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## Geological Survey Ireland and Irish-type deposits

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**To cite this article:** McGrath, E. (2023) Geological Survey Ireland and Irish-type deposits. *In:* Andrew, C.J., Hitzman, M.W. & Stanley, G. 'Irish-type Deposits around the world', Irish Association for Economic Geology, Dublin. 671-676. DOI: <https://doi.org/10.61153/VJRG3481>

**To link to this article:** <https://doi.org/10.61153/VJRG3481>

# Geological Survey Ireland and Irish-type deposits

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**Abstract:** Geological Survey Ireland (the Survey) is a line division of the Department of the Environment, Climate and Communications. Founded in 1845 by an Act of Parliament, the Survey was tasked with “*ascertaining the Rocks, Strata or Minerals*” present across the country. Over the ensuing 178 years, the Survey has evolved into Ireland’s public earth science knowledge centre with a broad remit across the entire geoscience area. In particular within the natural resources sector, the Survey hosts a world class database of pre-competitive data which is freely available to the public. As a frequent first port of call for most exploration companies and a key partner in Ireland’s geoscience research ecosystem, the Survey has always striven to be at the heart of the minerals sector within Ireland.

**Keywords:** Zinc, Lead, Tellur, ‘Geological Survey Ireland’, Government

## Introduction

Geological Survey Ireland (the Survey) is a line division of the Department of the Environment, Climate and Communications. Founded in 1845 by an Act of Parliament, the Survey was tasked with “*ascertaining the Rocks, Strata or Minerals*” present across the country. Over the ensuing 178 years, the Survey has evolved into Ireland’s public earth science knowledge centre with a broad remit across the entire geoscience area. The Survey acts as the State’s geologists whenever expert scientific input is sought within its area of expertise and it maintains a large repository of data, physical samples, and a significant core library.

Following the establishment of the Irish state, and into the 1950s and 1960s, the Survey acted as advisers to the government on mineral matters and provided recommendations on exploration and mining. A growth in staff numbers through the 1960s and 1970s saw an increase in the outputs of the organisation with an emphasis on updating the bedrock mapping across the country.

Into the 1980s and 1990s, the Survey underwent several reorganisations, initially divided internally into Mapping, Groundwater and Minerals with a later separation of exploration and mining regulation into the then Exploration and Mining Division (EMD). The emphasis within the Survey across the turn of the millennium was focused on the development of new map products, publicly available databases, and geoscience research.

Since 2020, EMD and the former Petroleum Affairs Division have been consolidated into a single regulatory division, the Geoscience Regulation Office while responsibility for policy development around minerals has been placed with the

Geoscience Policy Division (GSPD). The Survey works closely in partnership with these units, providing scientific input where required and ensuring that research and innovation informs policy development.

## Minerals and the Survey

Since its establishment, minerals and geogenic resources have been a core focus for the Survey and initial mapping efforts recorded any mineral occurrences on the original 6” mapping sheets. These occurrences and all available data were consulted by exploration companies in the early days of the modern Irish industry and the recognition of mineral occurrences in East Clare was one of the factors which prompted Northgate’s subsidiary Irish Base Metals to focus their efforts in the region and opened up east Clare and Galway as prospective terrain. Derry et al (1965) record that the location was one of a number of areas recommended by Murrough O Brien, then Director of the Survey, as prospective for base metals. A Survey map from 1859 referenced “*Tynagh lead mines, about [15km] from Loughrea*”, an occurrence which was approximately 2km east of the modern mine. The Survey conducted field work in the area in the early 1950s, confirming the presence of copper-stained sandstone in float material and identifying a fault structure analogous to Silvermines. Gordon Herries Davies wrote that Murrough O Brien had made “*himself, the survey, and Ireland, familiar to economic geologists from all corners of our globe*”. Indeed, he was later to become the general manager and chief executive of Tara Exploration and Development Company, highlighting his belief in Ireland’s exploration potential.

While there are many contributors to the discovery and subsequent establishment of Tynagh mine, it is fair to say that the work of the Survey played a key role in this discovery and the

consequential development of a thriving exploration and mining industry in Ireland.

## Corestore

With a boom in exploration arising from the discovery of Tynagh, a significant volume of data and core was generated within the industry. While exploration data had always been submitted to the state for archiving, it was only in the 1970s that the first major consignment of industry drill core was provided to the Survey.

This core came from Pennaroya, with later archives gathered from Irish Base Metals and Riofinex as exploration activity increased across Ireland. The core was initially housed in a former British army barracks in Glenree prior to the development of a dedicated facility in Sandyford where the repository still (2023) resides.

