

Supplementary material

Annex S1. Depth of Investigation (DOI) parameters

ERT 1

Set Depth of Investigation (DOI) Parameters

The DOI methods uses two different reference models. The reference resistivity values are usually set a one-tenth and ten times the average apparent resistivity values. You can change the multiplication factors for the first and second models below.

First model reference factor :- Second model reference factor

Optimize inversion settings for DOI calculation? :- ☒ Yes ☐ No

Damping factor for reference model (0.02 to 0.20) :-

Instead of the multiplication factors, you can choose to directly set the reference background resistivity for the first and second models.

Type of background reference model :- ☒ Multiplication ☐ User defined

If you had selected the user defined resistivities, you need to enter the first and second model reference resistivities below.

First model resistivity :- Second model resistivity :-

Normally the smooth (L2-norm) inversion method is used for the DOI calculations.

Select inversion method :- ☐ Smooth (L2-norm) ☒ Robust (L1-norm)

Factor to extend depth range for DOI model (3.0 to 6.0) :-

Number of iterations for optimization routine (2 to 4) :-

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Factor to extend depth range for DOI model (3.0 to 6.0) :-

Number of iterations for optimization routine (2 to 4) :-

Change of damping factor with depth

Since the resolution of the resistivity method decreases exponentially with depth, the damping factor used in the inversion least-squares method is normally also increased with each deeper layer. This is done in order to stabilize the inversion process. Normally, the damping factor is increased by 1.05 to 1.10 times with each deeper layer, but you can change it.

Enter the value to increase the damping factor :

Alternatively, the program can calculate the value to increase the damping factor with depth automatically if you select the appropriate option below.

☒ Do not use automatic calculation. ☐ Use automatic calculation.

Limit range of model resistivity values

You can choose to limit the upper and lower values of the resistivity values of the inversion model can take. In some cases, this might be necessary to ensure that the model resistivity values do not become too large or too small.

☒ Do not limit resistivity values ☐ Limit range of resistivity values

Enter upper limit factor Enter lower limit factor

☒ Use average resistivity ☐ Use first iteration resistivity

Use L curve method

You can select the L curve method to estimate the optimum damping factor for the inversion model.

Use the L curve method? :- ☒ No, do not use L curve ☐ Yes, use L curve method

If you use the L1 norm for the model roughness or data misfit, you can use the the same norm for the L curve method, or always use the L2 norm method within the L curve algorithm.

Use the same norm? :- ☒ No, always use L2 norm ☐ Yes, use same norm

If you choose to use the L curve method, it is recommended that you use the model refinement method with model cells of half the unit electrode spacing so that near surface structures with large lateral variations are sufficiently modeled by the model grid used.

Type of model cell width :- ☒ Cells with 1 unit spacing width ☐ Cells with 0.5 unit spacing width

The L curve method will usually select reasonable damping factor values. However to prevent the inversion from becoming unstable in rare cases where the method does not select a reasonable value, the program will set the upper and lower limits for the damping factor value as shown below. You can adjust the limits by typing in the new values.

Minimum allowed damping factor value :-

Maximum allowed damping factor value :-

Normally, the damping factor selected by the L curve method decreases with each iteration and settles down to near constant values after the first few iterations. This option allows the user to ensure that the damping factor does not increase. If it increases, the damping factor for the previous iteration is used. Select option for damping factor change below.

☐ Damping factor not allowed to increase. ☒ Damping factor allowed to increase.

Use reference model in inversion

A background reference model helps to stabilize the inversion model by reducing large departures from a fixed resistivity value. A homogeneous reference model will be used. Select your choice below.

☒ Yes - Use reference model ☐ No - do not use a reference model

The damping factor for reference model controls the degree which the resistivity variations from the background model is constrained. A larger damping factor will result in smaller variations. A value of between 0.05 and 1.0 is normally used.

Reference model damping factor :

You can choose to use the default reference resistivity value (usually the average of the apparent resistivity values) or a user defined reference value.

