Estimating sulphide abundances from 3D physical property models

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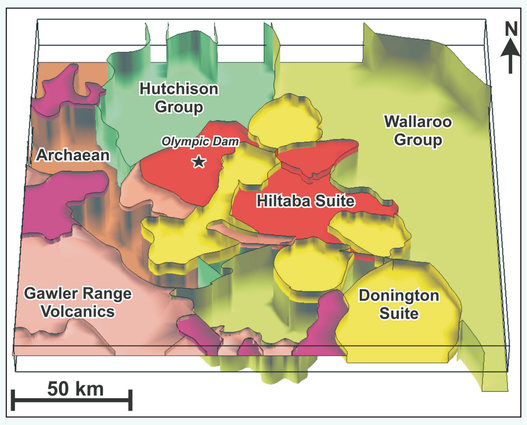
Previous 3D inversion modelling

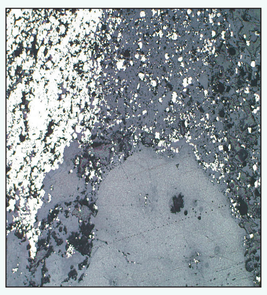


- **New techniques needed to identify and prioritise geophysical targets at depth or under cover**
- Geologically-constrained magnetic and gravity inversions, based on *apriori* geological information, have refined our geological understanding around Olympic Dam (Williams et al., 2004)
- **Alteration 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 area showing unit geometries. Physical properties were assigned to each unit based on sample measurements

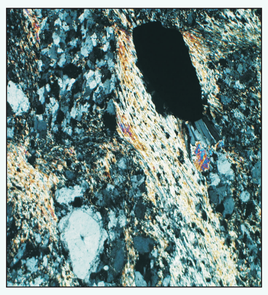
Physical properties depend on mineralogy

- Inversions provide **models of density and magnetic susceptibility** consistent with known geology and the observed geophysics



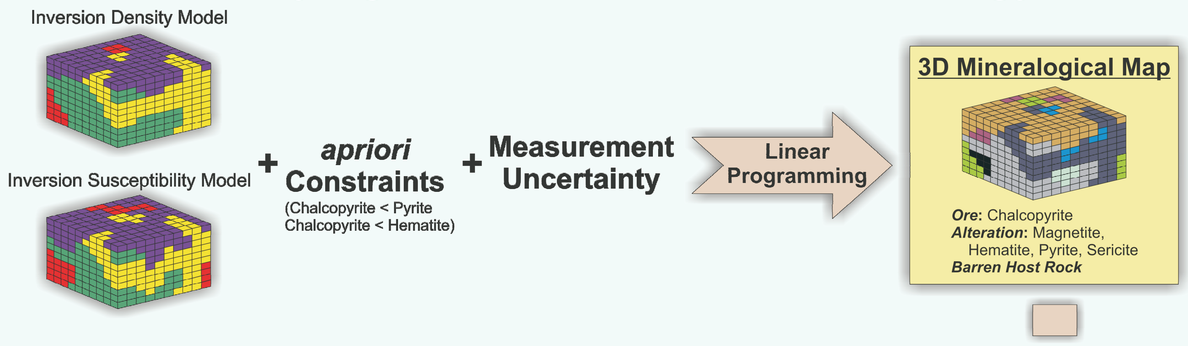
Sulphides in a barren silicate host

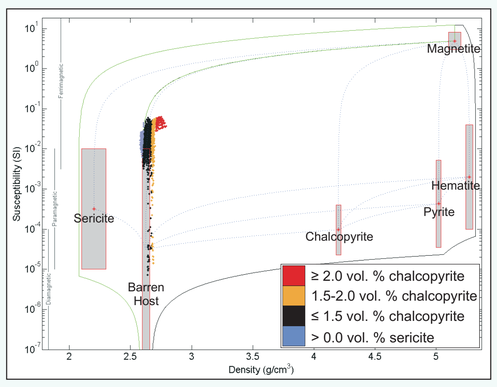
- The densities and susceptibilities are a **linear function of the density and susceptibility of each constituent mineral**
- Assume volume consists of:
  - High density **sulphides and oxides** *(chalcopyrite, pyrite, hematite, magnetite)*
  - Low density **alteration phases** *(sericite)*
  - "Barren" silicate or carbonate host rock



