



#### Introduction

The drive for low-carbon technologies has increased the demand for critical metals. Due to the long-term decline of mining in Europe demand has been met by less developed economies where regulation is less strict, commonly with negative environmental and social impacts <sup>[1]</sup>. The sustainability of low-carbon technologies is greatly affected when the supply chain is taken into account <sup>[2]</sup>. The need for secure and sustainable supplies of mineral resources for a low-carbon economy is creating renewed interest in European mineral resources <sup>[1]</sup>. However, sustainable development of domestic mineral resources poses new challenges. How can exploration practices contribute to greater sustainability in the UK minerals sector?

### Social impact

Many former mining areas in the UK are now valued for their industrial heritage. The mining heritage has become a locally important source of tourism revenue (Figs. 1, 3, 4). It is unclear how efforts to rejuvenate domestic mining would affect post-industrial communities. How can perceptions and concerns about negative impacts be addressed? E.g. on local businesses, agriculture and quality of life.



Figure 1. Economic, environmental and social dynamics, Leadhills-Wanlockhead.



Figure 2. Sheep at Leadhills, Scotland, grazing on Pb sulphide mine waste.

# Low-Impact Exploration for Gold in the Scottish Caledonides, UK.

## Samuel Rice, Simon Cuthbert, Andrew Hursthouse, Gabriele Broetto

Exploration Geosciences Group, School of Science, University of the West of Scotland, Paisley, Scotland, UK. samuel.rice@uws.ac.uk





Community engagement can play an important role in maximising positive impacts of exploration and mineral resource development <sup>[3]</sup>:

- An open and honest approach, listening to, and responding to local concerns.
- Work in partnership with local organisations and communities.
- Support local tourism and businesses e.g. provide geodiversity interpretation.
- Support local employment opportunities and employ local services and skills.
- Outreach activities and education.

Figure 4. Entrance to the Lochneill Mine, Wanlockhead: open for tourists.



Figure 5. In parts of Scotland and central Ireland extensive thick periglacial cover poses significant challenges for exploration and mining (Fig.). Photo: County Monaghan, Ireland.



#### Research

We are currently investigating the ore system at Leadhills-Wanlockhead in the Southern Uplands, Scotland. Our approach aims to reduce the environmental footprint of exploration through high resolution targeting based on constraining the tectonomagmatic controls of the mineralised system (see poster TS7.5; Figs. 6, 7). We are keen to collaborate on new interdisciplinary research into how geoscience

can contribute to more sustainable exploration.



Figure 6. An approach to more sustainable exploration.

#### Some potential environmental impacts of exploration:

- Noise
- Increased road traffic

### **Community engagement**

#### Exploration



- Ph of mine drainage is naturally buffered by carbonate in the lode zones.
- Deeply weathered regolith identified during exploration at Leadhills-Wanlockhead means exploration activities require special mitigation against pollution of watercourses.
- Lithological information obtained during exploration can inform planning for mine waste e.g. suitability for construction of tailings dams and spoil heaps.

#### **Future work**

- To what extent can detailed studies of local ore-forming processes improve the sustainability of exploration programmes through targeting at the district scale?
- What low-impact exploration techniques could be used to explore for mineral deposits beneath thick superficial cover (Fig. 5)?
- What role can geodiversity and community engagement play in supporting sustainable mineral exploration in post-industrial settings?

#### References

- [1] de Ridder, M., 2013. The Geopolitics of Mineral Resources for Renewable Energy Technologies. Centre for Strategic Studies, The Hague.
- [2] Pell, R. and Wall, F., 2016. Comparing the environmental performance of rare earth deposits using GaBi software to perform a cradle-to-gate Life CyCcle Assessment. Sustainable Minerals '16. Falmouth, UK.
- [3] Newmont Exploration ESR Guidebook 2011.





Loss of vegetation and topsoil from access roads, drill pads and excavations.

Increased run-off and suspended pollutants e.g. clays in drainage.

. Airborne dust with contaminants e.g heavy metals Pb, As.

Visual impact of excavations, machinery, signage and flagging

Hydrological disturbances: localised flooding, drying of peat bogs.

Contamination of soil and water from leaks and spills from machinery.

Figure 7. Stream sediment sampling, Leadhills, Scotland. PhD project investigating gold and pathfinder element dispersion by surface processes (student Gabriele Broetto, UWS).