☒ Default reference value ☐ User defined reference value

User defined reference resistivity value :

You can set the reference I.P. model value to the average apparent I.P. value, or set it to zero if the background medium is expected to be non-polarizable.

☒ Use average apparent I.P. value ☐ Use zero reference I.P. value

ERT 2

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Optimize inversion settings for DOI calculation? :- ☒ Yes ☐ No

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Select inversion method :- ☐ Smooth (L2-norm) ☒ Robust (L1-norm)

Factor to extend depth range for DOI model (3.0 to 6.0) :-

Number of iterations for optimization routine (2 to 4) :-

ERT 3

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Number of iterations for optimization routine (2 to 4) :-

ERT 4

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Factor to extend depth range for DOI model (3.0 to 6.0) :-

Number of iterations for optimization routine (2 to 4) :-

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First model resistivity :- Second model resistivity :-

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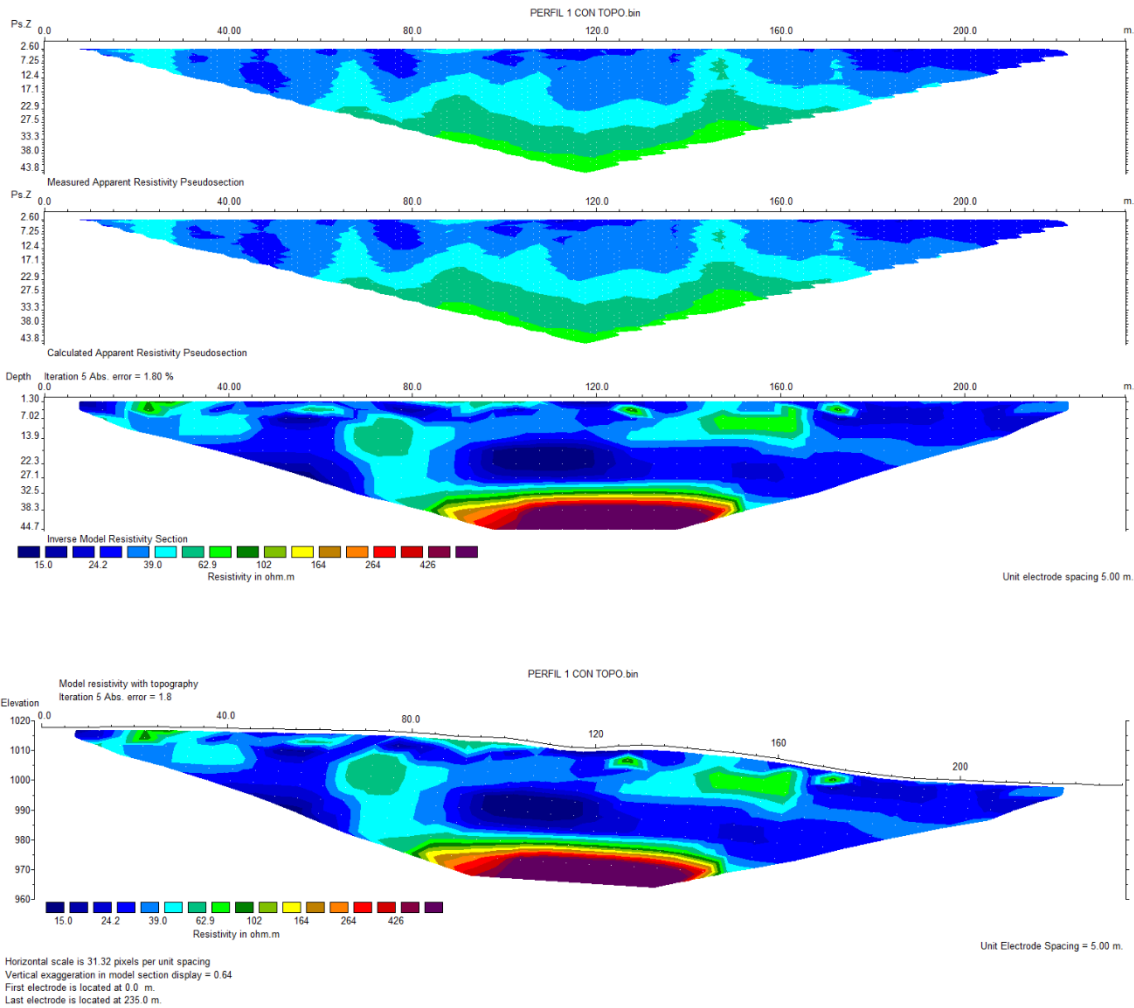
Select inversion method :- ☐ Smooth (L2-norm) ☒ Robust (L1-norm)

