

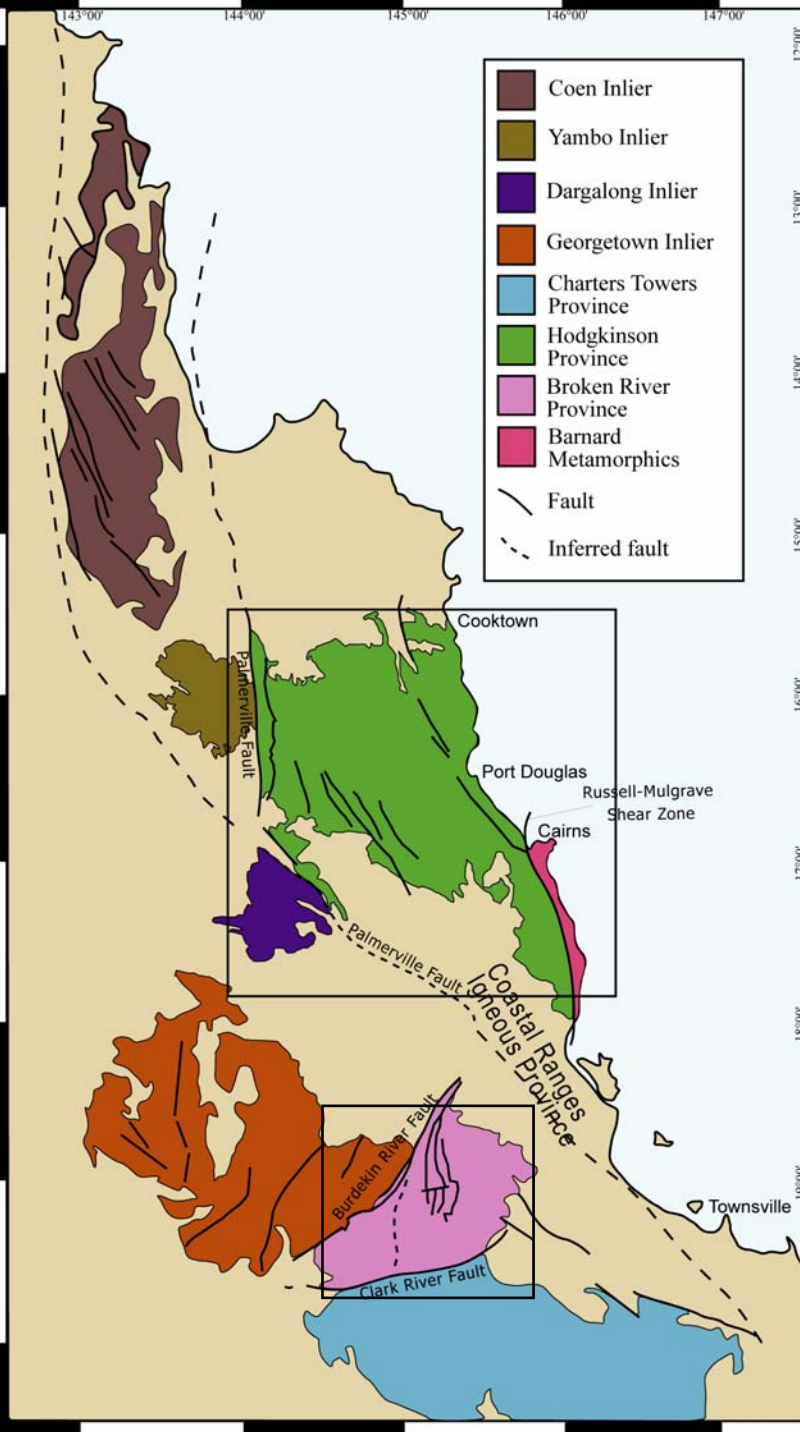
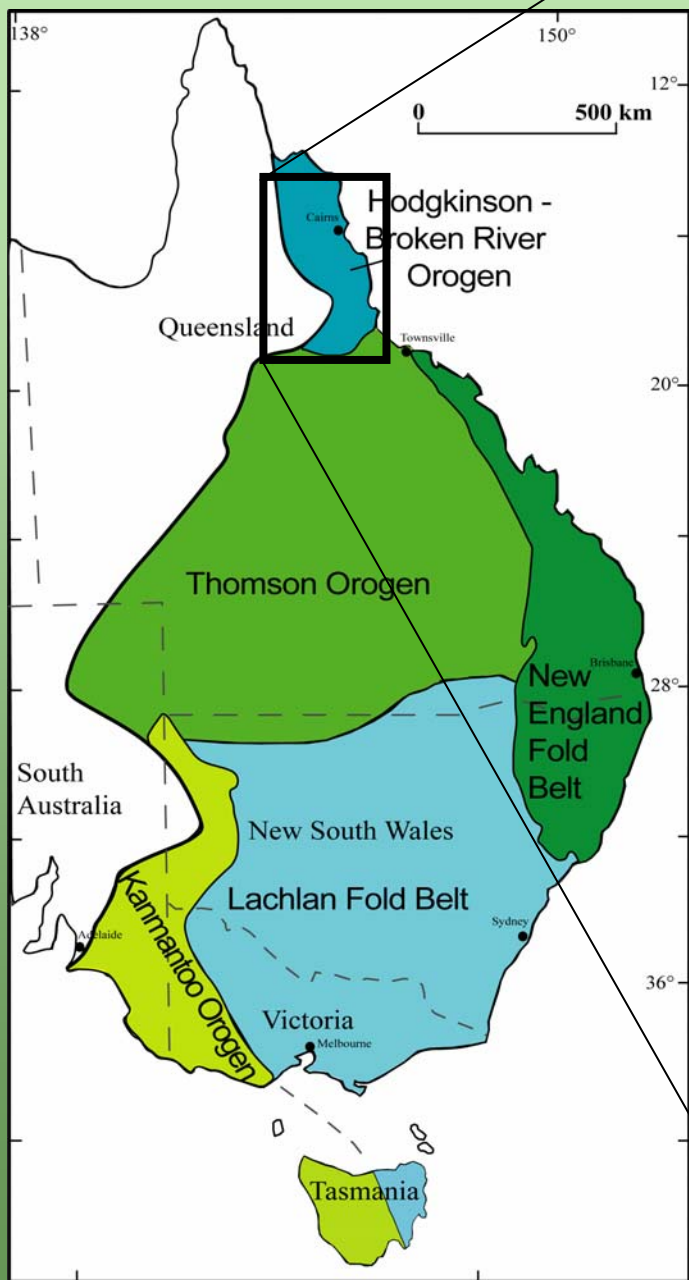
**Coupled deformation and fluid flow  
modeling of a listric fault geometry:  
implications for the Palmerville  
Fault, northeast QLD, Australia**

