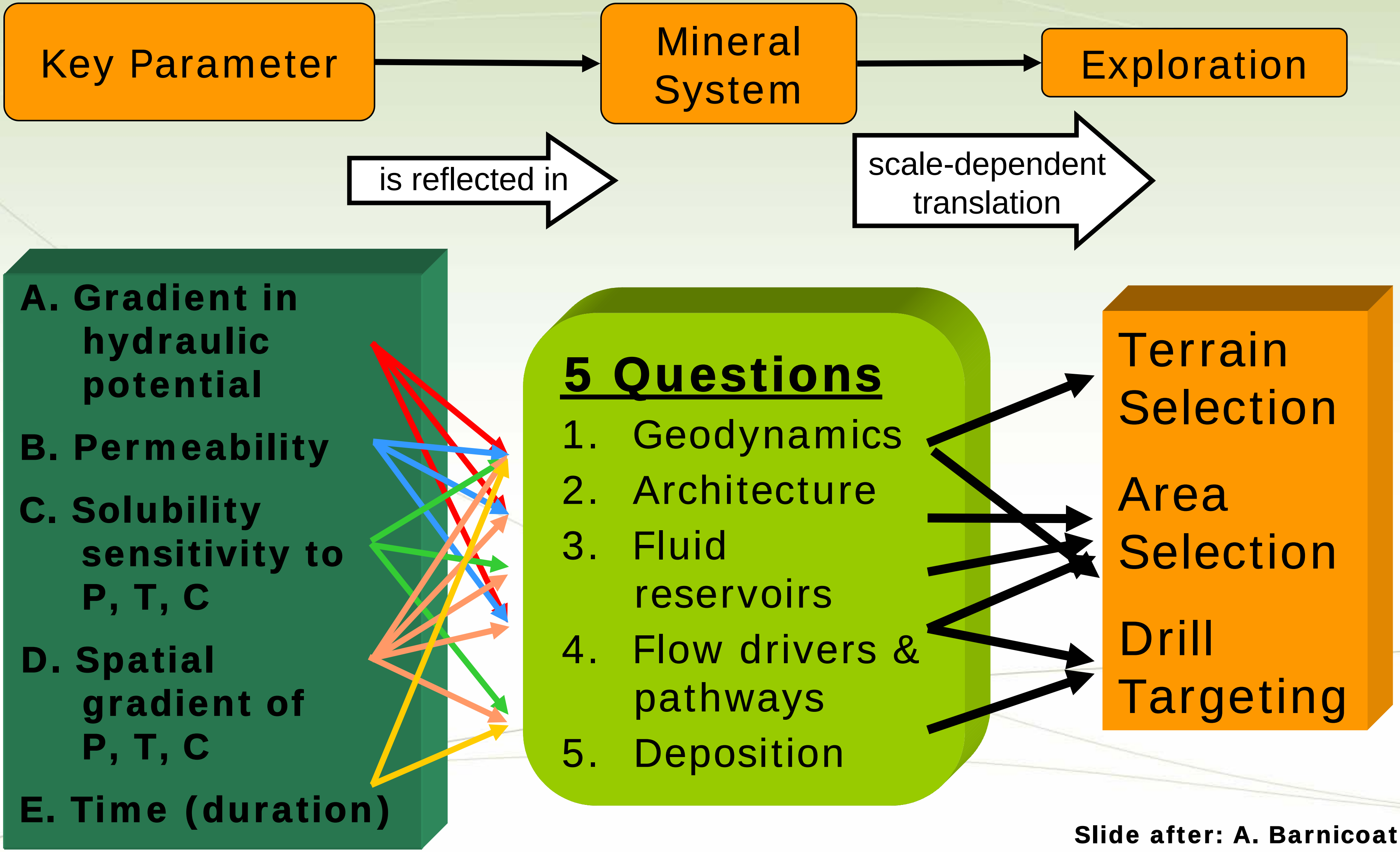
Enabling Technologies

3D Architecture

Why build 3D geological models?



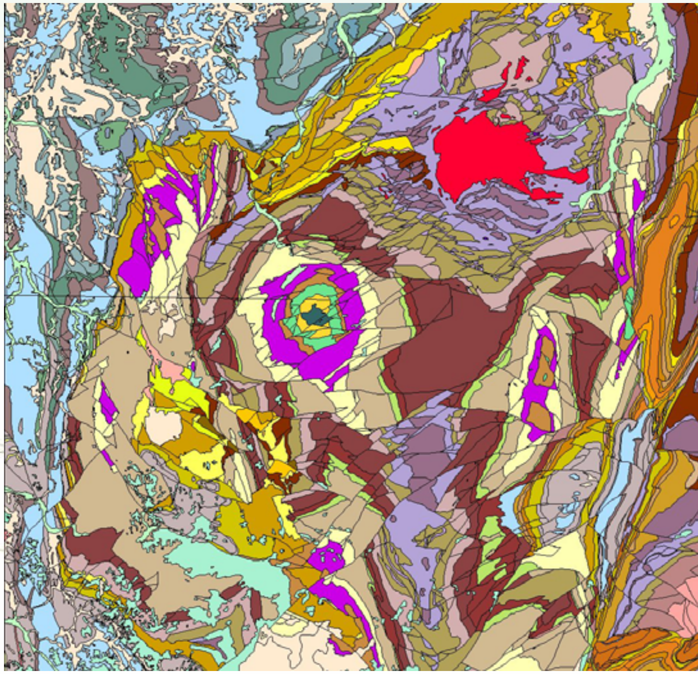
Slide after: A. Barnicoat

What is a 2D model?

An interpreted simplified representation of (interpreted) "facts".

Built by interpolating interpretation between observation points!

Degree of uncertainty dependent on:
- **Scale**
- **Authors (topical / model driven),**
- **Coverage area and quality of coverage**

