Case study: Wolf Minerals Limited

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Jump to navigation Jump to search

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Project Partner
Wolf Minerals Limited was incorporated in September 2006 as a metals exploration and development company and is dual listed on the Australian and London stock exchanges. It recently commenced production from its flagship project at Drakelands Mine, located near Plympton in South-West England, where it provides permanent employment for over 200 people on site.

Project Rationale

Drakelands Mine, operated by Wolf Minerals Limited, commenced production of tungsten (W) and tin (Sn) from the Hemerdon Deposit in autumn 2015. It represents the first 'new' metal mine to open in South West England for over 40 years and is presently one of only two mines outside China with the capacity to produce over 3000 tonnes per year of tungsten concentrate. Tungsten is a critical raw material due to its economic importance and supply risk. The ore body is hosted by the Hemerdon Granite and has been very-well defined by near-surface excavations and drilling to depths of almost 400 m below surface. However, the broader geological setting is poorly defined, partly because there has been no systematic geological re-survey of the Ivybridge area since the 1890s. The purpose of this project was to use Tellus South West data to provide an up-to-date geological context for Drakelands Mine and the immediately surrounding area in order to develop a framework in which to understand the processes that have come together to form this world-class mineral deposit.

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Data Sources

Tellus South West airborne magnetic, radiometric and LiDAR datasets were combined with British Geological Survey (BGS) digital land geology and land gravity (Bouguer anomaly) data as separate layers. Magnetic anomaly values record local variations in the Earth's magnetic field strength due to juxtaposition in the ground of rock bodies with contrasting magnetic properties. The technique is particularly useful where bedrock is concealed beneath superficial sediments or made ground. However, the magnetic data can be strongly influenced by anthropogenic effects and this is particularly the case in and around Plymouth. Radiometric data record gamma rays from the near surface of the ground generated by the decay of naturally occurring potassium, uranium and thorium. Natural radiometric signals can be suppressed or absent in urban areas. LiDAR data provides extremely detailed and accurate heights of landscape features. The data provides information on the landscape which may be influenced by the underlying geology. BGS digital geology 1:50 000 scale and 1:625 000 scale were used. BGS land gravity data represent Bouguer anomaly values that are caused by density contrasts in the ground both near and far from the measurement positions. Dense bodies of rock cause positive gravity anomalies while less dense bodies produce negative anomalies; the shapes of gravity anomalies offer constraints on the geometries and positions of the geological features that cause them.

Methodology

The magnetic data were processed to generate derivative images used in the interpretation. These include the vertical and horizontal magnetic gradients and the analytical signal (gradient amplitude). The radiometric data were processed to generate the relative abundances of potassium (K), thorium (Th) and uranium (U). This removes the spatial differences in radioelement concentrations due to varying levels of moisture in the ground. Radioelement ratios were produced to highlight rocks with different geochemical signatures. LiDAR terrain data covering the area of interest were merged into a single image.
A 'high-pass' filter was applied to highlight subtle changes in slope that might relate to underlying geological boundaries. The Bouguer anomaly data from irregularly spaced stations were interpolated into a regular 1 km grid. A Bouguer gravity image and derivatives of the Bouguer data, designed to highlight any detailed geological signals, were also computed. The Tellus South West and supporting data sets were imported into a GIS project, rendered in colour to highlight geological features (principal rock units) and inferred boundaries and faults. The most significant geological features visible in each datasets were digitised. Features were coded according the type/s of data that show them, how clearly defined the features were, and whether the features relate to boundaries or truncations of boundaries. Some geological features are represented in more than one dataset. For example, a geological boundary might appear as a radioelement boundary in the radiometric data, a linear anomaly in the magnetic data and a break in slope in the LiDAR data. Geological features that are barely discernible in a single dataset gain credence when present in multiple sets. Adjustments in theme layer transparencies and pseudo-hill shading effect were used to visualise multiple data sets simultaneously.

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Results

We have traced the boundary between the Tavy Basin and South Devon Basin eastwards from the Plymouth area into the Ivybridge area. Drakelands Mine is located towards the northern boundary of the South Devon Basin, an area defined further west as the Landulph High. The geology of the Drakelands Mine Site is consistent with the host rocks to the Hemerdon Granite being formed by the Saltash and/or Torpoint Formations. The location on the Landulph High, plus presence of significant strike-slip faults zones, may have exerted a fundamental control on the emplacement of the Hemerdon Granite and development of fracture-controlled mineralisation. The study provides a framework that can be tested and developed by future research.

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Categories:

- Pages with broken file links
- Tellus How

Navigation menu

Personal tools

- Not logged in
- Talk
- Contributions
- Log in
- Request account

Namespaces

- Page
- Discussion

□

Variants

Views

- Read
- Edit
- View history
- PDF Export

□

More

Search

Search Go

Navigation

- Main page
- Recent changes
- Random page
- Help about MediaWiki

Tools

- What links here
- Related changes
- Special pages
- Permanent link
- Page information
- Cite this page
- Browse properties

- This page was last modified on 26 July 2021, at 15:35.

- Privacy policy
- About Earthwise
- Disclaimers
-
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