Pyrite Trace Element Chemistry of the Fenelon Gold Deposit, Québec

Joy Carter[1], Daniel Gregory[1], Dominique Genna[2]

(1) Department of Earth Sciences, University of Toronto, Toronto, Ontario M5S 3B1, Canada, joy.carter@mail.utoronto.ca,
(2) Département des Sciences Appliquées, Université du Québec à Chicoutimi, Chicoutimi, Québec G7H 2B1, Canada

Abstract

The Abitibi Greenstone Belt hosts several world class gold deposits. Most of these deposits are located in the southern Abitibi, where exploration endeavors have been focused for the last several decades. In recent years, increasingly more effort has been expended to explore the highly prospective northern Abitibi, most notably by the Wallbridge Mining Company Ltd. Wallbridge acquired the Fenelon Gold deposit in 2018, which is situated in the northern Abitibi along the Sunday Lake Deformation Zone. This poster presents the sulfide textures and chemistry related to gold mineralization at the Fenelon Property. A combination of reflected light microscopy, scanning electron microscopy (SEM), and Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS), were used to establish the relationship between sulfide and gold precipitation in the Fenelon deposit.

The two main areas of known gold mineralization at the Fenelon Gold Property are known as the Area 51 and Tabasco zones. Area 51 mineralization is hosted in quartz veins that crosscut the main intrusive body in the Property, the Jeremie Diorite. Tabasco mineralization is associated with a shear zone along the contact between the Jeremie Diorite and the host sediments. The textures and chemistry of sulfides from both zones reveal the relationships of the sulfides to the gold mineralization and significantly enhance the understanding of mineralization at the Fenelon deposit. This study contains the first observations of sulfide textures and chemistry at the Fenelon Property and is among the few studies that have been conducted along the Sunday Lake Deformation Zone. Its success will encourage future exploration in the northern Abitibi and generate growth for the Canadian mineral resource sector.

Sample Location

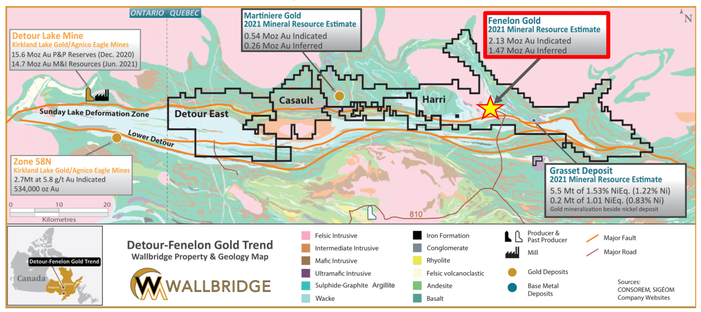

Figure 1: Regional geology map showing the location of the Fenelon Gold Deposit (Wallbridge Mining, 2022).

The Fenelon Gold Property is located in the northern Abitibi, situated along the Sunday Lake Deformation Zone. Most of the gold mineralization is associated with the Jeremie Diorite which intruded into a sedimentary basin dominated by greywacke sedimentary rocks. Another package of argillite and graphitic argillite sedimentary rocks is located to the north and gabbro dykes crosscut all lithologies.

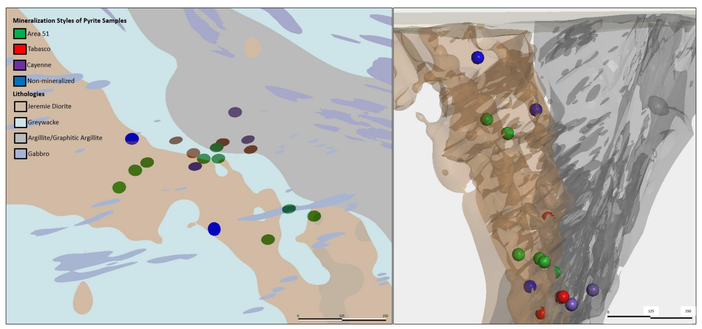

Figure 2: (A) Plan view geology map showing the main lithologies and the locations of the samples taken for this study; (B) Cross-section view of the Jeremie Diorite and the argillite package, showing the locations of samples taken for this study.

Methods

Representative drill core samples of the Area 51 and Tabasco-style mineralization at Fenelon were collected. Thin sections were made by Vancouver Petrographics and they were etched for 4 minutes using NaClO. SEM work was conducted at the University of Toronto. The LA-ICP-MS at the University of Quebec at Chicoutimi was used to conduct spot analyses with a 25 µm beam. The spot data was processed using SILLS software. The sulfide maps were analyzed using a 25 µm beam.

