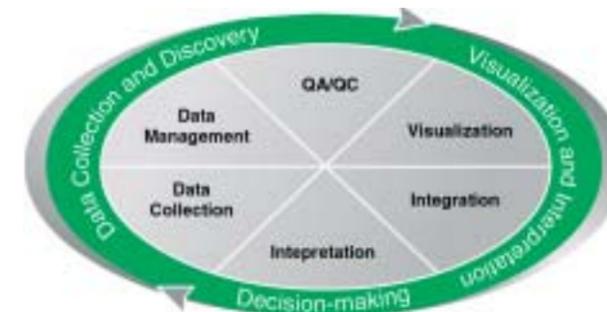


Benefits of rapid data assessment and visualization prove themselves in exploration scenarios

Use of mapping and visualization software is growing rapidly in exploration. Carmel Burns of Canadian company Geosoft, provider of geospatial solutions to earth science industries, describes how some of its customers are adapting to the possibilities.

The ability to effectively display, rapidly assess and dynamically experiment with multiple datasets has helped to reduce risk and increase prospecting capabilities in exploration. Increasingly, what's required in exploration is software that can handle large volumes of data and multiple data sources and data types, such as geophysical data, geochemical data, drillhole data, satellite imagery, GIS data and any kind of mapping data, within one single environment or transparently linked environments. Utilizing today's visualization tools, geoscientists are able to reduce risk and increase understanding by looking at as much different data as they can, in as many different ways as they can, within compressed project time frames.

Despite the fact that exploration companies are leaner, with fewer people and shorter project time frames, Dr Michal Ruder, principal of US-based Wintermoon Geotechnologies, says she has seen exponential improvements in productivity and data quality as a result of new software for mapping and visualization. Whereas it used to take weeks to process and interpret geoscience datasets, today it is not uncommon for geoscientists to address the salient issues of interpretations in the course of one or two days.



Mapping requirements are integral throughout the exploration data lifecycle. The ability to rapidly and dynamically display, compare, adjust and enhance multiple maps within a single, spatial environment is essential from initial data processing and quality control to visualization, interpretation and integration

'I can remember doing batch maps in paper copies back in the 1980s,' says Dr Ruder. 'Since then, the ability to image geoscientific datasets on a computer screen in real-time and continual improvements in visualization software have had an amazing impact on what we can do as geoscientists, and how quickly we can do it.' Interpretation results are also more accurate because geoscientists have the tools to view the quality of the data in every single phase, from initial data processing and quality control through to visualization, integration and the final interpretations.

Dynamic and integrated visualization

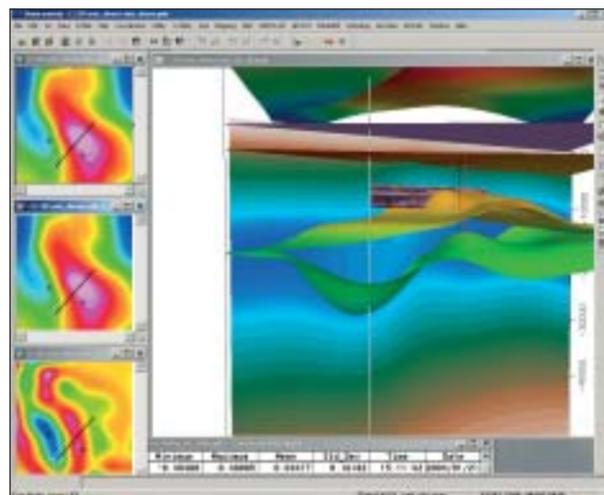
Equipped with her laptop and mapping software, it's not uncommon for Dr Ruder to do interpretations on-the-fly, in collaborative meetings with major oil and gas customers. 'I can do a lot of work in my clients' offices on my laptop,' says Dr Ruder. 'My mapping software enables a lot of interactivity and testing of their hypotheses, and I can show customers the results in real time.'

There are efficiency and quality advantages in being able to dynamically pull customer data in, whether it's well data, satellite imagery or other types of data, and to immediately look at it as part of the interpretation. The dynamic linking of multiple views of imagery, maps, profiles, plots and data also provides an easier point of reference for visually linking common features or areas of interest.

This type of rapid assessment and dynamic experimentation depends on the ability to interactively display, and enhance, different attributes in different ways, whether through contrast enhancement, shade relief, angle illumination, two dimensional or three dimensional displays. Speed in creating and recreating visualizations, or refreshment time, is also an important consideration, especially when dealing with large datasets.

