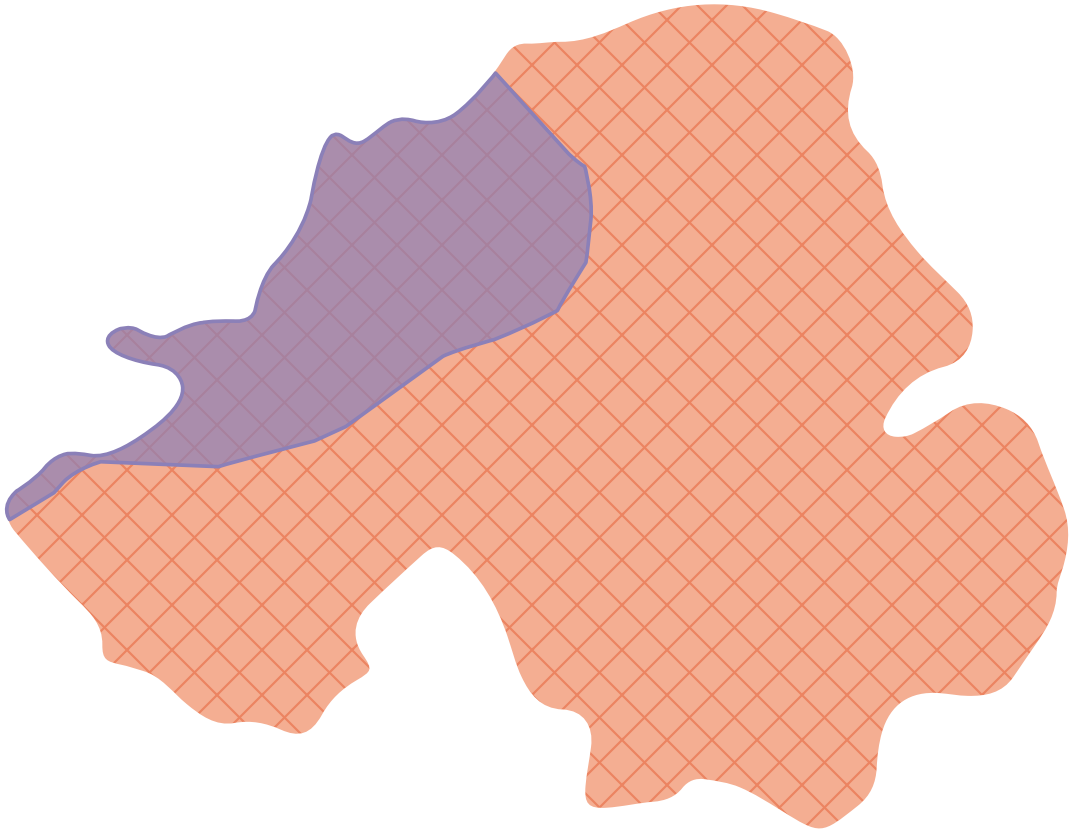
Radioactive Waste Management



Northern Ireland

SUBREGION 4

Contents

Clicking on words in green, such as sedimentary or lava will take the reader to a brief non-technical explanation of that word in the Glossary section. By clicking on the highlighted word in the Glossary, the reader will be taken back to the page they were on.

Clicking on words in blue, such as Higher Strength Rock or groundwater will take the reader to a brief talking head video or animation providing a non-technical explanation.

For the purposes of this work the BGS only used data which was publicly available at the end of February 2016. The one exception to this was the extent of Petroleum Licences which was updated to include data to the end of June 2018.

Our work shows that we may find a suitable geological setting for a GDF in most of this subregion, but the potential host rock may not be present in suitably shaped or sized volumes.

Rock can be seen at the surface in some of this subregion such as the Sperrin Mountains and in man-made excavations such as quarries or road cuttings. Combined with some deep boreholes and geophysical investigations, this gives us an understanding of the rocks present and their distribution.

There are volcanic lavas and similar strong rocks under most of the subregion, in which we may be able to site a GDF. These rocks are varied, folded and faulted and we would need to do more work to find out whether these rocks have suitable properties and thicknesses in the depth range of interest for a GDF.

