The GoldCorp Challenge, 2000

Presenter: William (Bill) Power
Member of the Winning Team (Fractal Graphics and Taylor Wall Associates)
Background – “The Challenge”?

- Rod McEwan – Goldcorp - early user of modern crowd sourcing
- Crowd Sourcing History:
  - GoldCorp Challenge (2000)
  - Netflix Challenge (2006-2010)
  - Integra Gold Challenge (2015)
The Challenge

• Supposedly inspired by the Linux open source model, McEwan pushed out “The Challenge” at PDAC in 2000.

• Environment was low gold price ($400 in 1996, $300 in 2001).

• Production cost at Red Lake was $360. The mine was facing closure.

• Stated goal: another 6 Million Oz.

• Prize: Total of US$525 K in prize money
Red Lake Mine – Inferred History and Status as of 2000

- Development was deep (1300-1800 m)
- Shafts were probably limiting production rate
- New development needed to 2500m?
Winning Team

Fractal Graphics – Taylor Wall Associates Team
- Nick Archibald
- Vic Wall
- Russell Mason
- Bill Power
- Steve Nichols
- Darren Holden
- Peter Ketelaar
- Donelle Utley
- Neville Panizza
Outline

• The Challenge
• Red Lake District
• Validation of GoldCorp Data
• Open File Data
• Knowledge Based Queries and 3D Model Building
• Targeting
• Presentation
• Feedback
Red Lake Mine and the District

- Discovery 1925, on shores of Red Lake

- Dickenson/Red Lake mine production start 1948 and 1949.

- 1989 – MacEwan/Goldcorp acquisition

- 1995 – Discovery High grade zone (HGZ)

- 2000 – GoldCorp Challenge

As of July 2014, approximately 27 million Oz or 839 tons of gold have been mined in the district
http://www.redlakemuseum.com/red-lake-history.html

About 7-8 million Oz from Red Lake Mine

The HGZ average grade: > 2 Oz/ton

The HGZ life to ~2020  http://www.goldcorp.com/
The Data Public and Private

- Public Data –
  - Regional Geology
  - Alteration and mineralization stories
  - Analogy to other lode gold nearby

- Private (company) Data
  - Level Plans
  - Drilling DB
  - Alteration and mineralogy
  - Development
Mines Department Data

Validation and review of Goldcorp data
Literature review, Red Lake District
GoldCorp Data

Data Valuation and Manipulation

Data from The Challenge CD were loaded into and analysed using various 3D CAD and mining software packages.

Drilling data were imported and colour coded for variations in attributes (e.g., lithology, alteration, etc).

Geological mapping was captured from PDF files and located in 3D spaces as raster drapes.
Validation Results

- Drilling DB was OK – not perfect . . .
- Alteration was only 30-40% complete
- Geological level plans were available, but were interpretive and somewhat simplified
- No “fact mapping”
- Mine development data (drives/shafts) were used to give an idea about where we could expect level plans or sections (interpretive) to be better or worse.
Work Stages

- One – Drilling, Assay, and Alteration
- Two – Import and Assemble in 3D
- Three – Interpretive 3D solid geology
- Four - Looking, Thinking, Targeting
Where is the Mineralization?

- Isosurfacing and summary of mineralization density and location
  - 20x50x100 ft – 0.1, 0.5, 1, 3 & 5 g/t
  - 10x10x20 ft – 1,3,5,10,20,30, 40 & 50 g/t
Where is the Mineralization?
Where is the Mineralization?

- Steep Planar Zones
- Equant Zones (HGZ)
Where is the Mineralization?

Isosurfaces and grade envelopes tell

1. where gold is,
2. where no gold is observed,

BUT

3. There are huge areas where there is no information, and these are not highlighted
The alteration, mineralization and lithology data (drilling) were merged & queried for:

- Carbonate alteration (carbonate +/- qtz)
- Biotite (biotite +/- tourmaline)
- Silicification (qtz veining, qtz, replacement)
- HG alteration – silicification +/- arsenopyrite, biotite, pyrrhotite
- Talc/carbonate (talc + chlorite in ultramafics)

Observed gold, particularly the HGZ, seemed correlated with the “HG alteration”, and arsenopyrite and Magnetite form a halo, with a more dispersed halo of Talc/carbonate and carbonate alteration.
1. Early alteration
   - increased Fe, Fe/Mg, K
   - decreased and Na, Ca
   - not directly related to mineralization
2. Prograde Metamorphism
3. Carbonate Veining and Alteration
   - Variable vein geometries
   - Ultramafics -> talc-chlorite-serpentine
   - Wall rock alteration includes biotite
   - Dolomite and ankerite are associated with Au
   - All in all, limited Au mineralization
Interpretive Alteration History

