Glass Earth gold exploration: combining Geoinformatics data intervention processes with ultra-detailed geophysical prospecting

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Abstract

The combination of Stage 1 Geoinformatics legacy[1] data intervention processes with the Stage 2 ultra-detailed airborne geophysical prospecting demonstrates a new approach to converting data to information to knowledge, and converting that knowledge into exploration results.

The Coromandel region of the North Island of New Zealand has long been know to host gold deposits of economic viability (Hauraki Gold Fields). To the SE of this area lies the Taupo Volcanic Region (TVR) where the geology and structural setting mirror the Hauraki Gold Fields, however mineral exploration in the past has been hindered by the blanketing volcanic ash deposits. Glass Earth Limited recognised that this whole potential epithermal gold province could be effectively explored utilising rapid, risk orientated processing to review legacy geoscience data: The Geoinformatics Data Intervention Process; which in turn directed ultra detailed airborne geophysical surveys over the TVR. Results have outlined 21 new drillable potential epithermal gold targets; and a plethora of other targets with high prospectivity.

Keywords: *Taupo Volcanic Region, Hauraki Gold Fields, Airborne Geophysics, Data Intervention*

Background

Glass Earth Limited, a public New Zealand based company listed on the Toronto Venture Exchange (TSXV:GEL) was established to discover and develop precious metal and geothermal opportunities. Glass Earth holds exploration permits for over 8,900sq.km of the Hauraki Gold Fields and Taupo Volcanic Region. The company formed an alliance with Geoinformatics Exploration Inc. to carry out a 'Sponsored Data Intervention' in the Coromandel Central Volcanic Region.

[1] Legacy data describes the collection of geoscience data accumulated by Glass Earth & Geoinformatics representing 100 years of scientific research and exploration in the Coromandel Central Volcanic Region (CCVR).

Geoinformatics has a track record of compiling large datasets from disparate sources, are leaders in 3D terrane scale to mine scale geodynamic modelling and have a multi-disciplined team of geoscientists that applies a risk managed focus to exploration. (Fig.1)

The Geoinformatics process enables the rapid and efficient integration of datasets, unlocking and enhancing the interpretation process by allowing the concurrent evaluation of multi-disciplinary information. The key to the process is decreasing the evaluation time, enhancing understanding of the multi-dimensional geology and how it relates to mineral deposit occurrences, and allowing objective exploration target ranking based on available data.

The Geoinformatics data intervention identified both potential epithermal gold targets, and the methodology to direct-target gold potential under ash cover. Glass Earth followed these recommendations completing ultra-detailed airborne geophysical surveys over the area in the autumn of 2005. Historically exploration of the TVR has been hindered by the recent volcanic ash cover in the area making conventional prospecting methods of the 1980's & 1990's less effective.

