



Mineral Deposits of Ireland and Northern Ireland

MUN-SEG 2023 Fieldtrip

May 1 - May 11, 2023



In collaboration with the National University of Ireland SEG
student chapter (NUI-SEG) at University College Dublin (UCD)

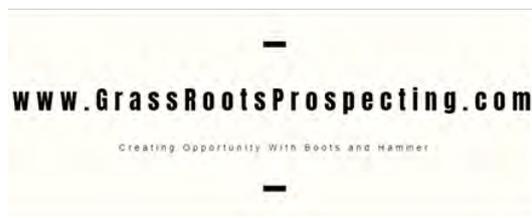


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Sponsors

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Summary

This field trip was first proposed by Memorial University's Society of Economic Geologists student chapter (MUN-SEG) in 2019 but was postponed until 2023 due to the pandemic. The goal was to expose students to a wide range of base and precious metal deposits that occur in rocks of the Appalachian orogen outside of Newfoundland. The primary objectives of this trip were to see deposits not found in Newfoundland (Irish-type Zn-Pb deposits), to visit deposits potentially analogous to those seen in Newfoundland, to gain exposure to the real-world functioning of the mining industry, and to network with both academics and professionals abroad. In addition, the trip offered opportunities to learn about Irish culture, visit historic sites, and experience other aspects of the geology of Ireland. The group consisted of four graduate students and one undergraduate student from Memorial University.

Graduate students from the National University of Ireland SEG student chapter (NUI-SEG) at University College Dublin also planned their own trip to Northern Ireland around the same dates and collaborated with us on the organization. On our first day in Ireland, we were welcomed at University College Dublin by members of iCRAG and NUI-SEG for a mini-symposium on critical metals. NUI-SEG then joined us halfway through our trip, beginning with the tour of Abbeytown lead mine.

Over the course of nine full days, we drove ~2500 km in a rented SUV and circled the island, going underground at six different sites including the currently operating Tara Mine. Prior to this trip, none of us had ever gone underground at an active mine, seen limestone caves, or been to Ireland. This field trip was a very enriching experience for us both culturally, academically, and professionally. We feel that it was a great success and would recommend Ireland as a destination for similar trips undertaken by other SEG student chapters.

Itinerary



Daily Summaries

Day 1: Mini Symposium on critical metals at UCD (May 2, 2023)

Immediately upon arriving in Dublin, we headed to the School of Earth Sciences at University College Dublin (UCD) for the iCRAG-DOME mini symposium on critical metals. This short symposium was a research exchange forum on critical metals and their mineral deposits with the aims of improving knowledge on the formation and enrichment of these metals and their importance for the green energy transition. We received talks from students and faculty from Trinity College, University of Dublin, University of Erlangen-Nürnberg, University of Mainz, University of Tübingen, and the University of Hannover. Afterwards, there was a networking opportunity where we had the pleasure of meeting students and faculty from these universities.



Figure 1: University College Dublin (UCD) campus: venue for the iCRAG-DOME mini symposium on critical metals.

Day 2: Dublin to Kilkenny Historic [Ballycorus mine](#) and [Galmoy](#) core shed visit (May 3, 2023)

From Dublin, we first drove south to visit the historic Ballycorus Pb-Zn-Ag mine. The mine was in production from the early 19th century up to the 1870s and the smelter was in use until 1913. The chimney is the best preserved part of the flue system that was used to extract lead and carry off poisonous fumes. We did not get to see the small area of the mine workings that are preserved as they were covered by trees.

Next, we visited the Galmoy core shed to view core from the Galmoy deposit, a Zn-Pb Irish-type deposit which is proximal and very similar to the Lisheen deposit. We were hosted by John Guven, Senior Geologist with iCRAG, who gave a presentation on the deposit. The deposit is hosted in Lower Carboniferous carbonate rocks that, along with many other occurrences, define a significant base metal province known as the Irish ore field. The host rocks are oolitic, fossiliferous, and commonly brecciated. Mineralization was achieved by replacement of the brecciated units and sulfide mineralization included pyrite-marcasite, sphalerite, and galena with minor sulfosalt minerals (tennantite), arsenopyrite, and copper sulfides. Their colloform textures could be seen in the core. Here, we also discussed the mine decommissioning and reopening process.



Figure 2: Exhaust chimney preserved at the historic Ballycorus Pb mine, County Dublin, Ireland.



Figure 3: MUN-SEG students looking at core from the Galmoy mine, a Zn-Pb Irish-type deposit. John Guven, Senior Geologist with iCRAG, middle.



Figure 4: Colloform pyrite and sphalerite mineralization in core from the Galmoy deposit.

