Estimating sulphide abundances from physical property measurements

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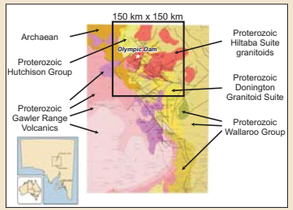
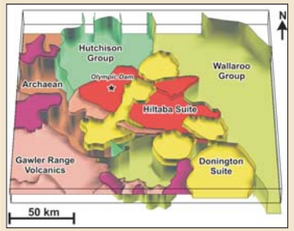
Olympic Dam



- **New techniques needed to identify and prioritise geophysical targets at depth or under cover**
- Olympic Dam is associated with voluminous hematite, magnetite and sulphides
- Targeting coincident magnetic and gravity anomalies has only had limited success

Basement geology interpretation around Olympic Dam (Direen and Lyons, 2002)

Previous 3D inversion modelling



- Geologically-constrained magnetic and gravity inversions have refined our geological understanding (Williams et al., 2004)
- The inversions are based on a reference model of *apriori* geological information
- **Alteration may be present in regions where inversion models do not match the expected geology**

3D geological model over the 150 km by 150 km by 10 km study area showing unit geometries

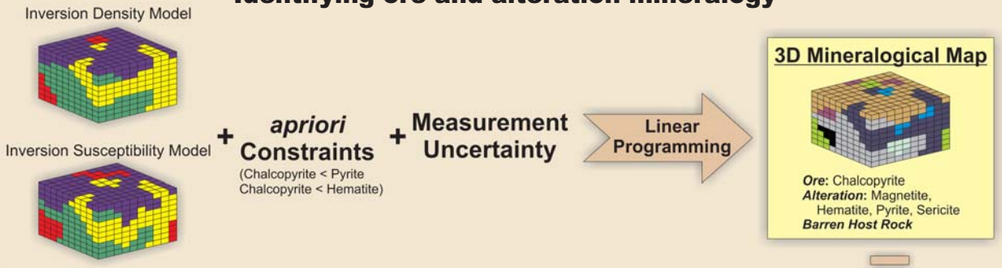
Physical properties depend on mineralogy

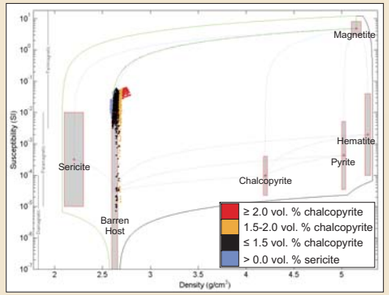
- Density and magnetic susceptibility of a sample are a linear function of the density and susceptibility of each constituent mineral
- Assume samples consist of:
  - Sulphides and oxides
  - Low density alteration phases
  - "Barren" silicate or carbonate host

Sulphides in a barren silicate host

Sericite in a barren silicate host

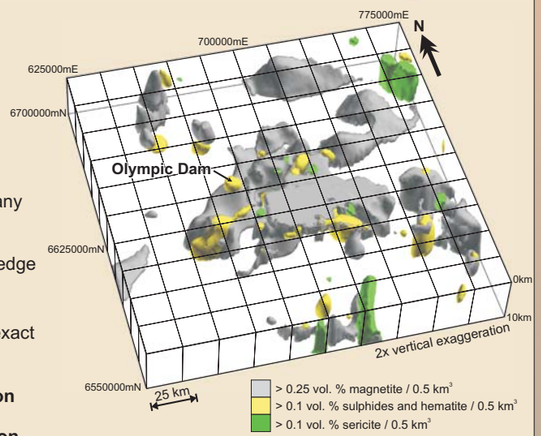
Identifying ore and alteration mineralogy





Each dot (inversion cell) is a mixture of "barren" host rock and either sulphides and oxides, or sericite. Rock properties closer to a component indicate more of that component

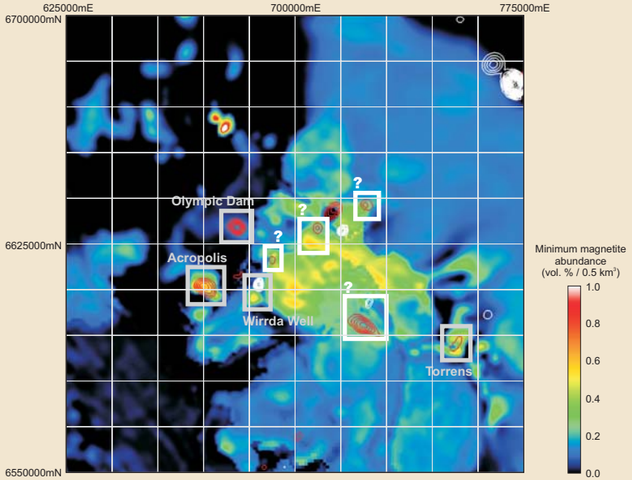
- Problem is **underdetermined** with 3 equations and many unknowns (the proportions of each component)
- **Linear Programming** methods allow:
  - **Uncertainty** and error in physical property knowledge
  - ***apriori* petrological information**
- Because of uncertainty and underdetermined nature, exact solution is not possible
- **Extract a range of solutions** corresponding to:
  - **Minimum amount of alteration or mineralisation possible**
  - **Maximum amount of alteration or mineralisation possible**
- These represent *possible* mineral distributions, not necessarily the *likely* distributions



Calculated 3D mineralogical model around Olympic Dam derived by integrating gravity and magnetic inversions and existing geological knowledge

Identifying new exploration targets

- Extract a map from calculated 3D mineralogical model
- **Coincident anomalies of magnetite and hematite/sulphide highlight four of the *known* Fe-oxide Cu-Au occurrences**
- **Several *additional* targets are highlighted that may not have been sufficiently tested previously**



Colour map: magnetite abundance
RED contours: 0.5 vol. % sulphides and hematite
WHITE contours: 0.5 vol. % sericite

Top-of-basement alteration map. Many of the known deposits and prospects are identified as having anomalous sulphides and oxides, as well as several new or poorly tested targets

This work is being further developed at The University of British Columbia for Ni exploration in Western Australia : **www.mdru.ubc.ca/home/research/em-lw.php**

References

Direen, N., and Lyons, P., 2002, Geophysical interpretation of the Central Olympic CuAu province: Geoscience Australia 1:500,000 scale map sheet.
Williams, N.C., Lane, R., and Lyons, P., 2004, Regional constrained 3D inversion of potential field data from the Olympic Cu-Au province, South Australia: ASEG Preview, n. 109, p. 30-33.