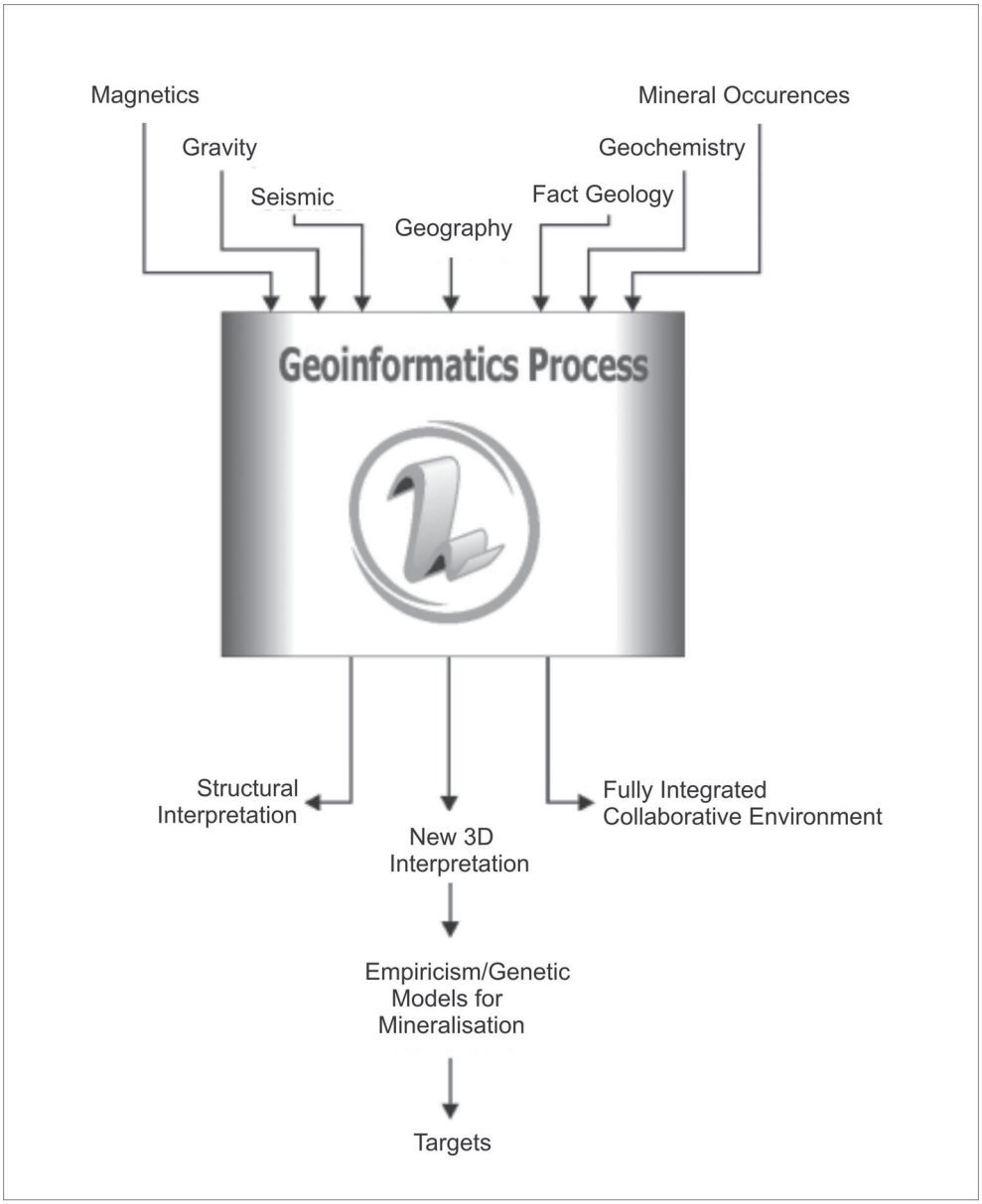


Fig. 1: Geoinformatics Data Intervention

Regional geology

The Coromandel Central Volcanic Region on the North Island of New Zealand is a continental margin magmatic arc. Volcanism began at ~ 20 Ma in Northland and the northern Coromandel with volcanic groups younging to the south. Miocene to Recent age volcanic deposits have undergone intra-arc rifting from approx. 9Ma to present. A switch from andesitic to rhyolitic/ basaltic volcanism occurred in the region and is dated at about 7-6Ma in the area around Waihi (Adams et al 1994) (Fig. 2).

SE of the Coromandel Volcanic Zone is the Taupo Volcanic Region (TVR), a tectonic rift environment showing a complex volcano-tectonic depression filled with pyroclastic deposits, domes and lavas (Simmons 1995). Active volcanism and geothermal activity are present in the southern part of the area. The TVR is approximately 40km wide and is undergoing extension of 8 mm/yr and 15 mm/yr at the southern and northern ends respectively (Wallace, 2004). The oldest rhyolite rocks in the TVR are dated at 1.6Ma (Adams et al 1994) A line of active and dormant andesitic, dacitic and rhyolitic volcanoes/ calderas extends in a NE-SW line from White Island in the NE through Rotorua and Okataina volcanic centres to the Taupo caldera and Tongariro volcanic Centre in the SW (Cole 1990). The rift is asymmetric with the thickest volcanic sequences found along the NW margin and the youngest and thinnest along the SE margin (Davey et al 1994).

Large parts of the region are covered with pyroclastic flows of varying thickness, the manifestations of the numerous eruptions including the Taupo Caldera eruption of 186AD (Wilson & Walker 1985).

