Comparison of predictive deformation and fluid-flow numerical modelling results with subsequent detailed structural mineralisation analysis at Wallaby

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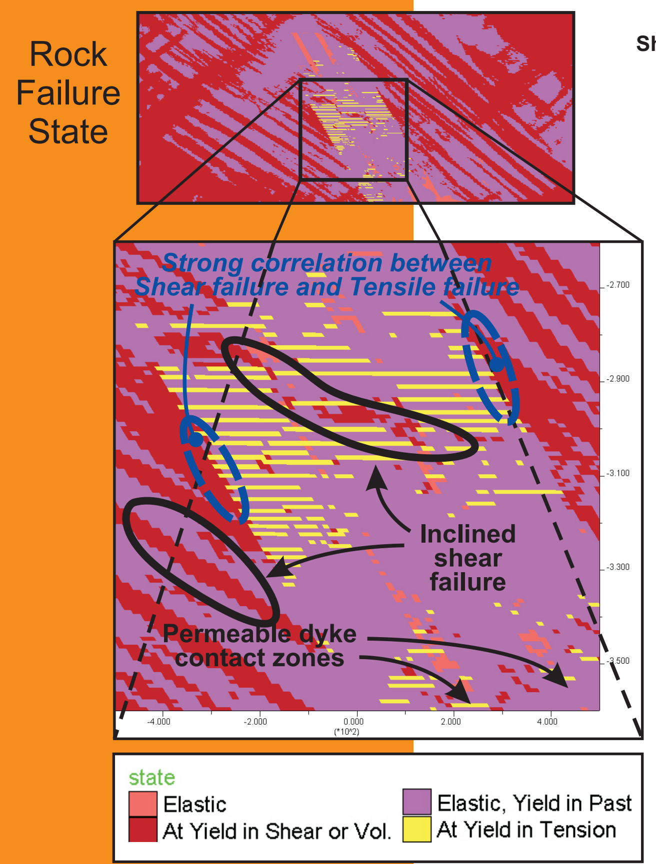
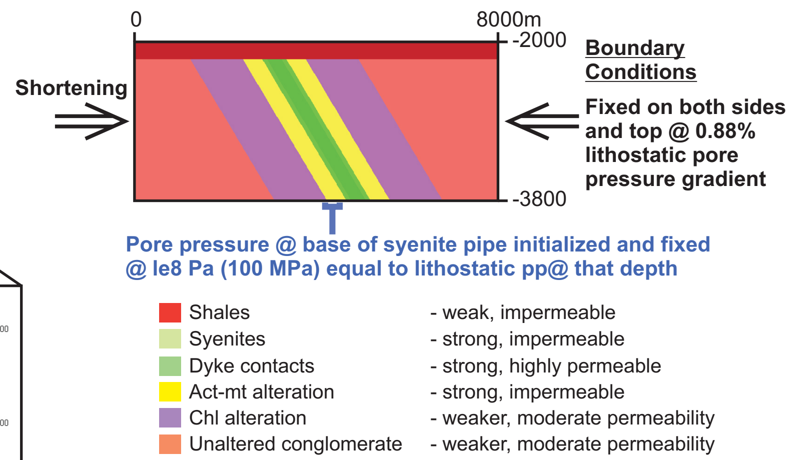
Introduction

2D & 3D deformation & fluid-flow numerical modelling of the Wallaby ore system was undertaken during 2003 (pre-underground development) using all available site data and soft geological models. The aim was to understand what controlled the location and nature of ore host structures at Wallaby, by quantitatively "reverse engineering" the Wallaby ore zones. It was hoped that this would help to predict what may be expected at depth, and help to identify targeting criteria for regional exploration of like ore bodies. In 2005 detailed underground observations and mapping by J. Miller tested many of the predictions made by the modelling, as well as constraining the deformation history of the deposit and identifying that there are two distinct major Au affinities, distinguished by both structural orientation & oxidation state. This flyer presents an overview of the integration of these two studies and highlights the value of early application of numerical modelling and detailed structural analysis.

NUMERICAL MODELLING RESULTS (Warren Potma, CSIRO)

0.21% Bulk Shortening





The slight competency and permeability contrasts between the host Wallaby Conglomerate and slightly stronger, less permeable actinolite-magnetite-epidote-chlorite (AMEC) alteration pipe, drives the segregation between the ore hosting, sub-horizontal, tensile veins and inclined hybrid extensional-shears which are completely confined within the AMEC pipe and the dominance of ductile shear failure outside the pipe.