In 2018, the corestore in Sandyford was close to capacity and the Survey was faced with a decision on which core to dispose of and which to keep. An initial solution led to the acquisition of a core scanner capable of rapidly digitising the archive and ensuring that a data record was retained for any core disposed of. This scanner consisted of a high resolution RGB camera along with an innovative hyperspectral camera, providing cutting edge data and opening up new avenues for research and exploration in Ireland. The Survey was the first survey globally to purchase one of these systems and in 2022 became the first survey globally to add a medium wave hyperspectral camera to the setup, designed to increase the equipment's ability to work in carbonates and its benefit to the mineral exploration sector. The Sandyford facility also hosts the "UCD Petrophysical Laboratory at Geological Survey Ireland", a partnership that allows additional research to be performed on core within the archive and allows for a much larger dataset to be gathered from any individual sample. This facility can now measure magnetic susceptibility, electrical conductivity, density, chargeability, resistivity, velocity (Vp and Vs), gamma spectrometry, and XRF, creating an important link with the Tellus geophysical data for three-dimensional modelling.

The core store holdings are in the process of digitisation, with approximately 40% of the Sandyford archive available as of 2023 to view online in high definition and numerous other research projects scanned and uploaded. The value of this data became apparent during the Covid-19 pandemic when companies exploring in Ireland could remotely access high quality scans of archived drill core from anywhere in the world, enabling the continuation of exploration work in Ireland while lockdowns were in force.

Following the acquisition of the scanner and in advance of having to dispose of core, an internal business case was made stressing the value of the core archive, which currently stands at a replacement cost in excess of €100 million. Given the immense value of this data, a decision was made to acquire a second core storage facility in the midlands which could also act as a base for the Survey's drilling teams. Opened in 2020, the core store in Birr has provided an overflow capacity for the National Geological Core Store and has allowed the Survey to acquire significant core holdings from exploration projects and known Irish type deposits. A new, purpose-built facility is planned for the late 2020s which will provide a central location

for core storage, scanning, research and training where the value of this archive in identifying the next Irish type deposit can be truly realised.

## Open File

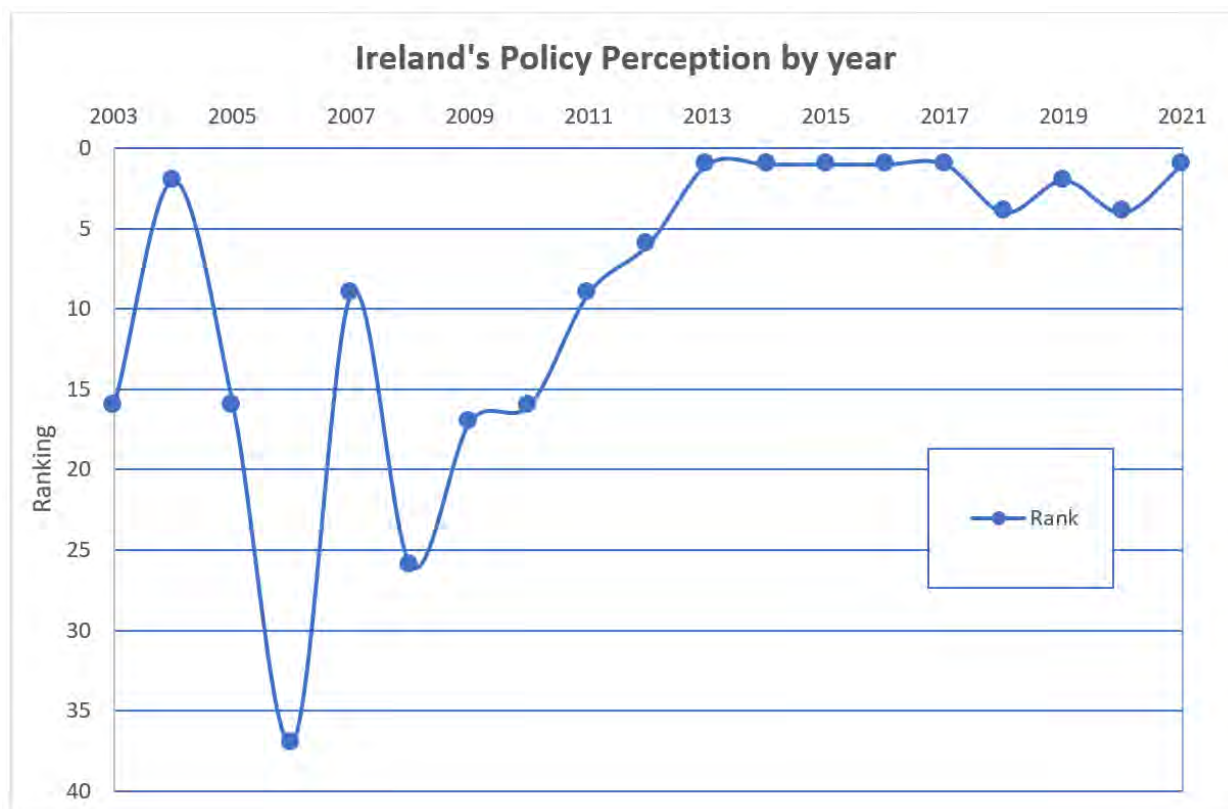
Following the establishment of the original core store, the focus of the Survey turned towards identifying how further data held by the state could be made available to stimulate the industry and investment. Significant quantities of work reports and survey results had been submitted to the Minister since the establishment of the industry in Ireland however this archive had never been collated and made available in a systemic fashion. In the early 1980s, the Open File archive was created, with initial data releases in 1984. While the core store is often the first physical point of interest visited by new prospecting licence holders, the open file rapidly became a geologist's first look at a prospective project and placed Ireland firmly at the leading edge of national geological data availability.