-

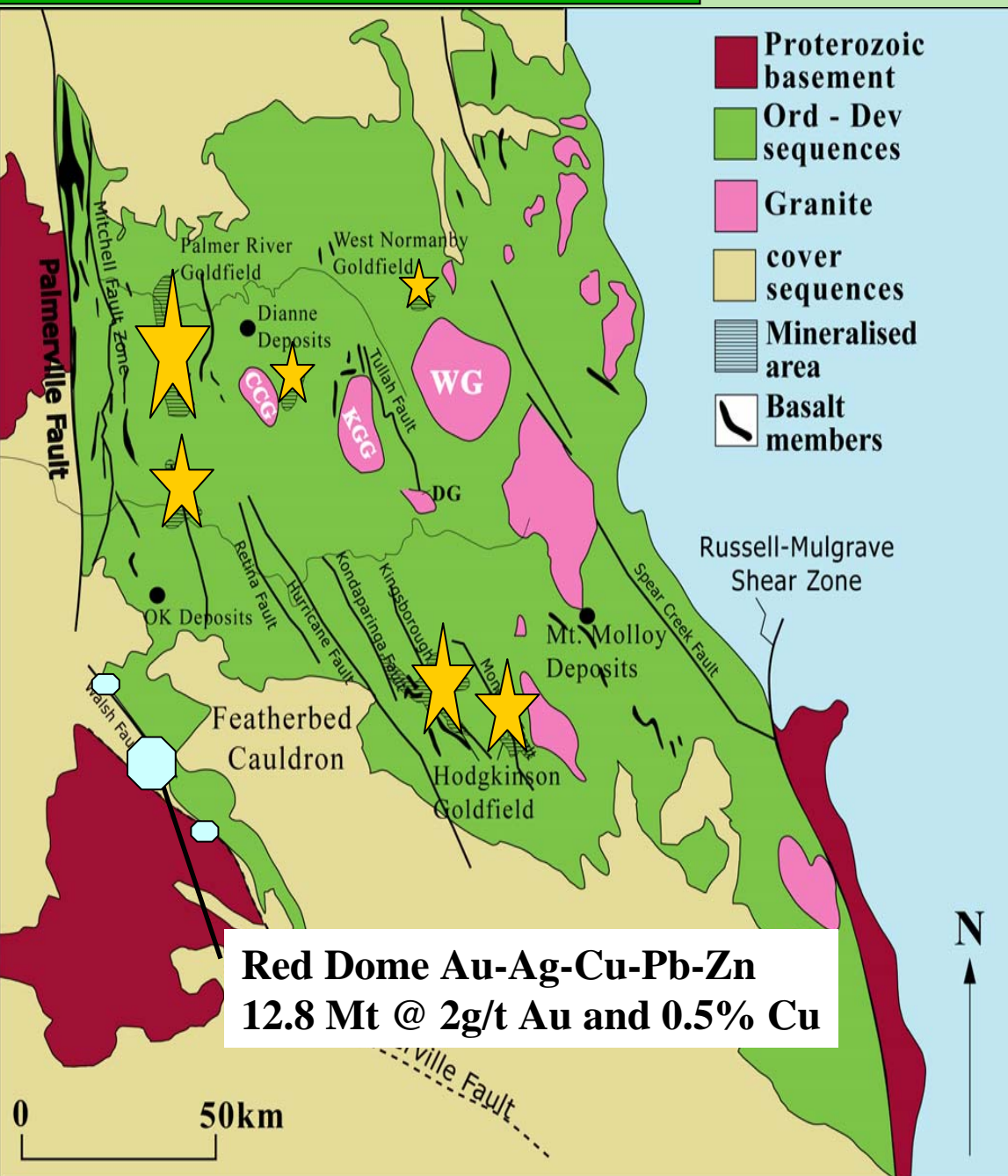
**preliminary results**

**Ivo Vos**  
**Warren Potma, Frank Bierlein**

# Preface



# Preface



**Red Dome Au-Ag-Cu-Pb-Zn  
12.8 Mt @ 2g/t Au and 0.5% Cu**

- Terrane boundary between Proterozoic and Palaeozoic sequences

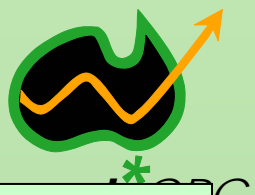
- No direct association with mineralisation along northern section

- Significant ~335 Ma orogenic gold mineralisation associated with subparallel secondary faults

- Southern SE-striking section spatially associated with Permo-Carboniferous granites that host porphyry and skarn deposits (e.g. Red Dome)

## Inferences from spatial and temporal distribution of magmatism and gold deposits:

1. North section of Palmerville Fault remains barren at all times suggesting absence of significant fluid flow
2. Structurally controlled gold deposits are associated with sub-parallel (N)NW-striking faults  
*Under what conditions does fluid flow focus on these faults while not activated along northern part of the Palmerville Fault ??*
3. Magmatism is spatially associated with southern NW-SE striking portion of the fault  
*Under what conditions does significant dilation and extension occur along this portion of the fault ??*
4. Temporal discordance between magmatism and gold deposition infers that controlling processes may be decoupled (i.e. change in far-field stress orientation)



**What did we set out to do?**

- 1. Create a number of simple 3D model geometries that can be used to interrogate the control of a listric fault geometry on fluid flow and deformation**
  - \* Vary number of active faults**
  - \* Vary lithological distribution and characteristics**
- 2. Apply a variety of boundary conditions to our geometry to understand effects of:**
  - \* Compression vs. transpression**
  - \* Pore fluid pressure variations**
  - \* Forced fluid flux through faults or sediments**
- 3. Interrogate results from a generic viewpoint and compare results to NE QLD situation**

