Exploring for minerals

- Wizards
- Map production
- 3D presentations
- Annotation
- Orthophoto
- Surface gridding
- Contouring
- Image mosaicing
- Data compression
- Geocoding
- Spatial analysis
- Raster to vector
- Land use classification
- Data integration
- Image analysis
- Radar processing
- Fast Fourier Transforms

Reduce costs
Lower field exploration and drilling costs by identifying target sites for effective use of field resources.

Find targets
Increase target quality and confidence by integrating all types of data.

Work in the field
Take your knowledge into the field with you on a lap-top computer.

Print maps
Accomplish all your mapping needs by producing maps for field use, for management reporting and for investor relations.
1. Minimize exploration costs

Field exploration is expensive. Some of your largest expenses are greater than they need to be, but by using technology you can drastically reduce your exploration costs.

**Land acquisition.** Using remote sensing and geophysical processing techniques you can limit the size of your exploration parcel.

**Field crews.** Geological field surveys are expensive. Have your geologists do their preliminary work remotely in the office and then verify their conclusions using ER Mapper in the field.

**Drilling programs.** Digging holes is expensive. If you can reduce the size of a drilling program, you can save a lot of money in the short term.

2. Select targets with confidence

ER Mapper’s unique ability to merge imagery, GIS and database information into a single view ensures a cost effective and efficient exploration program by minimizing field work and drilling. Each type of data you use adds to your knowledge of a target area and increases your level of confidence about potential target sites.

Use:
- Magnetics data for subsurface structural information
- Radiometrics data for information on soils and elements
- Landsat data for clay, iron oxide, vegetation, alteration and other information
- SPOT and airphoto data for detailed surface structure
- GIS data to reference images and cultural or geochemical data

Combining data types allows you to make correlations incredibly quickly. This is what makes ER Mapper so valuable to mining companies around the world.
3. Effective field work
Having all existing knowledge about the area in the field maximizes the effectiveness of geologists and geophysicists. With ER Mapper on a notebook computer, you can:

- View existing exploration data
- View and update geological interpretations from GIS systems such as Autodesk World, Arc/Info or MapInfo
- Show anomalies that need to be explored in more detail
- Do interpretations while enhancing imagery
- Do field checking and ground truthing of interpreted data

ER Mapper #1 for interactive modelling

- Perform Fourier Transformations on your data in seconds
- Make changes and redisplay the result on the spot no need to save a new dataset
- Display enhanced TM images like PC, band ratios and alteration mapping without saving out intermediate datasets
- Interactive data enhancement saves valuable time in the processing of large datasets
- Geolink windows with different views for an interactive evaluation of all your data

4. Quality maps and presentations
With ER Mapper’s easy to use map creation system you can create superb maps on demand.

Field maps. Create maps integrating all your exploration data, to give your geologists up-to-date information. Include GIS data, as well as imagery.

Maps for investors to see. Professional presentations can make all the difference to a business decision. Print vivid maps for investor and prospectus reports, showing exploration leases, and target areas, prospect potential, and exploration progress.

ER Mapper #1 for analyzing data

- Create a profile of a magnetics scene or DEM for a different view and better understanding of your data
- Highlight small faults and features using real time shading by interactively moving the light source
- Highlight hydroxyls, iron oxides and lineaments using satellite images
- Measure dip and strike using DEMs
- Analyze the effects of terrain on the migration of geochemical and stream samples

5. Try for yourself
Evaluate ER Mapper with the free CD-ROM which contains:

- The complete ER Mapper software
- Online manuals
- 14 day evaluation licence
- Over 500Mb of sample data

The world’s most well known geological and geophysical organizations use ER Mapper, including:

Application by David Pratt & David Farquhar-Smith, Encom Technology Pty Ltd, Australia

Encom Technology routinely uses ER Mapper for its international mineral and petroleum exploration projects. Its 3D capabilities have greatly improved our ability to understand datasets in areas of significant topographic relief. A recent project for base metal exploration in Northern Africa integrated Landsat TM and SPOT satellite data with aeromagnetic and electromagnetic geophysical survey images.

With the terrain relief of some 3000 metres, the project area presented some special problems. The Landsat data was acquired at 6:48 a.m., and as a result much of the scene has extensive shadows cast from the high mountain terrain. This is excellent for mapping structures with surface expression, but the shadows dominate any contrasts that could be associated with changes in rock type or alteration associated with mineralisation events.