Recent investigations have identified gold, copper, lead and zinc at depths which are of relevance to the siting of a GDF in the Sperrin Mountains around Omagh. It is not known whether the minerals in these areas will be exploited. RWM will continue to monitor how this exploration programme progresses.

Introduction

This subregion comprises the western half of County Londonderry, the northern half of County Tyrone and the extreme north of County Fermanagh.

Rock type

Figure 1 shows where in the subregion there are likely to be Higher Strength Rocks (HSR) within the depth range of interest, there are no Lower Strength Sedimentary Rocks (LSSR) or Evaporites in the subregion. The geology of this subregion is dominated by metamorphic rocks of the Dalradian Supergroup, sedimentary and volcanic rocks deposited approximately 570 to 650 million years ago. The Dalradian Supergroup in this subregion has been metamorphosed and is dominated by schistose rocks rich in quartz and mica, often interbedded on a centimetre to metre scale. Additionally, there are layers of amphibolite and marble derived from metamorphism of basalt and limestone respectively. These rocks are pervasively folded and cut by thrust faults and dip moderately to the north and north-west. Older, strongly metamorphic rocks are also present in the extreme west of this subregion in the Lough Derg Inlier and include schists and gneisses. Most of these rocks are potential HSR host rocks if they have sufficient volumes with uniform properties.

In some parts of the subregion these basement rocks are overlain by older sedimentary rocks, sandstones and limestones of Carboniferous age (approx. 300 to 360 million years old).

A summary of the geological attributes of Northern Ireland can be found here, including a simplified rock column showing the oldest and deepest rocks at the bottom, with progressively younger rock units towards the top.

Rock structure

These rocks are intensely folded and cut by major faults (Figure 2); their relatively complex structure is likely to complicate the search for a volume of rock with sufficiently uniform properties in this subregion. In addition to the area of major folding indicated in Figure 2 the rocks are commonly folded on a smaller scale of metres to tens and hundreds of metres. Often, where the layers have contrasting mechanical properties, the folding is accompanied by small scale faulting and this may impact groundwater movement. Faults may act as barriers to or pathways for groundwater movement, depending upon their characteristics, and these would need to be considered during the siting of a GDF[1].

Groundwater

There is very little information on groundwater in the depth range of interest for a GDF, 200 to 1,000m below NGS datum, although there is some information on shallow groundwater above 200m. Over most of the subregion there are no significant aquifers as the low permeability basement rocks extend to the surface. The Tyrone Group of the Carboniferous Limestone aquifer comprises a major aquifer where it occurs on top of the basement rocks in the vicinity of Newtownstewart and Dungiven. Some parts of the Carboniferous Limestone aquifer are karstic, where concentration of groundwater flow has enlarged fractures by dissolution to form a network of major channels and caves, resulting in fast movement of groundwater near the surface. There are no low permeability clay-rich rock layers to act as barriers to vertical flow between the more permeable limestone layers described here and any groundwater present at depth in the basement rocks. Groundwater from depths greater than 400m is unlikely to be suitable as drinking water anywhere in the UK[2].

There is one small area in this subregion where deep exploration boreholes may influence the connectivity between shallow and deep groundwater which would need to be considered during the siting process (Figure 3). There are no thermal springs in this subregion to suggest rapid flow of deep groundwater to surface.

[1] Faults occur on a diverse range of scales, from centimetres to kilometres, and the subsurface is criss-crossed by networks of numerous individual faults. However our work includes only those faults identified by the BGS with throws (vertical offset) of 200m or more. This is because the data available to the BGS are not able to resolve all faults consistently, across all thirteen regions, with throws less than 200m. We recognize the potential importance of smaller scale faults to the integrity of a GDF and will need to survey them in detail as part of the site evaluation process.

[2] Water Framework Directive UK TAG. Defining and reporting on groundwater bodies, 2012.

