The antimony-gold mineralisation in Newfoundland and Ireland: a large-scale magmatic-hydrothermal system?

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Project Highlights:

- A unique opportunity to investigate potential sources of a key critical metal in Ireland and Newfoundland
- Field work in Newfoundland and Ireland
- Gain wide skill-set using microanalytical and geochemical approaches supporting both academic and industry career routes
- Collaborative multinational project with access to industry data

Overview:

Antimony (Sb) is listed as a critical raw material (CRM) by the UK and the EU, due to its key role in the economy and the Green Energy Transition, and the high risk to its supply chain. Antimony is used in a wide variety of technologies, including semi-conductors, circuit boards, photovoltaic cells, and batteries. Over 90% of global antimony is produced in China, Russia and Tajikistan, so there is a need to diversify the global supply of the metal. Particularly in light of the recent export restrictions by China, the world's most significant antimony producer, puts increasing pressure on finding other significant antimony resources. Gold, on the other hand, is a crucial commodity for the global economy. The occurrence of the two economically significant metals together is relatively rare but offers an extremely exciting opportunity to investigate the factors that results in this type of mineralisation.

This multi-disciplinary project examines antimony mineralisation associated with orogenic vein-gold deposits in Ireland and Newfoundland. Two areas are of particular interest: the Clontibret deposit in Ireland, and the potentially world-class Beaver Brook area and other similar deposits and prospects in Newfoundland (Fig. 1). The antimony is found in stibnite and can form massive pods within the veins: in drill core at Beaver Brook, for example, Sb grades in some intervals reach >30% whilst gold grades in both areas of up to 28-35 ppm have been recorded in drill core and channel sample intervals.

Both deposits are located within the geological terrane straddling the Iapetus suture (known as the Southern Uplands Terrane in the UK and Ireland and the Gander Zone in Newfoundland). The deposits are, therefore, analogous in terms of their tectonic association and geological framework. These offer an excellent natural laboratory to compare and contrast deposits, in order to illuminate the entire mineral system and the relationships and wider geological controls on antimony-gold mineralisation. The project will also feed into wider research interests of the project partners to understand the controls on vein-hosted gold mineralisation along the Caledonian-Appalachian belt from Scotland to Eastern North America. Finally, research into antimony is an emerging field within economic geology, and the results of this project will be of a significant value to understanding antimony mineralisation globally.

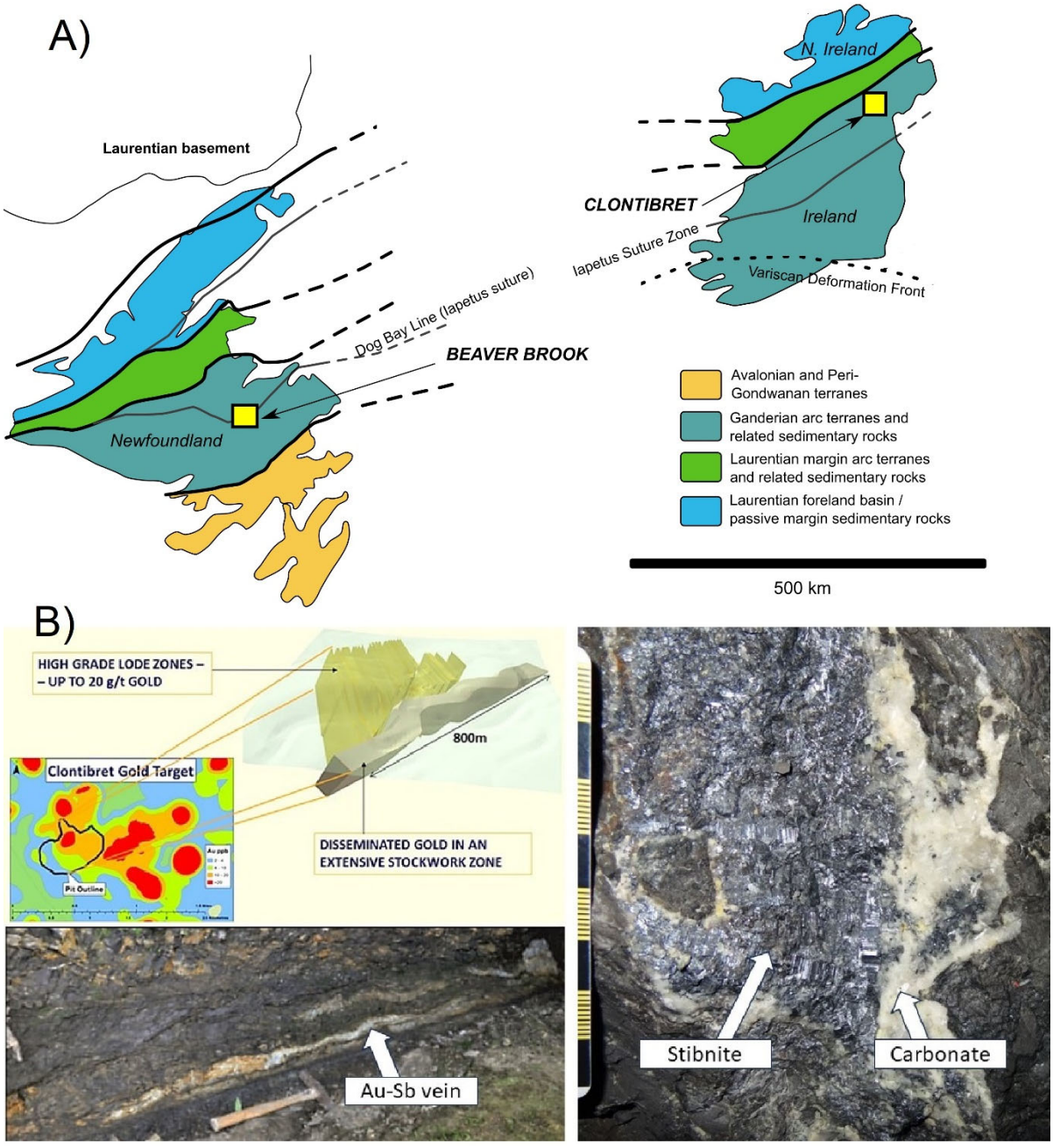

Figure 1. A) Generalised geological map of Ireland and Newfoundland, showing the locations of the