Modelling indicates that there should be a strong correlation between distributed shear failure outside the pipe and localised tensile failure (and sometimes shear failure) within the pipe.

Observation of ore-type alteration of the more steeply plunging porphyry contacts confirmed their potential to be steep permeable fluid pathways, as predicted/required by the modelling.

Inclined more reduced Au mineralisation is interpreted to be associated with a late stress switch resulting in a change to sinistral-slip transpression. This observation accounts for the one major ore host structural orientation that was not explained by the 2D numerical modelling.

Conclusions

This work demonstrates the value in the the early application of numerical modelling during a research program, and the value in testing multiple "what if scenarios" as was done with the 3-D model. The results of the modelling were largely validated by the underground mapping, which also identified additional complexity and provided new constraints that could be used as inputs to follow-up modelling work.

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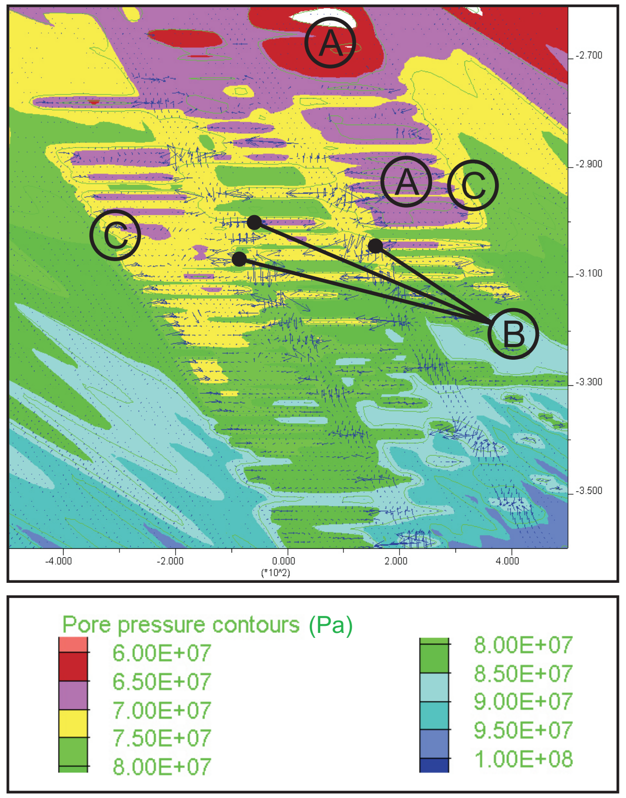
Darcy Fluid Flow Vectors and Pore Pressure Contours

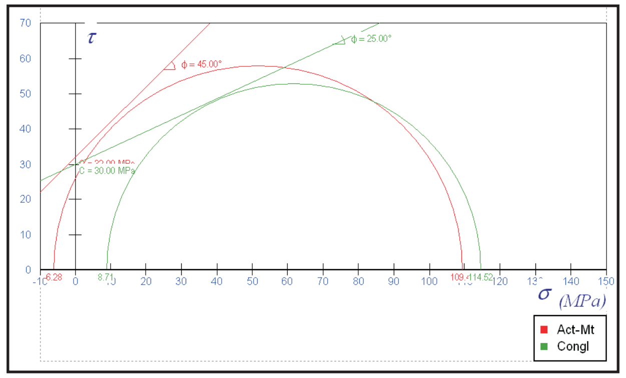


Tensile failure results in:

- (A) Strong perturbation of pore pressure and hydraulic head gradients.
- (B) Rapid fluid flux into dilatant zones from more permeable dyke contact zones (deep magmatic? Fluid source) and from host rock mass (basin fluids?)
- (C) Potential fluid mixing at distal margins of dilatant ore zones.