Resources

Recent exploration has identified base metal mineralisation in the Dalradian basement rocks of the Sperrin Mountains. Drilling has shown that copper, lead and zinc mineralisation occur below 100m in this area. Two significant gold deposits were discovered in the 1980s within Dalradian Supergroup metamorphosed sedimentary rocks at Cavanacaw and Curraghinalt near to Omagh, County Tyrone (Figure 4). Gold and silver has been extracted by opencast mine working at Cavanacaw and planning permission has been granted to develop an underground mine. Drilling has proved that gold-bearing veins extend at least 300m below NGS datum at Cavanacaw and over 400m below NGS datum at Curraghinalt. It is not known whether the minerals in these areas will be exploited, but they would need to be considered during the siting process.

There are no other known mineral, hydrocarbon or geothermal resources in this subregion.

Natural processes

Earthquakes and glaciations are unlikely to significantly affect the long-term safety of a GDF in the UK. Therefore, whilst a GDF would need to be sited and designed to take account of natural processes which may occur during its lifetime, they are not considered further as part of this screening exercise.

Figure 1 The areas of the Northern Ireland subregion 4 where Higher Strength Rock Types of Interest are present between 200 and 1,000 m below NGS datum.

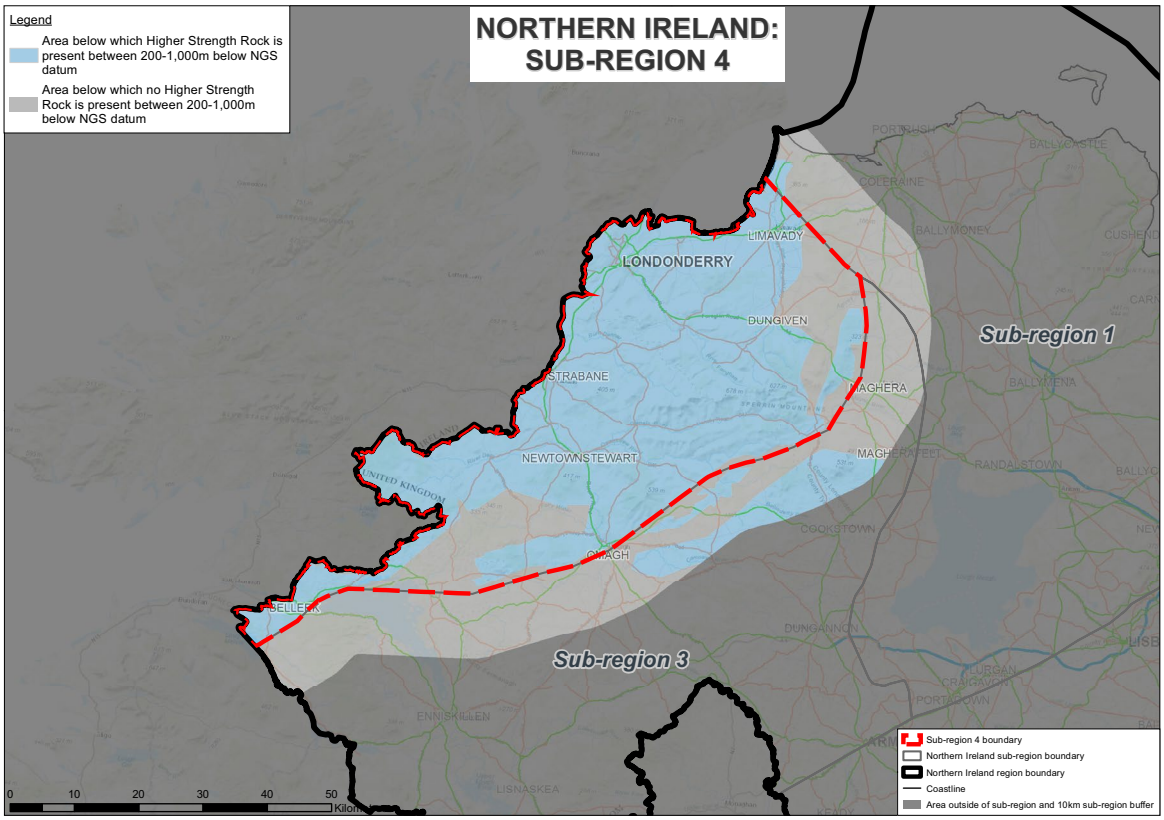


Figure 2 Location of major faults in the Northern Ireland subregion 4.