Factor to extend depth range for DOI model (3.0 to 6.0) :-

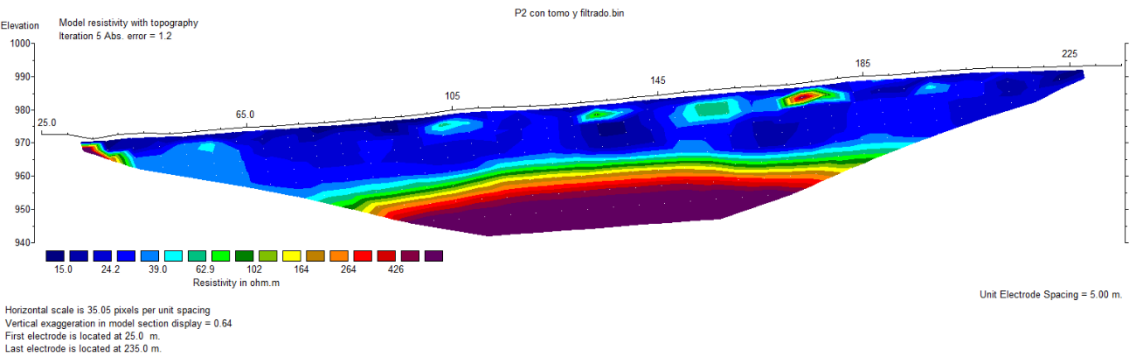
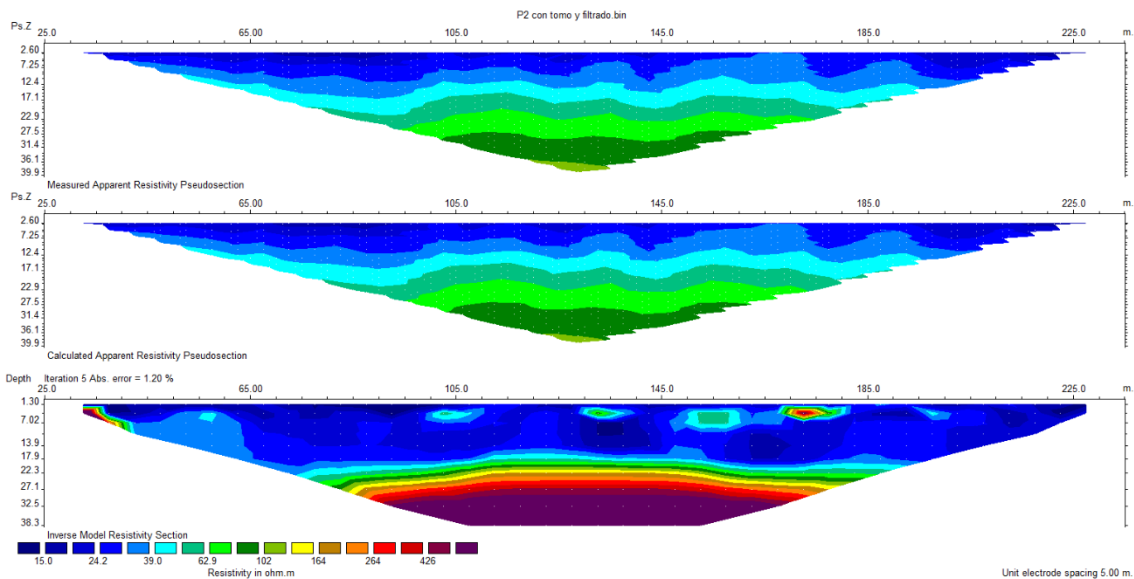
Number of iterations for optimization routine (2 to 4) :-

