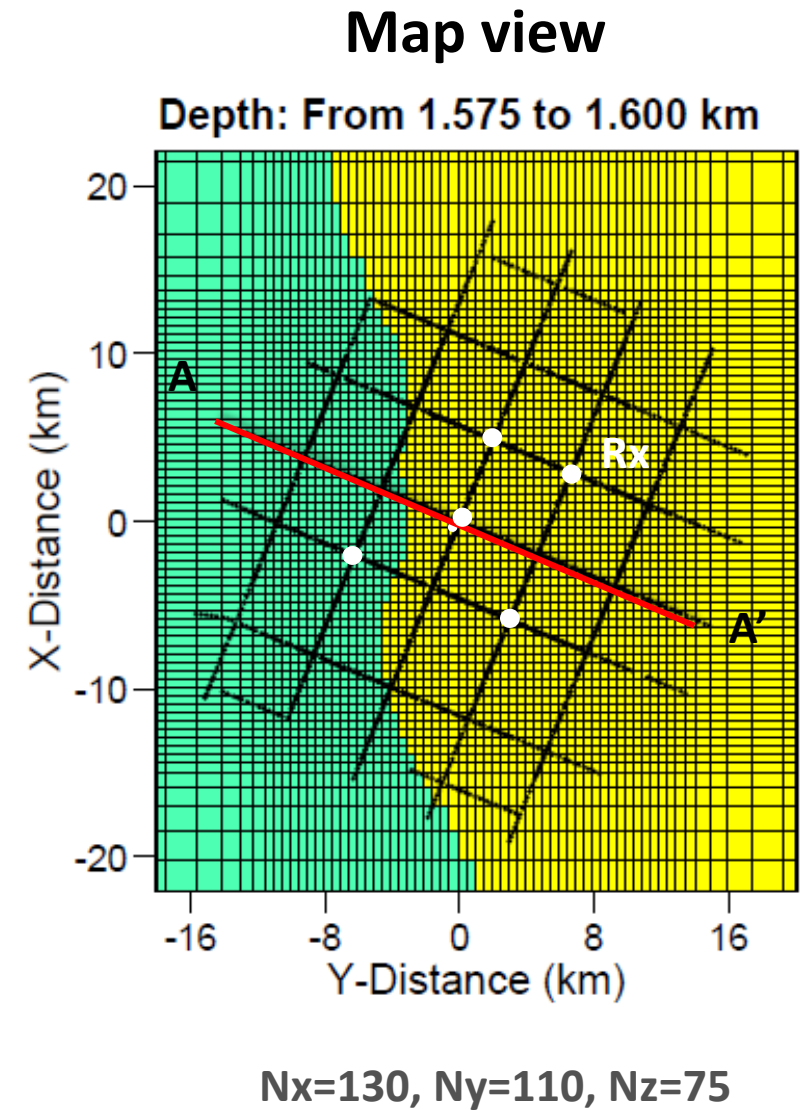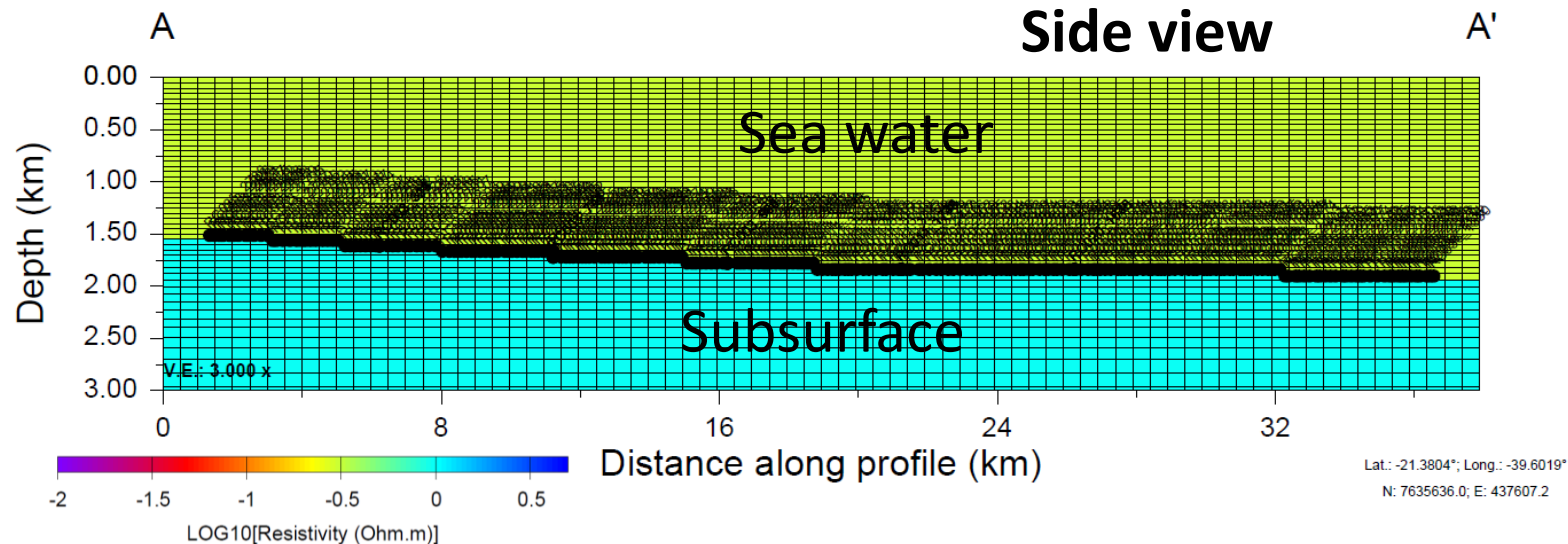- Tx points were sampled every 20m ship's displacement, a total of 16250 Txs.