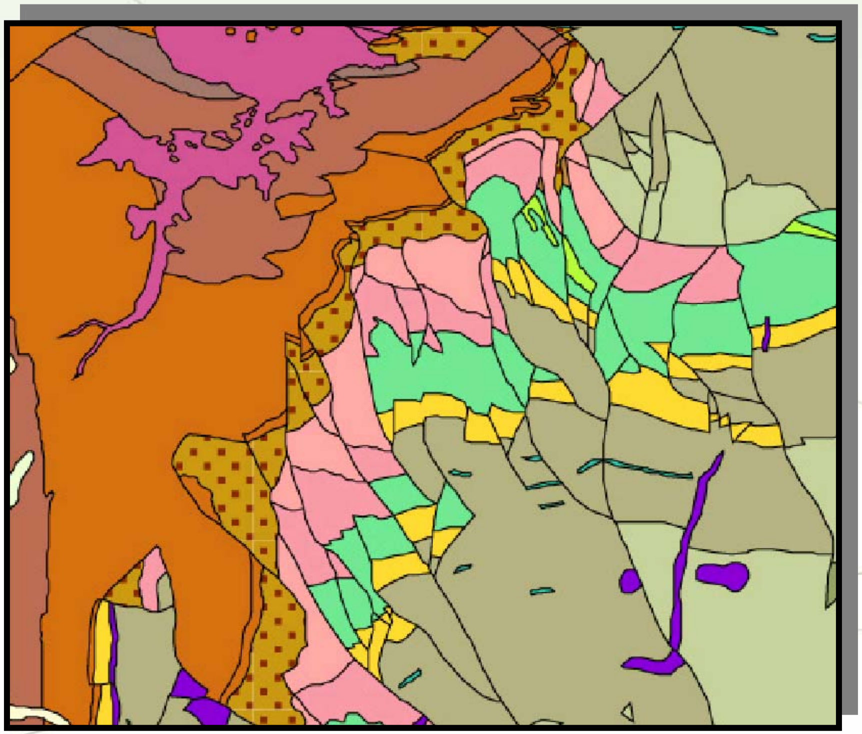


Slide after: L. Ailleres

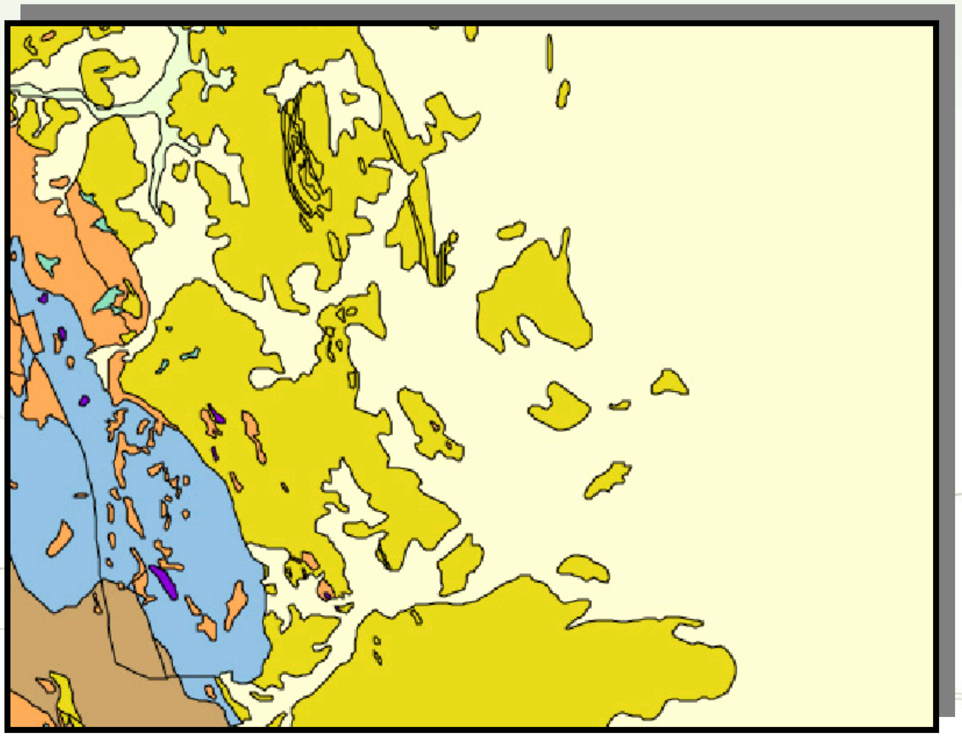
Slide after:
Henson 2006

Solid geology

A detailed solid geology
simplification may be required



A detailed solid geology
a new solid geology must be
Constructed from all available data



Solid geology

Rationalize what you do!
  simplify, minimize, homogenize

Understand relationsships!
  structures, lithologies

Area & Scale

Conformity

Finalize

The complexity of the final solid geology should reflect the time constraints of the project and its directives

Slide after: L. Ailleres

What is a 3D model?

An interpreted simplified representation of (interpreted) "facts".

Built by interpolating interpretation between observation points!

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- Scale
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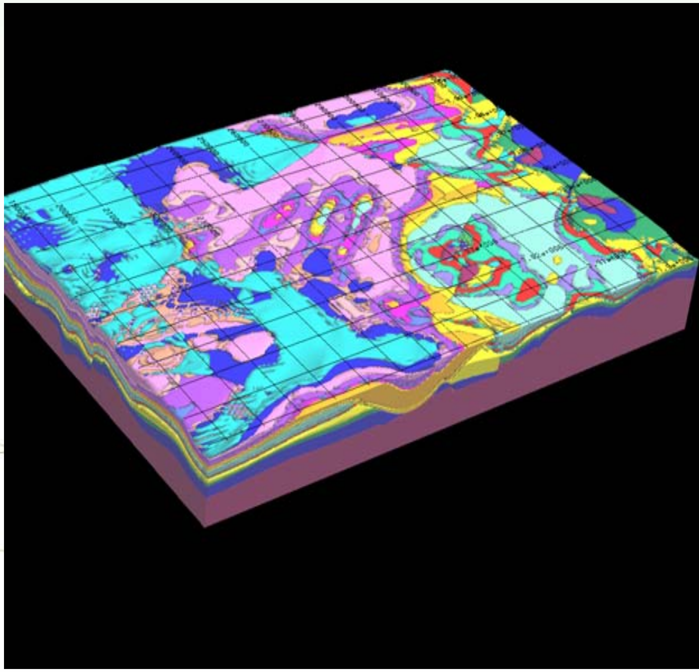
uncertainty increases with depth (adding the 3rd D)

level of complexity of the geology decreases with depth



What is a 3D model?

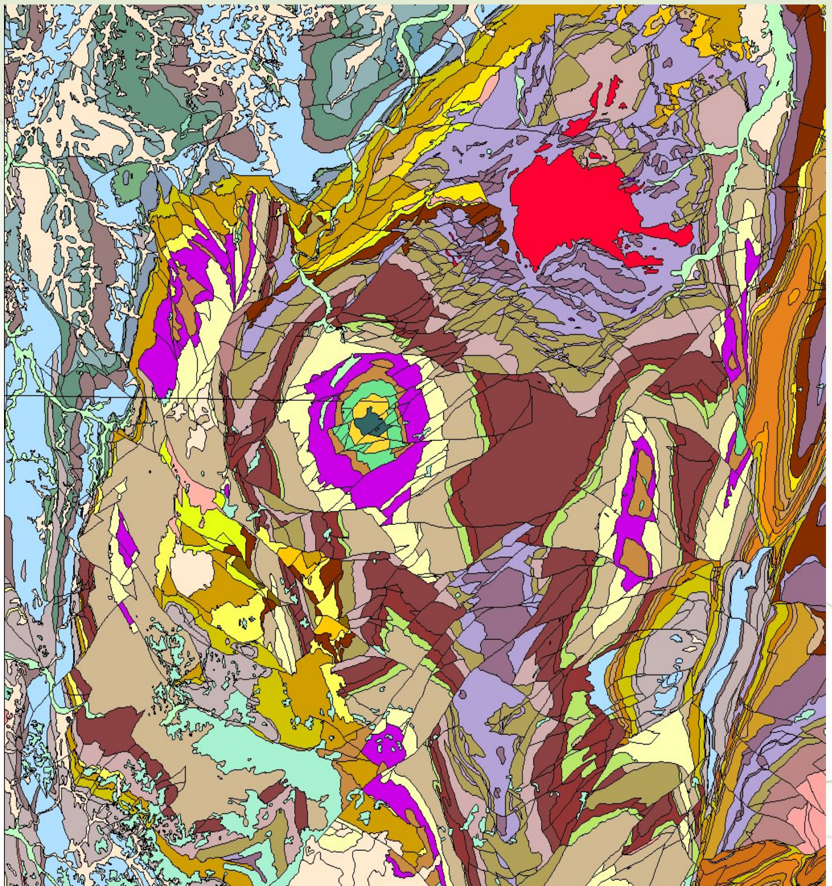
A 3D model is a highly interpretive construct