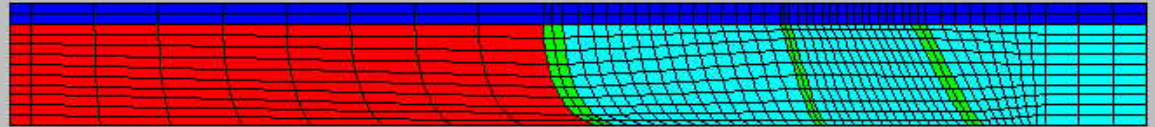


## Geometries

### Listric vs Planar fault

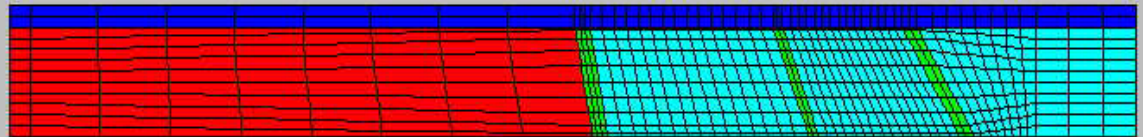
#### Block Group

- TopBlocks
- ProtCrysBas\_ext
- Faults\_ext
- PalBasSed\_ext



#### Block Group

- TopBlocks
- ProtCrysBas\_ext
- Faults\_ext
- PalBasSed\_ext



## Geometries

### 1. Three faults, two lithologies, 0.5 x lithostatic pp

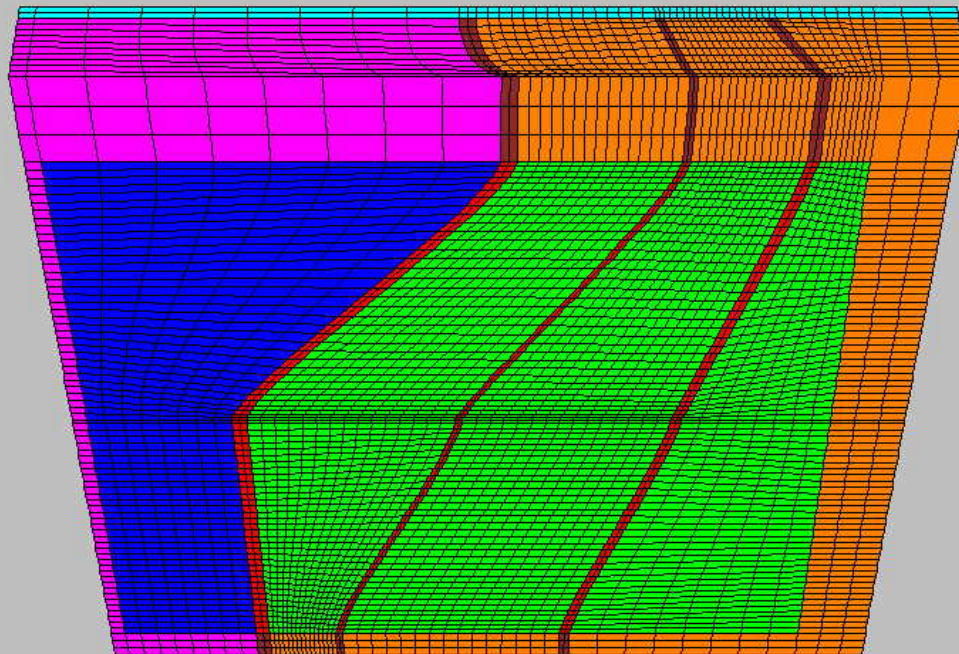
*FLAC3D 2.30*

Step 1500 Model Perspective  
15:17:14 Fri Feb 25 2005

Center:	Rotation:
X: 2.800e+004	X: 320.000
Y: 3.000e+004	Y: 0.000
Z: -1.550e+004	Z: 0.000
Dist: 1.848e+005	Mag: 1
	Ang: 22.500

#### Block Group

ProtCrysBas
Faults
PalBasSed
TopBlods
ProtCrysBas_ext
Faults_ext
PalBasSed_ext



## Geometries

### 2. One fault (PF), two lithologies, 0.5 x lithostatic pp

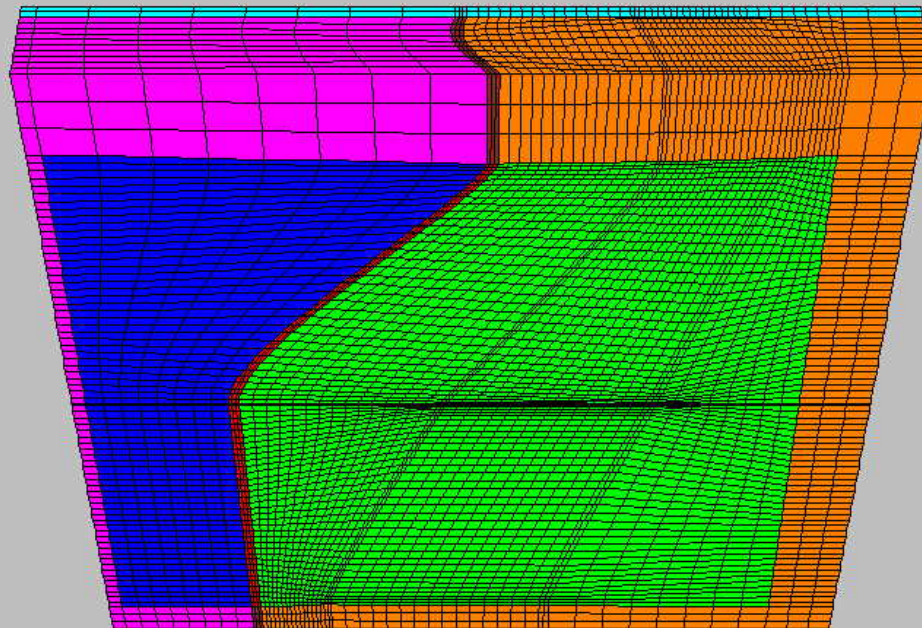
#### *FLAC3D 2.30*

Step 1500 Model Perspective  
15:23:20 Fri Feb 25 2005

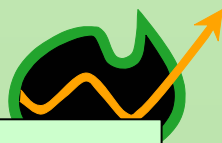
Center:	Rotation:
X: 2.800e+004	X: 320.000
Y: 3.000e+004	Y: 0.000
Z: -1.550e+004	Z: 0.000
Dist: 1.848e+005	Mag.: 1
	Ang.: 22.500

#### Block Group

■	ProtCrysBas
■	Faults
■	PalBasSed
■	TopBlocks
■	ProtCrysBas_ext
■	Faults_ext
■	PalBasSed_ext