Evidence of the terrain shadows is easily seen in the RGB (741) image.

A modification of the Abrams ratio was used to highlight spectral contrast, with RGB channels mapped to 3/2, 5/7 and 4/3. The 3/2 ratio enhances iron oxide content, while the 5/7 ratio is small in the presence of abundant iron and large in the presence of abundant clay. The 4/3 ratio highlights vegetation in green. We applied a light 3 point gaussian filter to minimise the noisy characteristics of the 3/2 ratio.

The effectiveness of the shadow elimination procedure is evident in the Abrams image.

Minimisation of the shadow effect can be achieved by ratioing different image bands on the assumption that each wavelength band is equally affected in the shadow zone. This assumes that the diffuse reflection characteristics of the ground surface is similar on the illuminated and shadow side of the terrain. Atmospheric back scatter must also be removed from the TM channels prior to ratioing.

This image highlights a major unconformity with Cretaceous rocks (yellow) over Proterozoic basement (blue-red).

Although the Landsat scene indicates dramatic terrain relief in the project area it was difficult to assess the relative relief across the scene. We decided that visualisation of this relationship would be much easier in 3D with the Abrams ratio image displayed over terrain.

SPOT stereo would be ideal for building a high quality digital terrain model but for preliminary evaluation we used data downloaded from the EROS data centre at the USGS. This data had a 1 km resolution, so we regridded it to provide a cell size of 100 metres. This produced a smoothly varying terrain image that did not add artifacts into the 3D presentation.

ER Mapper 5.5 was then used to incorporate the modified Abrams ratio image with the USGS elevation data as a height layer to produce a 3D perspective view, where it could be rotated and tilted in real time. This allowed us to zoom into particular areas and concentrate on delineating the geological units.
Case study — Exploring for Gold

Application by RGC
EXPLORATION, Perth, Western Australia

In the search for gold deposits in Archaean greenstone belts, it is important to understand the geology, the structure and the regolith of the area of interest. In this example, RGC used aeromagnetic, radiometric, Landsat and SPOT data to help identify different rock types, geological structures and regolith units in a gold exploration program within the Yilgarn Craton of Western Australia.

Aeromagnetic Data shows the characteristics of the magnetic rocks beneath the soil cover.

- Figure 1 shows the trend and distribution of strongly magnetic BIF units and more weakly magnetic basaltic rocks.
- Figure 2 shows the data enhanced using the first vertical derivative to improve resolution. Breaks and offsets of magnetic units may also indicate the presence of faults.

Radiometric Data - A K/Th/U (Red/Green/Blue) display (Figure 3) shows the surface distribution of these radioactive elements and, combined with the magnetics, the correlation between magnetic units and radioelements can be easily visualised. Poor correlation between the radiometric response and the underlying geology, as indicated by the magnetic data, suggests that the radiometric response may be related to less prospective transported soils (e.g. dull red colors in the northwest of the image correlate with a stream). In the more prospective areas of outcrop, the correlation between the radiometric response and the magnetic data is better (e.g. green areas in the centre of the image follow the trend and position of the magnetic BIF).

Landsat TM Data - The Landsat data bands can be ratioed using ER Mapper to enhance the regolith response (TM bands 5/7, 4/7, 4/2 displayed as an RGB ternary image). For example, in Figures 4 and 5, discrete regolith units are enhanced (e.g. purple areas on the eastern side indicating granitoid rocks). The Landsat data are also useful in identifying areas of transported cover (generally unprospective), related to streams (dark blue areas), and potentially more prospective in-situ soils. Identifying these different regolith regimes is important in planning and interpreting soil sampling programs.

SPOT Data - The excellent spatial resolution of SPOT Panchromatic data (10 m) (Figure 6) allows easy identification of general landforms (e.g. ridges, streams, vegetation density) and this type of imagery can be used as a base map or for rectifying scanned aerial photos.

Advantages of ER Mapper:

✔ Ability to enhance magnetic images (by manipulating histogram displays, sun-shading, and specialised mathematical transforms) to bring out subtle features.
✔ Ability to integrate different datasets on a single image e.g. shaded magnetics overlain by radiometrics, shaded magnetics overlain by Landsat TM, to see relationships between different datasets and provide an integrated interpretation of the geology e.g. The Landsat image (Figures 4, 5) provides a good indication of the granitoid-greenstone contact to the east in areas where it is poorly defined on the magnetics.
✔ Ability to enhance Landsat TM data using band ratioing (formulas).
✔ Ability to display multiple datasets simultaneously and visualise the same area for all windows using the geolink tool.
✔ Ability to rectify scanned aerial photos using the SPOT image as a reference.
✔ Ability to add vector annotation to an image eg. Magnetic interpretation over Landsat TM image (Figure 6).