Day 3: Kilkenny to Cork [Copper Coast Geopark](#) and [Dunhill Castle](#) (May 4, 2023)

Our destination was the Copper Coast Geopark located along the southern coast of Ireland in County Waterford. This United Nations Educational, Scientific, and Cultural Organization (UNESCO) site was host to several copper mines in the 18th and 19th centuries. An Ordovician aged submarine volcanic center known as the Bunmahon Volcano is interpreted to have driven a volcano-hydrothermal system that led to the formation of these deposits. Below are examples of the rocks and minerals from the Geopark which can be found in the visitor interpretation center.

Road closures and single-lane roads made navigation in the area a challenging new experience. We visited the historic ruins of Dunhill Castle before heading to Cork for the night.

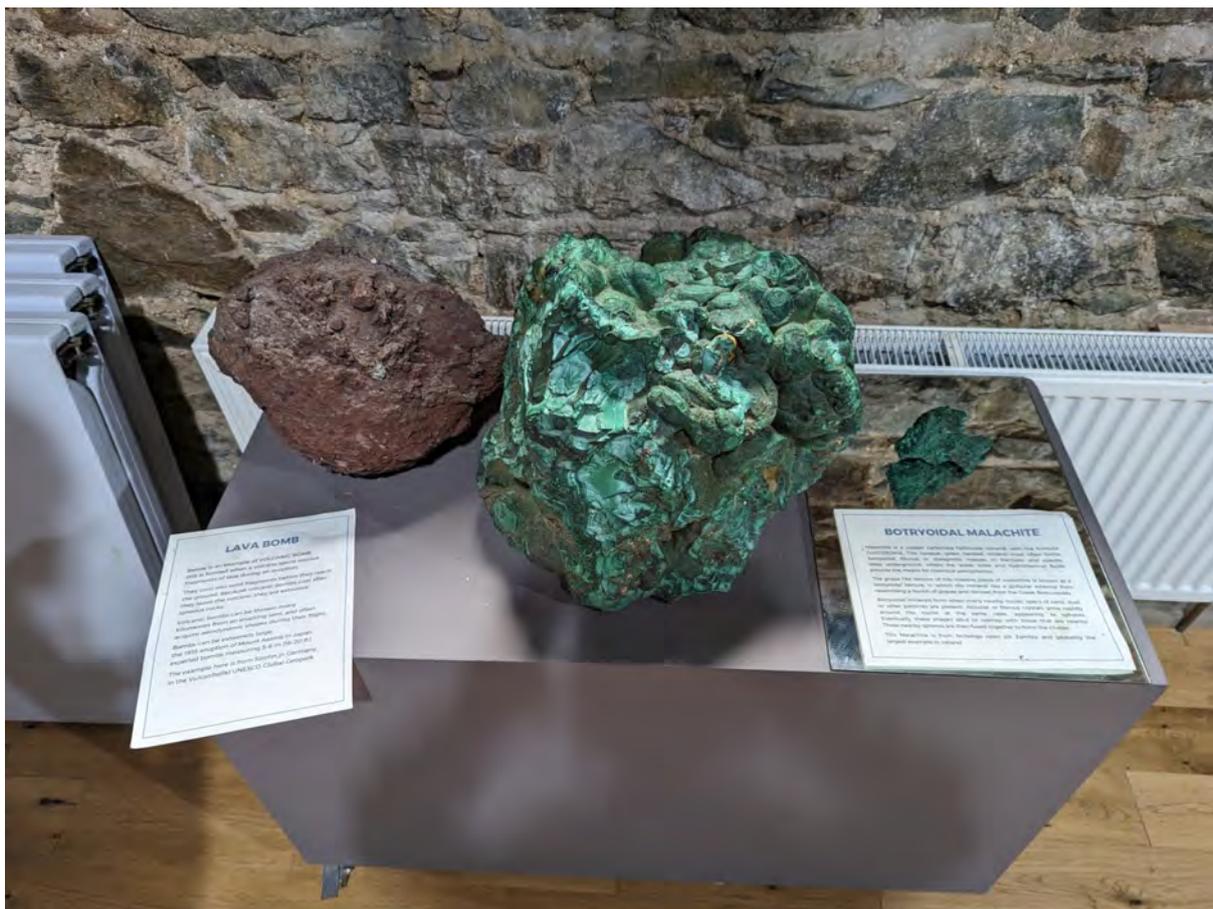


Figure 5: Botryoidal malachite on exhibit at the Copper Coast Geopark visitor's center.

