



Exploration in Three Dimensions

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Introduction

Computers and software applied to the exploration problem have had a significant impact on the exploration process, particularly over the past 25-30 years. Within data processing, analysis and interpretation environments, technology has improved the ability to manipulate and query data with greater ease and efficiency. Today, 3D visualization technologies are delivering better insight into our data, reducing uncertainty and helping to improve the quality of exploration decisions.

The Value of Visualization

Visualizing drillhole exploration data in true 3D space is fundamental for any exploration drilling campaign.

Traditionally, exploration data sets have been processed and visualized using one or two-dimensional methods. Two-dimensional cross-sections or maps were produced from spreadsheets to help determine the location, orientation and relationships of data that is really three-dimensional.

While cross-sections and maps do a good job of showing the position of data, they often fail to demonstrate the interaction between surface and subsurface features. For example, the relationship between mineralization, weathering profiles, and their associated geophysical signatures is complex and difficult to process and interpret using a simple plan or section view.

Working within the 3D Environment: An Exploration Case Study using Geosoft's Oasis montaj

Within the Oasis montaj geospatial data platform, Geosoft data processing and analysis (DPA) software applications provide a range of options for processing and visualizing related data sets. Survey, location and GIS data can be integrated and processed in a single, one-dimensional spreadsheet database. Two-dimensional line profiles, plans and section views can be created to visualize and interpret data. For 3D viewing, the 3D visualization tool can be used to display drill holes, surface and other data in an integrated, dynamically linked and interactive viewing environment.

The 3D visualization tool is fully integrated with other Geosoft modules, and grids generated in "sectional" views from other software applications such as Interactive IP can be displayed directly into the 3D view in their correct orientations "on-the-fly". Other grids and images (including bitmaps and jpegs) can be opened and easily located in any orthogonal plane that the user desires. The transparency of individual layers (planes) can be controlled, in the 3D viewer, much like a light-table effect. Data such as MapInfo tables and 2D DXF files can be imported directly to the 3D environment and drawn on any surface displayed in the viewer itself. Data in the database are dynamically linked (in real-time) through the cross-section and plan maps to the 3D environment. Dynamic linking is a core feature of the Oasis montaj environment and available in all Geosoft software applications.

The 3D environment, within Oasis montaj, can help us understand some of the relationships between mineralization and oxidation profiles as illustrated by the following example.

Summary

Visualizing drillhole exploration data in true 3D space is fundamental for any exploration drilling campaign.

Industry

Mineral Exploration

Solution

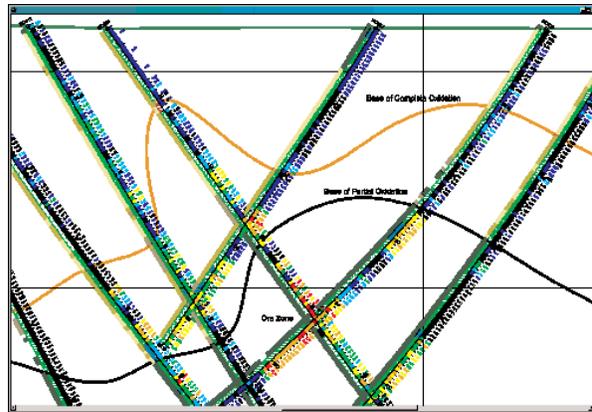
Geosoft's 3D visualization tool can be used to display drill holes, surface and other data in an integrated, dynamically linked and interactive viewing environment.

Products Used

- Target Surface and Drillhole Mapping
- Drill 3D

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Figure 1



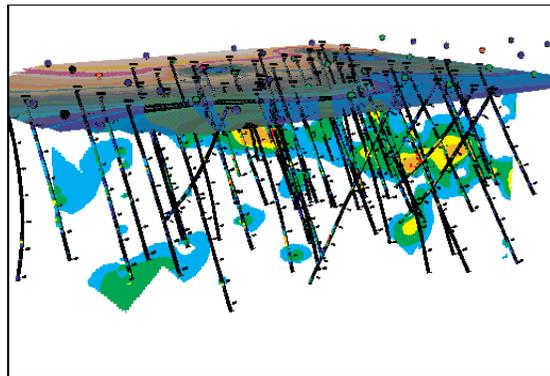
A N-S cross-section (Figure 1) displays the weathering, lithology and gold assays down each individual drillhole in a graphical and text representation (as per the legend). The section also displays an interpretation of where the surfaces of complete (orange) and partial (brown) oxidation intersect the section. From this section view, one can conclude that there is a relationship with some of the mineralization and level of oxidation. It does not tell us how this relates to the drillholes on either side of this section.

ROCK CODES	LR	PAT	CODE	DESCRIPTION
Weathering	L		SW	
			MW	
			WW	
			FR	
Lith 1	L		AGLT	argillite
			ARNT	arenite
			BLSH	black shale
			CLCR	calcrete
			CLY	clay
			GYAK	greywacke
			MDST	mudstone
			METS	metasediment
			QZVN	quartz vein
			SCHT	schist
			SDST	sandstone
			SED	sediment
			SHLE	shale
			SLSL	siltstone
			SND	sand

VALUES	LR	COL	RANGE
AU_FASD_ppm (PPM)			19.87
			6.866
			2.263
			0.7624
			0.258
			0.08731
0.02855			

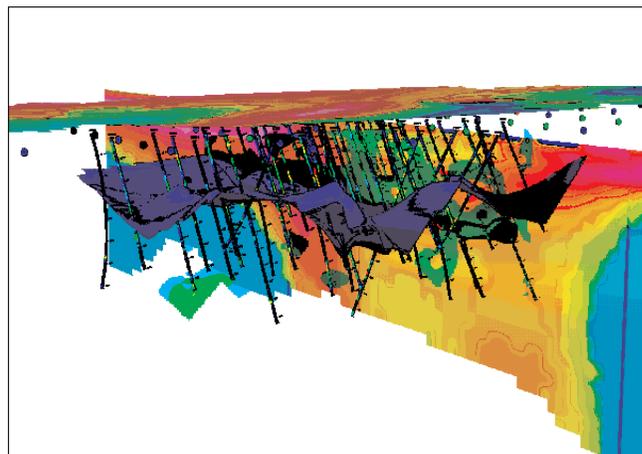
In a 3D view of this same data (figure 2), a topographic grid is displayed together with surface soil samples (shown as spheres)

Figure 2



that are colour-coded according to their gold content. The drill holes are displayed in their true three-dimensional space and include the attributes of up to two different data types along their trace. In this diagram the traces are attributed with gold, which is shown as coloured bands according to the grade distribution shown in the 2D cross-sections. Also, displayed in its true 3D location is a long section with the distribution of gold mineralization shown as a gridded image clipped to gold values greater than 0.1 ppm. This figure illustrates the significant westward plunge of the mineralization and that the mineralization, though not outcropping, has a subtle expression in surface soils.

Figure 3



A second 3D view (figure 3) 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.

The diagram also includes an image, generated by an EM software package, located along its survey traverse. The apparent increase in signal along the mineralization is an effect of the level of oxidation, rather than the mineralization itself. The magnetic grid draped over the topographic surface appears to relate to a crosscutting structure in the mineralization, which is depicted by a break in the gold mineralization and a valley in the partial-fresh oxidation surface.

Conclusion

This example demonstrates the value of visualizing data in 3D, and illustrates how data integrity can be maintained by dynamically linking to the original data in 1D space and 2D sections.