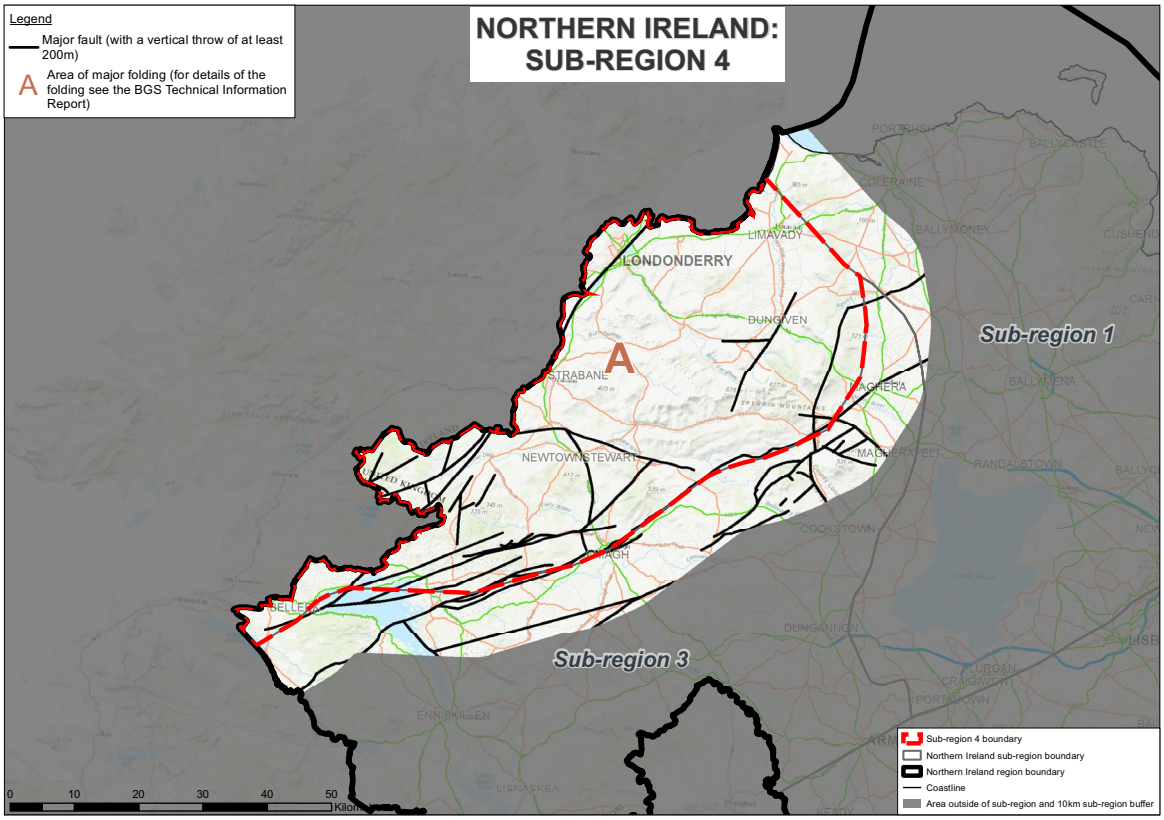


Figure 3 Areas in the Northern Ireland subregion 4 with concentrations of deep exploration boreholes.