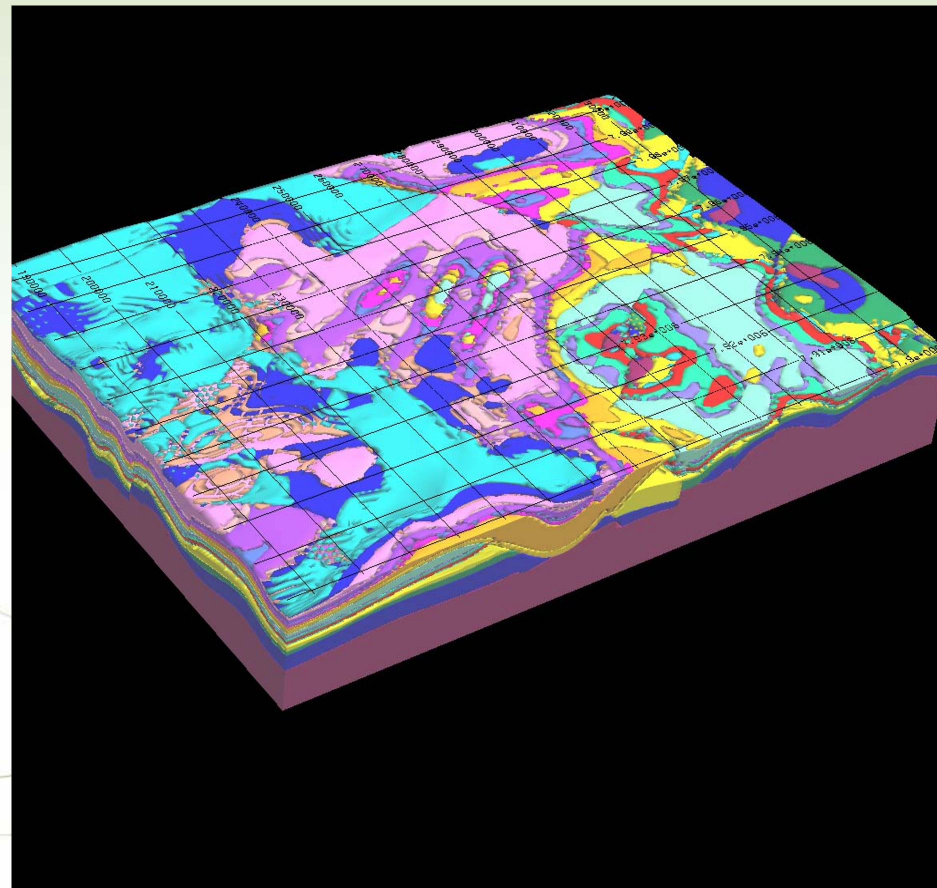
Its factual nature is implicitly linked to the quality and quantity of data within a geological area

Multiple interpretations may be consistent with the available data (non-unique)

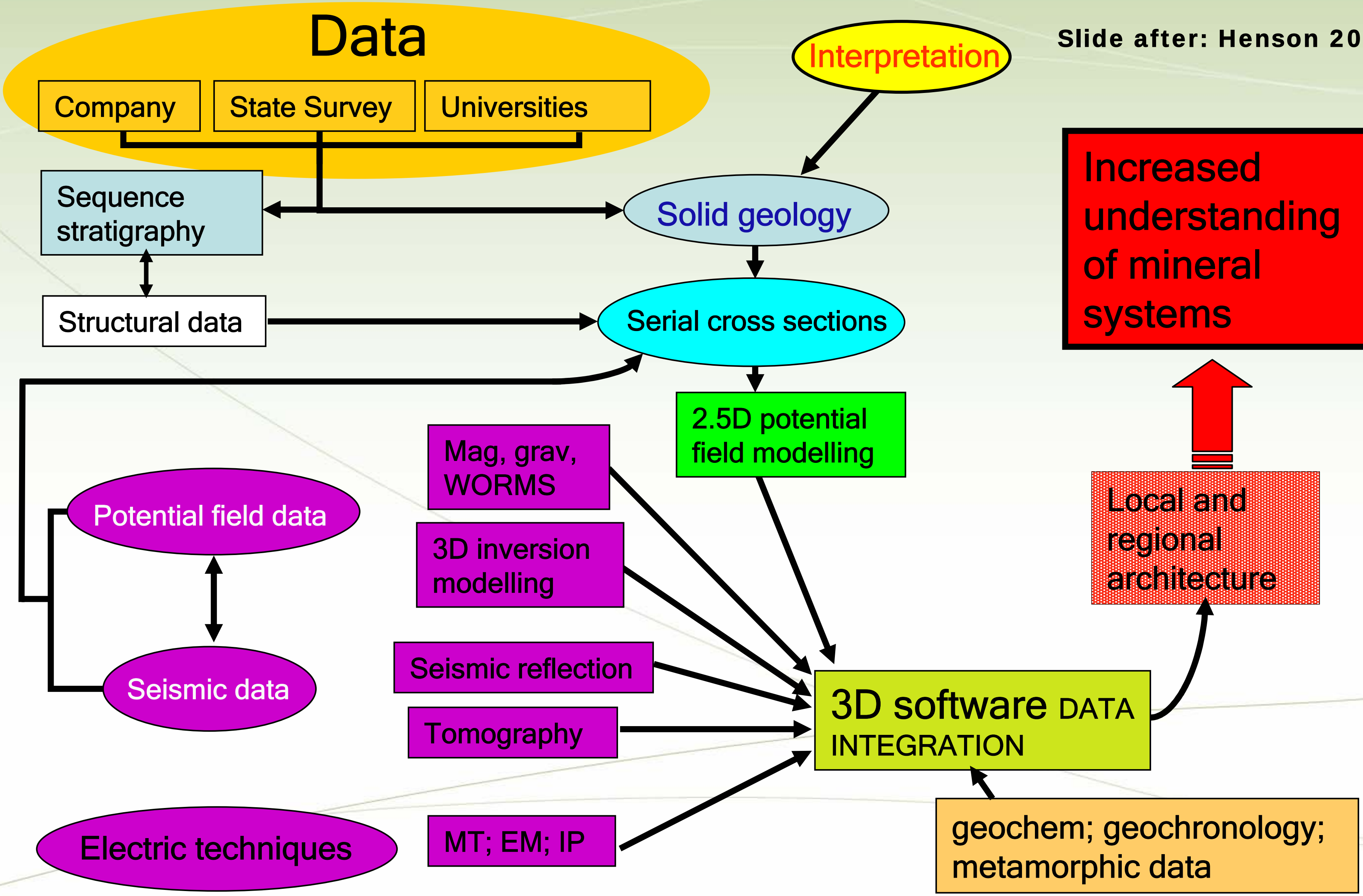
A 4D evolution ('model') is often used to both interpret, validate and explain the constructed geometries