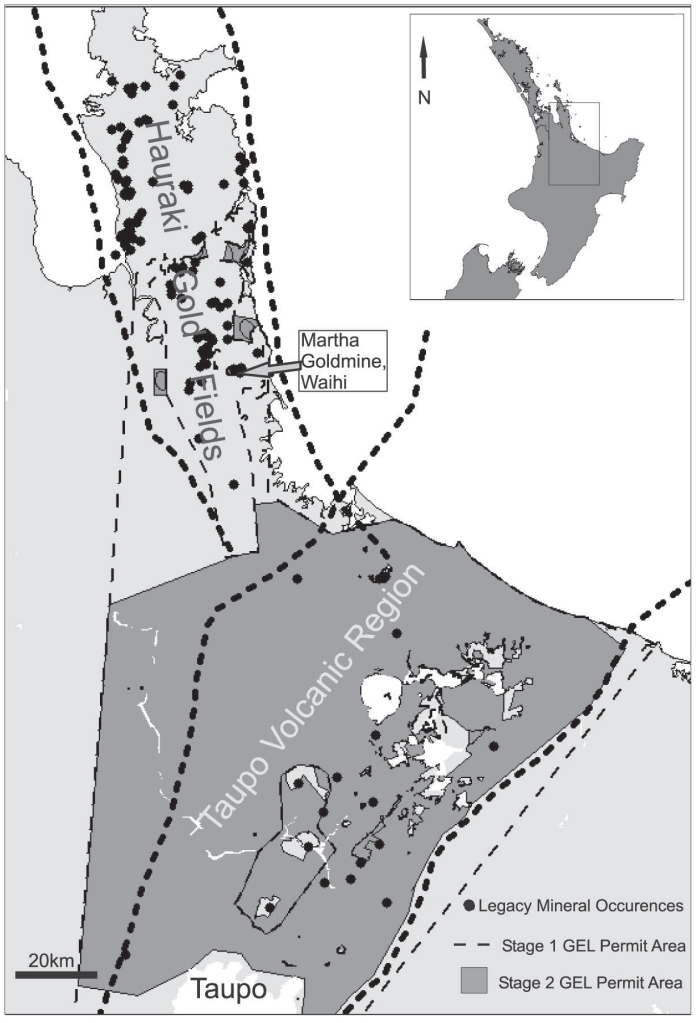


Fig. 2: Location Map

Economic geology

Historically the Hauraki Gold Fields have over 50 gold-silver mines. The earliest discoveries go back to 1852 and over the past 150 years three major goldfields with over 50 individual deposits have operated on the Coromandel peninsula.

In 1879 prospectors began exploring the hills of the Waihi plain and soon found a 17 foot-wide quartz lode, which they named Martha Hill. The deposit was mined for over 70 years closing in 1952 having produced 5.5M oz Au. (Lockwood 2003). Operations at Martha Goldmine reopened in 1987 and are currently producing approximately 130,000 oz.Au per annum.

9km north west of Martha Hill, Golden Cross mine was opened 1991 and produced 550,000 oz Au during the 7 years it was in production (IGNS 2003).

Further deposits were found on the edge of the Hauraki Gold Fields in Miocene volcanics. Here at Muir's Reef, operations of the 1920's produced approximately 54,000 oz Au (Christie 1984).

Pliocene/Pleistocene and Recent rocks in the TVR have been found to host Au and Ag deposits also. While excavating the Ohakuri Dam in the 1980's a large alteration zone was discovered with 0.4g/t Au (Grieve 2000). This deposit has not been mined. A further 16 minor Au/Ag occurrences exist in the TVR and Au deposition is currently active with anomalous Au grades recorded in sinter deposits around active geothermal fields and within geothermal wells (Barker 1993).

Given the geological setting, style of mineralization and current geothermal resources in the TVR, the probability of finding a large, low-sulphidation epithermal gold deposit of economic merit remains very high.

Stage 1 Geoinformatics data intervention

A database of drill-hole, geophysical, geochemical, mineral occurrence, geochronology and remote sensing data was compiled from numerous sources including research institutes, universities, IGNS, and geothermal/power companies; This data set consists of over 100 years of high quality scientific endeavour focussing on regional mapping, economic geology, geothermal exploration and engineering geology of the numerous hydroelectric power and transport developments. Data on recent hazard assessment and agricultural, horticultural and forestry industries was unparalleled in detail, size and quality providing a rich resource of factual geoscience information. These data sets were integrated, queried and visualised in a single, seamless digital environment.