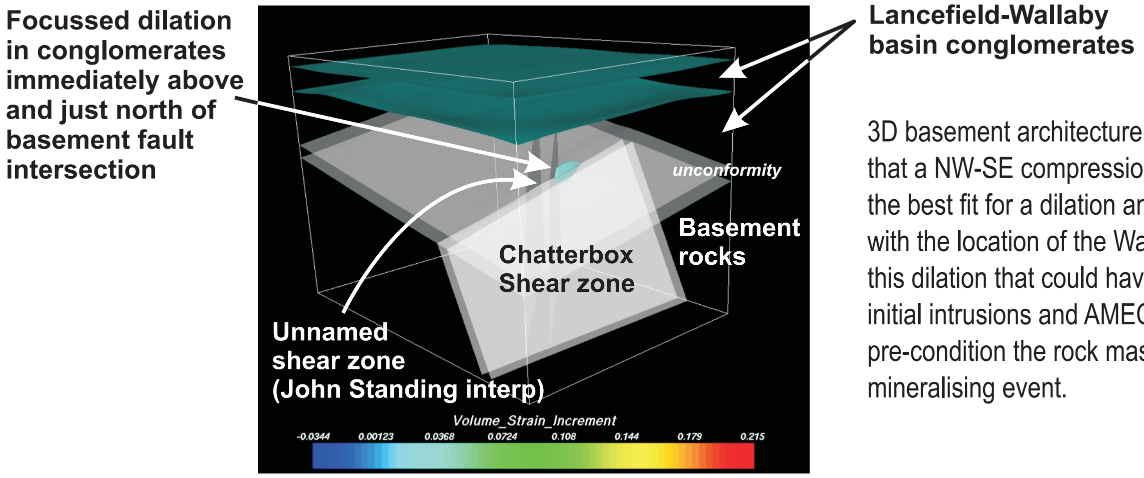
Models predict a requirement for some steep permeable fluid pathways within the otherwise low permeability pipe at the time of mineralisation to facilitate the distributed laddering of lodes throughout the pipe. These fluid pathways were interpreted to be the porphyry contacts (which were modelled as more permeable).

Mohr Coulomb stress behaviour



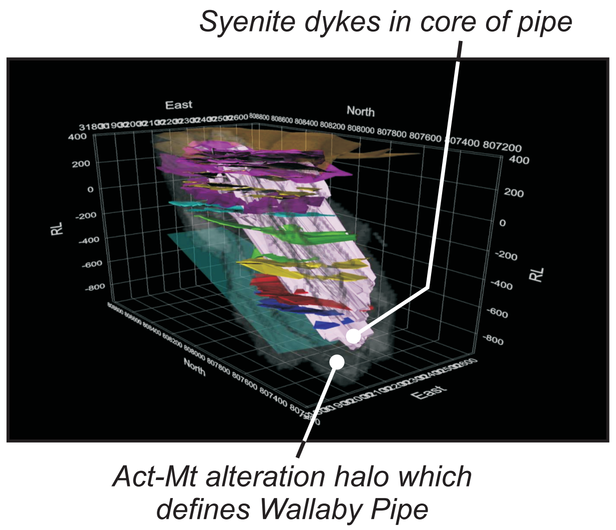
Ore host structures develop after very small amounts of bulk shortening (<0.2%), and require relatively low differential stresses <100 MPa.

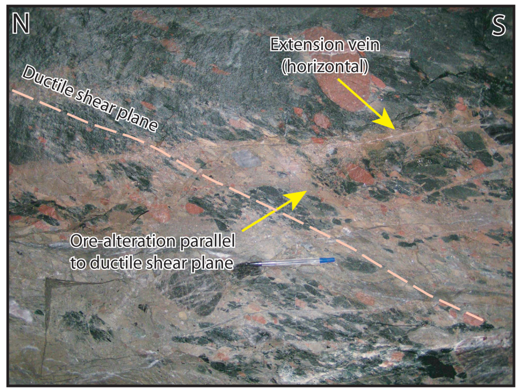
3D model - dilation during NW-SE compression

