An integrated and interoperable platform enabling 3D stochastic geological modelling

Testing Loop in the Cobar Basin, a Work in Progress

Ayla Edwards[1], Lachlan Grose[1], Mark Lindsay[2], Helen McFarlane[2] and Laurent Ailleres[1]

[1]Monash University
[2]CSIRO

Background

Geological structures often control mineralisation, however visualising the interaction of theses geometries in 3D space continues to prove challenging. Loop3D offers a novel approach to stochastic 3D geological modelling, through opensource Python libraries: map2loop, LoopStructural and LoopResources. Loop improves the ease and accessibility of modelling by allowing users to create 3D models from digital maps produced in programs such as QGIS. An evidence-based, time-aware approach is applied, meaning that data relating to the most recent events is used to constrain the geometries of older features (Grose et. al, 2020). This enables interpolation algorithms to incorporate multiple deformation and fault events into models.

This poster explores the ongoing implementation of Loop3D across a series of case studies in Cobar NSW, in a collaboration between CSIRO, MinEX CRC and Monash University's Loop3D research team. The project **aims to test and improve the capabilities of map2loop, LoopStructural and LoopResources using opensource geo-survey datasets**.

Workflow

Input Data:

NSW Seamless geology data was cropped, cleansed and consolidated into 3 shapefiles:

1.Geological contacts- polygons

2.Orientation data- point data

3. Fault traces- linear data

Data was upscaled to remove any tiny features (e.g. parasitic folds, insignificant litho-lenses).

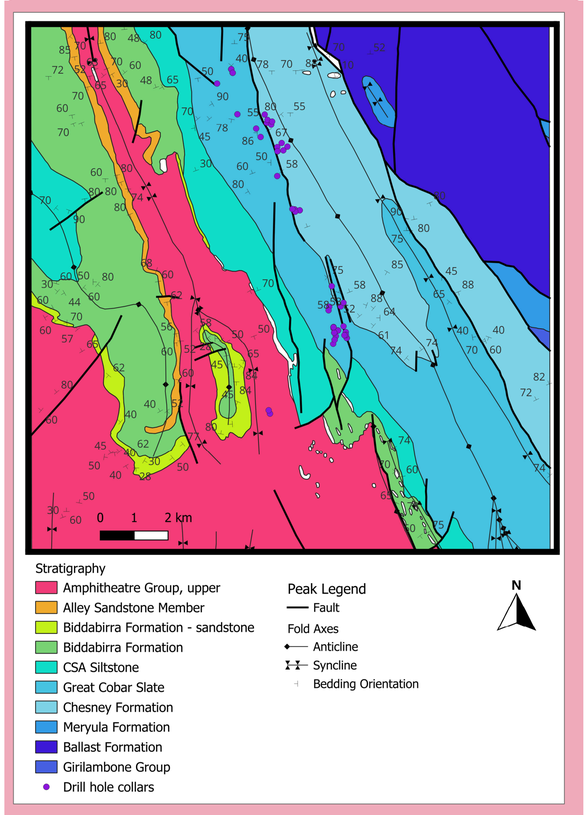

Figure 1: Input map passed to map2loop derived from GSNSW Seamless Geology

map2loop:

Automated pre-processing of **input shapefiles** to produce a .loop3d output file. A stratigraphic column is defined during this stage, basal contacts extracted and unit thicknesses calculated (where possible). No information about the 3rd dimension of faults, nor their offset was calculated by map2loop for this example.

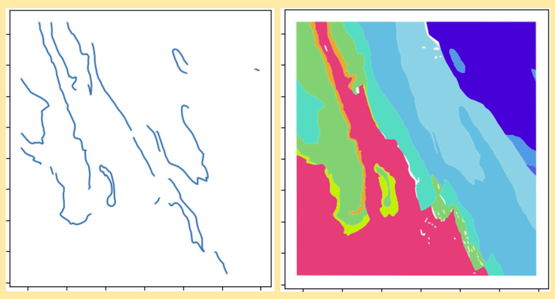

Figure 2: Maps showing the basal contacts extracted (L) by map2loop and the geological units extracted (R)

Table 1: An excerpt of the stratigraphic column calculated by map2loop. Here thicknesses (meters) are calculated using structural measurements (StructuralPoint columns). Values of -1 were unsuccessful

stratigraphic_Order	name	StructuralPoint_mean	StructuralPoint_median
0	Amphitheatre_Group__upper	2679.488288	2679.488288
1	Alley_Sandstone_Member	-1.000000	-1.000000
2	Biddabirra_Formation___sandstone	-1.000000	-1.000000
3	Biddabirra_Formation	1661.873261	1427.281370
4	CSA_Siltstone	1144.034718	610.091281
5	Great_Cobar_Slate	889.799351	552.262750
6	Chesney_Formation	-1.000000	-1.000000
7	Meryula_Formation	-1.000000	-1.000000
8	Ballast_Formation	-1.000000	-1.000000
9	Girilambone_Group	-1.000000	-1.000000

LoopStructural:

The .loop3d output file is read by loopStructural and the **3D model is built** during this stage.