Three dimensional modelling

The use of specialized three-dimensional modelling software for prospect modelling of salt bodies can further help to reduce risk in areas such as potential field exploration. 'It's very prudent to do 3D modelling for prospect model-



3D modelling: This 3D visualization of gravity and magnetic models was created using NGA's GMSYS 3D modelling software. The three flat maps along the left side of the workspace show Observed Gravity, Calculated Gravity, and the Difference. The black line marks the location of the seismic section shown in the 3D visualization on the right. The '+' symbol in the flat maps tracks the location of the 3D cursor in the 3D visualization (the long vertical line at the end of the seismic section). The other vertical plane in the 3D visualization is the sub-surface gravity response.

ling of salt bodies when you're considering a very expensive well in deep water,' says Dr Ruder.

One example is the GMSYS 3D application, developed by Northwest Geophysical Associates, which is integrated with, and fully exploits, the three dimensional visualization capabilities of Geosoft's Oasis montaj product. Geoscientists can use the software to plot 3D displays of the entire model in one simple step while retaining control over each element in the 3D visualization. The 3D visualizations update automatically during inversion and structure editing. Geoscientists can also add wells, seismic sections, or other vector or raster information to their 3D model visualizations.

Software and data integration

Today's visualization software is required to enable and support the easy integration of different types of datasets, including geoscientific data, satellite imagery and other GIS data into the mapping environment. Working in multiple software environments is a reality for geoscience consultants like Dr Ruder who need to meet the needs of customers with a variety of software preferences. 'In general, I find that the software tools I use work well together. I also welcome the ability to distribute datasets and grids back and forth between my GIS and mapping software.'

While geoscientists recognize that there's a lot to gain by looking at different types of data, Dr Ruder admits that there is still a tendency within each discipline to use the data that they understand the best. 'In general, I think people don't realize how easy it is to integrate all of their datasets, whether it's seismic and non-seismic, raster and vector.'

Targeting mineral exploration mapping needs

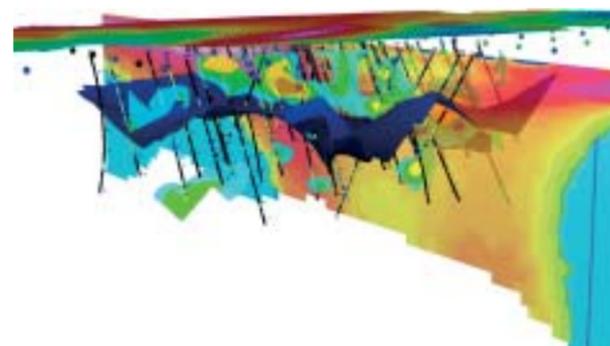
Mineral exploration projects can have upwards of five hundred drillholes. As exploration projects increase in size and the number of drillholes and other datasets increase, effective software has become essential for managing and visualizing these large datasets.

Major and junior exploration companies each bring their own unique and diverse perspective to the business of exploration. However, when it comes to mapping software there is a common view on essential requirements and emerging priorities. With so many options available, focusing on the software functionality required from exploration mapping software is considered a good strategy for maximizing efficiency and exploration investment dollars.

Power mapping for mineral exploration

Mark Parker, managing director of African Eagle Resources, a London AIM-listed junior exploration company operating in East Africa, has a clear view of his needs when looking for mapping software, 'We knew that what we needed was a good, computer-based means of archiving and visualizing our drillhole data.'

Parker has been using a mapping system for geophysics



This 3D visualization shows how a number of different exploration techniques can be integrated to help define and interpret the mineralization. The plunge of the gold mineralization can be seen to follow the interface between partial and fresh oxidation (shown as a dark blue surface). The enrichment of the mineralization that was seen in the 2D cross-section can be explained by the intersection of the mineralization with the oxidation interface.

and geochemistry since 1990 and this past year African Eagle added drillhole software to its system. The ability to work efficiently with all the data in one integrated environment was a key consideration. 'Our system provides a powerful way of viewing and visualizing the data,' explains Parker, 'and it allows you to combine different data sets, in different ways, to make the best use of all the data you have available.'

Visualization has played a critical role in African Eagle's exploration projects. 'In a situation where you don't have any outcrop, which is typical in Tanzania, you're relying very much on your drillholes to do basic geological mapping, as well as actual mineralization interpretation,' says Parker. 'In this case, it's quite important that you have powerful tools for visualization which allow you to make the best use of the data you have and to interpret the data to the maximum.'

Integration with its Geographic Information System (GIS) environment has become a greater priority for African Eagle. In addition to meeting internal needs, GIS integration allows data to be shared effectively with African Eagle's major exploration partners.