Day 4: Cork to Galway [Aillwee/Doolin Caves](#), [Cliffs of Moher](#), [Rock of Cashel](#) (May 5, 2023)

On day four, our geostops in the Burren region included tours of both the Aillwee and Doolin caves followed by the Cliffs of Moher. Both cave systems are composed of limestone/calcite and were naturally carved out by subterranean glacial rivers. The wall rock limestones are ~360 Ma, corresponding to a period when Ireland was covered by a shallow tropical sea. The Doolin cave features an impressive 7.3 m long stalactite, the largest in Europe, that has been growing for some 500,000 years.

Later that evening, we visited the famous Cliffs of Moher. The total thickness of the sedimentary succession exposed in the Burren is ~672 m of limestone and siliciclastic rocks, underlain by an additional 300 m of limestone. The cliffs, an exposure of the siliciclastic sequence, span approximately 8 km of coastline and reach a height of 214 m. The cliffs are comprised of the 300 Ma Namurian sedimentary sequence. This preserved sequence is an excellent example of a sedimentary basin that was formed by the rapid deposition of sediments from a once active river system.

Our main cultural stop of the day was the Rock of Cashel, a prominent landmark which hosts a historically significant and well-preserved medieval cathedral and castle.



Figure 6: Aillwee Caves located in the limestone karst landscape of the Burren, County Clare, Ireland.



Figure 7: Largest stalactite in Europe and third largest in the world, Doolin Cave.



Figure 8: Cliffs of Moher after a long day of exploration.

Day 5: Galway, [Glengowla historic Pb mine tour](#), Sky Road loop, [Kylemore Abbey](#), Connemara National Park (May 6, 2023)

The day began with an underground tour of the historic 19th century Glengowla Pb mine. Mining at Glengowla took place between 1851-1865 by means of manual labor. The primary ore mineral at Glengowla was galena (PbS), although byproducts included Ag, Au, and gem quality fluorite. The mine has been converted into a “show mine” complete with an impressive mineral collection including smoky quartz, amethyst, citrine, fluorite, turquoise, calcite, epidote, malachite, bornite, and galena. After the tour, our group of geologists was granted a complimentary private tour of the owner’s personal mineral collection which included world class examples of minerals extracted from the Connemara region. We were also given advice on our route for the rest of the day.

Our tour of the Connemara region continued with a coastal drive along the famous Sky Road, which gave us an opportunity to observe natural exposures of bedrock along the western Irish coastline. Our route took us past Kylemore Abbey before diverting back through the highlands of the Connemara National Park. The mountainous and rugged landscape of the park was carved out by recent quaternary glaciations. The bedrock geology in this region is dominated by metasedimentary rocks deposited approximately 850 Ma ago during the breakup of the Rodinia supercontinent. The later development of the Iapetus ocean led to seafloor

sedimentation in addition to subaqueous volcanic activity (e.g., pillow basalts, tufts, etc). The drive through Maam Valley was particularly memorable.



Figure 9: Historic Glengowla Pb-Zn-Ag mine. Miners excavated shafts by hand in pursuit of a galena-bearing vein.

Day 6: Galway to Donegal, reunite with NUI-SEG, [Abbeytown mine](#) underground tour, [Marble Arch Caves](#) (May 7, 2023)

On day six, we met up with students from NUI-SEG at the Abbeytown mine and were given an underground tour by consultant economic geologists Aiden Lavelle and Kevin Dalton. Abbeytown is the site of a historically significant Irish type Pb-Ag-Zn mine situated along the northwestern coast of Ireland near the border with Northern Ireland. Principally, lead from Abbeytown served in the production of ammunition for the Korean War. The mine is currently owned by Erris Zinc Ltd. but is inactive. Mineralization in the Abbeytown mine was driven primarily by fluid movement along fault systems leading to sulfide replacement of Carboniferous limestones and calcareous sandstones. Mineralization is dominated by galena and associated sphalerite. This mine contains excellent examples of colloform sphalerite with radial galena replacement.

In the afternoon, we visited the Marble Arch Cave in Northern Ireland. Much like the Aillwee and Doolin caves, wall rock consists of limestone that formed ~330 Ma when Ireland was covered by a tropical sea. The cave system's 11.5 km length makes it an impressive example of karsting.



Figure 10: MUN-SEG and NUI-SEG visiting Abbeytown mine. Image shows the open pit quarry with the mine adit visible to the left of the posted signage.



Figure 11: Marble Arch Cave tour through a partially flooded area.

