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Geo-Echoes

Casa Berardi: gravity data modelling applied to geology

The following is a prime example where numerical modelling applied to a gravity survey campaign allowed deep subsurface geology interpretation leading to the discovery of new exploration targets below existing drillings. The quartz veins style mineralization of the Casa Berardi gold-bearing deposit is generally hosted within a sedimentary environment whose complexly folded structure results as the most important control factor upon mineralization emplacement. The use of geophysical methods thus became essential in order to map lithological markers located at various depths. However, the lack of distinct quartz veins style mineralization signature attributed to a masking effect from highly conductive graphitic horizons, required ground-breaking interpretation tools. Results from preliminary testing have shown that a 15% density contrast between 100 m thick stratigraphic units could yield gravity unconformities measurable as deep as approximately 800 metres.

Figure 1 : Regional geology

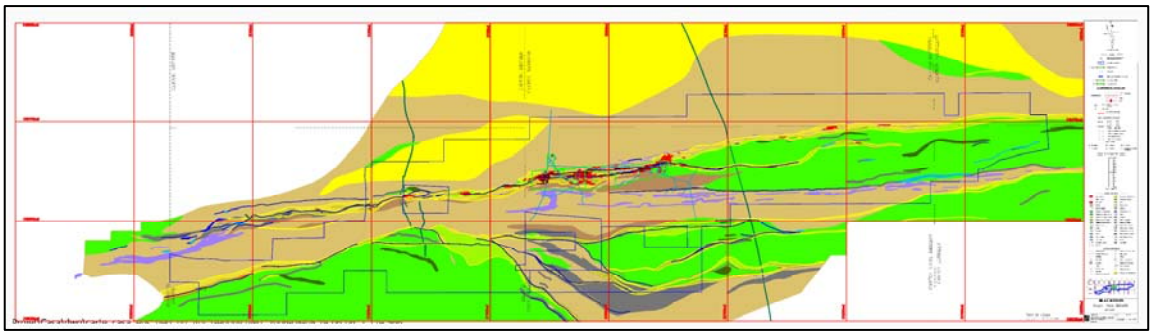
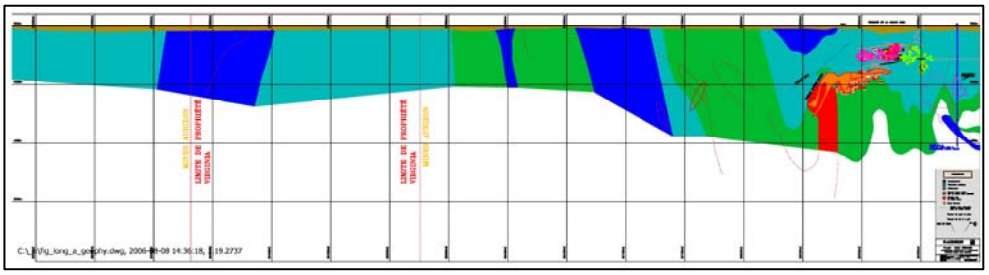


Figure 2 : Long-section



A gravity survey was undertaken over part of the Casa Bérardi property during the summer of 2003 and winter of 2004. A total of 1863 stations at intervals of 50 and 250 m were surveyed in order to best help delineate geological features that may control the location of ore bodies. The residual Bouguer anomaly map (figure 3) revealed the following structures: **(A)** metamorphic halo associated to the Récher Pluton, **(B)** fold hinge zone located within an iron formation, **(C)** faulted (strike-slip type) fold hinge lineament resulting from a displacement along the Casa Berardi fault.

The latter fault hosting the West Casa Berardi deposit's hanging-wall **(D)** Casa Berardi high strain zone.

