

## RES2DINV - 2D RESISTIVITY & IP INVERSION software for Windows 98/2000/NT/XP/Vista/Win 7

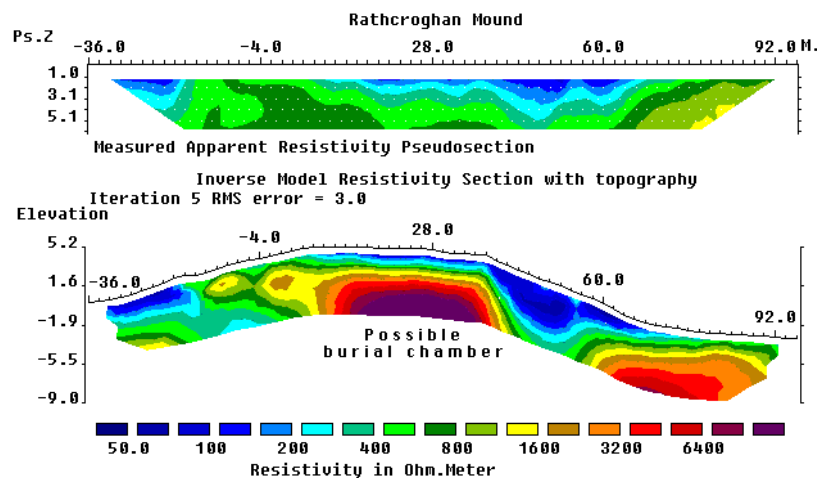
- Supports on land, underwater and cross-borehole surveys
- Supports smooth and sharp contrasts inversions
- Supports exact and approximate least-squares optimization methods
- Supports up to 16000 electrodes with almost any electrode arrangement
- Fast seamless inversion of very long survey lines using sparse inversion techniques

Two-dimensional (2D) electrical imaging surveys are now widely used to map areas of moderately complex geology where conventional 1D resistivity sounding surveys are inadequate. The RES2DINV program uses the smoothness-constrained least-squares method inversion technique (Sasaki 1992) to produce a 2D model of the subsurface from the apparent resistivity data. It is completely automatic and the user does not even have to supply a starting model. On a Pentium based microcomputer, the inversion of a single pseudosection is usually completed within minutes. It supports the Wenner ( $\alpha, \beta, \gamma$ ), Schlumberger, pole-pole, pole-dipole, inline and equatorial dipole-dipole, gradient and non-conventional arrays.

The program will automatically choose the optimum inversion parameters for a data set. However, the inversion parameters can be modified by the user. Three different variations of the least-squares method are provided; a very fast quasi-Newton method, a slower but more accurate Gauss-Newton method, and a moderately fast and accurate hybrid technique. The smoothing filter can be adjusted to emphasize resistivity variations in the vertical or horizontal directions. It can also be optimized to produce models with smooth boundaries (f.e. chemical plumes), or with sharp boundaries (f.e. fracture zones). Resistivity information from borehole and other sources can also be included to constrain the inversion process. Three different techniques for topographic modeling (Loke 2000) are available in this program. Figure 1 shows an example from an electrical imaging survey in an area with fairly complex subsurface geology and significant surface topography.

This survey was carried out across a circular mound which is thought to contain some important Irish archaeological burial chambers (Waddell and Barton 1995). The inversion of this data set, which has 67 electrode positions and 339 data points, took about 24 seconds on a 3.4 GHz Pentium 4 computer.

**Figure 1 Rathcroghan mound survey (a) apparent resistivity pseudosection, and (b) computer inversion model.**



## References

- Edwards, L.S., 1977, A modified pseudosection for resistivity and induced-polarization. *Geophysics*, 42, 1020-1036.
- Loke, M.H., 2000. Topographic modelling in resistivity imaging inversion. 62nd EAGE Conference & Technical Exhibition Extended Abstracts, D-2.
- Waddell, J. and Barton, K, 1995, Seeing beneath Rathcroghan. *Archaeology Ireland*, Vol. 9, No. 1, 38- 41.
- Sasaki, Y. 1992. Resolution of resistivity tomography inferred from numerical simulation. *Geophysical Prospecting*, 40, 453-464.

## RES3DINV - 3D RESISTIVITY & IP INVERSION software for Windows 98/Me/2000/NT/XP/VISTA/Win 7

- Supports **on land** and **underwater** surveys
- Supports exact and approximate least-squares optimization methods
- Supports smooth and sharp contrasts inversions
- Supports up to 5000 electrodes
- Now available as a combined package together with RES2DINV.
- **NEW** 64-bit version for fast inversion available

In areas with complex structures, there is no substitute for a fully 3D survey. The RES3DINV program is designed to invert data collected with a rectangular grid of electrodes (Loke and Barker 1996).

The arrays supported include the pole-pole, pole-dipole, inline dipole-dipole, equatorial dipole-dipole, Wenner, Schlumberger, and non-conventional arrays.

The RES3DINV program uses the smoothness-constrained least-squares inversion technique to produce a 3D model of the subsurface from the apparent resistivity data. A Pentium III or Pentium 4 based microcomputer with at least 256 megabytes RAM and a 20 gigabytes hard-disk is recommended. Depending on the size of the survey grid and the number of field measurements, as well as the speed of the computer system used, the inversion of a single 3D data set can take anywhere from a few minutes to more than 12 hours!