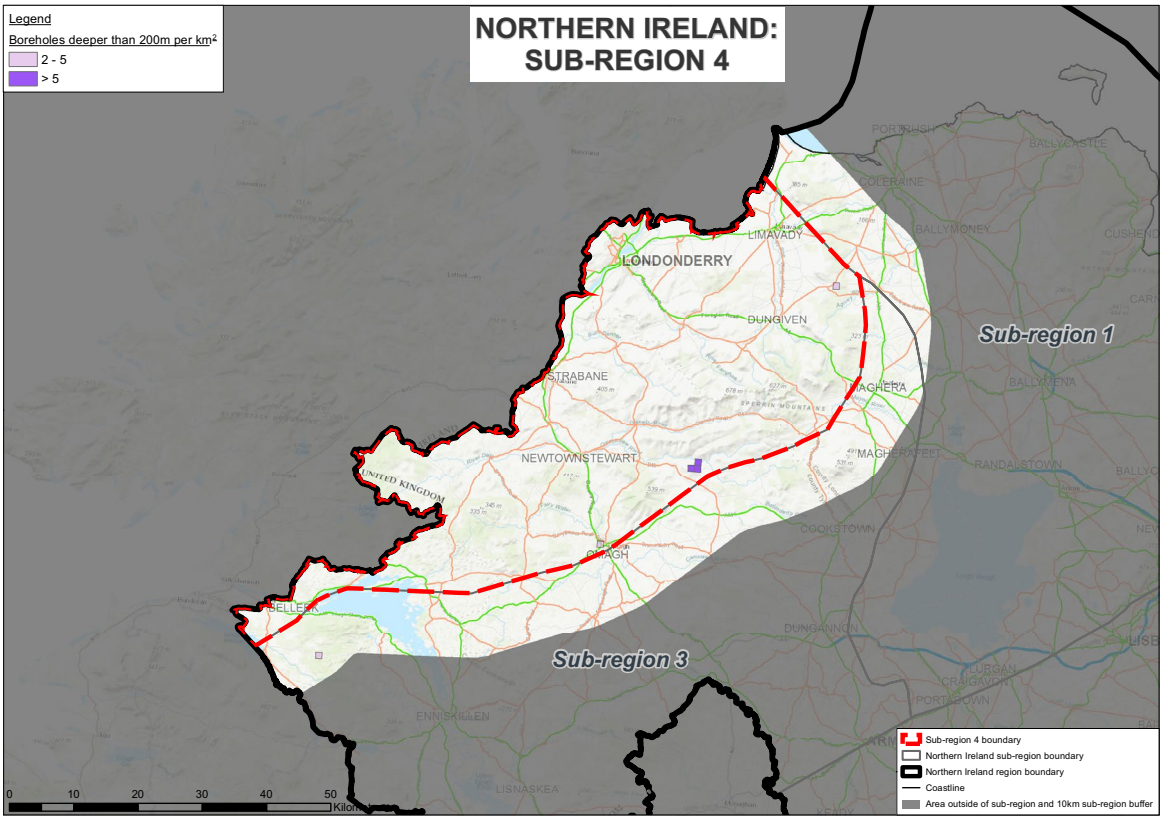
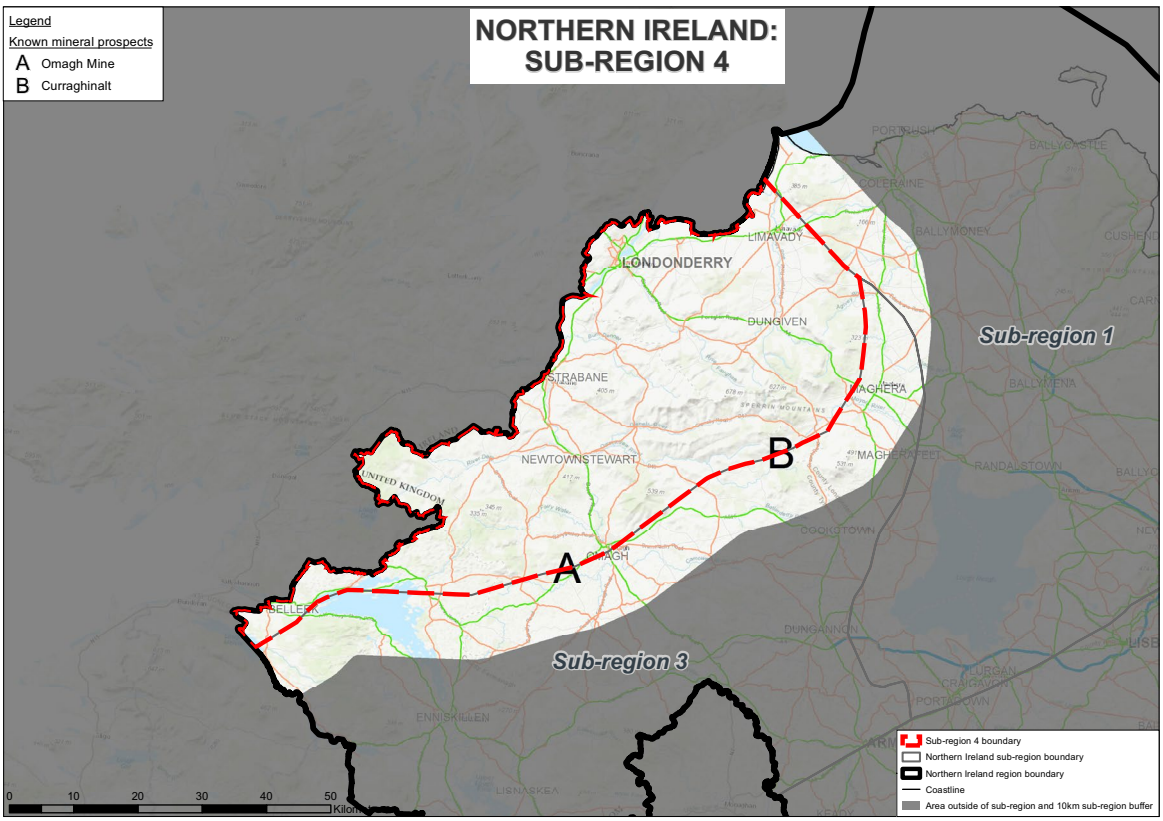