System: ER Mapper version 5.5 on a Digital Celebris XL with dual Pentium 166 MHz processors and 64 Mb RAM, running Windows NT 3.51.
Getting started with ER Mapper

Here are a few tips to get you started with visualizing and integrating geological and geophysical data. These examples use sample data that is installed with the “Typical” ER Mapper installation option. If you have not received a CD-ROM please contact your reseller.

Viewing magnetics data

A unique feature of ER Mapper is the ability to display the same dataset in different ways to aid interpretation. Here we will create Colordraped and 3D perspective views of some sample magnetics data.

1. Add the Geophysics toolbar by selecting it from the Toolbars menu.

2. From the Geophysics toolbar, select the Common Geophysical Images Wizard button.

3. Choose the images you wish to view. In this example, choose Colordraped and 3D perspective.

4. For the input image, select, from your ER Mapper installation area, the `examples\Shared_Data` directory and the `Newcastle_Magnetics.ers` dataset.

5. Click Finish.

You can move around in the 3D window using combinations of left and right mouse clicks.

6. Click on the Colordraped window to make it active, then click the Edit Realtime Sun Shade button to open the Edit Sun Angle dialog. The small circle in the top right quadrant of the concentric circles represents the position of the simulated sun. Move the sun by clicking and dragging it with your cursor and see how it highlights different features as its position changes.

3D perspective view of Newcastle Magnetics dataset.
A Colordrape of two datasets

1. Click the Open Algorithm into Image Window button.
2. From the Directories menu select the ‘examples’ directory and choose the ‘applications\Mineral_Exploration’ subdirectory and the file ‘Radiometrics_K_Th_U_RGB_over_Magnetics_RTS.alg.’

This image shows Radiometrics data in RGB draped over the structure of the magnetics dataset.

3. Right mouse click on the image and from the quick zoom menu select Zoom to all datasets.

Viewing a Potassium/Thorium ratio

1. Click the New Image Window button.
2. Click the Create Ratio K/Th Algorithm button on the Geophysics toolbar.
3. For the input image, select, from your ER Mapper installation area, the ‘examples\Shared_Data’ directory and the ‘Newcastle_Radiometrics.ers’ dataset.

The image shows a ratio of the Potassium and Thorium data. Blue represents high Thorium and low Potassium, Red represents high Potassium and low Thorium and colors in between representing the range of concentrations.

Annotating your image

1. Select the Annotate Vector Layer button.
2. Click OK on the New Map Composition dialog.
3. Close the warning dialog and begin to experiment with the annotation system, adding map items and drawing vector lines.

You can continue to do image enhancement, such as sun-shading, while annotating.

Other examples

These examples showed you how to use toolbar buttons and supplied algorithm views to visualise your geophysical data. To get some more ideas for using ER Mapper try the following:

- Try the other buttons on the Geophysics toolbar.
- Try loading the other algorithms in the ‘examples\Applications\Mineral_Exploration’ directory

Note that the “Typical” ER Mapper installation option only installs a small subset of the algorithms available in the ‘Mineral_Exploration’ directory. To retrospectively install example directories, run the ER Mapper installation program again, select the “Custom” installation option, and choose only the required directories. Refer to the ER Mapper Installation Manual for more information.

Going on from here

Explore the other algorithms supplied with ER Mapper. Also, open the Algorithm window by clicking the View Algorithm for Image Window button and observe how the processing is represented as you view different algorithms. You may use your own data. Read Chapter 3, Basics, in the ER Mapper User Guide for an explanation of how ER Mapper works. Check out relevant chapters in the Tutorial manual for a more thorough walk through of examples.
ER Mapper 6.0
Helping people manage the earth

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New features include:
✔ Free imagery plugins for GIS systems
✔ Orthorectification of airphotos
✔ Image display and mosaic wizard
✔ The Image Balance wizard
✔ The Geocoding wizard
✔ The Surface Gridding wizard
✔ The Contouring wizard
✔ Save as... to popular formats
✔ File open... directly from popular formats
✔ Image compression wizard
✔ Real time roaming and zooming
✔ Radar processing fully bundled

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