Ambiguity in geological datasets



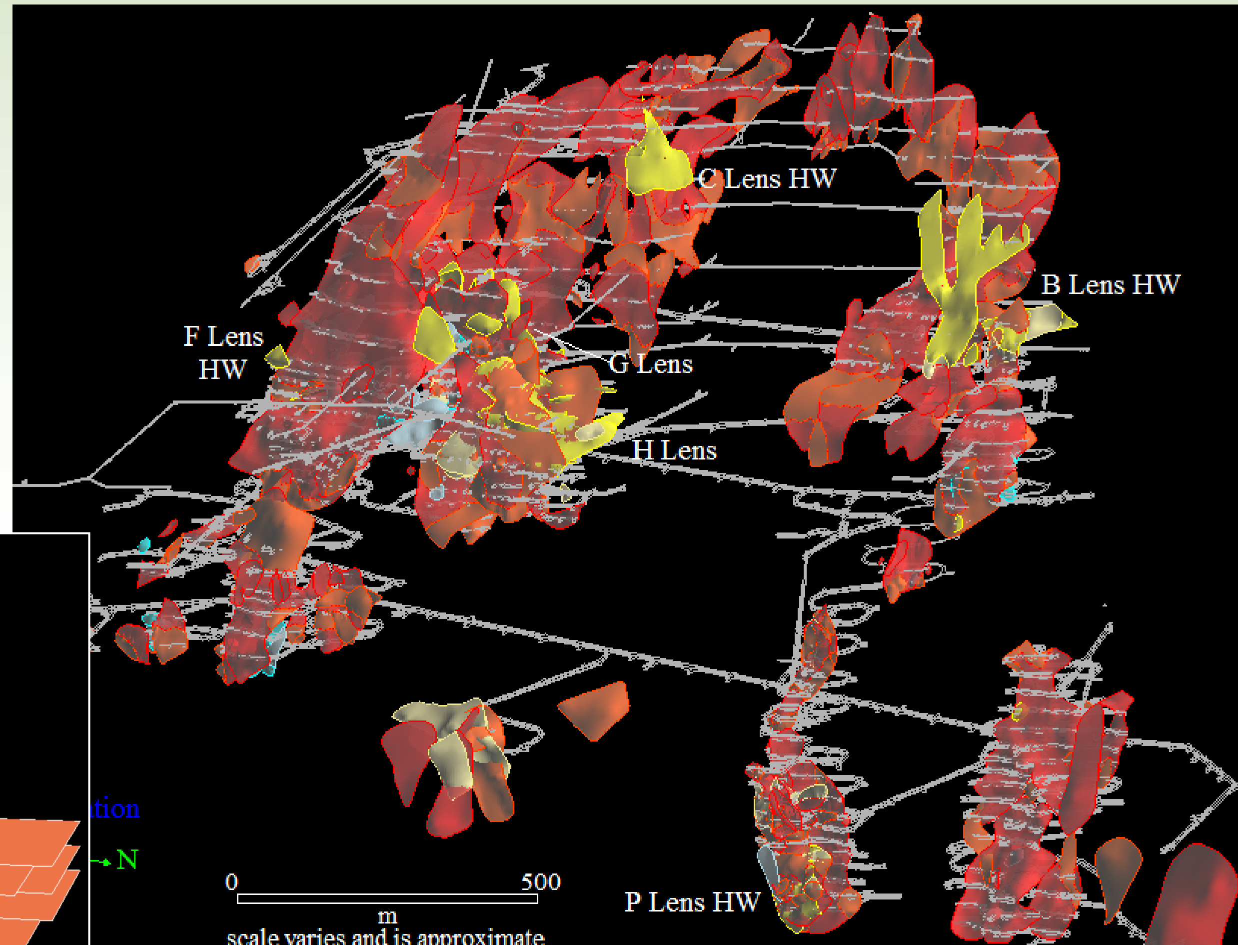


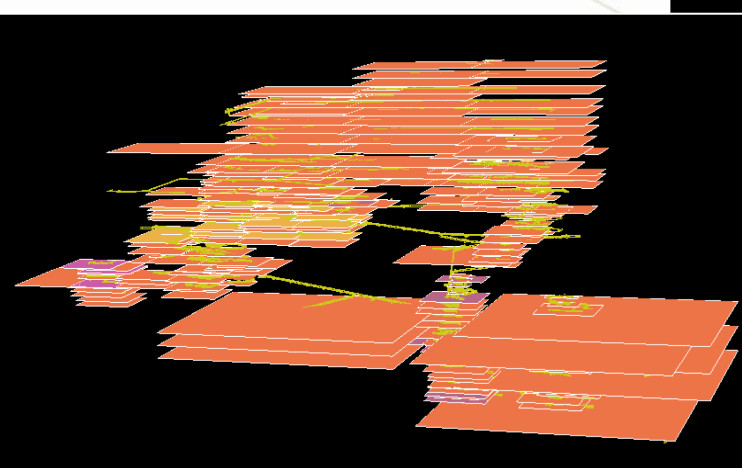
Slide after: Henson 2006



The explicit method

Based on sections

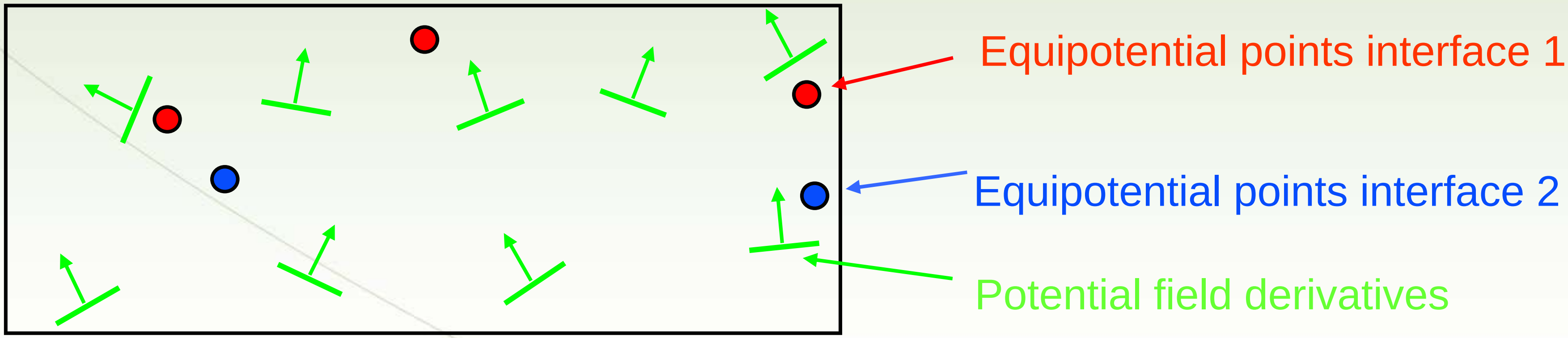




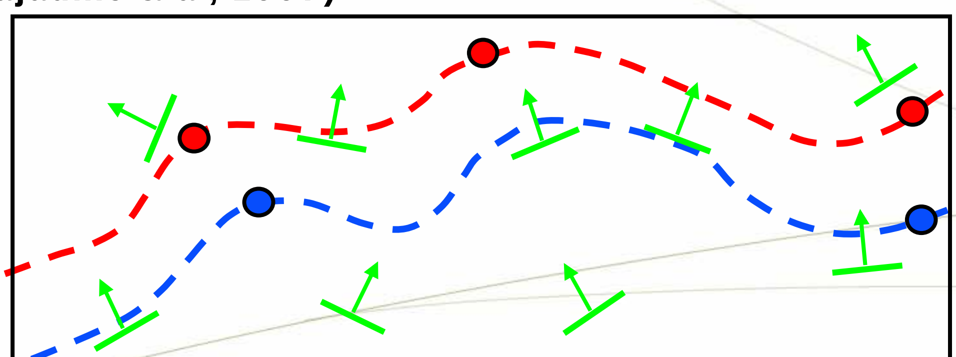
Zinifex: Rosebery South - Project T14

The implicit method

Interpolation between observation points (potential field data)