Mineralization Styles

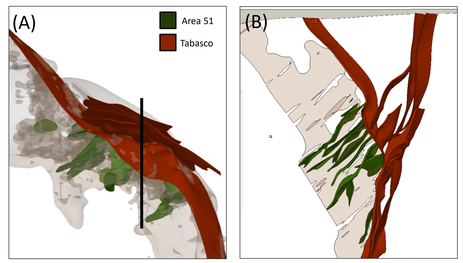

Figure 3: (A) Plan view map of the Jeremie Diorite showing the Area 51 and Tabasco zones with a black line represents the cross section taken in (B); (B) Cross-section of the Jeremie Diorite showing the Area 51 and Tabasco zones.

Area 51

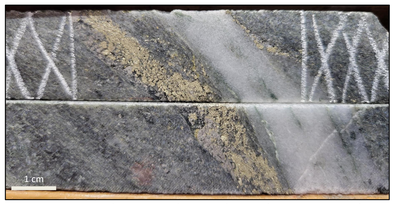

Figure 4: Typical Area 51-style mineralization (FA-21-288; 329m).

Area 51-style mineralization occurs as visible gold, pyrite, chalcopyrite, and lesser arsenopyrite, pyrrhotite, and sphalerite in smoky quartz veins with a NE-orientation. They are mostly hosted in the Jeremie Diorite, but also occur in the greywacke close to the contact.

Tabasco

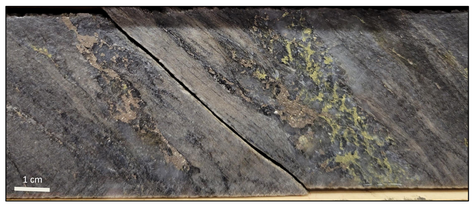

Figure 5: Typical Tabasco-style mineralization (FA-21-226-W1-W1; 823 m).

Tabasco-style mineralization occurs as visible gold, chalcopyrite, pyrrhotite, and lesser pyrite, sphalerite, and arsenopyrite. The Tabasco Zone is mostly hosted in sheared and sericitized sediments near the contact with the Jeremie Diorite.

Etched Pyrite in Reflected Light

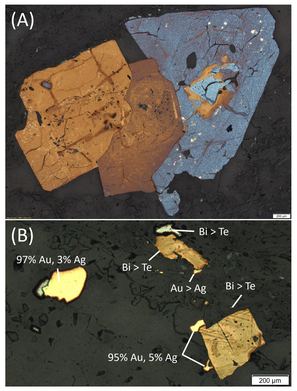

Figure 6: (A) & (B) Photos of etched pyrite grains from Area 51 samples taken under reflected light.

Pyrite etching has shown that there are four generations of pyrite present in the Area 51 samples. Zoning is also evident.

A combination of reflected light and scanning electron microscopy show that gold is often associated with Bi, Te, and Ag.

LA-ICP-MS Spot Analyses

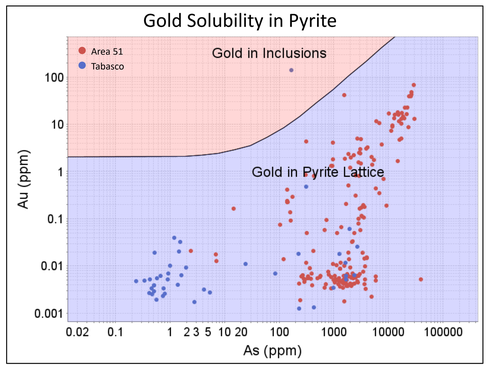

Figure 7: Gold Solubility in Pyrite (Reich et al., 2005). A few analyses had obvious gold inclusions.

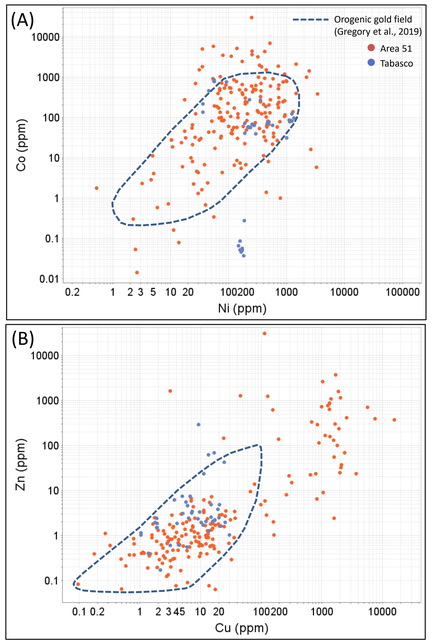

Figure 8: (A) Ni-Co ratios of the Area 51 and Tabasco analyses shown to plot dominantly within the orogenic gold field determined by Gregory et al. 2019; (B) Cu-Zn ratios of the Area 51 and Tabasco analyses shown to plot dominantly within the orogenic gold field determined by Gregory et al. (2019).

