IRON ORE EXPLORATION

Location: Hamersley Basin, Australia

CASE STUDY

Solution by **FALCON® AGG**

FALCON® AGG airborne survey combining airborne gravity radiometry and magnetometry has been flown over the Hamersley Basin with the aim of identifying iron ore target areas in a fast and effective way where ground access is difficult. A portion of the survey is discussed here.

1. GEOLOGY

In the Hamersley Province in the Pilbara district of Western Australia (Figure 1) BIF enrichment iron ore deposits can be split into three broad groups comprising leached BIF, hematite-goethite and martite-microplaty hematite (Geosciences Australia, 2010). Of particular interest to this case study, hematite-goethite ore is produced by the oxidation of magnetite (i.e., destruction of magnetic minerals) and metasomatic replacement of gangue minerals by goethite. Continual groundwater leaching or surface exposure can modify this ore, producing a range of different ore types, from porous to extremely dense. This type of Mesozoic-aged, nonmetamorphosed ore constitutes over 90% of the resources in the Hamersley Province (Morris, 1998).

The BIF of the Hamersley Group ('Iron formation and shale', indicated by violet, in Figure 1) are conformably overlain by siliclastic rocks and conformably underlain by mafic volcanic and clastic sedimentary rocks. The strike direction of the Hamersley Group is generally East-West and the dip direction towards the North. A polyphase deformation has affected the Hamersley Group and structural control on mineralization is recognized (Tyler, 1991).

CHALLENGE

Banded Ironstone Formations (BIF) generally cover large areas, which are difficult to explore from the ground due to the rugged topography associated with the differential erosion between the BIF and their host rocks. This is the case in the southeast of the Hamersley Basin where extensive BIF are prospected for economic deposits of iron ore. Further challenges are that the magnetic signature of BIF is often complicated by the presence of magnetic remanence and that the ore-forming processes may alter the magnetite content.

SOLUTION

Due to its high-sensitivity, low-noise sensors, the FALCON airborne gravity gradiometer and magnetic system is ideally suited for mapping the prospectivity of BIF, especially in rugged terrain.

CONCLUSION

The FALCON system provides a powerful exploration tool by rapidly and uniformly measuring the effects of physical properties that are characteristic of BIF enrichment iron ore deposits, thereby fast-tracking the exploration process.