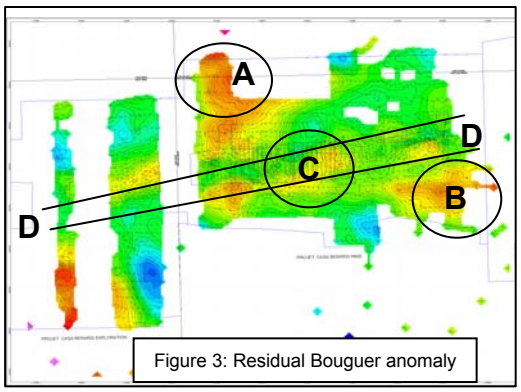


Figure 3: Residual Bouguer anomaly

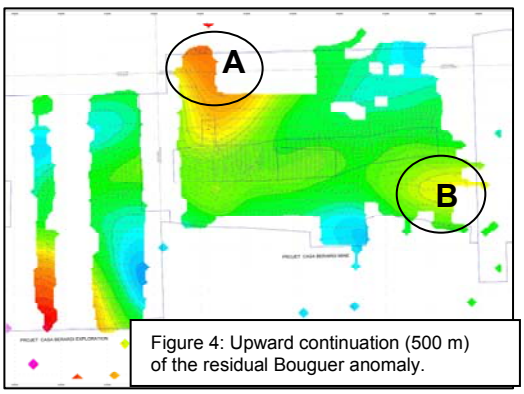


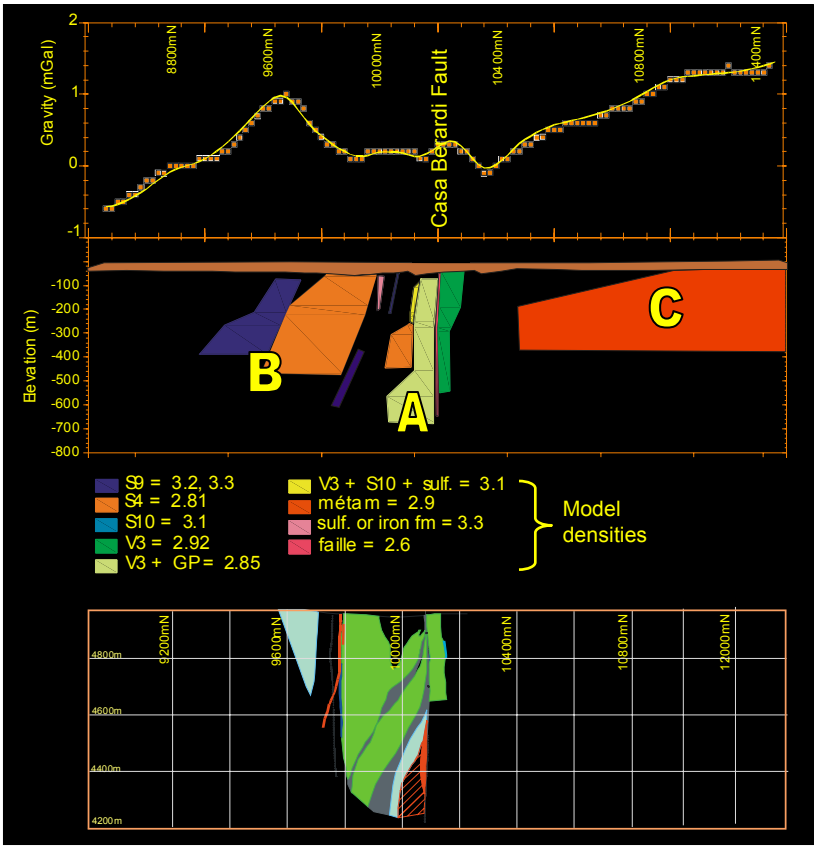
Figure 4: Upward continuation (500 m) of the residual Bouguer anomaly.

A particularly nice aspect of gravity data is its highly specialized processing applications. Among which, the upward continuation process used for enhancement of deeply rooted high density structures. In this example, a 500 m upward continuation was applied to the residual Bouguer anomaly (figure 4). This map illustrates the simulated depth extent of the metamorphic halo **(A)** and of the fold hinge zone **(B)**.

In order to fully investigate the gravity survey results, numerical modelling was used as an interpretative approach. This process involves construction of a subsurface geology model fitting the observed field data profile. Local geological knowledge was used as valuable constraints that were applied throughout the modelling process.

A total of eight N-S gravity profile sections were modelled over the Casa Bérardi deposit. For a given section lacking available geology constraints, one could feel that the modelling process had yielded a very useful interpretation of the subsurface. Figure 5 illustrates how gravity modelling helped in the construction of a geological model up to a depth of 500 m. In this example, the top portion compares the profiled theoretical gravity data with the observed one, whereas the central portion shows the gravity-derived model and the bottom section represent the initial geology constraints.

Figure 5: Gravity modelling results – profile section 11800 mE
(TOP: observed and calculated data profiles, CENTRE: gravity-derived model, BOTTOM: initial geological interpretation



The following information were estimated from the above model:

- **A** Stratigraphic thickness & dip
- **B** Folding pattern
- **C** Alteration zones & metamorphic envelopes

Once a preferred gravity-derived model is validated with available drill hole data and local geology knowledge, modelling can effectively be used to detect potential targets located as far as a few kilometres away from the deposit and in regions lacking borehole information .

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