Real World Layout

Tow lines

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3D CSEM Inversion tests

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3D CSEM Inversion

The 3D CSEM inverse problem has been solved using a new version of the ModEM code under development at National Observatory.

$$\Phi(\mathbf{d}, m) = \underbrace{(d - f(m))^T C_d^{-1}(d - f(m))}_{\text{data misfit term}} + \underbrace{\lambda(m - m_0)^T C_m^{-1}(m - m_0)}_{\text{model constraint term}}$$

- Homogeneous Half-space of 1 Ohm.m
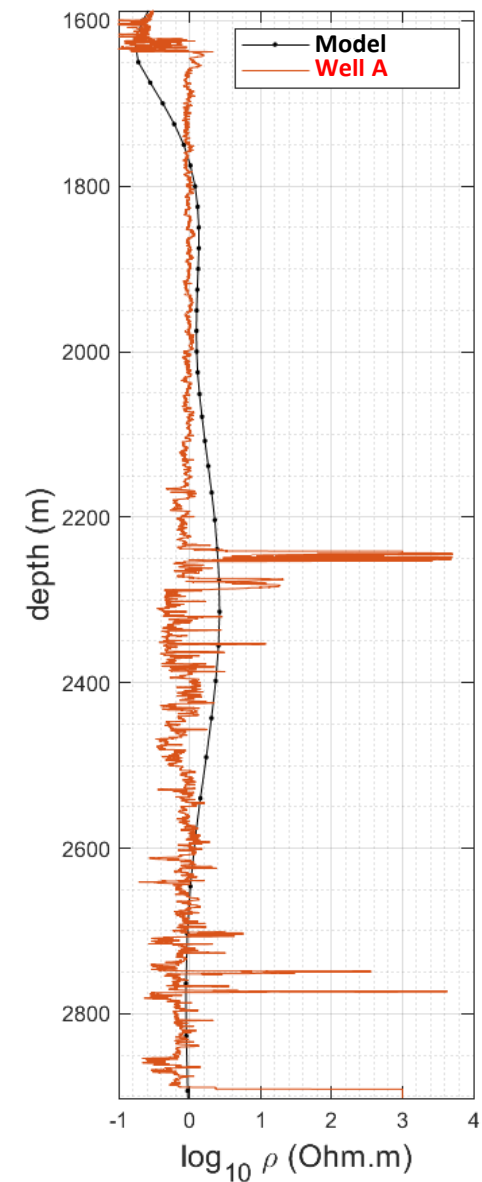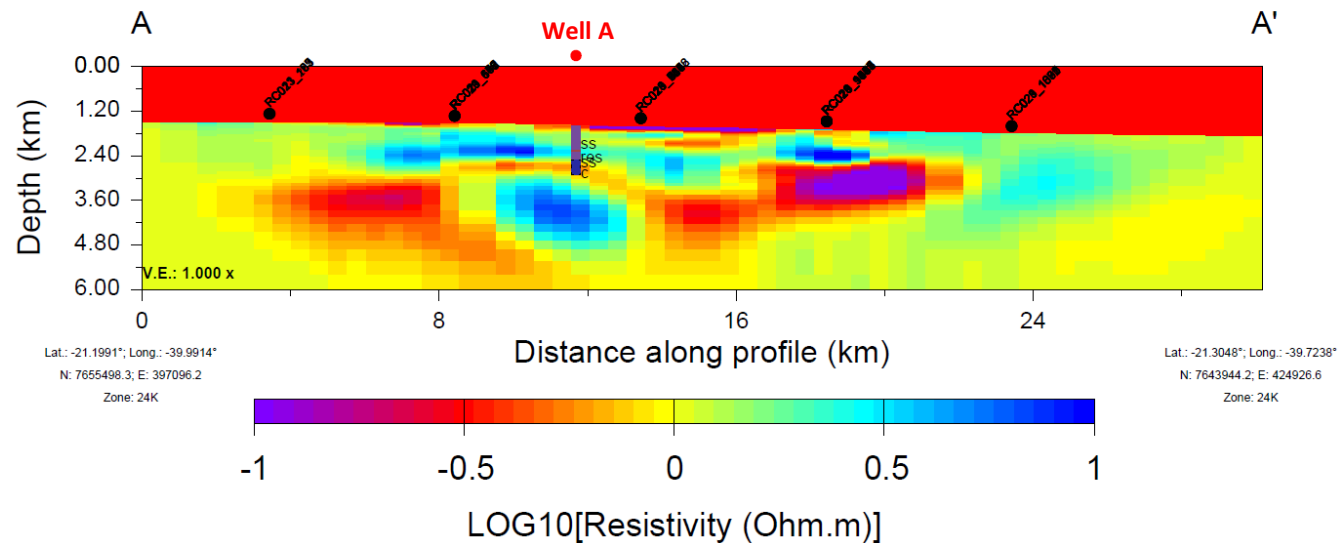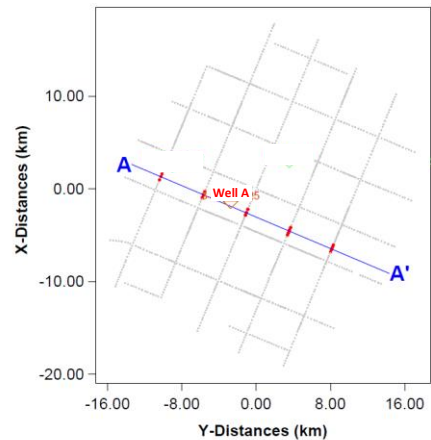- Real bathymetry included
- Model Covariance = 0.2 (x, y, z)

