

TOOLS OF THE TRADE

Drone-based surveys of mineral deposits

The rising demand for raw materials, such as rare earth elements and lithium, makes the exploration and extraction of mineral deposits critical. Identification of Earth's hidden treasures is becoming increasingly difficult, owing to the continued depletion of easily accessible deposits and the social stigma surrounding mining activities. Efficient methods that minimise invasive and costly drilling are key for the discovery of potentially profitable mineral resources. However, a gap in observation scales remains. Traditional ground-based surveys (such as rock and soil sampling), although detailed, can only cover some 15–30 kilometres per day, and large-scale mapping via helicopter, plane and satellite fails to provide sufficient resolution to efficiently map small-scale (<1 km²) geological features.

Drones present the perfect trade-off between coverage and scale of observation, and are essential when ground access is impossible, dangerous or logistically costly. Drones can carry lightweight sensors that, for example, capture changes in the Earth's magnetic field as well as a continuous spectrum of reflected sunlight in the visible and near-infrared regions (hyperspectral imaging). Subtle variations in the measured properties can be used to determine the abundance and composition of key minerals at Earth's surface. For example, specific spectral absorption features and magnetic anomalies could indicate the presence of iron alteration related to mineralisation. The hyperspectral and magnetic data



Credit: Photo courtesy of Richard Gloaguen, Helmholtz Institute Freiberg for Resource Technology, Germany.

collected by the drones can be used alongside high-resolution true-colour cameras or laser-scanning sensors to place mineral deposits into a 3D geographical context. Therefore, economic mineral deposits can be identified down to depths of several hundred meters.

Drones are becoming important tools for mineral exploration by contributing to the safe, efficient and sustainable provision of the high-tech metals that are required by modern society. For example, drone-based hyperspectral imaging has been used to rapidly map rare-earth-element-rich minerals in Namibia. In addition, in Greenland,

drone-based magnetic surveys were deployed to identify sub-surface ore potential at a fraction of the cost of traditional surveys. Drones have the potential to provide non-invasive and eco-friendly platforms from which the environmental impact of exploration and mining activities (such as soil erosion, acid mine drainage and vegetation stress) can be assessed.

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The author declares no competing interests.