Figure 4 Known mineral prospects in Northern Ireland subregion 4.



Glossary

Aquifers
Aquifers are rocks that contain freshwater in pores and/or fractures and whose porosity and permeability are sufficiently high to make the extraction of groundwater possible.

Basalt
Dense, dark-coloured lava rich in iron and magnesium. Forms during non-explosive eruptions of shield volcanoes, often in oceanic islands such as Hawaii.

Dip
The angle, or slope of a plane, such as sedimentary layering, measured relative to the horizontal.

Fracture
A crack in rock. Fractures can provide a pathway for fluids, such as groundwater or gas, to move in otherwise impermeable rock.

Gneiss
A metamorphic rock that has experienced very high pressures and temperature such that minerals in the original rock undergo melting and recrystallization. The rock has a characteristic texture with minerals aligned parallel to one another to form distinctive colour banding.

Hydrocarbon
A compound of hydrogen and carbon. Hydrocarbons are the chief components of oil and natural gas.

Karst
A distinctive type of landscape consisting of deep cracks and caves in limestones. Karst forms due to the action of mildly acidic groundwater dissolving the limestone.

Marble
Hard, 'sugary'-textured rock type that forms due to metamorphism of limestone. Original structures found within the rocks (like fossils or sedimentary features) are usually destroyed or heavily modified. Marble is extensively used as a decorative building material or in sculpture.

Metamorphic/metamorphosed
A rock that has undergone change due to the action of temperature and pressure.

Opencast mining
A type of mining that occurs from the surface without the use of tunnels or underground workings. A large pit or quarry is dug to extract the target mineral/rock. Also known as open-pit mining.

Glossary

Schist

Recrystallized metamorphic rocks with a distinctive texture caused by the parallel alignment of tiny crystals of mica. As a result, schists are characteristically sheet-like, rather like the pages of a telephone directory.

Sedimentary

A type of rock resulting from the consolidation of material that has accumulated in layers to form gravel, sandstone, mudstone and limestone. The layers may be built up by movement from erosion (e.g. by rivers, the sea or wind) or by chemical precipitation. Generally, the material that accumulates has originated from the weathering of other rocks. Sedimentary rocks constitute one of the three main classes of rocks identified by geologists, the others being igneous and metamorphic.

Thrust fault

A type of fault, or break in the earth's crust that forms due to the action of compressive forces.

Radioactive Waste Management

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