## Geometries

### 3. Two and a half faults, two lithologies, 0.5 - 0.8 x lithostatic pp

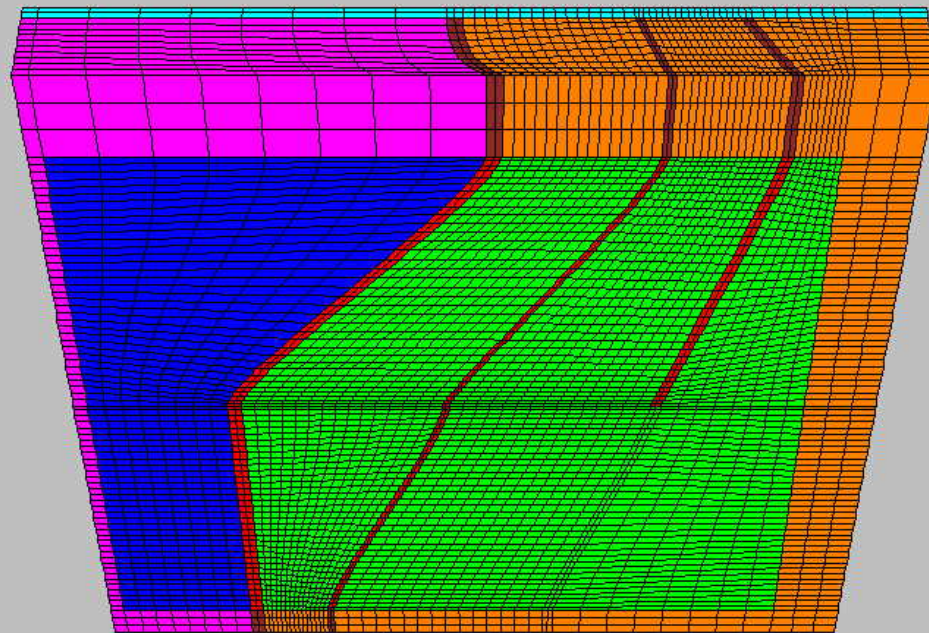
#### *FLAC3D 2.30*

Step 1500 Model Perspective  
15:18:03 Fri Feb 25 2005

Center:	Rotation:
X: 2.800e+004	X: 320.000
Y: 3.000e+004	Y: 0.000
Z: -1.550e+004	Z: 0.000
Dist: 1.848e+005	Mag.: 1
	Ang.: 22.500

#### Block Group

Blue	ProtCrysBas
Red	Faults
Green	PalBasSed
Cyan	TopBlocks
Magenta	ProtCrysBas_ext
Brown	Faults_ext
Orange	PalBasSed_ext



## Geometries

### 4. Two and a half faults, three lithologies, 0.5 x lithostatic pp

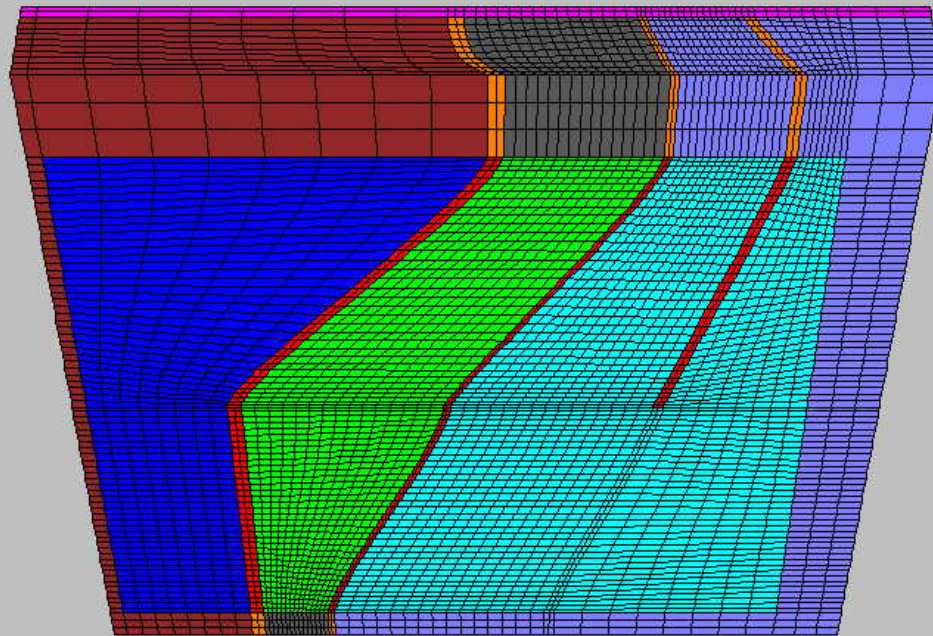
#### FLAC3D 2.30

Step 1500 Model Perspective  
15:19:59 Fri Feb 25 2005

Center:	Rotation:
X: 2.800e+004	X: 320.000
Y: 3.000e+004	Y: 0.000
Z: -1.550e+004	Z: 0.000
Dist: 1.848e+005	Mag.: 1
	Ang.: 22.500

#### Block Group

ProtCrysBas
Faults
ChilBasLim
PalBasSed
TopBlocks
ProtCrysBas_ext
Faults_ext
ChilBasLim_ext
PalBasSed_ext



## Geometries

### 5. No faults, three lithologies, 0.5 x lithostatic pp

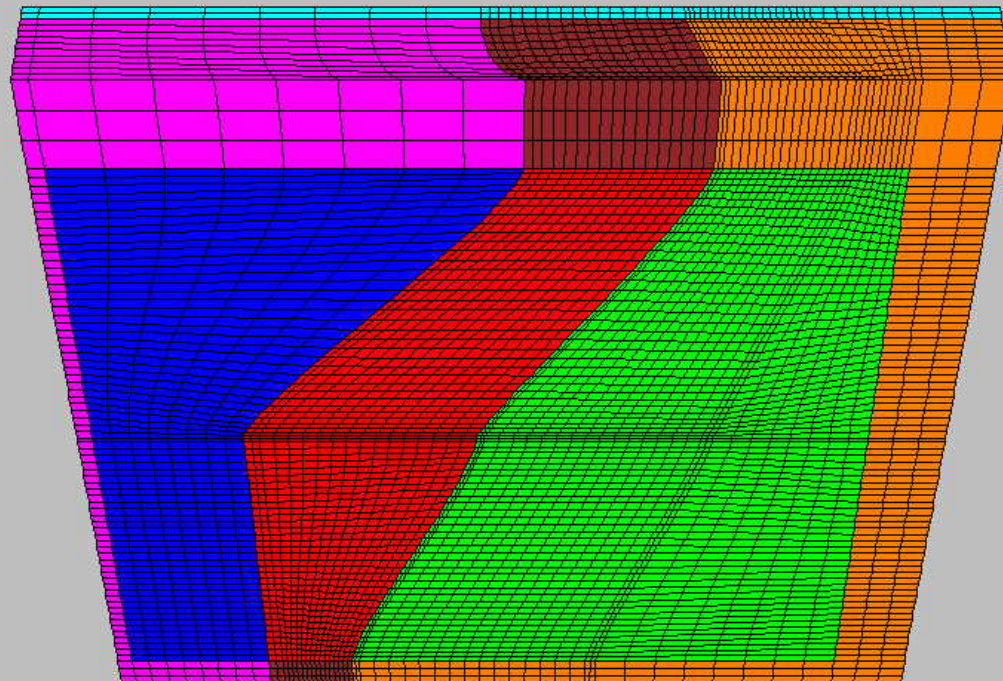
FLAC3D 2.30

Step 1500 Model Perspective  
14:58:07 Wed Mar 02 2005

Center:      Rotation:  
X: 2.800e+004 X: 320.000  
Y: 3.000e+004 Y: 0.000  
Z: -1.550e+004 Z: 0.000  
Dist: 1.848e+005 Mag.: 1  
Ang.: 22.500

#### Block Group

ProtCrysBas  
ChilBasLim  
PalBasSed  
TopBlocks  
ProtCrysBas\_ext  
ChilBasLim\_ext  
PalBasSed\_ext





