

Power of EMIGMA

EMIGMA is a powerful interpretation platform for many kinds of non-seismic geophysical data. But it is much more than that! It is an extremely useful self-learning tool for both the novice and the longtime professional to provide insights into geophysical processes, help you understand the characteristics of your geophysical systems and aid in survey design. Once you are proficient in the product, you will discover that it can provide you with many, many lasting and useful insights.

This page is not an extensive description of all the amazing capabilities in EMIGMA; those can be found in the lists of features provided both for the entire software platform and for each of its components. This page is supposed to give you an overall idea of the “*Power of EMIGMA*”.

Data Organization: Data organization is easy to follow and depends much on your preference. The back end of EMIGMA is an object database. It allows you to organize data in three levels: projects, surveys and data sets. You can have different projects based on a variety of criteria, such as the type of your data or the interpretation method you are going to use. Or you may choose to create a single project for multiple datasets to provide more ready analyses of different data types and integration of your interpretation across all data sets within a project.

Data Import and Export: A suite of imports is available allowing you to bring your measured data into the database in either the manufacturer’s file format or as an ASCII columnar data file. EMIGMA is often smart enough to recognize your imported data and permits direct interactive modeling/inversion of your data. Many binary files can be first imported to QCTool, many imports are now available directly from QCTool or organized and then exported to ASCII for import to EMIGMA. We are in process of developing even more direct imports from QCTool to EMIGMA. Many processing capabilities are available in QCTool. Data may then be exported in a very easy and flexible manner from QCTool to ASCII for import to EMIGMA. Your processed or modeled data may be exported to various formats including ASCII columnar and Geosoft .gcn data files. You can also export them to another EMIGMA database or to PetRos EiKon’s ASCII format when you want to share your results with other EMIGMA and GeoTutor users. Your grids can be exported as either XYZ or Geosoft/Surfer grids. Of course, there are many printing functions for hardcopy and a variety of formats to save your models, images, and contours in. The grids may be exported as Geotiff (Arcview or Mapinfo) for import into other applications or for input to our new PEGeoMap for annotation and marking or geotiffs may be imported for map overlay or underlay in EMIGMA’s data mapping tools.

Data Processing: A comprehensive set of tools is available for editing, filtering, cleaning, trend removal, plotting, comparing your data along with many other special functions for particular types of data. If you have large data sets or wish to focus on certain areas of your data or its main structural attributes; you can easily create subsets of surveys or compress your data in a variety of manners. This allows you to more rapidly work with an interesting part of the data without modifying the entire original data set and also to gain quick overviews of structure or the principal features in your data.

Data Display and Analyses: EMIGMA's design criteria for data display is not merely to create pretty pictures for your clients or your supervisor but to improve the data interpretation process by focusing on the use of your own intuition and assisting in building your intuitive strengths.

3D Visualization: EMIGMA's 3D visualization can display your data (measured, modeled, processed, inverted) in 3D space as profiles, vectors, true 3D surfaces or 3D contoured surfaces and allows detailed analyses of anomaly position, shape and amplitude. You can examine your model from any viewpoint or manipulate it using a convenient array of menus and dialogs. Easy toggle buttons allow you to move through your data or semi-animate them for enhanced intuitive understanding. Data can be converted quickly into pseudo-sections, transformed to apparent resistivity, displayed as decay constants and in many other ways made possible by a variety of original imaging algorithms.

The visualization is also used to build or edit your 3D models or inversions. A single command will create a new model primitive, profile or other object with default settings that can then be modified for the specific model. 3D structural manipulators are available, while editing of your model becomes even easier owing to the simple and intuitive GUI.

Gridding and Contouring: Five interpolation algorithms are available for 'gridding', with various tools to view the results of your interpolations. The *GridPresentation* and *Contour* tools allow you to switch between data channels and components without the necessity to load different grids; to easily select other grids that you have generated and to convert grid data to data imaging transforms such as apparent resistivity and conductivity. You may examine the values of your gridded data, overlay grids with profiles (transects), actual data, contours, or superimpose them on calibrated maps. The *MultiGrid* tool permits you to simultaneously view and compare up to four grids from the same or different data sets or grids. Apart from the 2D representation of your data, you can stack multiple frequencies, time windows and separations proportional to depth for investigating your data three-dimensionally, generate pseudo-sections, depth images, carry out depth transformations and build 3D volume contours of your 1D and 3D inversions.