The hard copy maps and reports of the Open File have frequently been a junior geologist's introduction to Irish type deposits, however as digital solutions became more important through the early 1990s the decision was made to make the entire Open File repository available online. One of the first fully searchable national geological and exploration datasets worldwide was created, the accessibility of which has significantly stimulated investment in Ireland. The ease with which previous drilling, geochemical sampling and geophysical surveys can be accessed free of charge has often been cited by industry figures in identifying Ireland's investment attractiveness for zinc and lead.

## Tellus

The Tellus project was conceived in 1998 as a joint project between the Survey and the Geological Survey of Northern Ireland (GSNI) with project design support from the British Geological Survey (BGS) and the United States Geological Survey (USGS). The project was initially titled "RESI" - the Resource & Environment Survey of Ireland. Focused on undertaking airborne geophysical and geochemical mapping across the island of Ireland, its aim was to assist with understanding Ireland's natural resources, geology and environment. The project wasn't immediately successful in gaining funding, however in 2003 GSNI secured resources to complete the reimagined "Tellus" project across Northern Ireland. Completed in 2005, it then paved the way for EU Interreg funding to be acquired to complete a Tellus programme in the border counties within the Republic. This was completed in 2013 and the results seamlessly merged with the GSNI data, providing a cross-border dataset unparalleled globally. The commitment by the Irish government to complete the Tellus survey across the remainder of the country led to an uptake in prospecting licences and investment from exploration companies. The value of the data for exploration was shown by the investment of several companies in co-funding acquisition of airborne data over prospective ground.

Within the minerals industry, Tellus has generated new targets for gold, base metal and critical raw materials exploration across the north of the island, with significant target generation for gold exploration identified by Earls (2016).



**Figure 1:** Ireland's Ranking for Policy Perception in the Fraser Institute Mining Survey by year.

## PDAC

The digitisation of the Open File dataset was a natural follow on from feedback Irish delegations had received at the Prospectors & Developers Association of Canada (PDAC) convention over several years. In 1989, Ireland made the decision to send a delegation to exhibit at PDAC and the Irish stand has been a consistent and regular presence at this major international event since. Ireland was the first country outside of the Americas to have an official government presence at the convention and over the three decades of attendance Irish politicians, officials and scientists have ensured that Ireland remains at the forefront of global mineral exploration. Highlights of Ireland's participation at the PDAC include the Minister signing Ireland's membership of the Intergovernmental Forum on Mining; Geoscience Ireland's hugely successful Irish Day series of seminars; and presentations and multiple scientific and technical presentations by Survey geologists, along with policy and regulatory personnel. Ireland has consistently presented the jurisdiction as "Open for Business" with a high reliance on the quality of Irish datasets as an attraction for foreign direct investment in the exploration and mining sector. In 2020, Ireland was invited to present at a PDAC technical session with Australia and Finland as world leaders in pre-competitive data provision and national prospectivity mapping.