study areas in Ireland and Newfoundland. B) Examples of the ore bodies and mineralisation at Clontibret (left) and Beaver Brook (right).

Methodology:

The project is underpinned by field work and sampling in Newfoundland and Ireland. A significant sample suite exists with the project partners (e.g. drill core and analytical data from both study areas) but additional field work and on-site visits are necessary to complement the dataset, particularly in terms of structural and other outcrop observations, and drill core logging. Regional high-resolution airborne geophysics and ground-based geochemistry are also available and may be useful to help tie the results into the wider geological and tectonic context. Existing datasets and samples will be combined with newly acquired samples and analytical data, including microanalytical and geochemical/isotope data as appropriate. The main methods are:

- Textural mapping and paragenetic interpretation using Scanning Electron microscope (SEM) based techniques including SE, BSE, CL imaging combined with EBSD (phase and crystallographic mapping), EDS (chemical mapping) and mineral liberation analysis
- Detailed geochemical/trace element characterisation of key phases using Electron Microprobe Analysis (EMPA) and Laser-Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS)
- Stable isotope analyses (both bulk and in-situ) of key sulphide phases to investigate fluid sources and mineralisation styles

In addition, depending on the vein mineralogy, the project will include other approaches such as directly dating the mineralisation, e.g. through Re-Os dating of molybdenite or pyrite, $^{40}Ar/^{39}Ar$ dating of muscovite.

Possible Timeline

Year 1: Data collation and new data acquisition: literature review, field work, sampling, sample preparation, petrography, GIS analysis/data compilation

Year 2: Main analytical phase: SEM/EPMA/LA-ICP-MS/isotope work; further field work; writing publication #1 (optional)

Year 3: Finish analysis; geochronology; writing publications #2-3 (optional); final interpretation and synthesis of data

Training and skills:

TARGET researchers will participate in a minimum of 40 days training over the 3.5 years of study composed of:

- an annual one-week workshop dedicated to their year group, and tailored to that cohort's needs in terms of skills development – *for the first three years of their study*;
- an annual all-TARGET workshop with cross-year interactions, advanced training and opportunities to specialise in particular areas – *all years of study*;

- a number of one-day workshops;
- additional online events and in-person workshops attached to relevant conferences.

In addition to the training within TARGET, the project provides specialist training in: (i) state-of-the-art microanalytical and geochemical techniques; (ii) textural-structural and mineralogical analysis and field work; and (iii) industry-standard exploration and software skills. The PhD is equally suited to academia or industry careers: there is excellent potential for publications, whilst exposure to industry-relevant skills in exploration and ore geology through data sourcing and collation, industry placement, and multi-method analyses provides non-academic vocational experience. You will be able present at both national and international, academic or industry facing conferences according to your career trajectory.

Partners and collaboration (including CASE):

The main supervisor is Dr Torvela (Leeds), expert in tectonic and structural analysis and interpretation of hydrothermal veins from macro- to microscale, particularly related to gold-related systems. Co-supervisors are Dr Dan Morgan (Leeds) with expertise in mineralogy and magmatic-hydrothermal systems; Dr Hollis (Edinburgh) with expertise in interpreting geochemical and stable isotope data from magmatic-hydrothermal ore deposits; Dr Shaw (GSNI) providing local expertise on Irish and Northern Irish ore deposits; and Dr Deady (BGS) who is an expert in antimony mineralisation.

Other key collaborators include Conroy Gold and Natural Resources who will provide sample materials and access to their exploration sites and drill core. In addition, this multinational project involves DIETNL (Dr Sandman) and NRC (and Dr Honsberger) who will assist with industry access to existing samples, field areas, data and expertise on Beaver Brook and other areas under active exploration in Newfoundland.

Further reading:

Earls G, 2016 'Gold exploration in the north of Ireland: new targets from the Tellus projects' in M.E. Young (ed.), Unearthed: impacts of the Tellus surveys of the north of Ireland. Dublin. Royal Irish Academy. DOI:10.3318/ 978-1-908996-88-6.ch6

Lusty PAJ, Scheib C, Gunn AG & Walker ASD, 2012. Reconnaissance-Scale Prospectivity Analysis for Gold Mineralisation in the Southern Uplands-Down-Longford Terrane, Northern Ireland

Sandeman HAI, Peddle C & Newman R, 2018. Beaver Brook antimony mine revisited: an update on operations and new structural and geological observations. Newfoundland and Labrador Department of Natural Resources, Geological Survey Report 18-1, 123-152.

http://www.conroygoldandnaturalresources.com/projects/clontibret

Further details:

Please visit https://target.le.ac.uk/ for additional details on how to apply.

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www.youtube.com/@ourmetallicearth

https://environment.leeds.ac.uk/see/staff/1576/dr-taija-torvela