Plotting: EMIGMA's remarkable XY plotting capabilities are represented by two quite different tools, *EikPlot* and *DataSpreadsheet*. The first is PetRos EiKon's specialty plotter used for comparison between measured, simulated and processed data as well as for a quick assessment of a single data set. Plots are generated almost automatically. You can switch between channels, separations, transmitters, profiles, frequencies, time windows or flip from resistivity to conductivity and back, arrange multiple plots on one page, build residual plots, adjust plot settings, scale and appearance and save plotting defaults – all at a click of the mouse.

The second, *DataSpreadsheet*, is a relatively new tool for EMIGMA that contains a line plotter linked to dynamic spreadsheets. It is intended for QC data analyses and correction prior to advanced processing and modeling. You can do changes right in the plot, cut its portions or even drag it to fit your interpretation purposes, while checking the adjustments being made in the spreadsheet alongside.

Profile Viewing and Editing: Survey Editor is also a relatively new tool in **EMIGMA** allowing the user to look at the detailed locations of data while viewing them as “stacked profiles”. You may edit and clean the survey locations by easily eliminating bad data points or removing whole profiles. Or, you can just window out portions of your data to select interesting subsets for interpretation. A number of new mapping features have been added to this tool that gives it considerable functional power.

3D Modeling (Simulation): **EMIGMA**’s 3D modeling contains a suite of algorithms all developed by PetRos EiKon. This is a great advantage of our product over similar applications where the algorithms are derived from academic codes. We can easily and quickly support and fix any problems arising in the platform. It is also an asset from the point of view of model building, as we know the details of the algorithms and their capabilities. For example, you need not select the proper algorithm for your data, whether it be EM, Resistivity, Magnetics, or Gravity, since the software itself loads the correct algorithm with required settings. As **EMIGMA**’s roots lie in a modeling application, there are also many “artificial intelligence” features built into the platform to provide you with quick and reliable results.

Most noteworthy are the speed and flexibility of our 3D modeling algorithms. But just as importantly, we pride ourselves on their exceptional accuracy from both a commercial and an academic perspective. As examples, we offer two 3D modeling algorithms for gravity, one standard and one enlightened approach providing not only speed but ensured accuracy as well. For magnetics, we also have both a standard and an advanced approach, with the latter including the capabilities for magnetic interactions and permanent effects.

You can import model constructions (anomalies and layered earths) or build your own models based on the hypothesis of your geological environment. **EMIGMA** allows for unlimited prism, plate and polyhedra targets, complex topography, multiple body interactions and provides fast and accurate 3D simulations, with a remarkable batch mode tool fully integrated into the platform.

1D and 3D Inversions: Although 3D modeling is by far the most accurate approach to data interpretation, the industry for a number of reasons has become reliant on inversion applications. PetRos EiKon has been involved in the development of inversion algorithms for almost 16 years now. Our 1D inversions are available for frequency-domain EM (FDEM or FEM), MT/CSAMT, resistivity and time-domain EM (TDEM or TEM). Like many other things in **EMIGMA**, there are more than one way to perform your inversions depending on its type, quality and your interpretation objective. These algorithms are, of course, in almost continual development, and every year you will find significant improvements not only to the algorithms but also to the interfaces and visual tools for analyzing and displaying results.

For some years, we have provided our own 3D magnetics inversion for susceptibility distributions. However this has been extended to the distribution of source magnetization vectors. Thus, we overcome problems related to man-made sources and natural permanent magnetic features. Our extended 3D Euler deconvolution has recently become available for magnetics and gravity applications and is supported by comprehensive post-

processing and data display tools. A new 3D Gravity inversion capability was released in 2006 along with 1D Resistivity inversion. 3D resistivity inversion has also been released as well as a new CSAMT inversion utilizing the three-dimensionality of the source and a 1D model. This greatly extends the usefulness of CSAMT data as now the near field data can be utilized. EMIGMA's 3D modeling of CSAMT is of course a complete solution.

The '*Power of EMIGMA*' results not only from the host of functionalities it offers, but also from the exceptional flexibility and responsiveness of the platform to the demands of the industry. Its many features can easily be customized for your application; they are being improved and updated practically continuously owing to the huge scientific and programming potential that was envisaged from the very inception of the software.