The scalar field is interpolated by cokriging the increments and their derivatives
(Lajaunie & al, 1997)



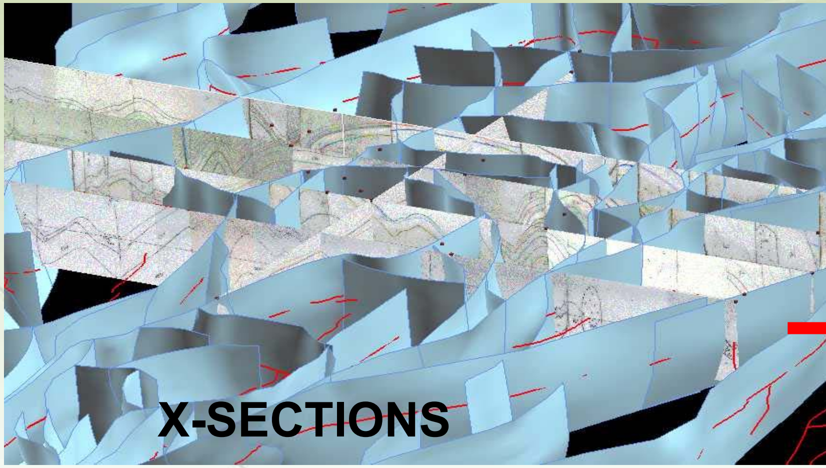
Interfaces are drawn as isovalues of the interpolated scalar field.

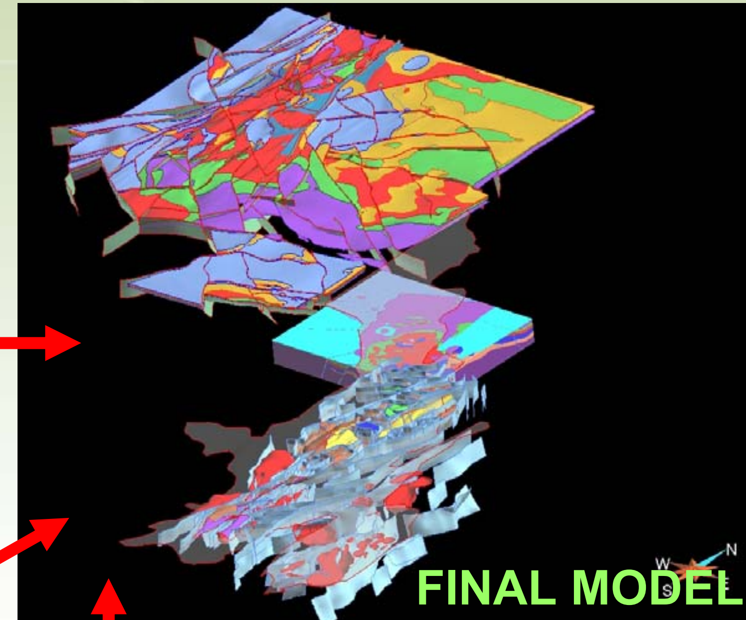
Isolines for a 2d scalar field
Isosurfaces for a 3d scalar field

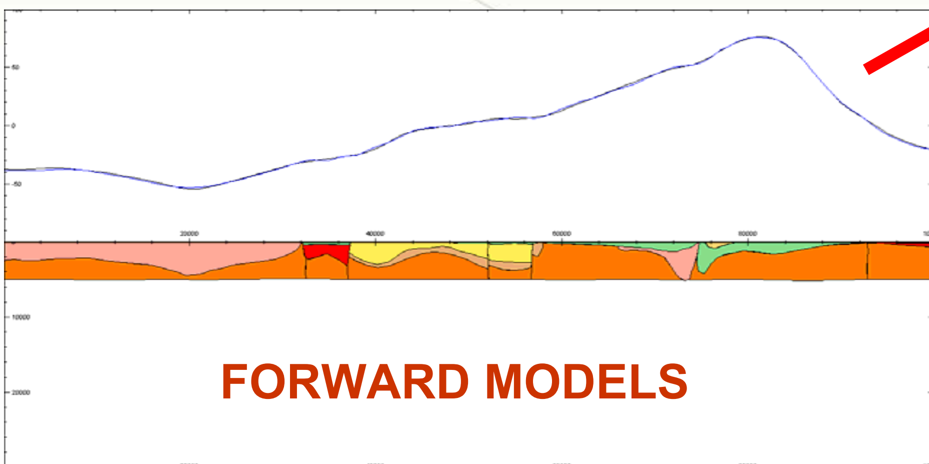
(adapted from Calcagno et al., 2008)