Annex S2. Measured apparent resistivity pseudosections, calculated apparent resistivity pseudosections , inverse model resistivity and model resistivity with topography

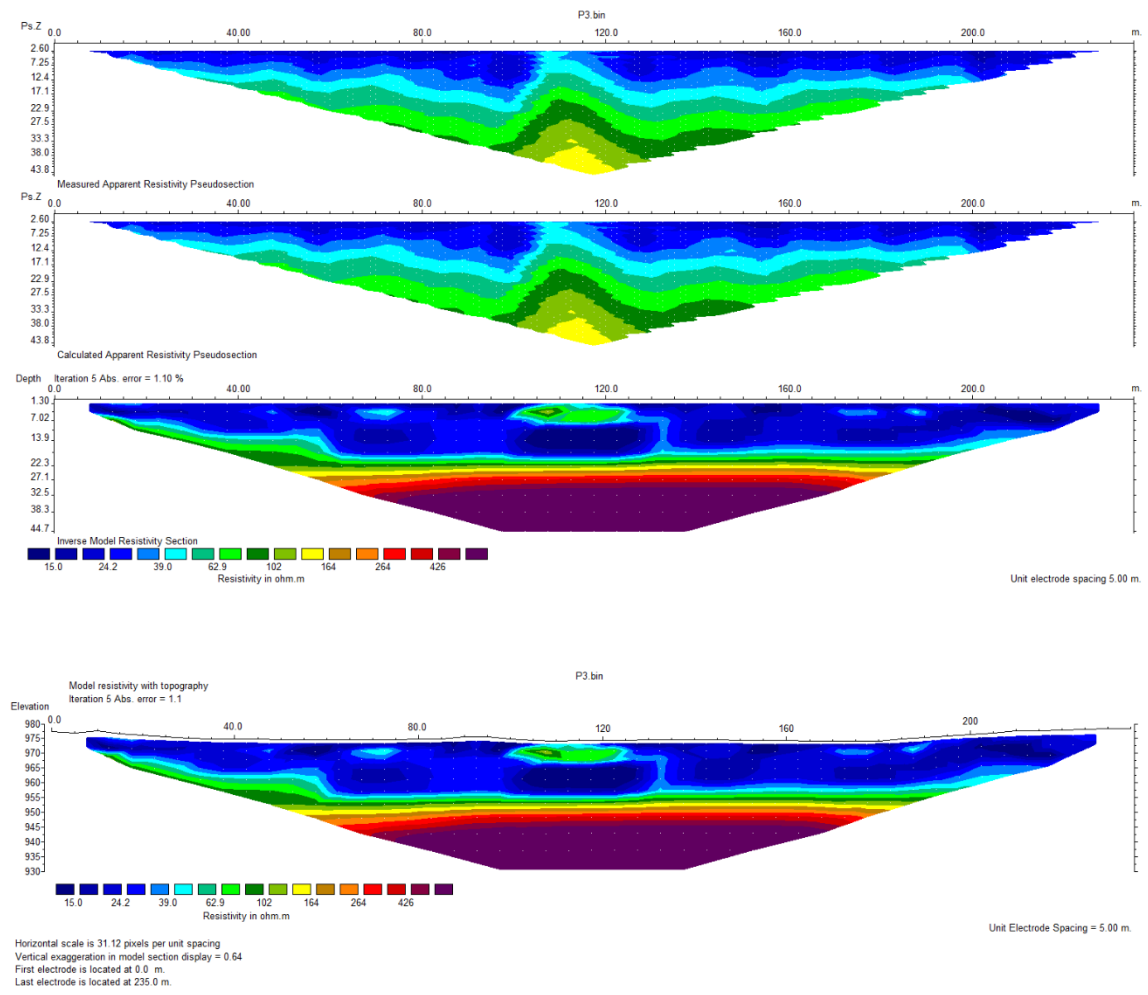