Sericite in a barren silicate host

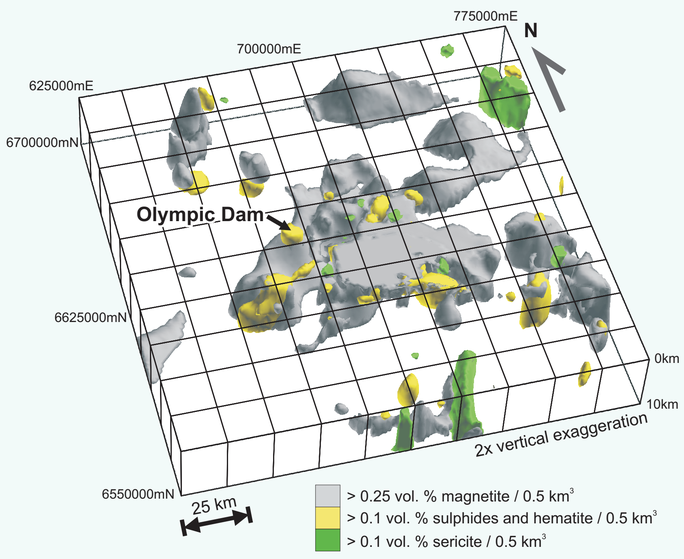
Identifying ore and alteration mineralogy





Each point (an 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

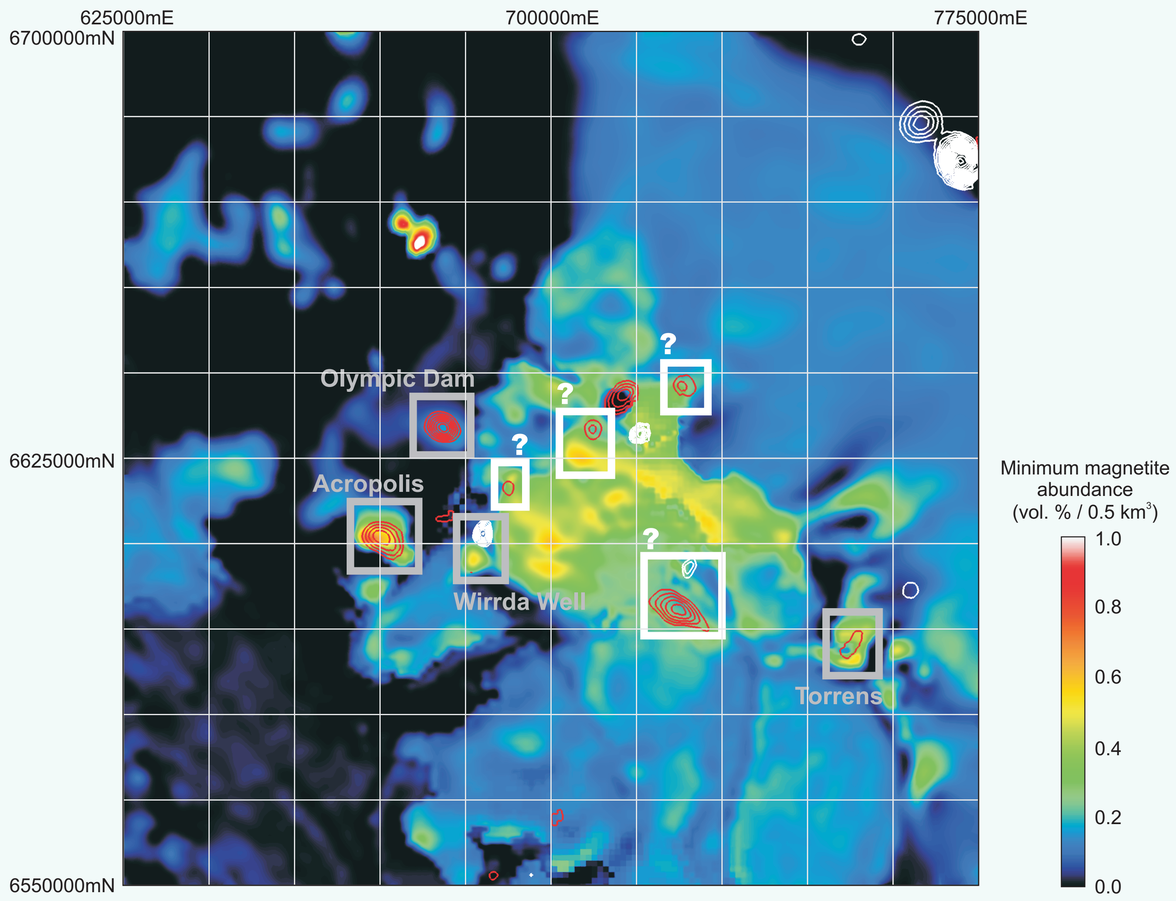
- Mineralogy estimation is **underdetermined** with 3 equations and many unknowns (the proportions of each component)
- **Linear Programming** methods incorporate **uncertainties** in physical property knowledge and ***apriori* petrological information**
- Exact solution is not possible
- **Extract a range of solutions** corresponding to **minimum and maximum amount of alteration or mineralisation** given known constraints
- 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 are several new or poorly tested targets

predictive mineral discovery
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