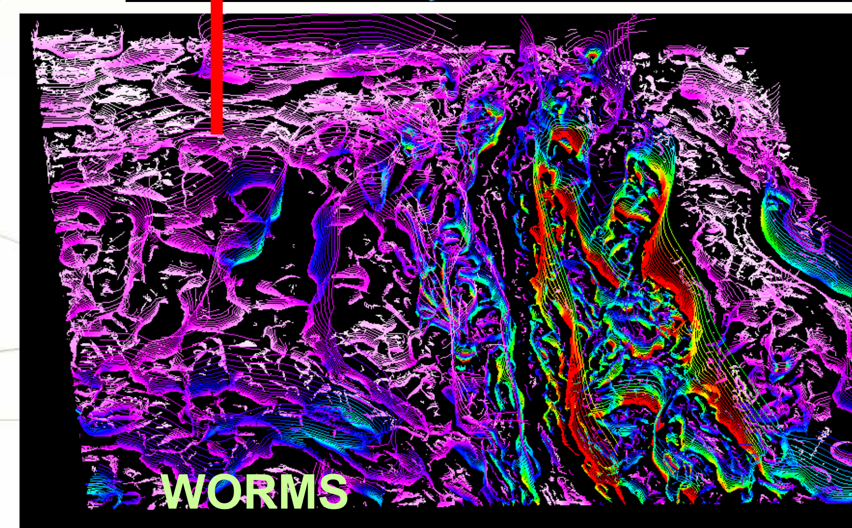
Slide after: L. Ailleres

A legacy for mineral exploration science









Slide after: B. Jupp

Movie a courtesy of B.Jupp

Integrating seismic

Faults should be constructed first, to provide a 3D framework

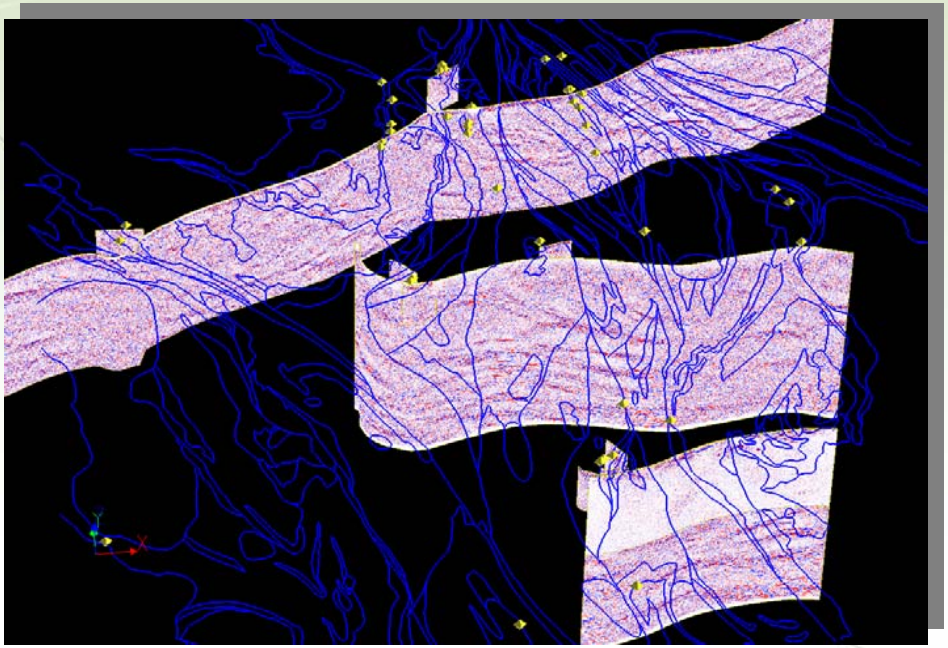
Seismic reflection provides both shallow and deep constraints

Constraints can be derived directly from 3D georeferenced seismic lines

Multiple seismic lines allow cross-cutting relationships to be compared

Slide after:
Henson 2006

Cross-section construction



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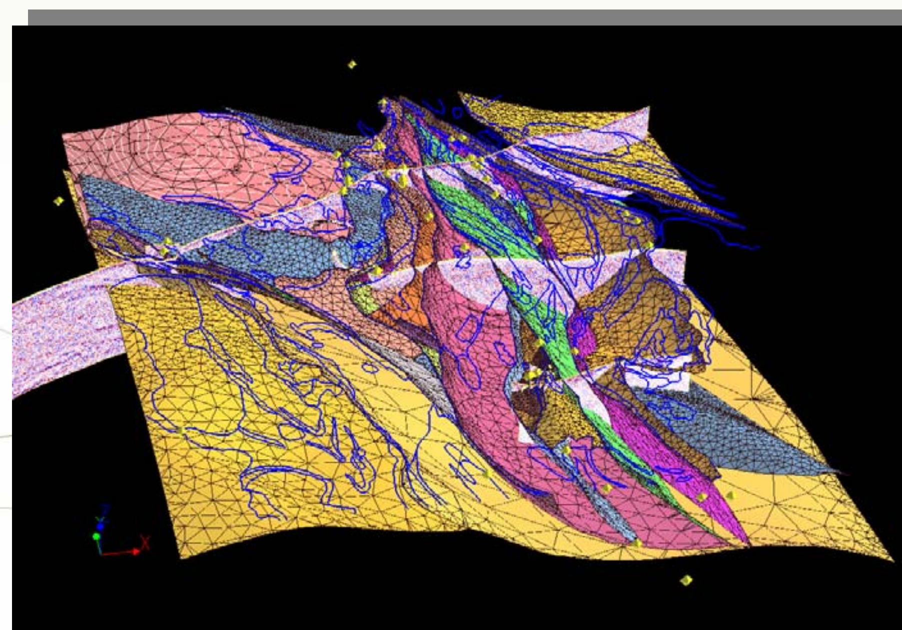

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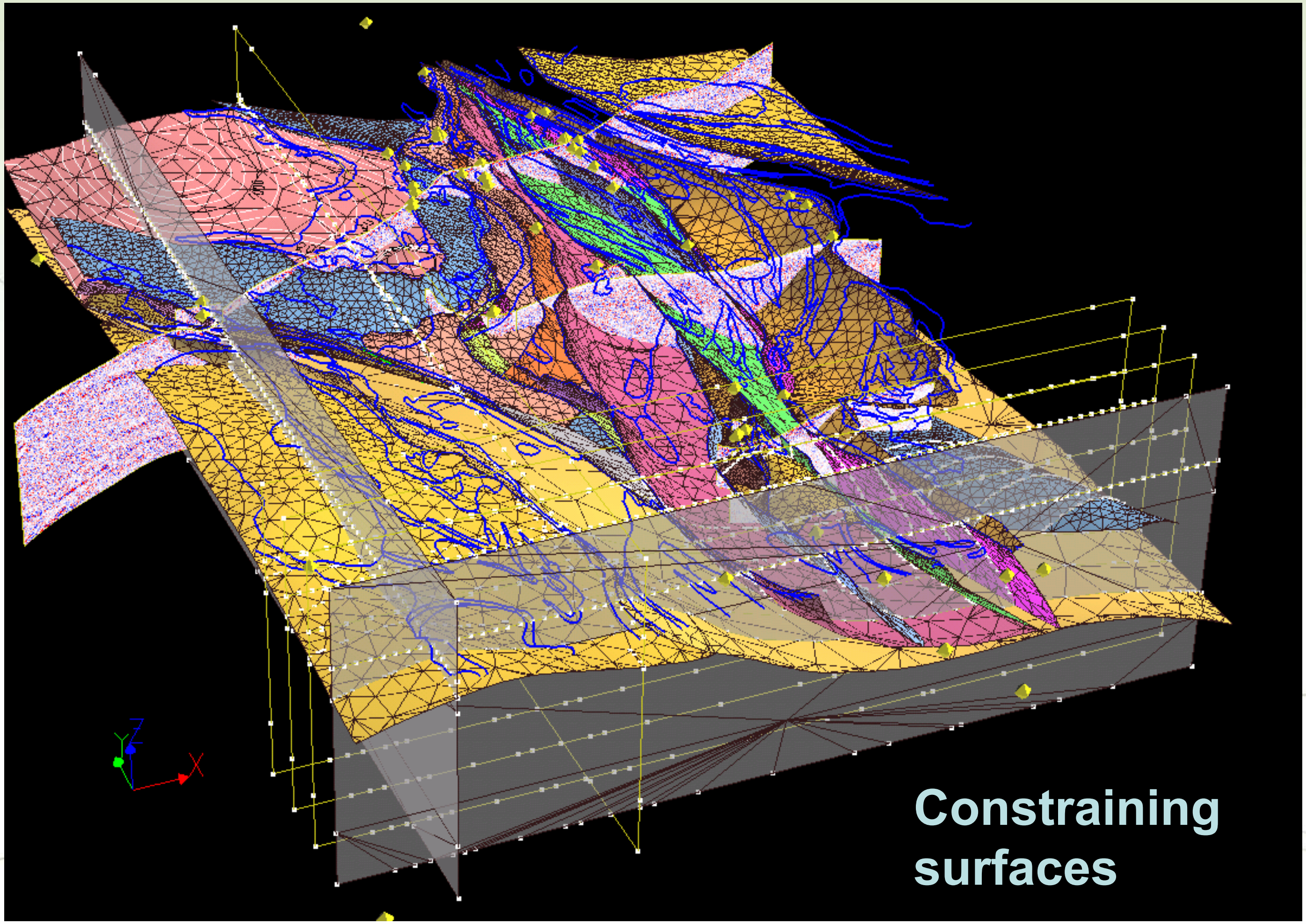