## Geometries

### 6. One fault, two lithologies + basalt layers

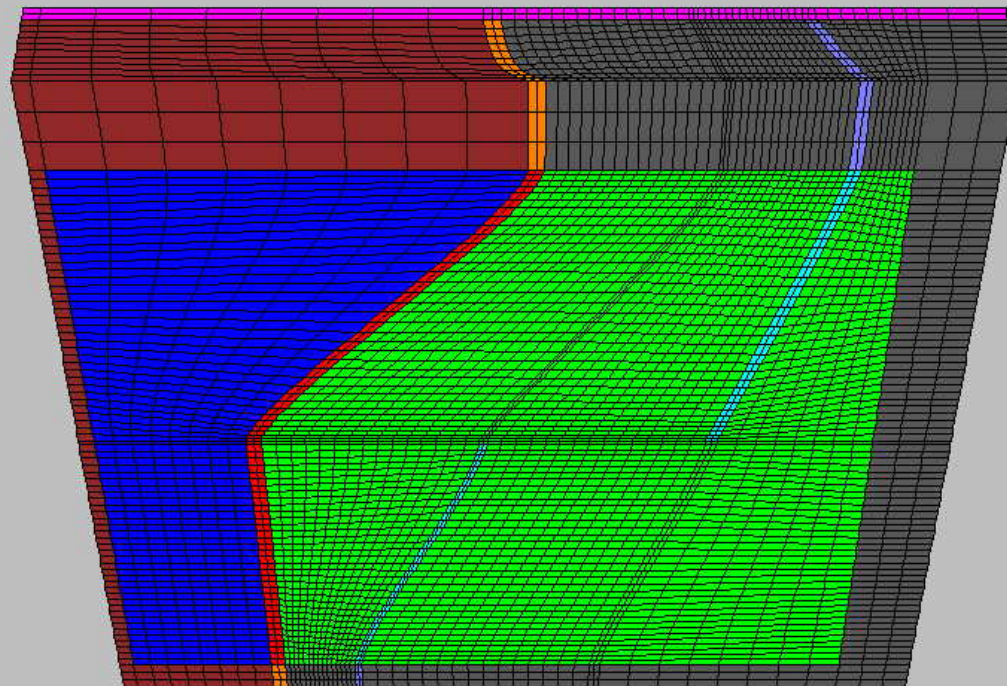
*FLAC3D 2.30*

Step 1500 Model Perspective  
16:06:34 Wed Mar 02 2005

Center:	Rotation:
X: 2.800e+004	X: 320.000
Y: 3.000e+004	Y: 0.000
Z: -1.550e+004	Z: 0.000
Dist: 1.848e+005	Mag.: 1
	Ang.: 22.500

#### Block Group

ProtCrysBas
Palmerville
PalBasSed
Basalt
TopBlocks
ProtCrysBas_ext
Palmerville_ext
PalBasSed_ext
Basalt_ext







## Initial model conditions (equilibrium file):

- **Burial depth of 12.5 km**
- **Metamorphic devolatilization provides fluid source**  
(Inferred from fluid inclusion studies of gold deposits)

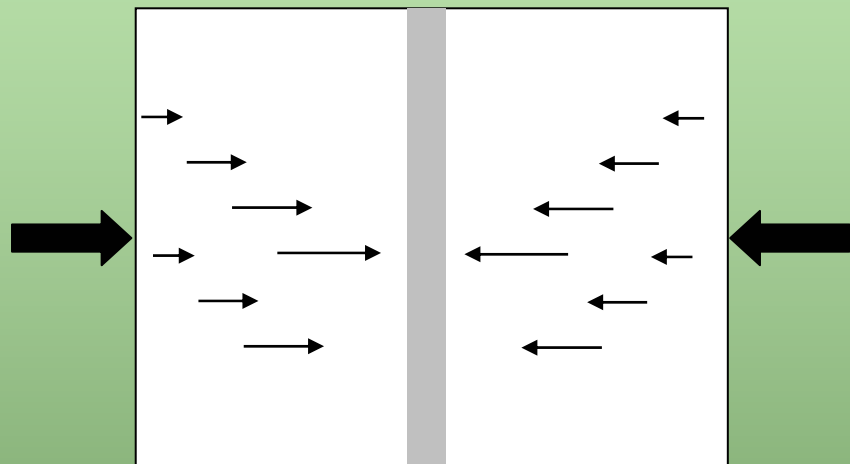
## Deformation and fluid flow conditions:

- **E-W compression**
- **E-W compression with strike-slip component**
- **Even fluid influx at bottom of model**
- **Forced fluid influx through sediments or faults**

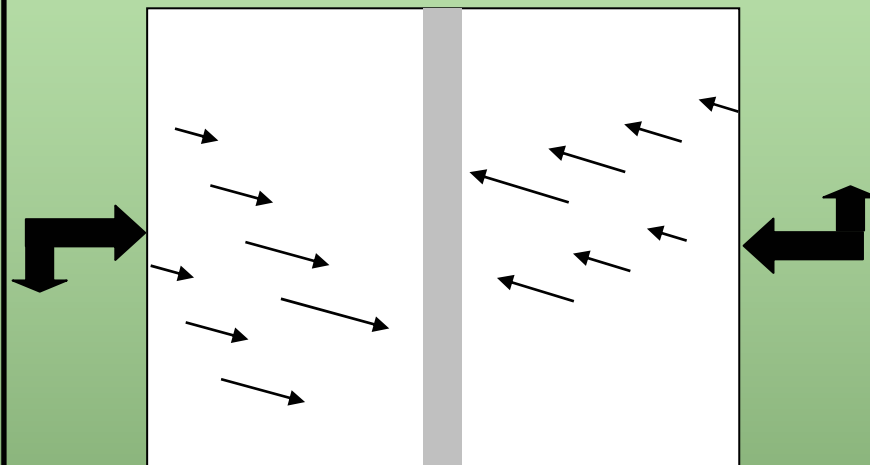
.....combined with various geometries

# Modelling setup

pure shear



pure shear + simple shear  
(sinistral)



strike-slip is set 0.5 x pure shear

## As compared to simple shear / dextral strike slip (note central zone)

### FLAC3D 2.30

Step 1500 Model Perspective  
19:07:52 Tue Mar 01 2005

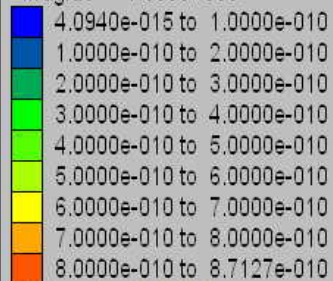
Center:	Rotation:
X: 2.800e+004	X: 90.000
Y: 3.000e+004	Y: 0.000
Z: -1.550e+004	Z: 0.000
Dist: 1.689e+005	Mag.: 1
	Ang.: 22.500

Plane Origin:	Plane Normal:
X: 0.000e+000	X: 0.000e+000
Y: 0.000e+000	Y: 0.000e+000
Z: -1.850e+004	Z: 1.000e+000