ERT 1



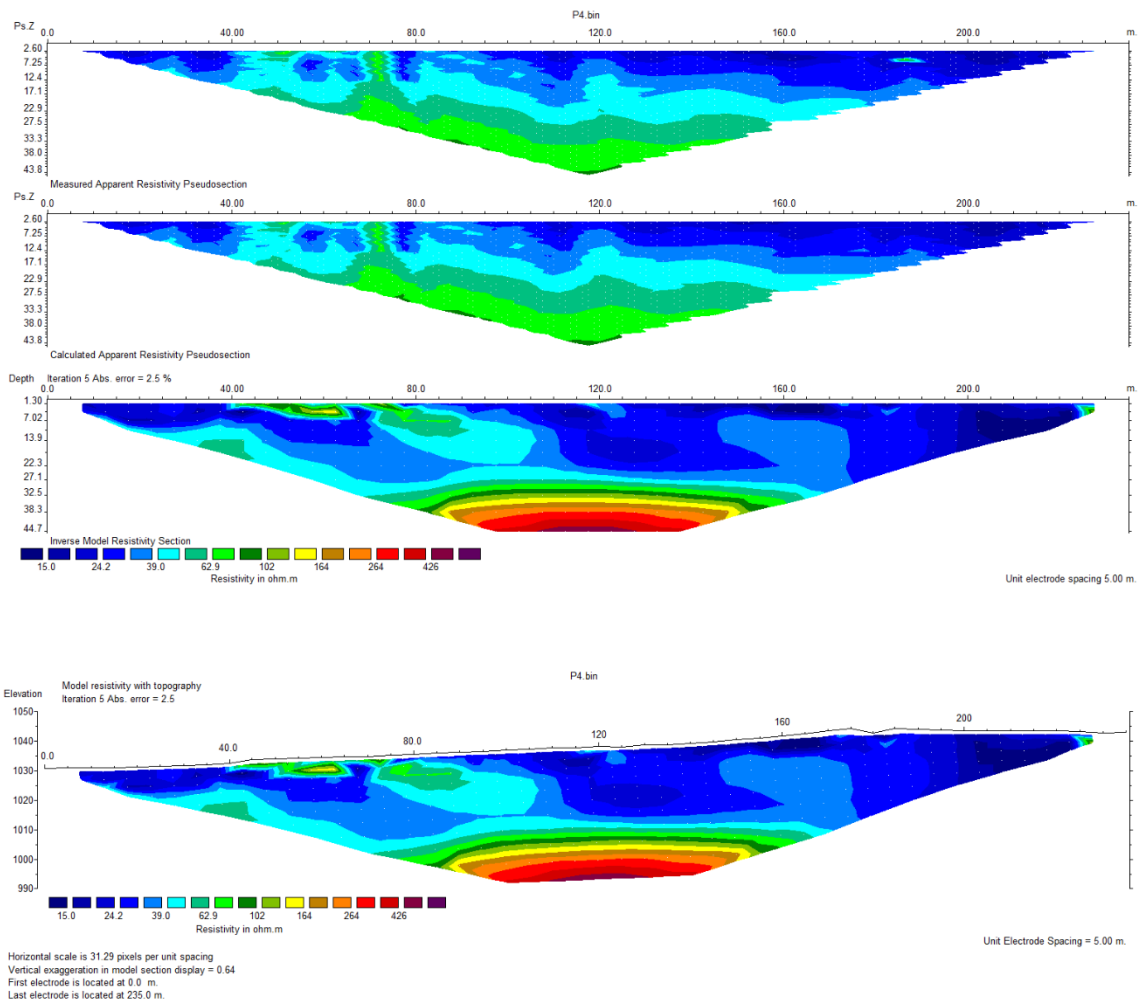
ERT 2



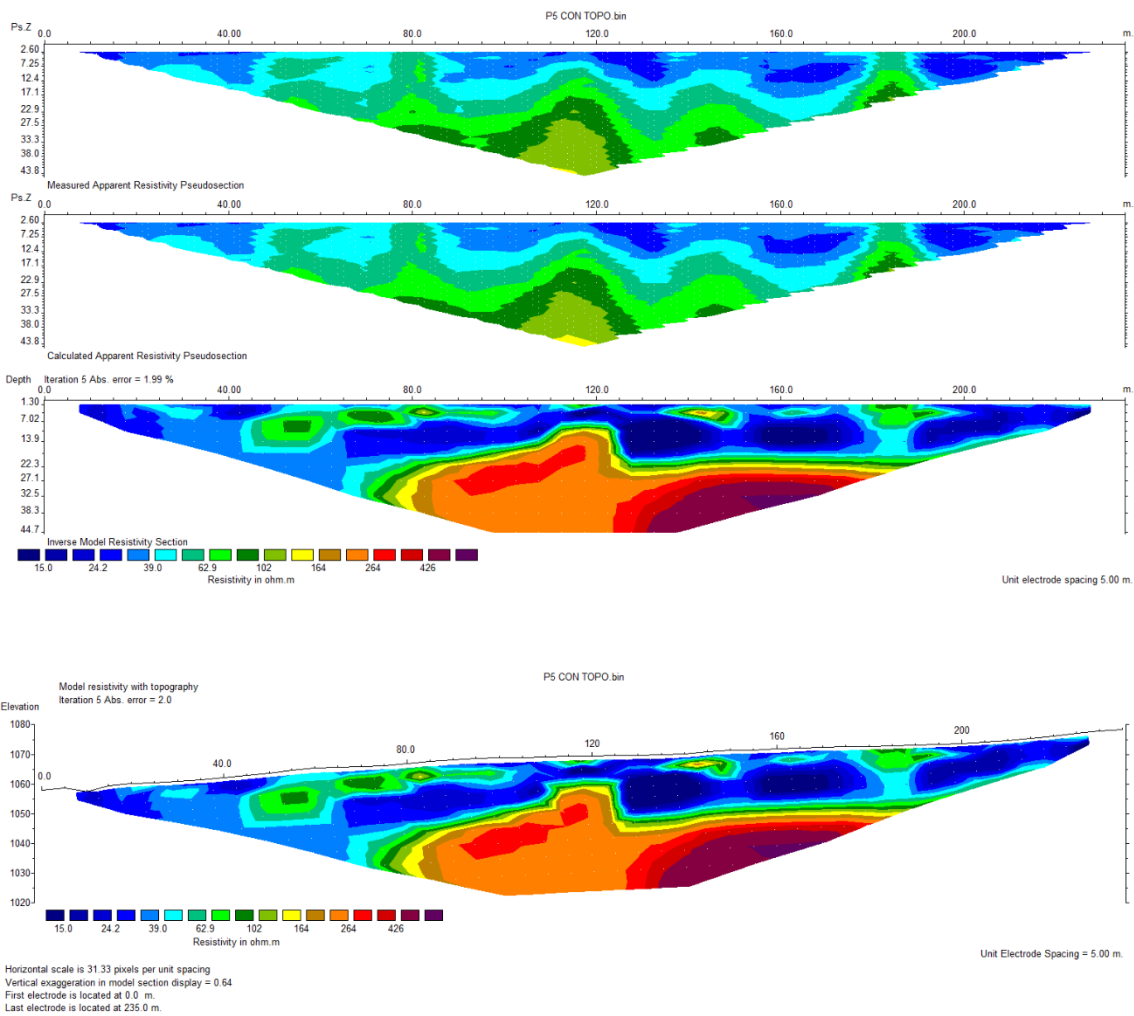