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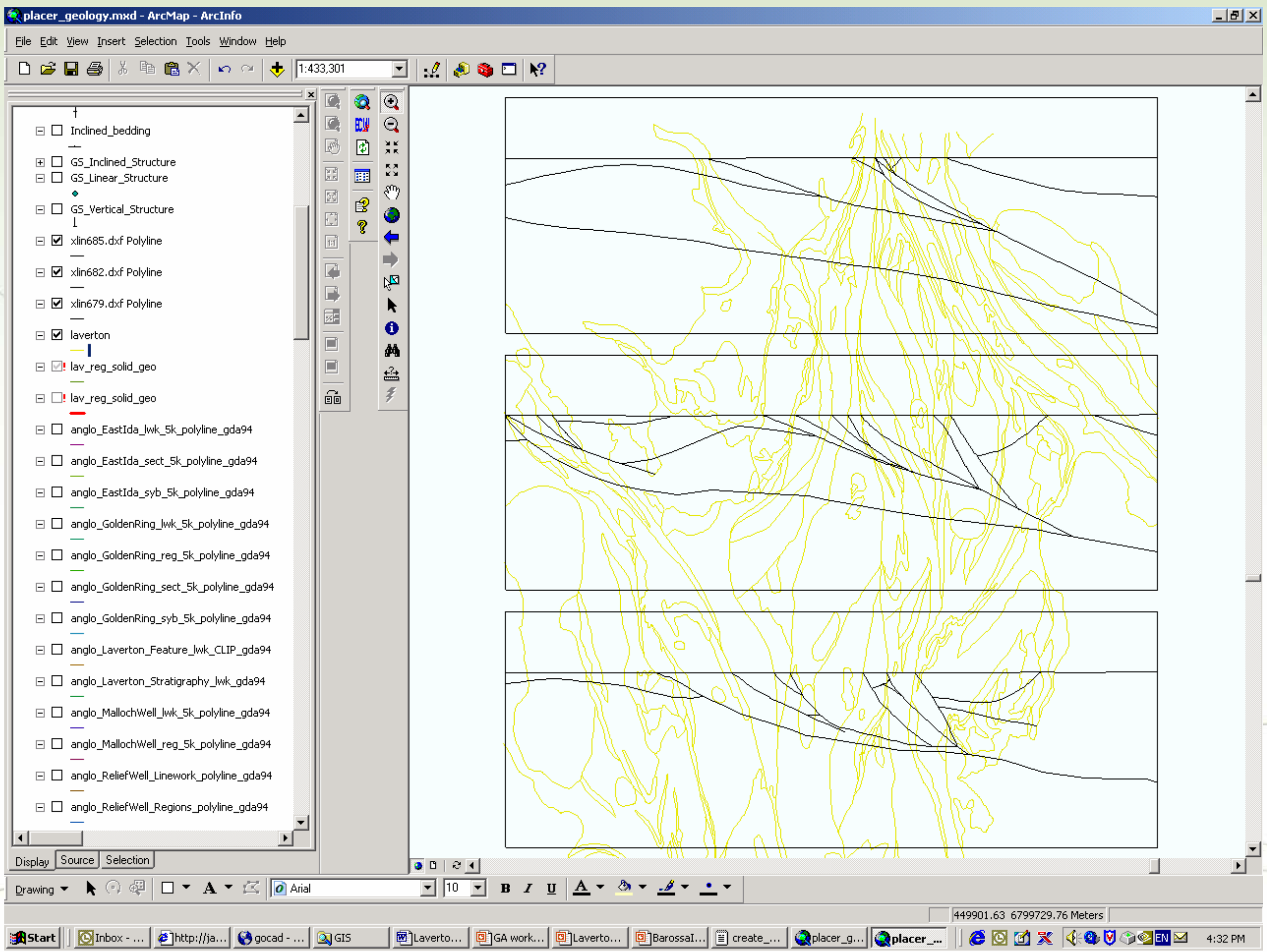
Henson 2006

Cross-section construction



Potential field constraints

Gravity gravity variations → rock density

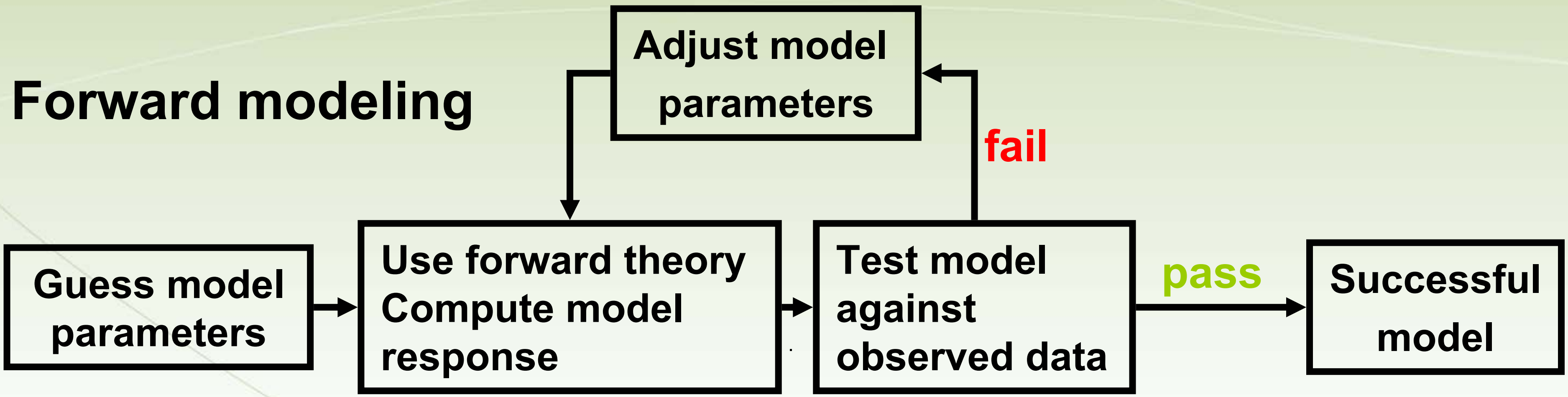
Magnetics magnetic field variations → magnetic susceptibility

WORMS Wavelet transformation of gridded potential field data

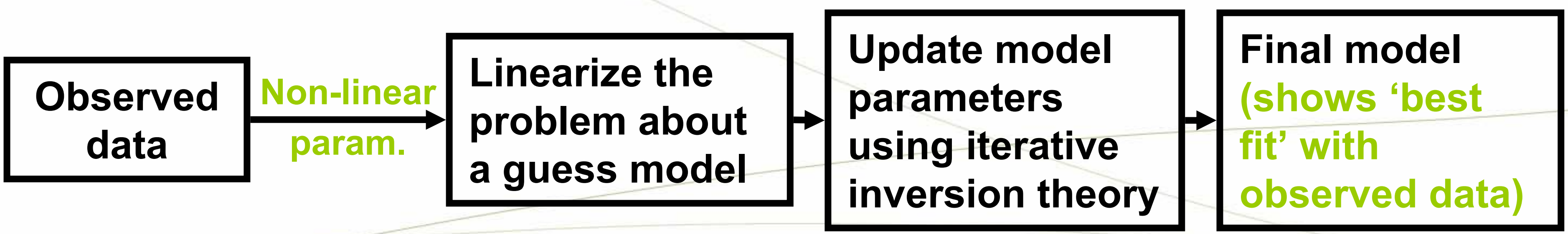
Forward modelling

Inversion modelling adjust physical property distribution until the potential field data can be reproduced ("how and why did this geological phenomenon form?")