### Contour of Velocity Mag.

Plane: on

Magfac = 1.000e+000

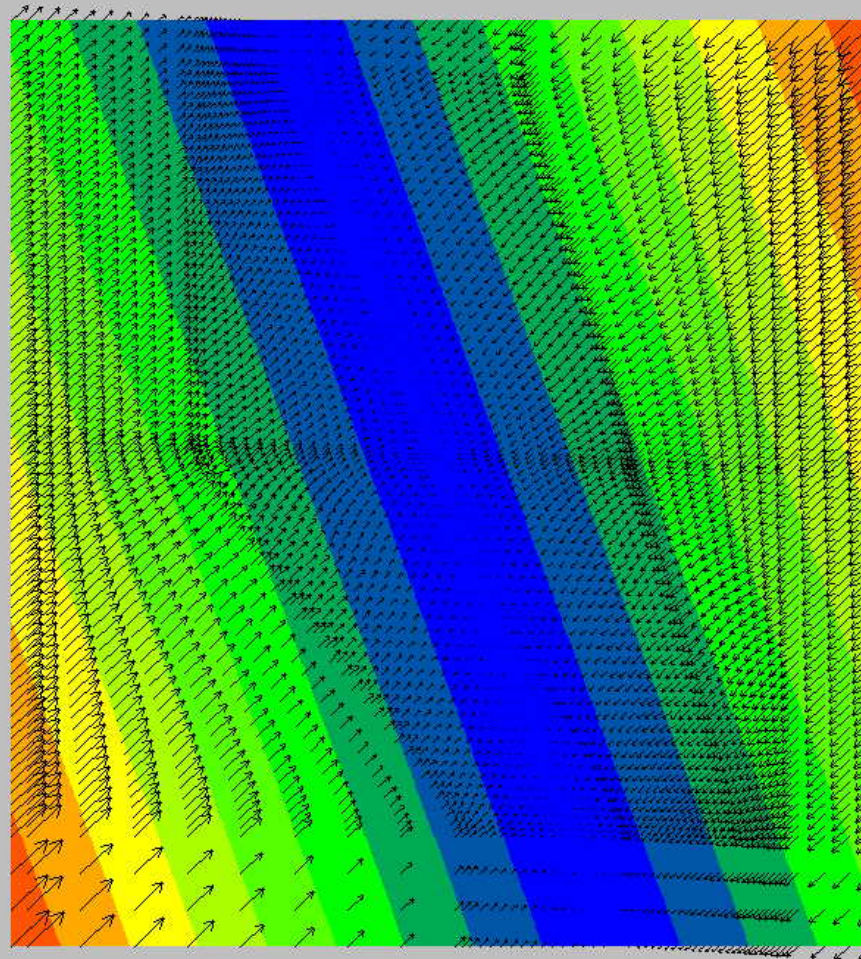


Interval = 1.0e-010

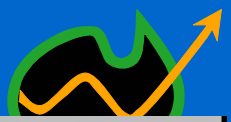
### Velocity

Plane: on

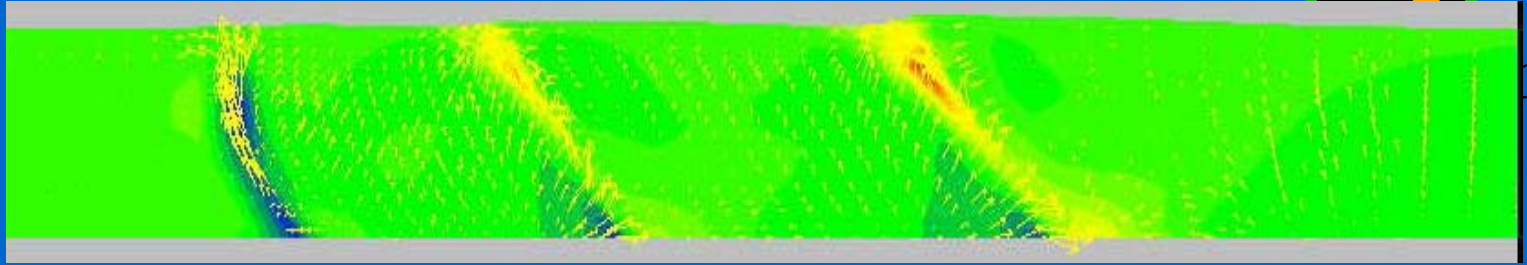
CSIRO  
Warren Potma



# Prelim results

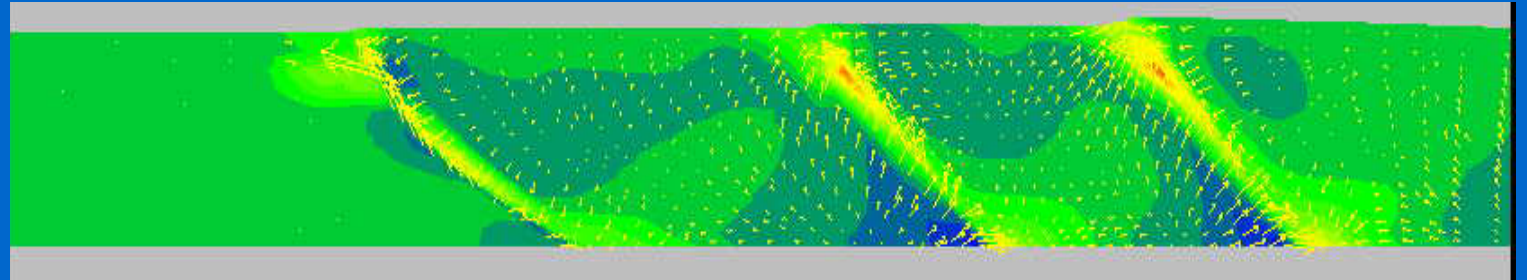


North



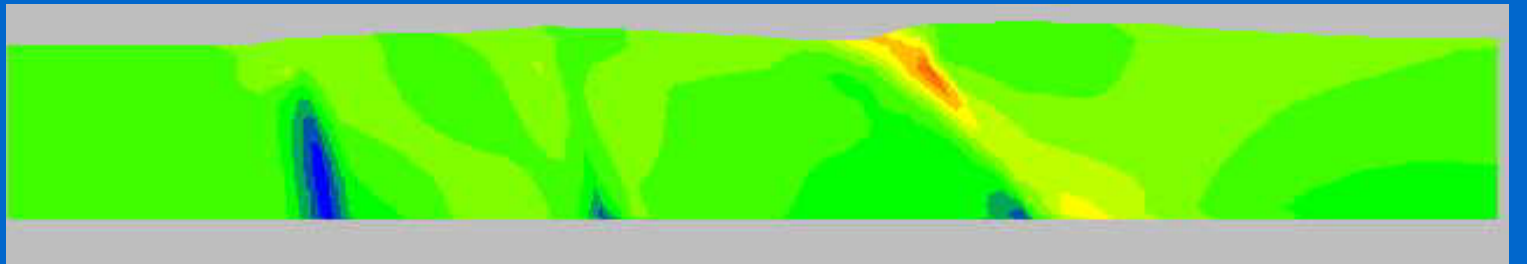
Listric

South



## Dilation

North



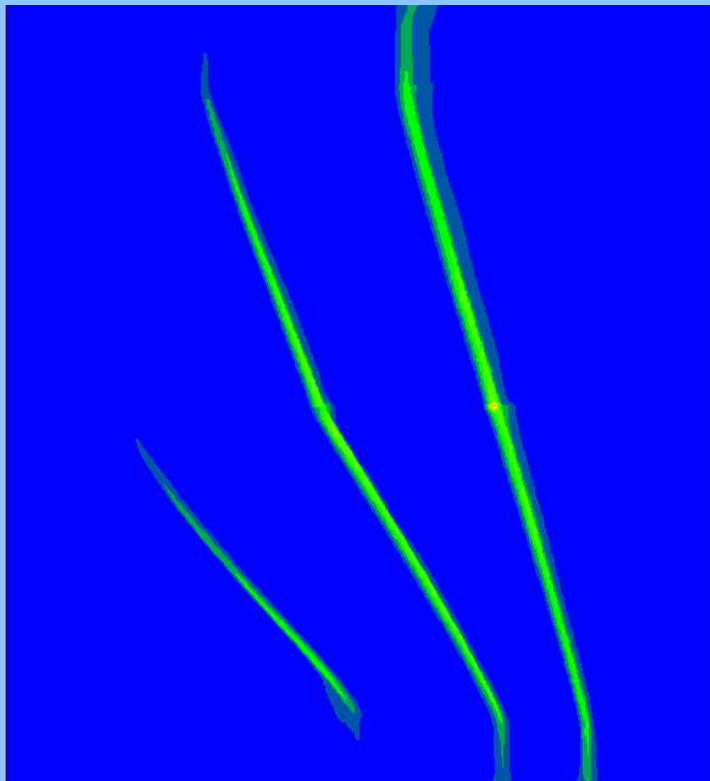