Day 7: Donegal to Belfast, [Slieve League](#) hike, [Giant's Causeway](#) (May 8, 2023)

On day seven, we first went for a hike at Slieve League, on the west coast. Later, following a long drive, we visited the Giant's Causeway UNESCO World Heritage Site on the northern coast of Northern Ireland. The outcrop is comprised of ~40,000 basalt columns that record the rifting and subsequent volcanism associated with the opening of the modern Atlantic Ocean. During the rifting of the continent Laurasia, large basaltic lava flows formed surficial lava "lakes" which slowly cooled to form the ~90 m thick sequence of columnar basalts now exposed along the Giant's Causeway. Various orientations of columnar basalts are visible and are indicative of the paleo-cooling direction of the lava. Additionally, an excellent example of modern spheroidal weathering of basalt is visible along the road leading to the main outcrop.



Figure 12: Columnar basalt at the Giant's Causeway.



Figure 13: MUN-SEG students hiking Slieve League.

Day 8: Belfast, Tara Mines (May 9, 2023)

On our penultimate day, we had an amazing opportunity to go underground at Tara Mines, currently owned and operated by Boliden. We had been in contact with Ian Farrelly, Head of Section for Exploration, who oversaw the planning of our visit and was our host. The mine reaches a depth of 1000 m (although expansions to Tara Deep at approximately 1750 m are currently being explored). Tara is Europe's largest Zn mine, having 2200 kt indicated resource grading 6.2% Zn and 7.3% Pb. Since production began in 1977, the mine has produced 85 million tonnes of ore. At Tara, the "Navan" orebody is an Irish-type Zn-Pb deposit hosted in early Carboniferous shallow-water carbonates. Mineralization in the Navan ore bodies occurs as strata bound lenses within muddy limestones of the "Pale Beds" and an overlying boulder conglomerate. During our underground tour, we descended some 700 m before a flat tire forced the bus to a halt. During the stop, we discussed mine operations, observed some of the mineralization styles, and were lucky enough to take hand samples. For our relatives, we also brought home a dramatic and "harrowing" tale of being trapped deep underground! Following the underground tour, we received a short presentation on the Tara project itself. Our time at Tara Mines concluded with a tour of the core shed where we were made familiar with key stratigraphic horizons, marker units, and mineralization styles.

Before returning to Belfast, we took a brief detour to visit the nearby Dowth megalithic passage tomb, with an estimated age of 5,200 years. It was constructed by the

early inhabitants of Ireland, long before the arrival of the Celts. Dowth is one of three passage tombs in the area – the most famous being the Newgrange site. Since it is not maintained as a tourist destination, it is a lesser known archeological wonder and made for a more intimate experience.



Figure 14: MUN-SEG and NUI-SEG students receiving talk at Tara Mines prior to the underground tour. Presenters include Ian Farrelly, Head of Exploration (rear, left) and Josh Smiles, Mine Geology (rear, second from left).

Day 9: Belfast to Dublin Curraghinalt Gold (May 10, 2023)

On the last full day of our trip, we visited the Curraghinalt Gold project, where we were hosted by Gareth Joseph, Geology Manager at Dalradian Gold. We learned about the gold exploration project, including the challenges of obtaining mining permits, and looked at many meters of core. The Curraghinalt quartz–gold vein–hosted deposit is one of several gold prospects that are proximal to the significant Highland Boundary Fault Zone (HBFZ). Mineralization is hosted in narrow, sub-parallel auriferous quartz–carbonate–sulfide veins and sericite-rich shears in metasediments. Mineralization includes pyrite, arsenopyrite, chalcopyrite, tennantite– tetrahedrite, tellurides of Bi, Au–Ag, Hg and Pb, and gold-rich electrum. The gold mineralization itself is hosted within auriferous pyrite and arsenopyrite but is not visible to the naked eye. As some of our students worked at gold exploration companies in Newfoundland, this was an excellent opportunity for us, and it was interesting to see similarities and differences between gold projects in Newfoundland and Northern Ireland.

After our visit, we drove back to Dublin, where we took some time to experience the city center before preparing for our departure back to Canada in the morning.



Figure 15: MUN-SEG students in Curraghinalt Gold core shed with Gareth Joseph, Senior Exploration Geologist and Geology Manager at Dalradian Gold.

Acknowledgements

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Galmoy: Many thanks to John Guven, Senior Geologist with iCRAG, who hosted us at the Galmoy mine and gave a thorough presentation and a guided tour of the core shed.

Abbeytown Mine: We thank Aiden Lavelle and Kevin Dalton, consultant economic geologists, for taking a significant portion of their day and sharing their insight with us as they gave us a presentation and tour of the Abbeytown Mine
Aiden Lavelle and Kevin Dalton, co for the insightful mine tour.

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Memorial University of Newfoundland:

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