Due to the lack of basal contacts between stratigraphic units, in this example, map2loop struggled to automatically calculate unit thicknesses. These were manually updated. The interpolation scheme used here is the finite difference interpolator (FDI).

Drilling Data:

Cobar's drill core data was extracted from the GSNSW database and desurveyed using code within the LoopResources library. Stratigraphic unit thicknesses were estimated using this data and reincorporated back into the loopStructural model. Stratigraphic surfaces can be built directly from drill hole datapoints. Alternatively these points can be added into the orientation dataset for modelling prior to running map2loop, or be used for model validation.

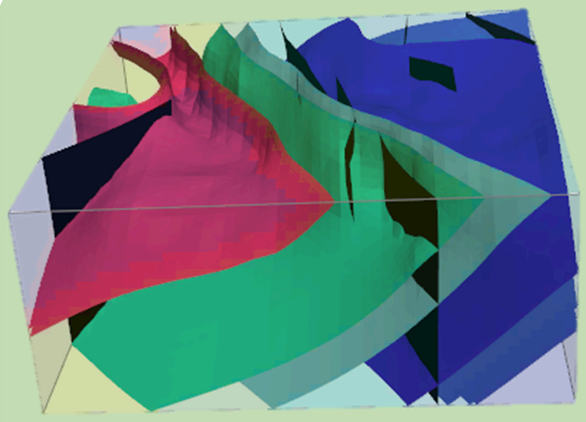

Figure 3: An example of an incomplete 3D Loop model produced using figure 1. Note that the colours of the stratigraphic units are the same across both figures.

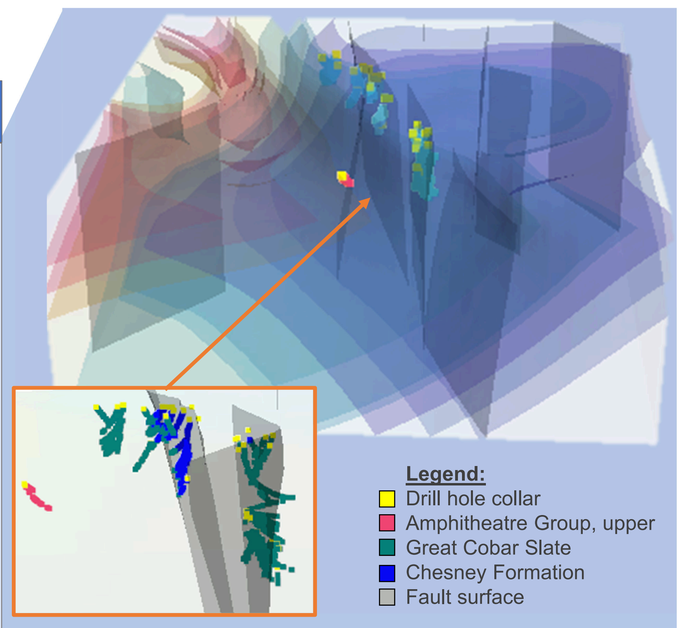

Figure 4: Drill hole data displayed in the 3D model. **Yellow dots** are drillhole collars, with traces segmented into stratigraphic units. There are only 3 stratigraphic units in the drill hole data and all holes fall along a NNW-SS trending fault zone, thus provide limited insight into stratigraphic variability over the region.

Summary

There remains **a lot of work to be done on the various Cobar basin models** (at regional and mine scales). **Key findings** include: segmented fault traces from GSNSW need to be joined into single features prior to modelling and fault offsets input. A lack of structural data within the area of interest makes it difficult to constrain geometries (seen here). Non-conformable geology needs to be manually domained and modelled separately. Map2loop's automated stratigraphic and thickness calculation is highly dependent on data quality. Drilling data can be incorporated into models with ease. Moving forward, simulations will be carried out to test how thickness variations influence modelled geometries and how drilling data can be used to constrain the geometries produced.

Acknowledgments

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