Case study: Combining Leapfrog Geo and ADAMTech to quickly and efficiently produce structural geological models

COWAL GOLD OPERATION, CENTRAL WEST NSW, AUSTRALIA

THE PROJECT

Evolution Mining’s Cowal Gold Operation in Central West NSW has successfully utilised ADAM Technology’s 3DM Analyst Mine Mapping Suite (ADAMTech) in conjunction with Leapfrog Geo to produce accurate structural models quickly and efficiently. The Cowal operation is an open pit mining operation with production from a number of different faces within the single pit. Mineralisation occurs in structurally hosted (epithermal to mesothermal) sheeted veins and shear hosted lodes.

Historically, 3D modelling of significant fault and shear structures could only be completed using a combination of pit mapping and core logging data. Two-dimensional sections were then used to connect these data points and produce an overall 3D mesh of the structure.

Evolution Mining’s Geotechnical Engineer, Richard Battison, says, “The implicit modelling algorithms used in Leapfrog Geo allow this process to be automated, saving many hours of manual modelling time. This time can instead be utilised towards producing a more detailed structural model encompassing numerous structures, which may not have been modelled in the past due to time constraints.”

SITUATION

The deposit occurs within the 40 km long and 15 km wide Ordovician Lake Cowal Igneous Complex to the east of the Gilmore Fault Zone and within the eastern portion of the Lachlan Fold Belt. The deposit is hosted by a shallowing-upwards sequence of semi-conformable sedimentary, volcaniclastic and volcanic rocks of trachyandesitic
composition that have been intruded by a diorite sill, andesite dome and various dykes. The sequence strikes northeast – southwest and dips moderately 30 to 40 degrees to the northwest.

**Photogrammetric Advances**

Utilisation of ADAMTech’s photogrammetric software has been increasing considerably within the mining geotechnical field. Its role in open pit mining for structural mapping is growing as access to high walls becomes restricted for safety reasons. In the past, photogrammetry models have been produced for individual benches for structural mapping in a window mapping format. With the capability for modelling whole bench stacks, structures can now be mapped across an entire pit wall, which in the past has been difficult to accomplish with field mapping alone. With improvements in computing capabilities, and ADAMTech’s software, accurate digital terrain models, overlain with photographs, can be produced for large areas of open pit high walls.

Structures were mapped onto an ADAMTech model as three-dimensional discs, which are a visual representation of the orientation of the fault in three-dimensional space at the location of the modelled disc. In the past, structures that trend across multiple benches have been mapped as a single large disc, which could end up being hundreds of metres in diameter. At Cowal, it was discovered that by mapping large scale structures with a series of smaller discs, normally only a few metres in diameter, the undulation of the structure can be reproduced as it trends across the pit wall.

The modelled structural discs which were mapped in a photogrammetric model in 3DM Analyst were exported in a format which can be imported into Leapfrog Geo. The structural discs were used to produce semi-planar fault meshes that used the orientation of the individual discs to guide the implicit modelling algorithms built into Leapfrog Geo.

**RESPONSE**

Leapfrog Geo allows for structural files to be appended with new data points as they become available. Field mapping and core logging data measurements in a dip/dip direction format can be appended onto the existing structural files to allow data from previous cut backs and logged drill holes to be included in the implicit modelling process. Adds Richard, “As a result, a much more accurate structure can be built that not only reflects what is happening in the current pit walls, but also projected into the rock behind them.”

Figure 1 - A model spanning an area approximately 500m across and 250m high that was photographed and made ready to map in an hour and a half.
The implicit modelling algorithms used in Leapfrog Geo allow this process to be automated, saving many hours of manual modelling time. This time can instead be utilised towards producing a more detailed structural model encompassing numerous structures, which may not have been modelled in the past due to time constraints.”

Richard Battison, Evolution Mining’s Geotechnical Engineer

Pit mapping information is useful for considering the interaction of the different structures, where they can be observed and accessed in the pit walls. Continues Richard, “Any interaction observed between structures can be applied to the structural model in Leapfrog Geo. When applied, the implicit modelling algorithm re-models the structures upon which the relations apply, slicing or constraining the 3D mesh where it is intersected by cross cutting structures.”

A full list of cross-cutting relationships is administered by Leapfrog Geo. Any conflicting cutting relationships in the chronological order of the structure is flagged so it can be rectified by the modeller. This gives the user the luxury of not having to keep track of hundreds of different structural intersection relationships that occur in a large structural model. The user can observe the cutting relationships of structures in the field, as well as in the photogrammetric model, and apply these rules to the Leapfrog Geo mesh without having to go through the other relationships to make sure there is not a conflict.

Figure 2 – Reproducing undulations in the structure.

Figure 3 - An example of before-and-after modelling relationships where they have been applied.

OUTCOME

The speed at which this modelling process can be completed means that geotechnical staff can update their structural model in Leapfrog Geo after a new bench is mined out. Previously-mapped structural discs can be opened in the updated photogrammetric model, after which the newly-modelled discs can be added to account for the newly-uncovered batter faces. Says Richard, “Updating the structural model in this manner means that it can be kept up-to-date continuously, rather than the current practice on most sites, which is to update the model quarterly-to-half yearly or more. By keeping the model up-to-date, structural analyses can be updated against pit designs to foresee possible future instabilities, and remediate them before they are actually mined.”
Updating the structural model in this manner means that it can be kept up-to-date continuously, rather than the current practice on most sites, which is to update the model quarterly-to-half yearly or more. By keeping the model up-to-date, structural analyses can be updated against pit designs to foresee possible future instabilities, and remediate them before they are actually mined.

Richard Battison, Evolution Mining’s Geotechnical Engineer

COMPATIBILITY

The newly-updated structural meshes can be exported as a DTM file in a format which is compatible with most other modelling software packages. Leapfrog provides a free Viewer so that structural meshes can be shared with other stakeholders who may not have access to Leapfrog Geo, for example, drill and blast engineers can use the structural information to adjust blast designs to protect batter faces from extensive blast damage along structural planes.

Concludes Richard, “The combination of ADAM Technology’s 3DM Analyst Mine Mapping Suite and ARANZ Geo’s Leapfrog Geo software to produce structural models has provided the ability to increase the efficiency and accuracy of structural modelling at Cowal Gold Operation. The replacement of manual modelling with implicit modelling has removed a very time consuming process. This ability freed the Geotechnical Engineer to concentrate on the interpretation of the structural model, as well as providing operations Geotechnical staff with the ability to dynamically update the structural model as required.”

ADAM Technology’s Managing Director, Jason Birch, says, “We’re excited to see that the ADAMTech information transfer is so seamless when used in conjunction with Leapfrog Geo.”

Leapfrog’s APAC Regional Director, Karl Howley, says, “We’re focused on ensuring that Leapfrog Geo continues to provide a highly flexible modelling solution for all of our clients. This case study clearly demonstrates Leapfrog’s ability in working with ADAMTech data and making sure clients can quickly make use of the very latest information.”