Map view

Side view

Nx=130, Ny=110, Nz=75

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Preferred resistivity model

- **Start RMS**: 3.9

- **Final RMS**: 1.2

- **Number of iterations**: 117

- **Number of cpus used per tests**: 41
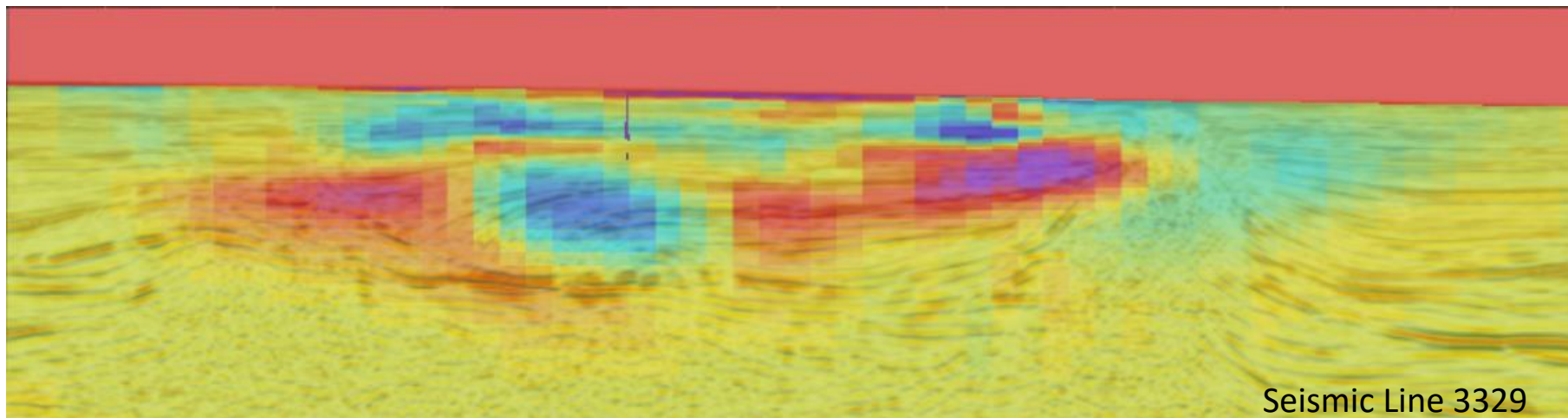
- **Time spent per iteration**: 9 min

- **Total time:** ~17 h

3D resistivity model

Log10 [Resistivity (ohm.m)]