Planar

South

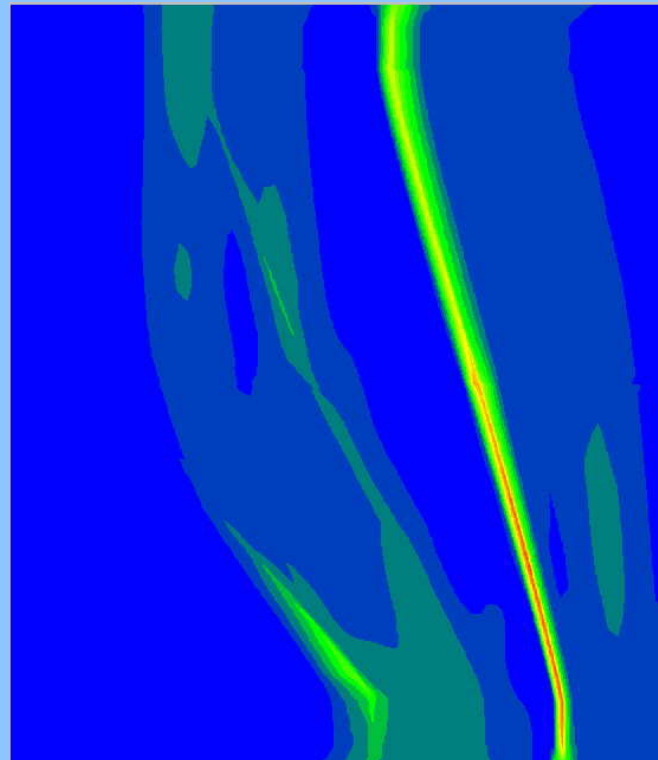




## Shear Strain



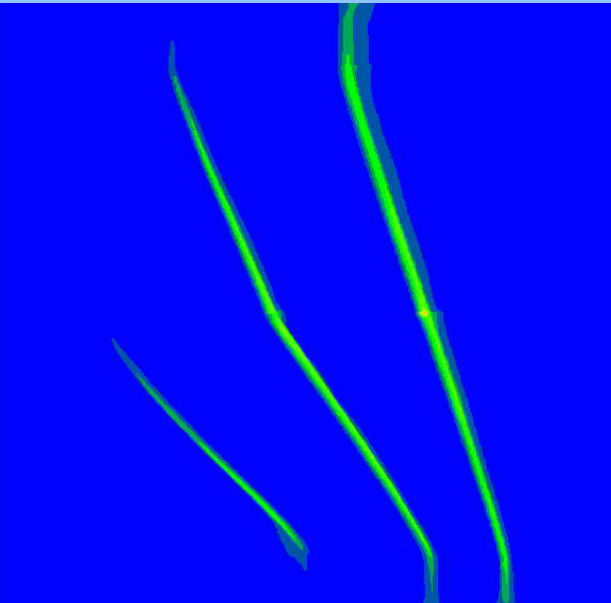
Listric



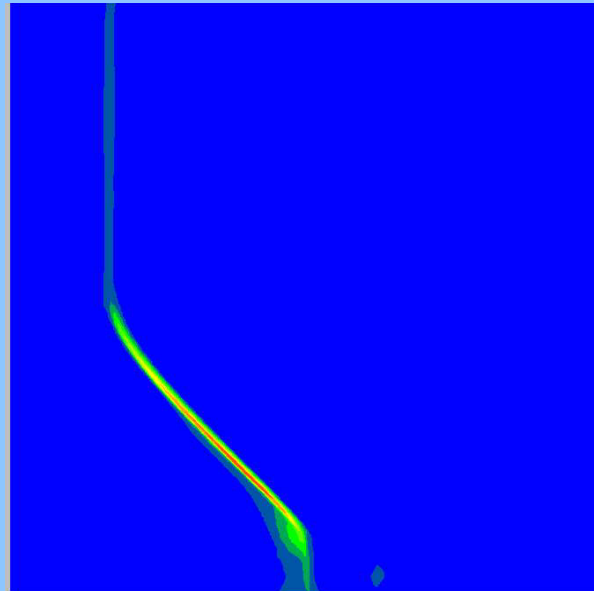
Planar

## Shear Strain

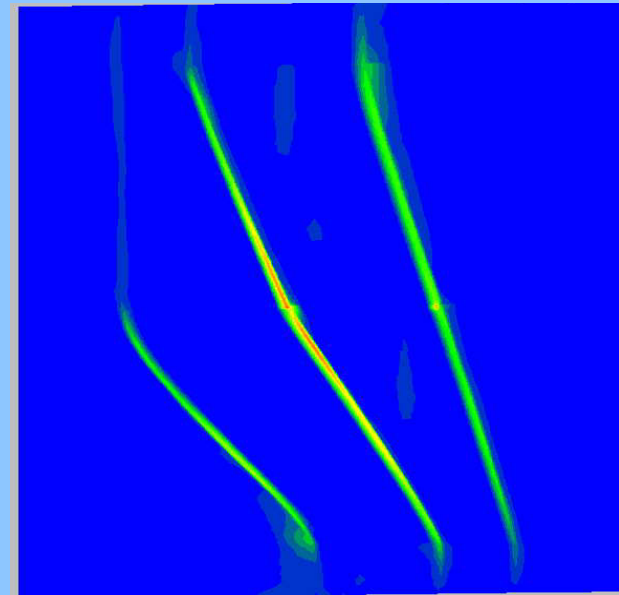
Listric



Three faults – pure shear



One fault – pure shear

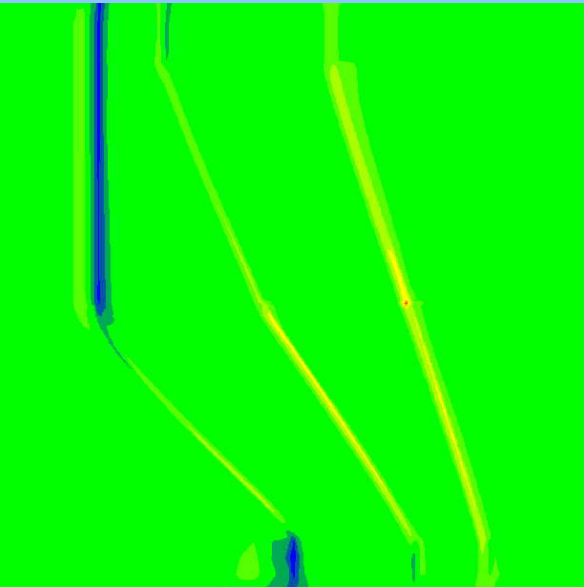


Three faults – simple shear

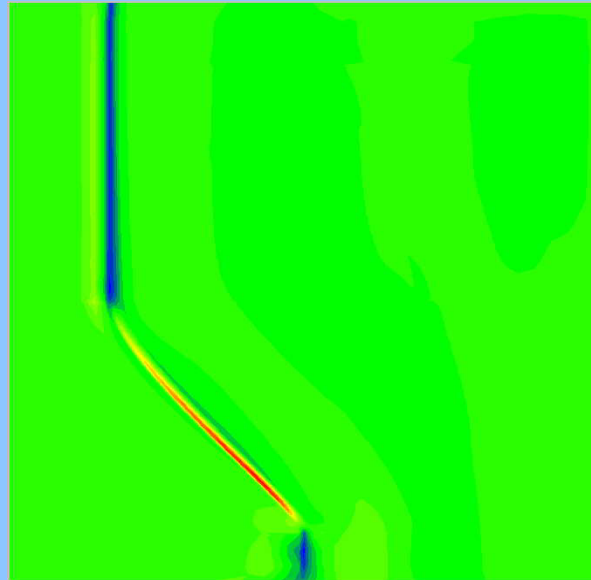