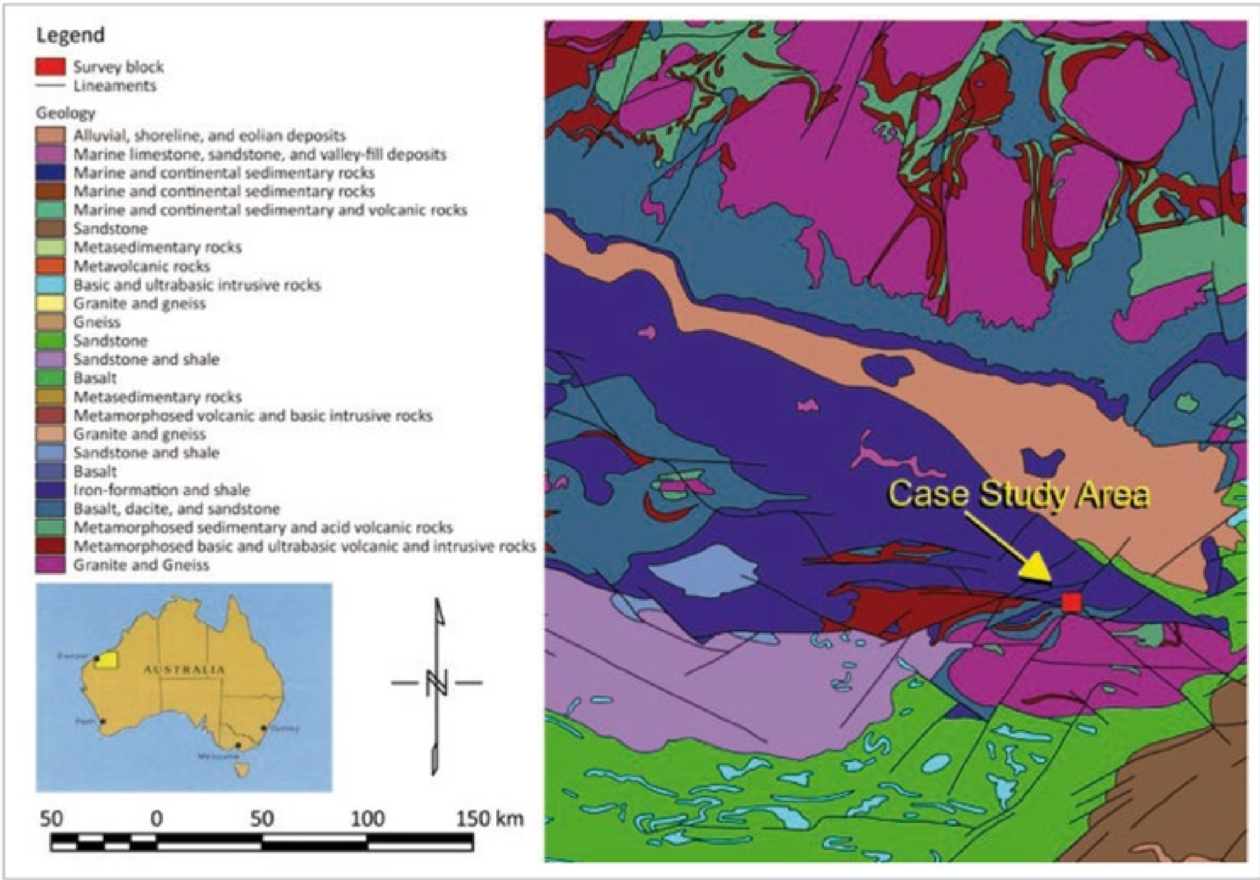


Figure 1. Simplified geology of the Hamersley Basin (modified from Government of Western Australia, 2014).

In the case study area, the shape of individual ore bodies ranges from tabular to podiform and each ore body can reach 300 m to 1.2 km in strike length, 30 m to 100 m in width and extend downdip for 200 m to 400 m (Kerr et al., 1994).

2. GEOPHYSICS

Due to the nature of the target mineralization, the density and magnetic susceptibility contrasts led to the selection of the FALCON® Airborne Gravity Gradiometer (AGG) and single sensor magnetic system as the most appropriate combination of technologies to facilitate detailed and rapid coverage of large areas (Miller and Dransfield, 2011).

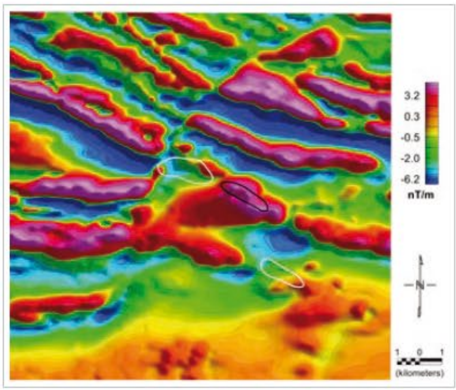
Two of the final products are presented in Figure 2. The two low magnetic anomalies depicted in Figure 2a coincide with two high gravity anomalies as expected from a massive hematite-goethite deposit. Three gravity gradient highs are marked in Figure 2b; two of these are characterized by relative magnetic lows, the third by a magnetic high.

Xcalibur SMART MAPPING

3. SOLUTIONS

Commercial grade iron ore bodies are expected to be more dense and less susceptible than the host within the area of study. By jointly interpreting the gravity gradient and magnetic data acquired by the FALCON® AGG system, it is possible to derive a prospectivity map (Figure 3) over the study area. Figure 3 clearly differentiates prospective (white boundary shape) from unmineralized (black boundary shape) BIF.

a



b

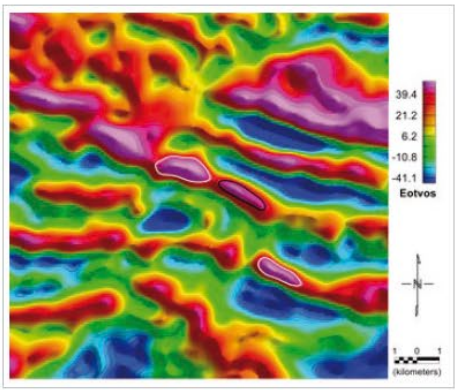


Figure 2a & 2b. Vertical gradient of the total magnetic intensity (a) and vertical gravity gradient (b) images from an area in the Hamersley Basin. The gravity gradient image (b) has boundaries drawn around three high amplitude features and the same boundaries are drawn in the magnetic image. The white boundaries are iron ore targets and the black boundary is an unmineralized banded iron formation.

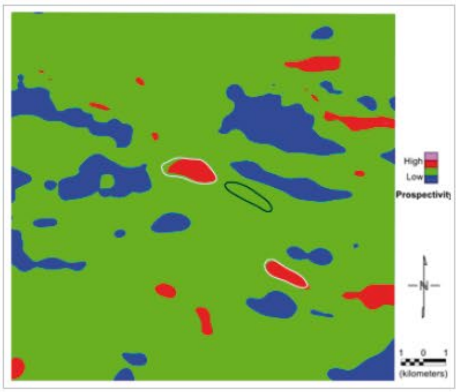


Figure 3. Prospectivity map derived from the gravity and magnetic data. The two features with white boundaries are iron ore targets and the feature with a black boundary is an unmineralized banded iron formation.

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