- **Data misfit**

Depth slices
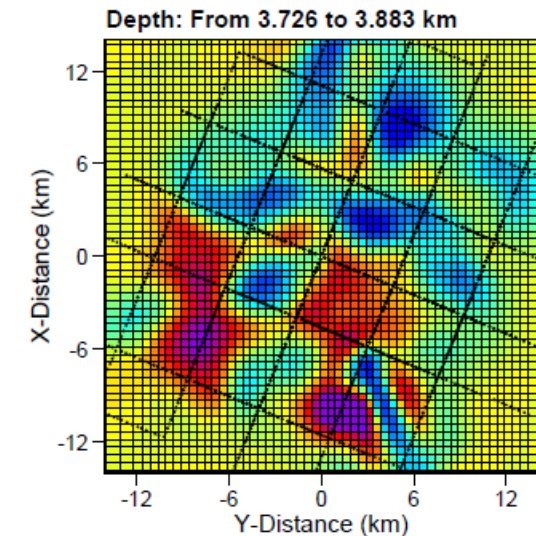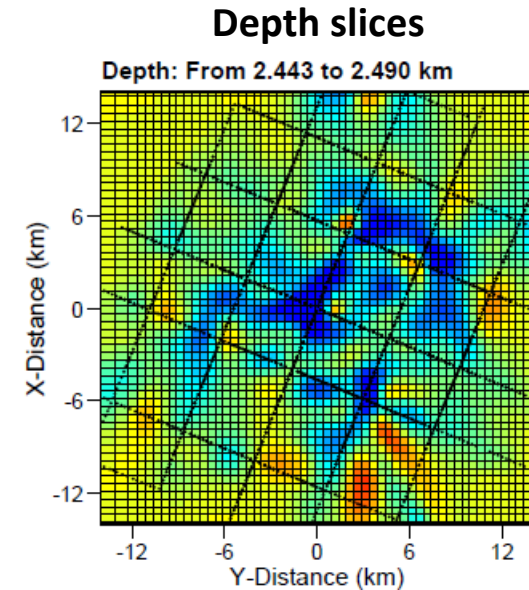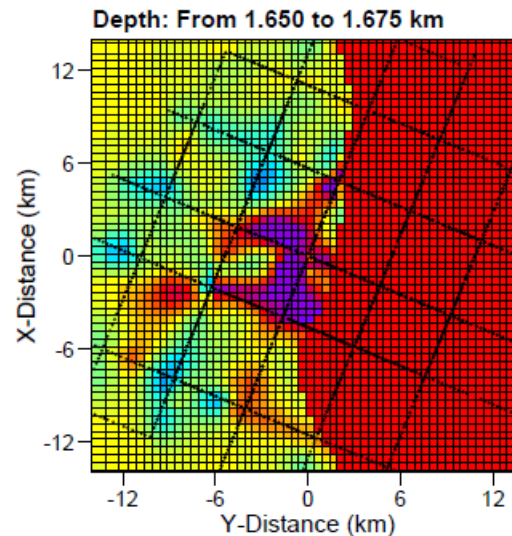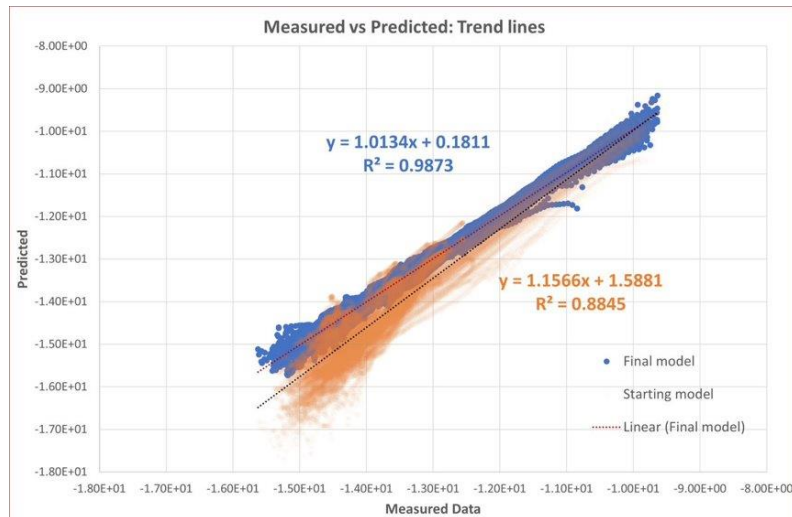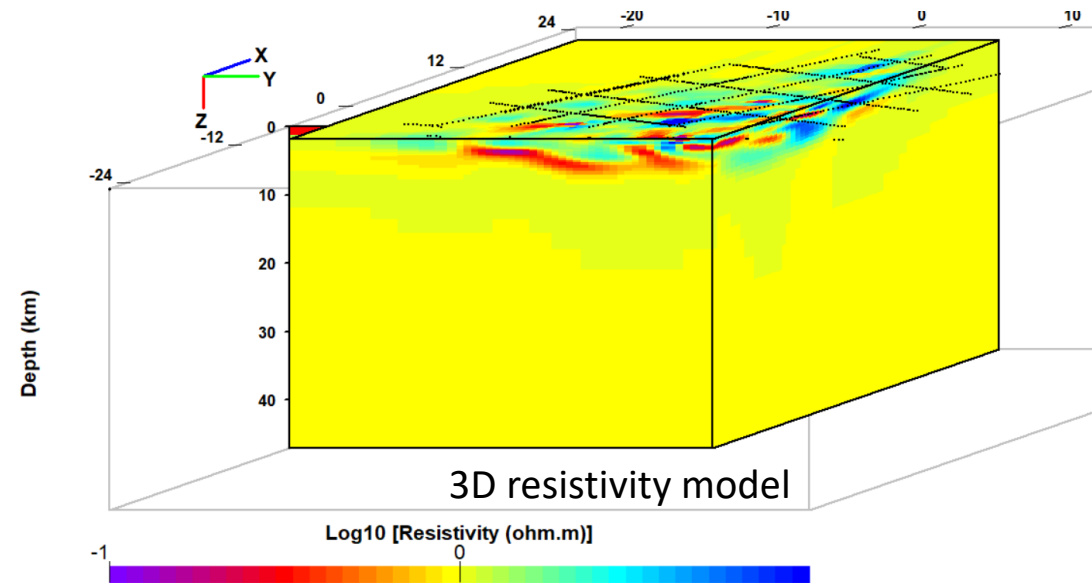
Model assessment and validation

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3D CSEM constraint inversion

- Seismic interpretation and resistivity well logs have been used to build prior models for the inversion.