Collation of these data sets allowed new queries and interpretations and enabled the creation of new interpretive geological maps, cross sections and 3D solid geological models. This allowed an integrated approach to gold targeting in the TVR and initial targeting found 29 sites for investigation. (Fig. 3).

Stage 2 Airborne geophysical data acquisition

The acquisition of high resolution airborne gravity and magnetic data was carried out in the autumn of 2005 when 2 planes flew simultaneous geophysical surveys over the TVR area. 38,000 line kms of aeromagnetics and radiometrics were flown at 60m height and 150m line spacing E-W in a swath from Taupo to Tauranga; 6,000 line kms of AIRGRAV™ was flown in a more restricted area between Taupo and Rotorua. This survey, the first such airborne gravity survey in NZ, increased the gravity data set in the region from 7,000 points to 90,000 points. The application of new gravity and magnetic data along with a comprehensive data compilation, data auditing, data processing and new interpretation in the area has allowed new insights into the geology, structure, alteration and mineralisation of the TVR. The high resolution data has allowed better definition of target areas and also found a further 46 targets for ranking.

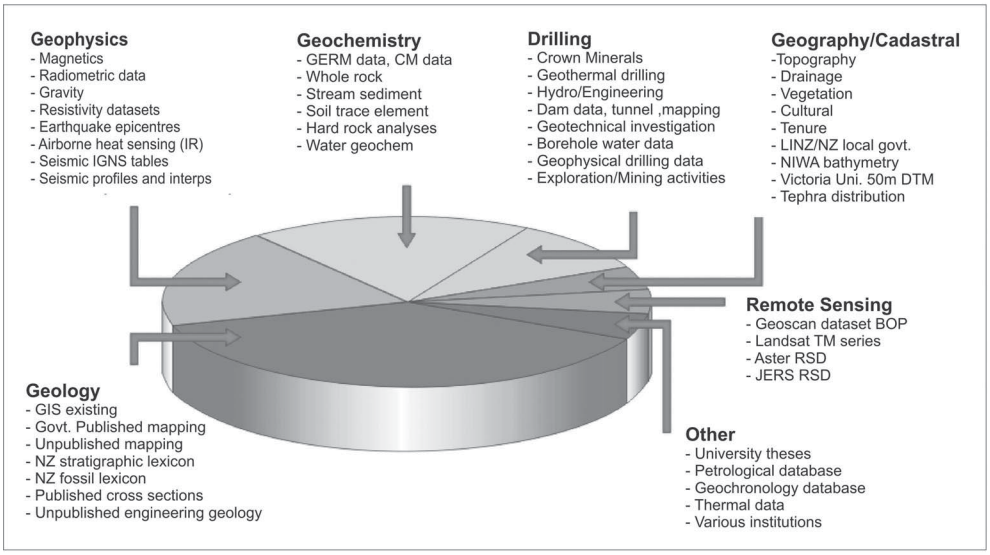


Fig. 3: Database sources used in Stage 1 Intervention

Targeting and ranking involved evaluation of concurrent multi-disciplinary information. Important findings include: New Caldera outlines were defined and existing ones modified. Volcanic (rhyolite) doming helps define geological and structural domains. Strong associations of gravity highs with potential mineralization and magnetic lows with alteration were found. Major NE-SW structures were highlighted and previously unrecognised NW-SE structures defined. Temporal relationships between major gold deposits and rift developments were established.

Case study

Stage 1 targeting outlined 29 areas of high prospective for gold deposits. Stage 2 intervention, while re-defining these areas also drew up new targets. The targeting involved a series of 16 questions examining structure, gravity, magnetics, geochemistry, host rock and facies, surface and subsurface geology, and hydrothermal features.