The program will automatically choose the optimum inversion parameters for a data set. However, the parameters which affect the inversion process can be modified by the user. Three different variations of the least-squares method are provided; a very fast quasi-Newton method, a slower but more accurate Gauss-Newton method, and a moderately fast hybrid technique which incorporates the advantages of the quasi-Newton and Gauss-Newton methods. Two different variations of the smoothness constrained least-squares method are provided; one optimized for areas where the subsurface resistivity varies in a smooth manner, and another optimized for areas with sharp boundaries. Topographic effects can be incorporated into the model by using a distorted finite-element grid such that the surface of the grid matches the topography (Sasaki 1994).

An example of the results obtained from an electrical imaging survey in an area with complex geology is shown in Figure 1. This survey was carried out at Lernacken in Southern Sweden over a closed sludge deposit using the pole-pole array (Dahlin *et al.* 2002). A fairly large survey grid of 21 by 17 electrodes was used. The former sludge ponds containing highly contaminated ground water show up as low resistivity zones in the top two layers. This was confirmed by chemical analysis of samples. The low resistivity areas in the bottom layer are due to saline water from a nearby sea.

The results from a 3D resistivity and IP survey over a copper and gold porphyry prospect in Southeast Asia is in Figure 2 displayed by a 3D Virtual Reality Modeling program to show selected regions of the model. The survey area covers a 5000 by 5000 meters grid. The main targets are regions with high IP values over 20 and 30 mV/V.

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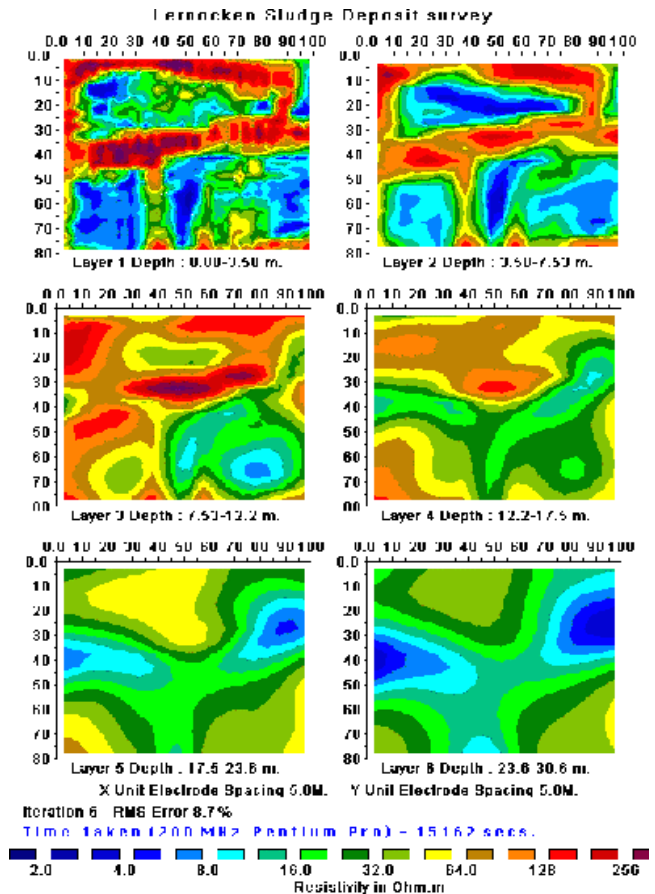
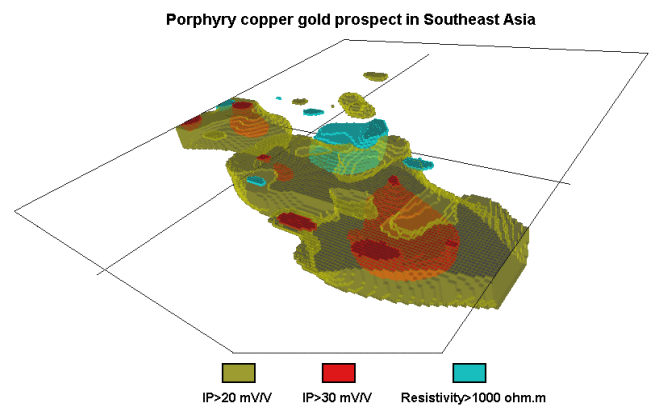


Figure 1. The 3D model obtained from the inversion of the Lernacken Sludge deposit survey data set. The model is shown in the form of horizontal slices through the earth.



Courtesy of Arctan Services Pty. Ltd. (Australia) and Phelps Dodge Corp. (USA)

Figure 2. 3D view from the southeast of the resistivity and IP model from a survey over a copper and gold porphyry prospect in Southeast Asia.

### References

- Dahlin, T., Bernstone, C. and Loke, M.H., 2002. A 3-D resistivity investigation of a contaminated site at Lernacken, Sweden. *Geophysics*, **67**, 1692-1700.
- Loke M.H. and Barker R.D., 1996. Practical techniques for 3D resistivity surveys and data inversion. *Geophysical Prospecting*, **44**, 499-523.
- Sasaki, S., 1994. 3-D resistivity inversion using the finite-element method. *Geophysics*, **59**, 1839-1848.