- The targets are the turbidite sandstones from Carapebus formation filled with Hydrocarbon and surrounded by conductive clayey sediments of the post-salt layer.
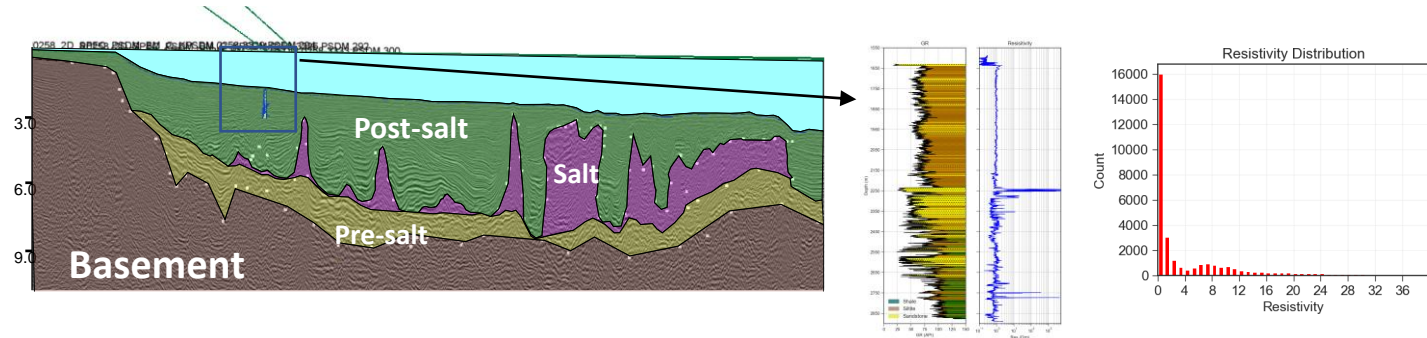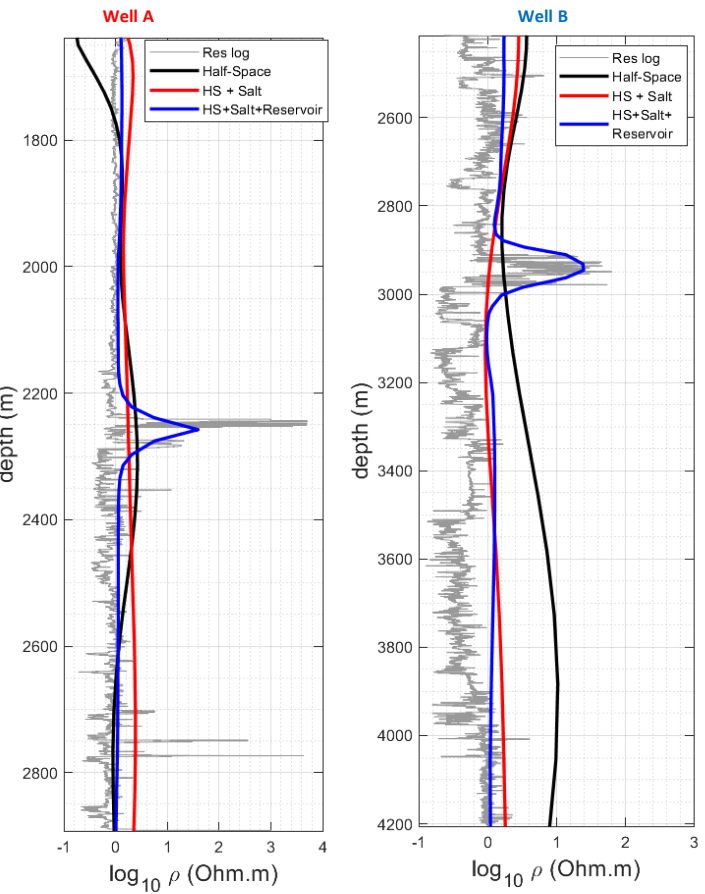

Scenario I) incorporating the Salt layer.