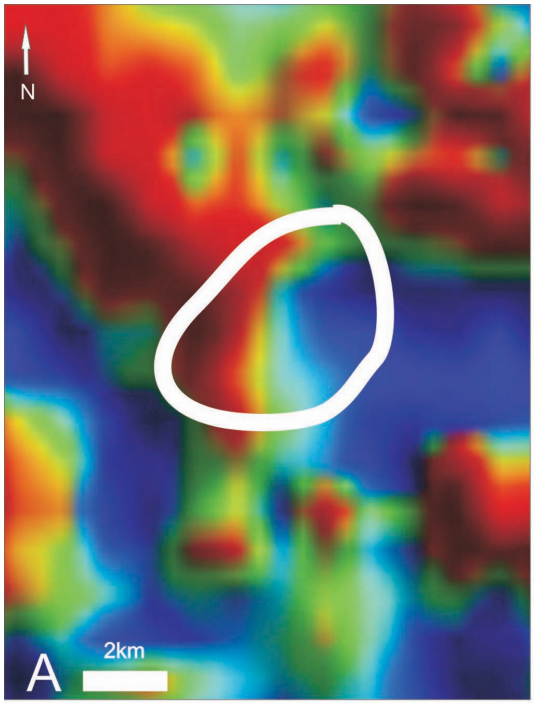
GELLY 1

The Stage 1 legacy data showed GELLY 1 (Fig. 4) to contain both high and low regions of magnetics and gravity with the gravity highs coinciding with the more positive magnetic area and similarly gravity lows coinciding with less positive magnetic anomalies. A single NW-SE trending structure is noted through the area and a magnetic feature (worm[2]) skirts the SW edge with a gravity feature following the line of change from high gravity to low gravity.

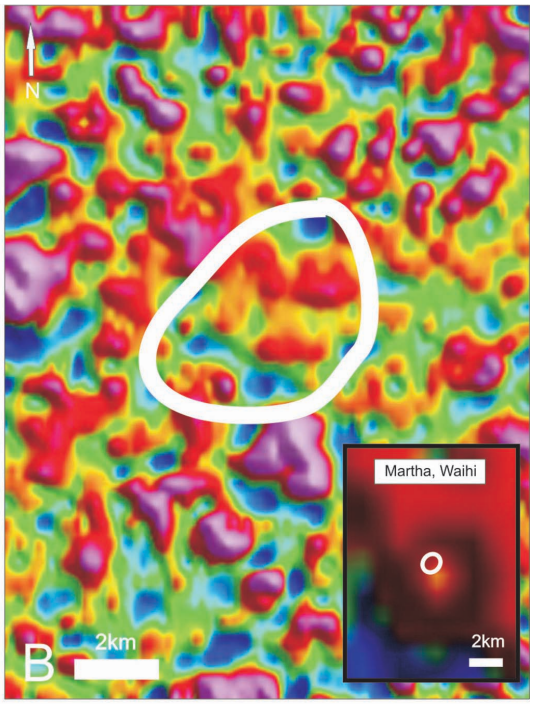
Stage 2 (new) data showed GELLY 1 to have a uniform magnetic low and a corresponding gravity high. Rhyolite intrusions are noted in the SW of the area and with the change in rock type give rise to the moderately higher magnetic signature in that part of the target. (A small region in the SE shows a very strong gravity high but this may be a topographic effect. The other gravity highs in GELLY 1 are however valid.) Two newly identified structures run through the area (NW-SE and SW-NE) and intersect in the SE. There is a strong magnetic structure in the west of GELLY 1 and it has a strong edge effect from the large gravity structure which borders it to the north. The host rock is competent rhyolite, sub-aerial and 450,000-300,000 years old.

[2] Worms are created by multiscale analysis of potential field data and highlight high gradient regions in 3D that appear to be related to surface and deep crustal features. (For more information please refer to: Inferring Geological Structures Using Wavelet-based Multiscale Edge Analysis and Forward Models. Holden et al. 2000, Exploration Geophysics 31(4) 67-71)