## Dilation

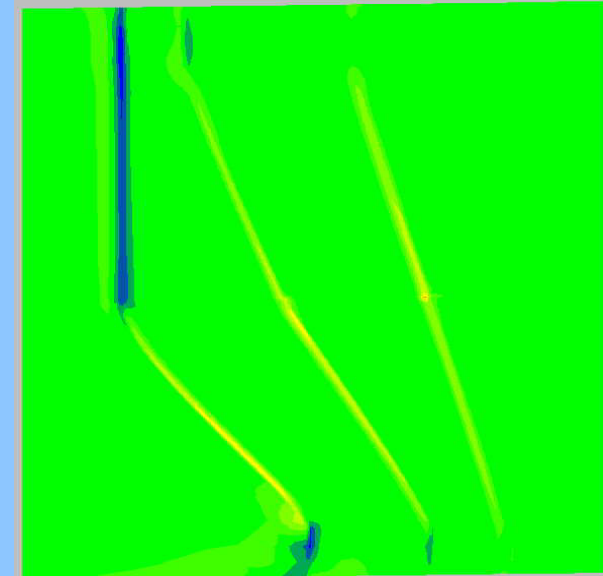
Listric



Three faults – pure shear



One fault – pure shear

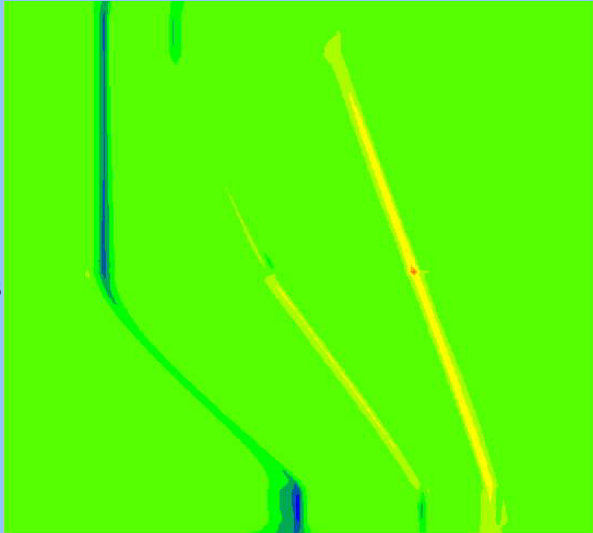


Three faults – simple shear



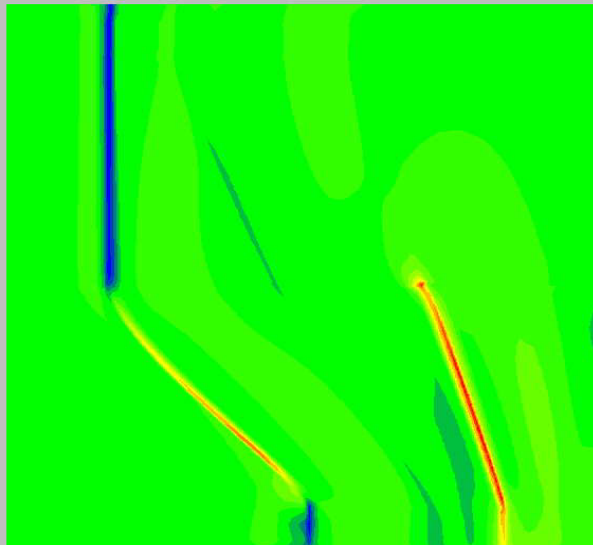
Listric – three lithologies

Three faults



→ pure shear ←

No faults



↘ simple shear ↗





# Thanks!!

**Special thanks to Warren, Peter, Thomas, Heather and Alison  
for their contributions to this work**