Scenario II) incorporating the Salt layer and the reservoirs thicknesses and resistivities

Salt topography
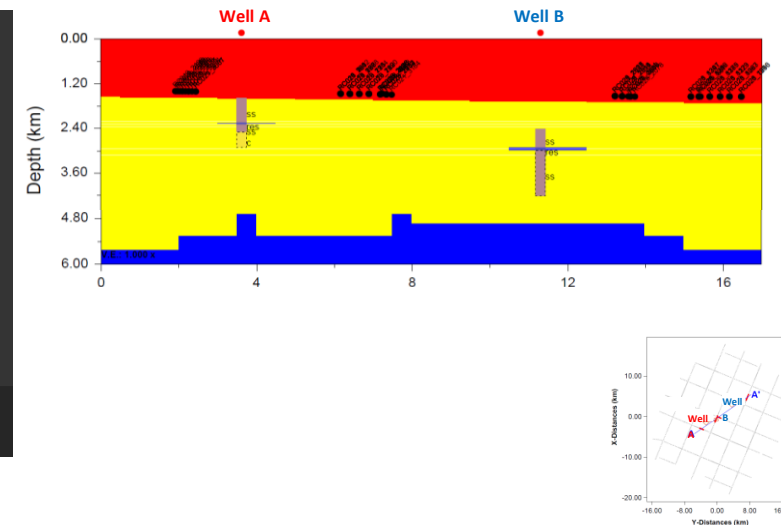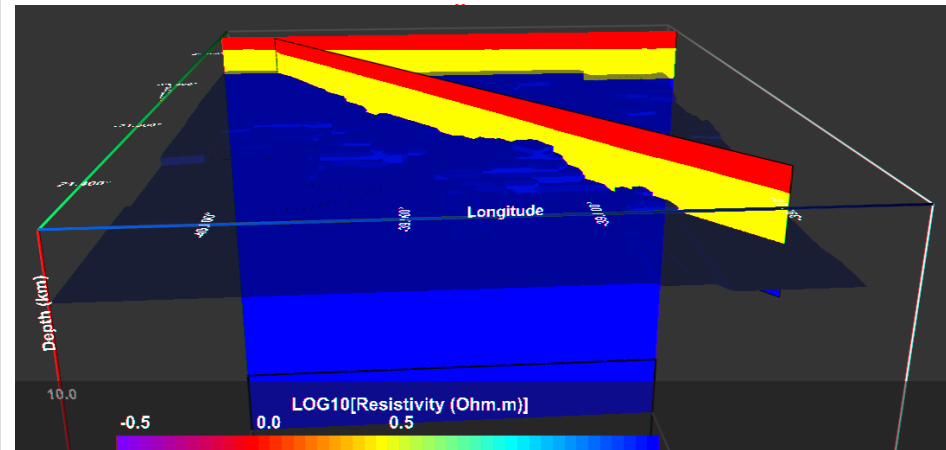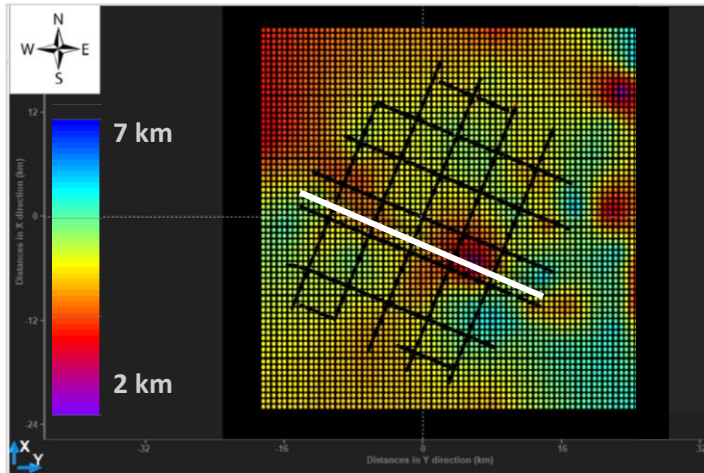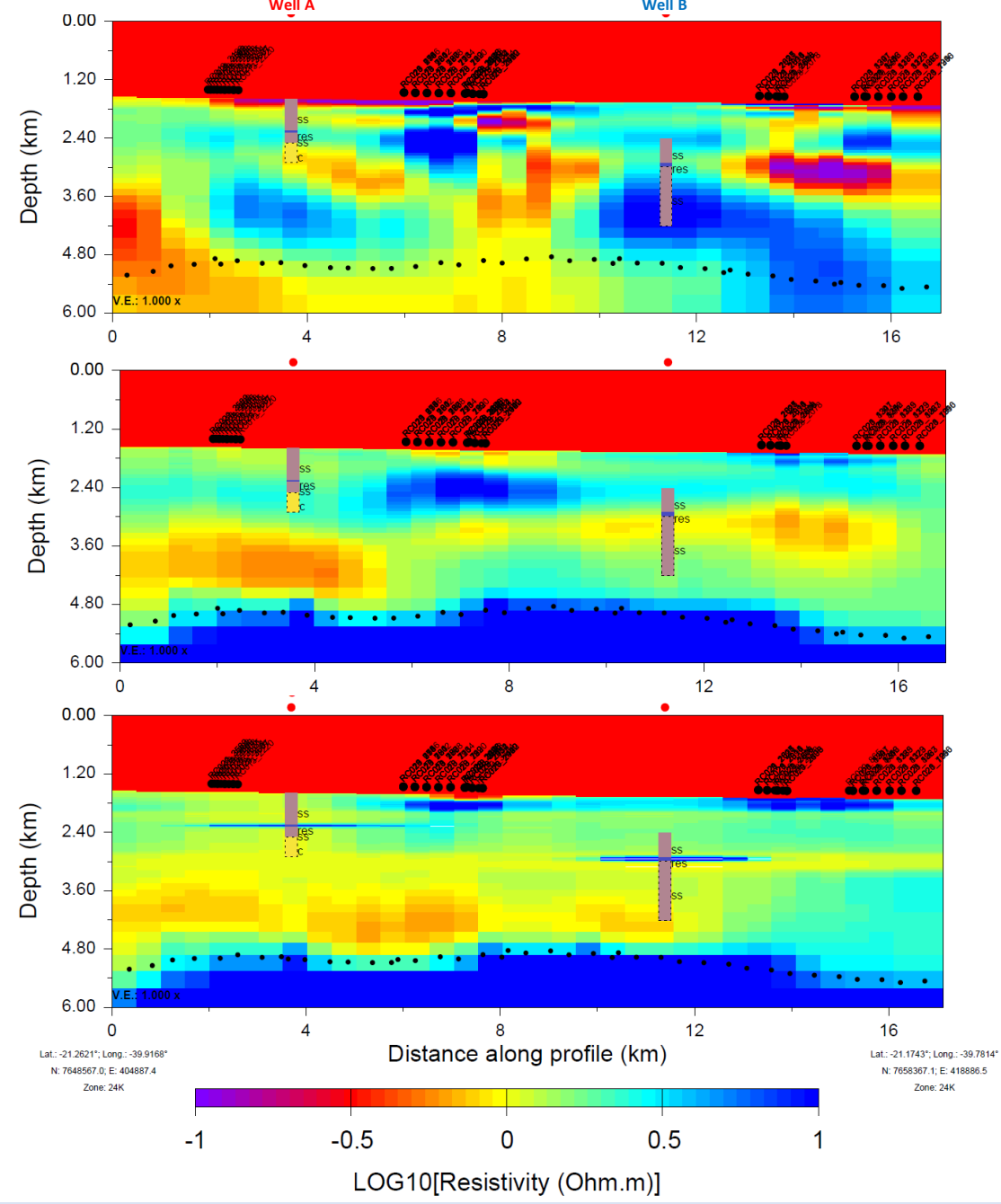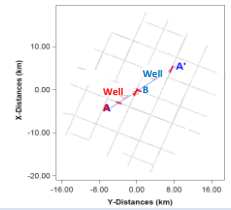
3D CSEM constrained inversion

- Model (constraint and non-constraint) comparison through well logs

Non constraint inversion:
The starting mode is a homogeneous half-space

Scenario I constraint inversion:
The starting model contains the **Salt** geometry

Scenario II constraint inversion:
The starting model contains the **Salt** geometry and two **reservoirs**

LOG10[Resistivity (Ohm.m)]

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