Forward modeling



Iterative inverse modeling



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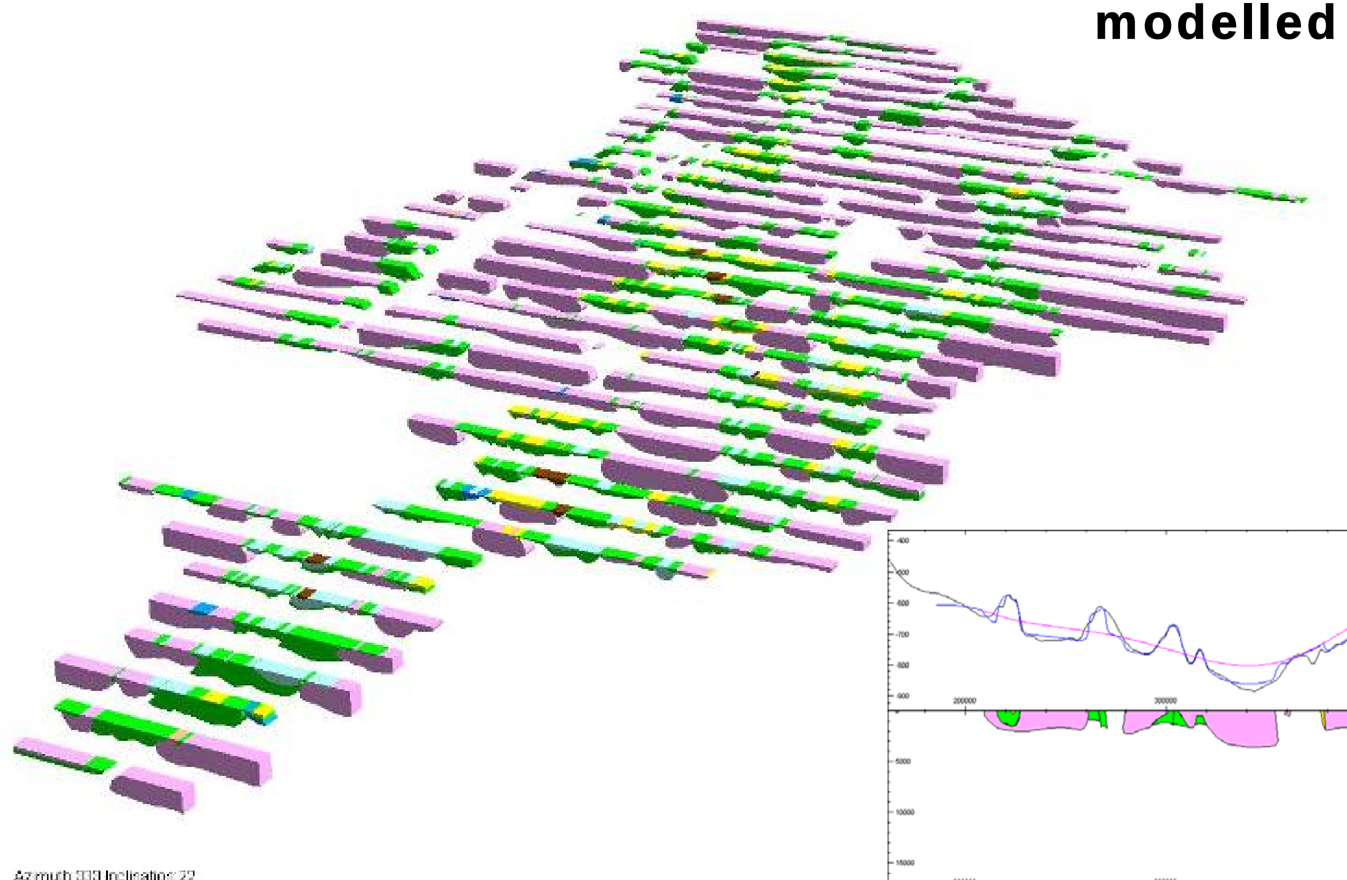
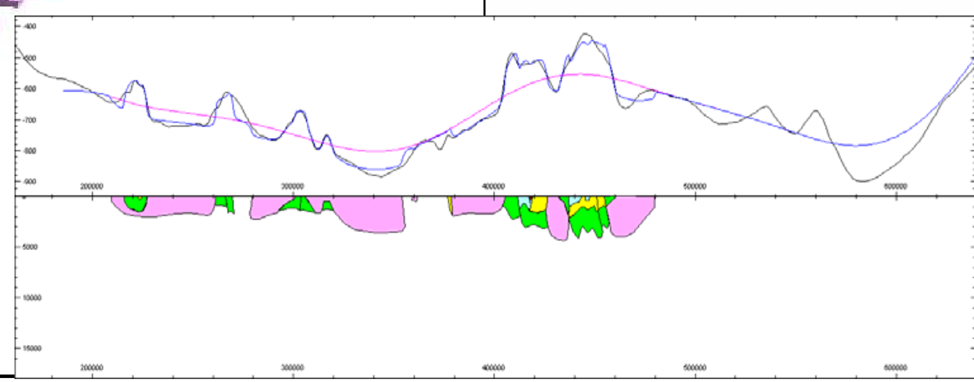
Henson 2006

Potential field constraints

Regional potential field modelled cross sections





What impact on exploration?

Improves confidence in knowledge of 3D architecture

Ability to look / visualise / dream undercover

Provides an architectural template to build in prospect / mine scale detail

Visualise 2D and 3D datasets in one system

Allows us to interrogate datasets and ideas within the 3D Construct

3D models are only a way to to visualize

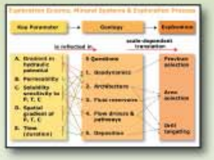
3D models add value to numerical models

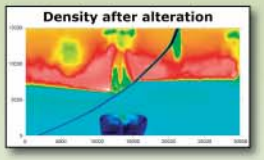
How to apply in targeting?

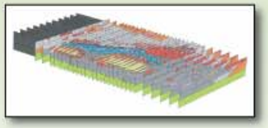
In undercover regions, evaluate depth to target positions and depth to bedrock

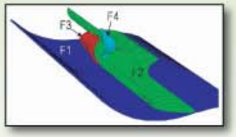
Evaluate spatial distribution of rock sequences, e.g. Isa Superbasin *predictive mineral discovery*Cooperative Research Centre*

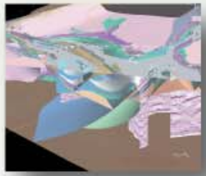
A legacy for mineral exploration science

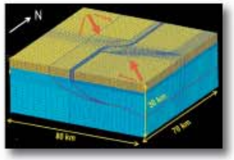


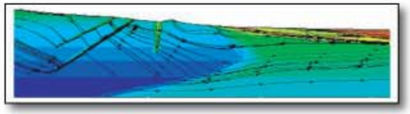


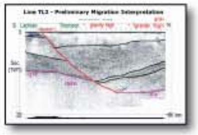












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