ERT 3



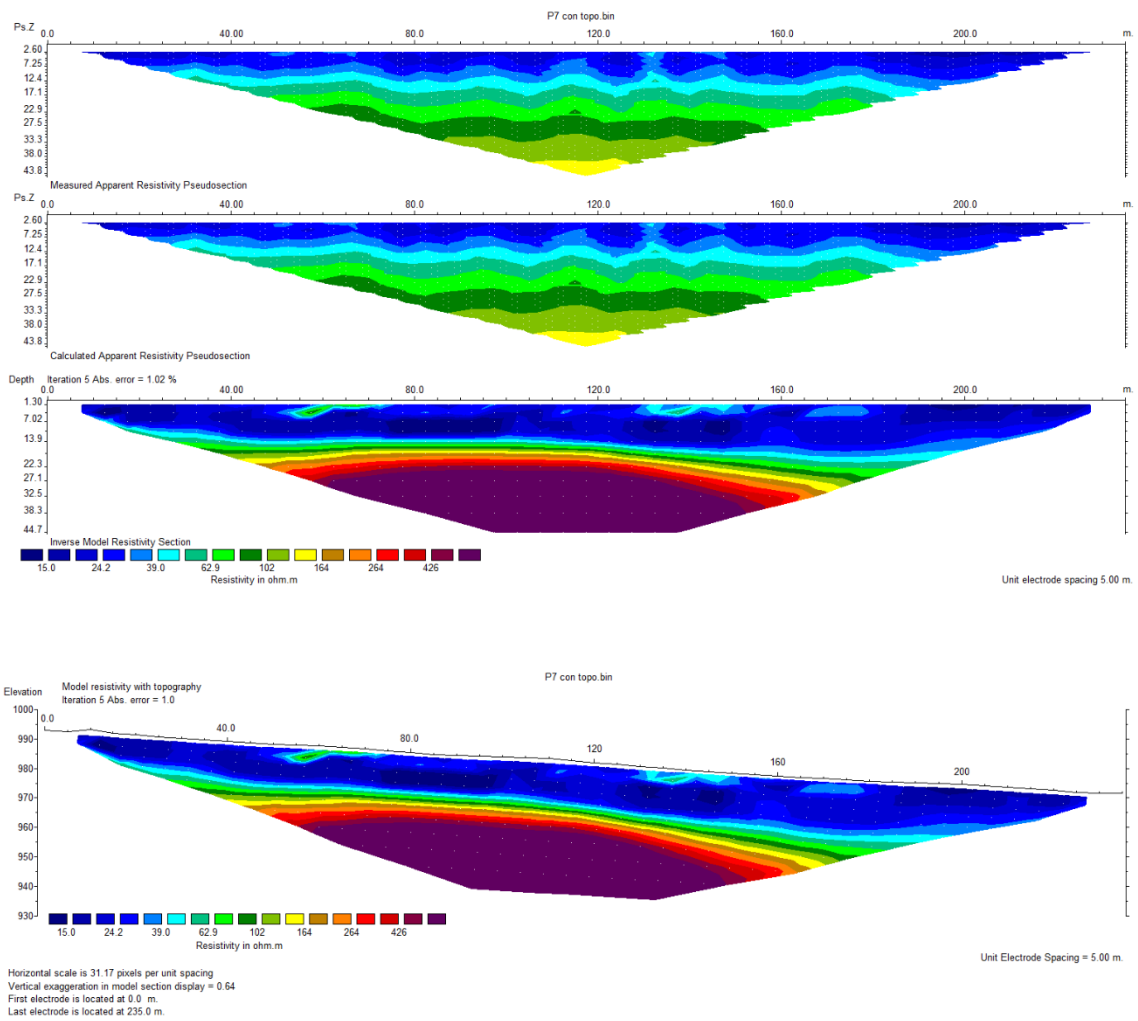
ERT 4



ERT 5



ERT 7



ERT 8