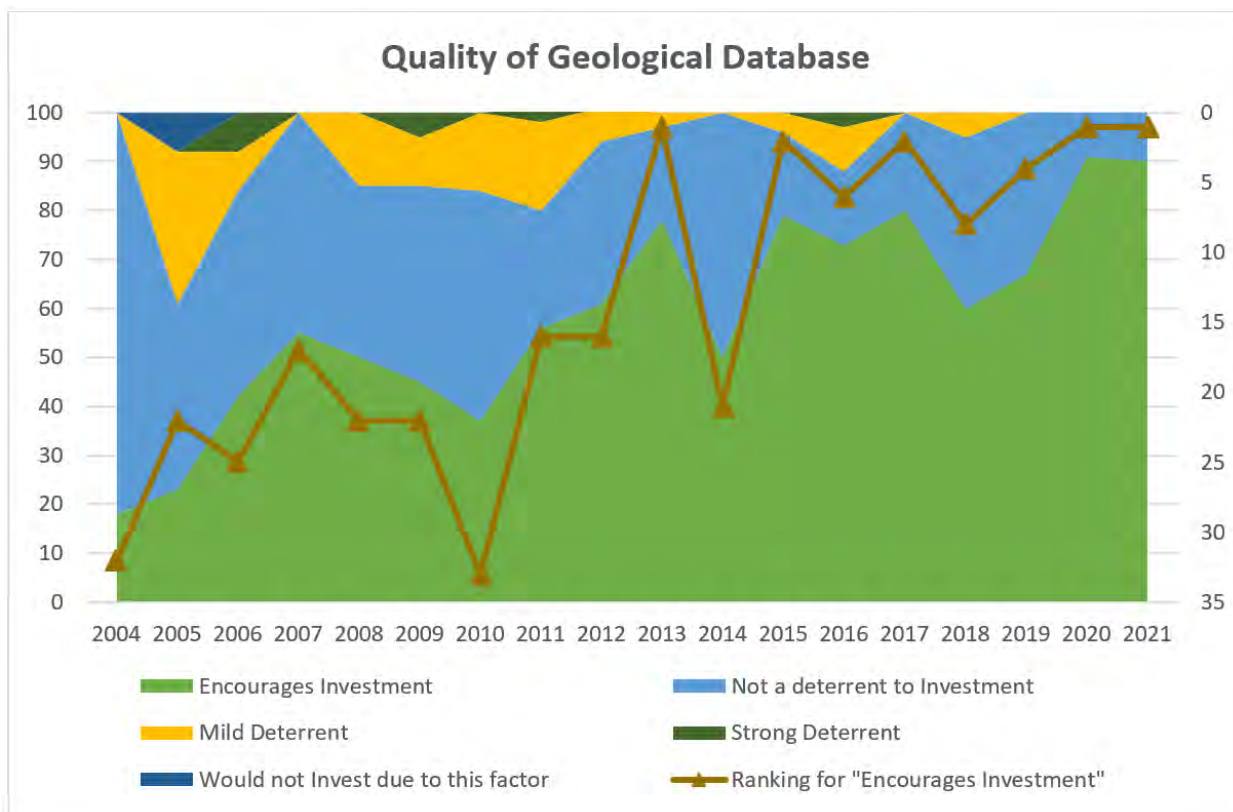
Arising from PDAC participation, Irish data is also now used as one of the key datasets for the Frank Arnott Next Generation Explorers Award, recognising Ireland alongside the Quesnel Trough (Mt. Milligan), Northwest Queensland (Mt. Isa) and the Gawler Craton (Olympic Dam) as hosting world leading

prospectivity. Since the Irish data has been included for this competition, a team using the dataset has been amongst the prize winners each year (Frank Arnott Award Website).

## Fraser report

It has been clear within the Survey and parent departments for a significant period that the geological good fortune which has bestowed significant mineral endowment upon Ireland is not, in and of itself, sufficient to attract and maintain the levels of investment required for a thriving exploration and mining sector. The policy implemented by successive governments and the quality of the data offering are equally, and in some cases, more important than the extent of prospects and deposits. The Survey has consistently striven to increase the quality of its available data, an effort which has been well received across the industry. A particular measure of this has been Ireland's position in the Fraser Institute's annual Mining Report. While Ireland regularly ranks in the higher echelons of the overall Investment Attractiveness Index, when it comes to the Policy Perception Index, Ireland has been consistently in the top 5 global countries for the last decade (Figure 1).