Exploration projects often involve two or more companies working together within joint ventures, option agreements and other partnership arrangements. 'As an example the partner on one of African Eagle's Tanzania projects uses ArcView,' explains Parker. 'In working with them, we need to supply formats that can be viewed in ArcGIS. If we can supply things in native ArcGIS, so much the better.' Parker sees the market introduction of Geosoft's Target for ArcGIS, a drillhole and mapping extension for ESRI's ArcGIS, as a positive step towards meeting its integration needs.

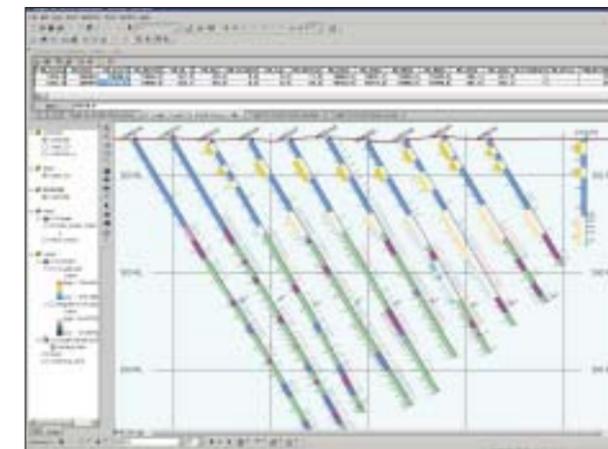
Exploring in GIS

Julian Misiewicz, consulting geologist for Africa and Europe with Gold Fields International, a South Africa-based major global gold producer, makes a distinction between essential and specialist-use mapping functionality. 'In mineral exploration, you need three basics: database software, a GIS package, and, definitely, a drillhole processing package. All three are essential. Having met those needs, if cost is not a factor, specialized three dimensional modelling packages are also very beneficial.'

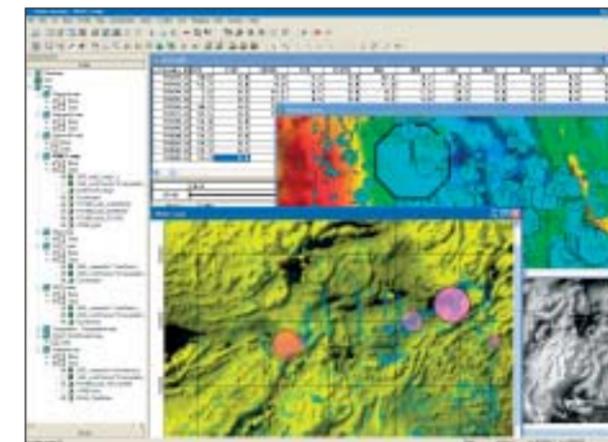
Efficiency in data processing is important, but ultimately the proof, and the power, is in seeing your data. 'The better you can see and plot your data,' says Misiewicz, 'the better you are able to understand it, firstly, and the better you are able to get the best value out of that data, and to use it effectively throughout the business environment.'

For many years, specialized exploration software has provided the ability to expertly visualize geophysical, geochemical and geological data within an integrated environ-

ment. Visualization technology has come a long way. Advanced rendering techniques together with three-dimensional modelling applications have added a lot of power to



New exploration software extensions, such as Geosoft's Target for ArcGIS, enable users to quickly and easily create and recreate their drillhole plans, sections and strip logs within their ArcGIS environment. This image shows a database that includes collar, assay, survey and lithology data. Below the database is a section map with 11 drillholes along a survey line (12625N). The colour patterns down the drillhole indicate the rock and weathering codes for various depths. Downhole depth markings are displayed every 100 m. The colour coded text postings on the right side of each drillhole represent the value of gold (Au) at that depth. The brown line across the top of the section shows the topography profile and the numbers identify each hole.



The project explorer toolbar and transparency capability demonstrated in this screen capture are two of the new features in Geosoft's latest Oasis montaj 6.0. release. This figure displays a residual magnetic grid overlain by proportional symbols showing kimberlite indicator minerals.

Data Visualization and Interpretation

the way data can be view and interpreted.

Until recently, however, visualization tools for exploration data in the GIS environment have been very limited. This is rapidly changing, as integration of exploration software with broad-based GIS systems takes greater priority in the industry. New exploration software is tasked with meeting the growing need for seamless integration of exploration datasets within the broad-based GIS environment, while continuing to meet the rigorous mapping and

processing requirements of geological users.

At the end of the day, explorationists use computerized methods because it's quicker and better than doing it by hand. Exploration drillhole and mapping software provides a key advantage by making it possible to handle large volumes of data and routinely visualize a thousand or more drillholes at a time. This enables geologists to create and revise maps and sections quickly and easily, while formulating and fine-tuning an understanding of their targets.