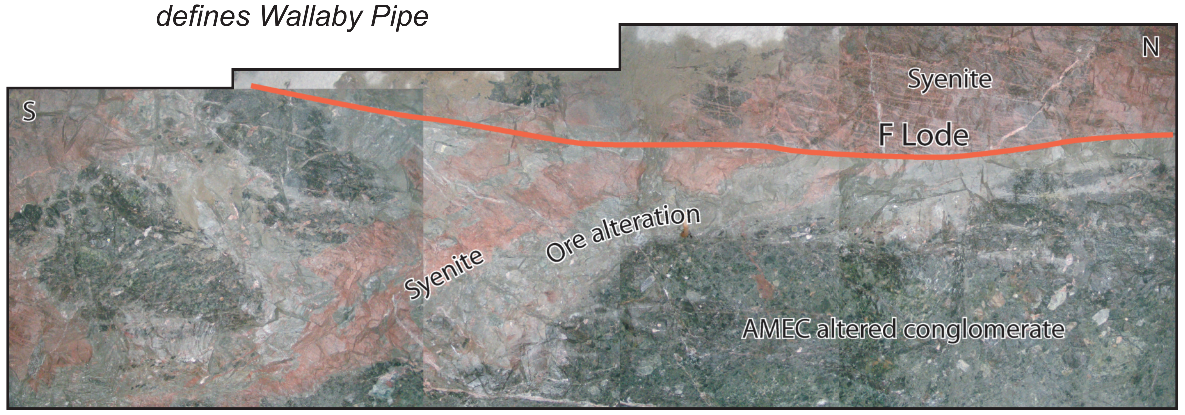


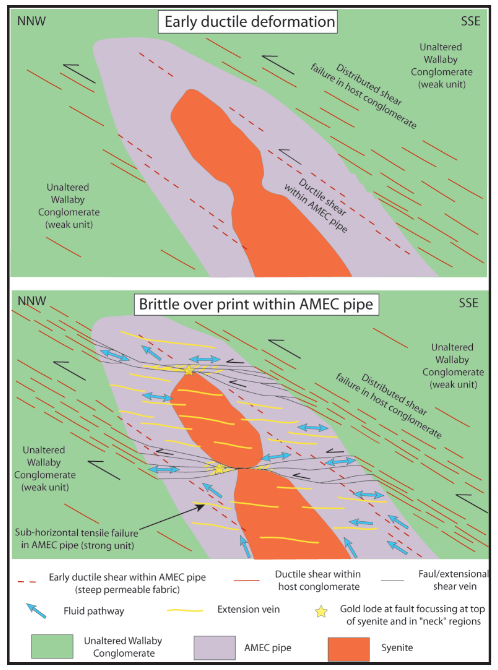
3D basement architecture modelling indicated that a NW-SE compression event resulted in the best fit for a dilation anomaly coincident with the location of the Wallaby Syenite. It is this dilation that could have focussed the initial intrusions and AMEC alteration which pre-condition the rock mass for the later mineralising event.

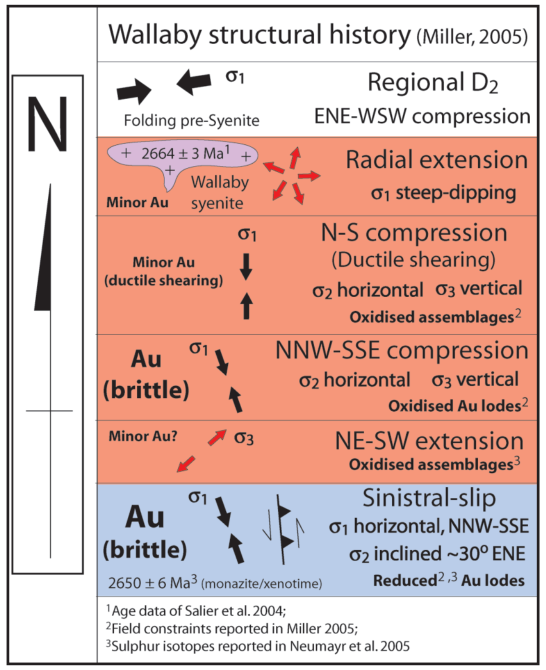
STRUCTURAL SYNTHESIS RESULTS (John Miller, UWA)











The major shallow-dipping ore lodes coincide with necks in the syenite porphyries which are interpreted to localise the shallow dipping shear and sub-horizontal tension vein structures.

Top to the NNW displacement on the main lode structures is generally minor, but is greatest in the focussed structures near the porphyry necks, and more distributed across multiple structures at the AMEC margins.

Mapping identified a set of early, localised, moderate-steeply SSE dipping zones of high shear strain within the AMEC pipe (predicted by modelling). These were observed to be altered with ore stage alteration assemblages thus are interpreted to have acted as steeper linking fluid pathways during the mineralisation event.