Policy Perception is the section which includes "quality of the geological database" as an element. Ireland was first included in the Fraser report in 2003 when it ranked 16<sup>th</sup> in Policy Perception, dropping to 37<sup>th</sup> in 2006. In early years, the quality of the geological database was poorly rated by industry, with nearly 40% of respondents describing it as a deterrent in 2005. Since then, Ireland has been lauded across the industry for the quality and accessibility of its data, and in the most recent



**Figure 2:** Exploration and Mining Industry perception of the Quality of Geological Database available in Ireland since 2004. This includes quality and scale of maps, and ease of access to information. The left axis and block colours show the percentage of respondents who assessed the quality of Ireland’s Geological Database at each level. The right axis and over-lain line graph show Ireland’s global ranking where the Geological Database is seen to encourage investment. All data taken from Fraser Mining Reports 2004-2022

studies, Ireland has received the highest score globally for a Geological Database which “Encourages Investment” (Figure 2). Since 2004 the percentage of the exploration industry which views Ireland’s geological database as encouraging investment has risen from 18% to consistently above 90%, with the highest marks coinciding with the publishing of the digital core viewer during the Covid-19 pandemic. The steady increase in global appreciation of Ireland’s data holdings highlights the value that industry and the Survey place on the acquisition and provision of high quality data.

Ireland’s overall ranking for policy perception tracks particularly closely with the investment attractiveness of the geological database and the two entries into the top 5 rankings in 2004 and 2013 happen to be two key dates within the Tellus project (Figure 1). 2004 saw the commencement of Tellus in Northern Ireland, however it wasn’t until 2013 that Tellus border was completed and the project began to be rolled out across the Republic of Ireland.

**Research**

The overall value of the data and samples acquired and archived by the Survey and the department has never been in doubt, however the data is of little value if it does not lead to further research, innovation and ultimately discoveries. Within the area of minerals and exploration, the Survey has a long

history of supporting and funding fundamental research, from valorisation of mine waste, to critical raw materials in Irish type deposits. The Survey is currently working with other European Surveys and academic institutions on critical raw materials, integrating hyperspectral core scanning into exploration techniques and historic mine sites. The minerals research conducted across Europe has been key in identifying trans-national mineral prospectivity and in harmonising databases across multiple countries.

The minerals programme in particular works with a wide range of universities and research centres, including the establishment of a geo-drilling apprenticeship course at South East Technological university (SETU) and the evaluation of deleterious materials in aggregates. The programme works with other state agencies like the EPA on radioactivity in building materials, characterising soil recovery facilities , radon risk, and recycled aggregates, and works with other government departments such as the Department of Housing, Local Government and Heritage where geological knowledge and input is required.

Within the research space, the survey has leveraged its collaborations with partner bodies to ensure high quality applied research can be undertaken to benefit Ireland’s natural resource sector.



## IAEG

IAEG has been a key facilitator in publishing work on Irish mineral occurrences, deposits and exploration over the past 50 years and Geological Survey Ireland is proud of the fact that each of the major IAEG publications to date has seen Survey staff act as editors, reviewers and authors.

Indeed it is a key IAEG publication which forms one of the keystones of the Survey's current mineral and exploration support work. The New Blue Book project builds on Dr. Michael Philcox's seminal IAEG publication and will collate the key pieces of information and data that have been acquired in the intervening 40 years. The publication will provide an accessible and living set of reports, cross sections and logs that will be of importance in future exploration across Ireland. Each hole within the project will be scanned and available to view online in high definition with consistent cross sections and stratigraphy providing a framework for increasingly exciting work on the architecture of the Irish sedimentary basins. Coordinated and funded by the Survey and iCRAG (the Irish Centre for Research in Applied Geosciences), the project has relied on significant inputs from many geologists who have worked across the Irish Midlands Orefield and continues a long tradition of collaborative work, exemplified by IAEG.

## Future

The 50<sup>th</sup> anniversary of IAEG provides an opportunity to evaluate the past 70 years of Irish exploration and to assess how far Ireland has come as a mining jurisdiction. It should also provoke the economic geology community into looking forward at the challenges to come. The European Union's Critical Raw Materials Act has clearly identified the need for additional exploration and geological investigation at a member state level and Geological Survey Ireland has ambitious plans to continue work in that area. Further use of seismics, innovative reprocessing of existing data, new state of the art facilities, strong international collaboration with industry and academia and acquisition of cutting-edge equipment are all planned over the coming years.

While commodities will fluctuate in and out of fashion as criticality assessments and society's requirements change, the need for fundamental, consistent data acquisition, mapping, and regional scale prospectivity analysis will remain. Geological Survey Ireland believes that Ireland is a model which can be replicated across Europe where industry, government, and academia work in harmony to achieve societal goals. The Survey will continue to strive for excellence in supporting the sustainable use of Ireland's natural resources and we look forward to a long and happy collaboration with our colleagues in this area.

## Acknowledgements

The author would like to thank the IAEG for their 50 years of contribution to the geological community in Ireland and for the opportunity to be included in this publication. The contribution of the Survey cannot be described without acknowledging the many staff who have passed through its doors over that period, in particular all those who have contributed to the minerals and Tellus programmes and whose hard work we continue to reap the benefits of.

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