Scanning Electron Microscopy

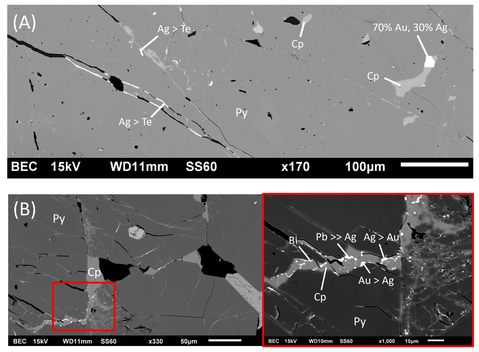

Figure 9: (A) SEM image of an Area 51 vein showing fracture-filling Ag, Te, Cp, and Au in a deformed pyrite grain; (B) SEM image of an Area 51 vein showing fracture-filling Cp with lesser Bi, Pb, Ag, and Au surrounding deformed pyrite grains.

Sulfide Maps

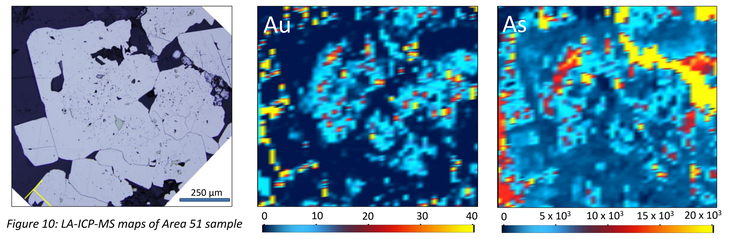

Figure 10: LA-ICP-MS maps of Area 51 sample

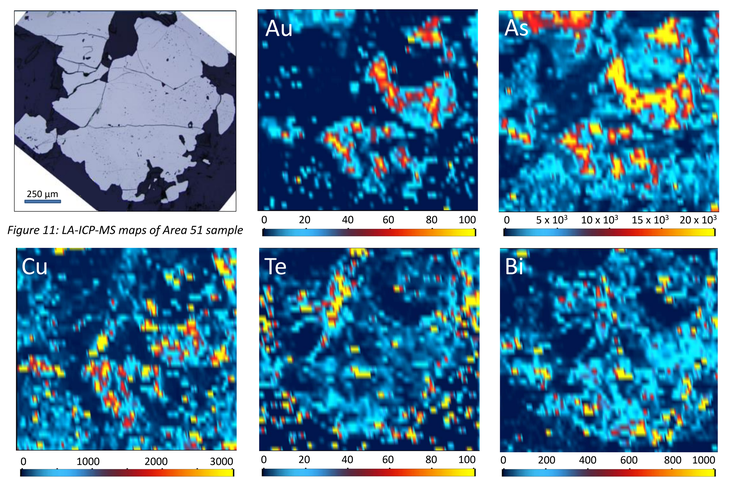

Figure 11: LA-ICP-MS maps of Area 51 sample

Conclusions

The combination of reflected light microscopy, SEM, and LA-ICP-MS spot and map analyses has provided valuable insight about mineralization at the Fenelon Gold deposit. Pyrite etching has shown that there are multiple generations of pyrite, and the SEM has shown that Area 51 gold mineralization is often associated with fracture-filling chalcopyrite and lesser amounts of Bi, Te, Ag, Pb in the youngest (least-etched) deformed pyrite grains. The spot analyses indicate that the gold in both the Area 51 and Tabasco zones are primarily hosted in the pyrite lattice (Reich, 2005). They also plot within the orogenic gold fields determined by Gregory et al. (2019). The LA-ICP-MS maps of Area 51 pyrite grains corroborate SEM observations and show that gold has a strong association with Bi, Cu, Te, Cu, and As. This study is among the first of its kind conducted along the Sunday Lake Deformation Zone and has successfully identified and described sulfide textures and chemistry of the Fenelon Gold deposit.

Acknowledgements

We would like to thank the geology team at the Fenelon Project for their thoughtful discussions and tireless support that have helped make this project a success. We are especially grateful to Attila Pentek, Evan Slater, Nicolas Gaillard, Chris Kelly, Cedric Mayer, and Jeremie Rivest for your support. To everyone from the Wallbridge Staff, including the technicians, core cutters, management staff, and the contractors, thank you for curating a safe and enjoyable work environment from which we could pursue our work.

References

Gregory, D.D., Cracknell, M., Large, R., McGoldrick, P., Kuhn, S., Maslennikov, V., Baker, M., Fox. N., Belousov, I., Figueroa, M., Steadman, J., Fabris. A., and Lyons, T. (2019). Distinguishing Ore Deposit Type and Barren Sedimentary Pyrite Using Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry Trace Element Data and Statistical Analysis of Large Data Sets. 2019. *Economic Geology,* 114(4), 771-786.
Reich, M., Kesler, S.E., Utsunomiya, S., Palenik, C.S., Chrvssoulis, S.L., and Ewing, R.C. (2005). Solubility of Gold in Arsenian Pyrite. *Geochimica and Cosmochimica Acta,* 69, 2781-2786.
Wallbridge Mining Company, Ltd. (2022, May 30). *Fenelon Gold Project, Québec, Canada.* https://wallbridgemining.com/our-projects/fenelon-gold/