4. Siliceous and Sulpheidic
   – Overprints earlier events
   – Siliceous infills common
   – Arsenopyrite, pyrite, pyrrhotite and Au

5. Retrograde
   – Chlorite-sericite assemblages,
   – Associated with latest faults,
   – Minor gold remobilization
3D Model

1. Lithologies
   - Basaltic Komatiite
   - Peridotitic Komatiite
   - Rhyolites
   - Campbell Diorite
   - Metasedimentary Sequence
   - Lamprophyres (not modelled)
   - Late Rhyolites (not modelled)
Lithologies

Movie 4a Lithology
Movie 4b Faults
Movie 5a Lodes and devel
Movie 5b Isosurfaces
Faults and Offsets

- Campbell Fault
- Dickenson Fault
- Red Lake Fault

Movie 4a Lithology
Movie 4b Faults
Movie 5a Iodes and devel
Movie 5b Isosurfaces
Structural Evolution

- F1 - Early, nearly isoclinal folding of komatiites, sediments and basalts
- Folds now steep, near isoclinal, with steeply plunging fold axes.
- Intrusion of diorites along axial planes
- F2 folding, resulting in more complexity
- Faulting as the folds “locked up”
Early Folding and Faulting
Continued Buckling and Fault Rotation
Faults Rotated to Sub-Parallel
Final Deformation

- Intrusion of Rhyolites along fault zones in many cases
- Continued shortening – causes vertical extension and some reverse faulting
Metamorphism – Quick Summary

Surface and upper levels - greenschist grade

Deepest levels - lower amphibolite
Alteration (and Mineralization) History

• Five Events:
  1. Early chlorite-clay-carbonate alteration
  2. Prograde metamorphism
  3. Carbonate veining and alteration
     a) Carbonate-quartz (unmineralized)
     b) Ferroan carbonate (slightly mineralized)
  4. Silica-sulphide alteration and veining (HG gold)
  5. Retrograde events (minor gold re-distribution)
Gold Mineralization Interpretation

- Two sites:
  1. Along fault surfaces, dominantly “planar”
  2. In fold hinges and more equant

- The second type represents the HGZ which is the most prolific

- Fine scale mineralization controls are also important, but were not modelled!
Targets

It became a pragmatic exercise

• Target Classes
  1. Near mine, extensions
  2. Close to infrastructure, but new ideas
  3. More Wild Blue Sky –more difficult to drill
Type 1 & 2 Targets
Target Type 3

- Type 1 Targets
- High Grade Zone (HGZ)
- Target 6
- Target 1
- Target 12
- Target 14
- Target 13 (Behind 8 and 14)
- Target 8
- Target 15

Summary
Presentation

• How to present the results?
  – It was OK on flat paper as a 20 page document
  – Better as 3D
  – 3D Presentation was as a menu based front end, which launched a number of short 10-20 second movies (actually animated gif files)
Localization Factors

- Competency Contrasts
- Favourable Host Rock Chemistry
- Fluid Mixing in Dilatant Sites
- Hot Fluids with High Au transport capacity
Judging and Results

- Judging and notification was as expected & on time
- Attention and Publicity was welcome
- We (Nick Archibald and Fractal Geoscience and Taylor-Wall Associates) generally lost money, despite the $105K prize money.
- Fractal Geoscience was acquired by Canadian Financier Glen Lang, and become Geoinformatics Exploration
- FracSIS Software was spun off to Fractal Technologies, and eventually acquire by Runge.
Judging and Feedback

- Detailed Feedback was limited
- We did participate in further analysis and capture of geological data at Red Lake
- GoldCorp has said they did well on all the targets
- Depending on who you ask, perhaps they did very well:

545K + expenses invested 6 billion Au
A. Shallow-dipping high-grade arsenopyrite-rich silicified carbonate vein and selvages folded by $F_{2'}$ section view.

B. Visible gold coating late, shallow-dipping fracture.

C. Gold veinlets stockwork.

D. Extensional carbonate veinlet replaced by quartz containing abundant visible gold and cutting replacement-breccia style ore.
Gold-rich quartz replacing already boudinaged carbonate vein as well as the amphibole in pull-aparts.

F) Figure 5F is a drawing of Figure 5E.

G) Boudinaged steeply dipping carbonate vein partly replaced by Au-rich silica with quartz filling pull-aparts and both carbonate and quartz being locally cut by subhorizontal shear plane, hanging-wall-side-up, section view.

H) Figure 5H is a drawing of Figure 5G.
Questions