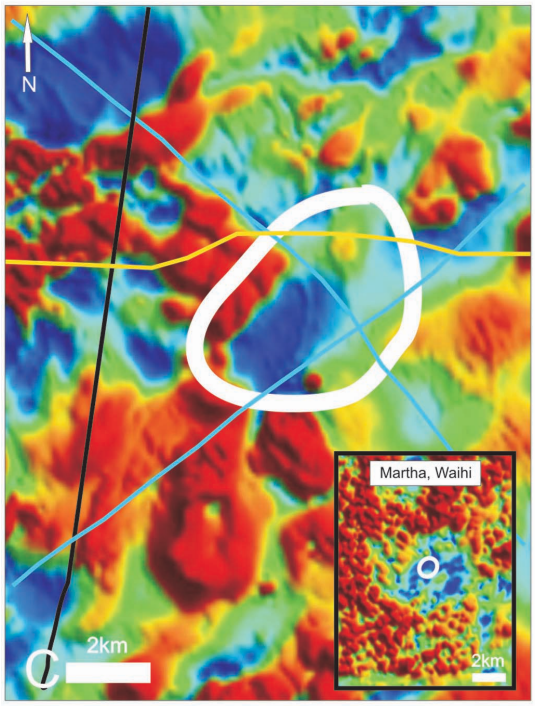
The target size of GELLY 1 corresponds well to that of the current mining operation at Martha Hill, Waihi (approximately 2.5km x 3.5km magnetic low). All the key significant geological/ structural features also relate well to those seen at the mine: At Martha, Waihi; legacy data shows a strong gravity high with corresponding magnetic low, several intersecting structures crossing the target area, a strong gravity structure_bordering to the south and subaqueous mid-Pleistocene host rocks.



A: Legacy Isostatic Bouguer Gravity Signature on target area



B: New BellgeoTM Gravity Signature Tzz 0-200m on target area
Waihi legacy isostatic bouguer gravity inset



C: New Magnetic Signature RTP 0-2km on target area with old structure(black), new structures(blue), gravity feature(yellow)
Waihi legacy RTP magnetics inset

Fig. 4: GELLY 1

High/strong geophysical signature

Low/weak geophysical signature

Discussion

The application of the new technology and collaboration between experts from various geosciences fields in a team environment has meant that the speed at which targeting and ranking occurs is vastly improved. The Geoinformatics Data Intervention was completed in five months, and included a multidisciplinary team from Wellington_(NZ), Perth_(AUST), and Mombay_(India). The second stage Geophysical Surveys and revision of interpretation and targeting (using contractors from Perth Australia (UTS Geophysics) and Bell Geospace (Aberdeen Scotland and Houston USA) was four months.

This was made possible by the integrational ability of the database; a 40GB, 3D dataset capable of comprehensive capture and validation of factual and interpretive data; the ability to add new data at any stage, the use of modern 3D spatial data processing algorithms such as Frac-Worming of potential field data, and the flexibility of the data to be viewed from regional scale to mine scale at any orientation.

Absorption of potentially fundamental changes in interpretation of the TVR geology made possible with the new and significantly more detailed data will take time; and the rigour of ground proofing is yet to be formalised. Some datasets (eg radiometrics) have only been cursorily examined. However, several new observations imply that Coromandel Age Volcanism may project southward on an extension of the Hauraki fault to south west of Lake Rotorua (magnetics and radiometrics) creating significant potential prospectivity in this zone south of Kaimai.

The Hauraki Gold Fields have over 50-60 known gold localities within an area of 6,500sq. km. In the Taupo Volcanic Region the Glass Earth area encompasses 8,900sq. km. Pre the data intervention and targeting the TVR area had 17 possible gold localities (CM Epithermal CD Study); after Stage 2 targeting this number was increased to over 70 possible gold targets. The relative number of potential targets (70-80/8,900sq.km) compares well with the distribution of gold localities in the Hauraki Gold Fields (50-60/6,500sq.km).

Conclusions

Glass Earth has carried out a structured risk managed process guided by the Geoinformatics Data Intervention to examine the Coromandel Central Volcanic Region as a virtually unexplored epithermal gold province under cover of Recent volcanic ash.

Intelligent, intensive, interrogation of digital data had provided a new geological and structural model of the geology of the CCVR. Compiled with new ultra-detailed geophysical data this has led to the defining of new calderas, structures and temporal relationships between gold and rift developments and enabled direct targeting of signatures representative of potential gold deposits.

This multi-layered strategic approach to exploration has taken green-fields areas of 14,000 sq. km to drill targeting within two years.

21 targets prioritised have alteration, structure and geological characteristics similar to that of the world-class epithermal gold deposit Martha, Waihi. Up to 70 other potential targets have been identified.

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