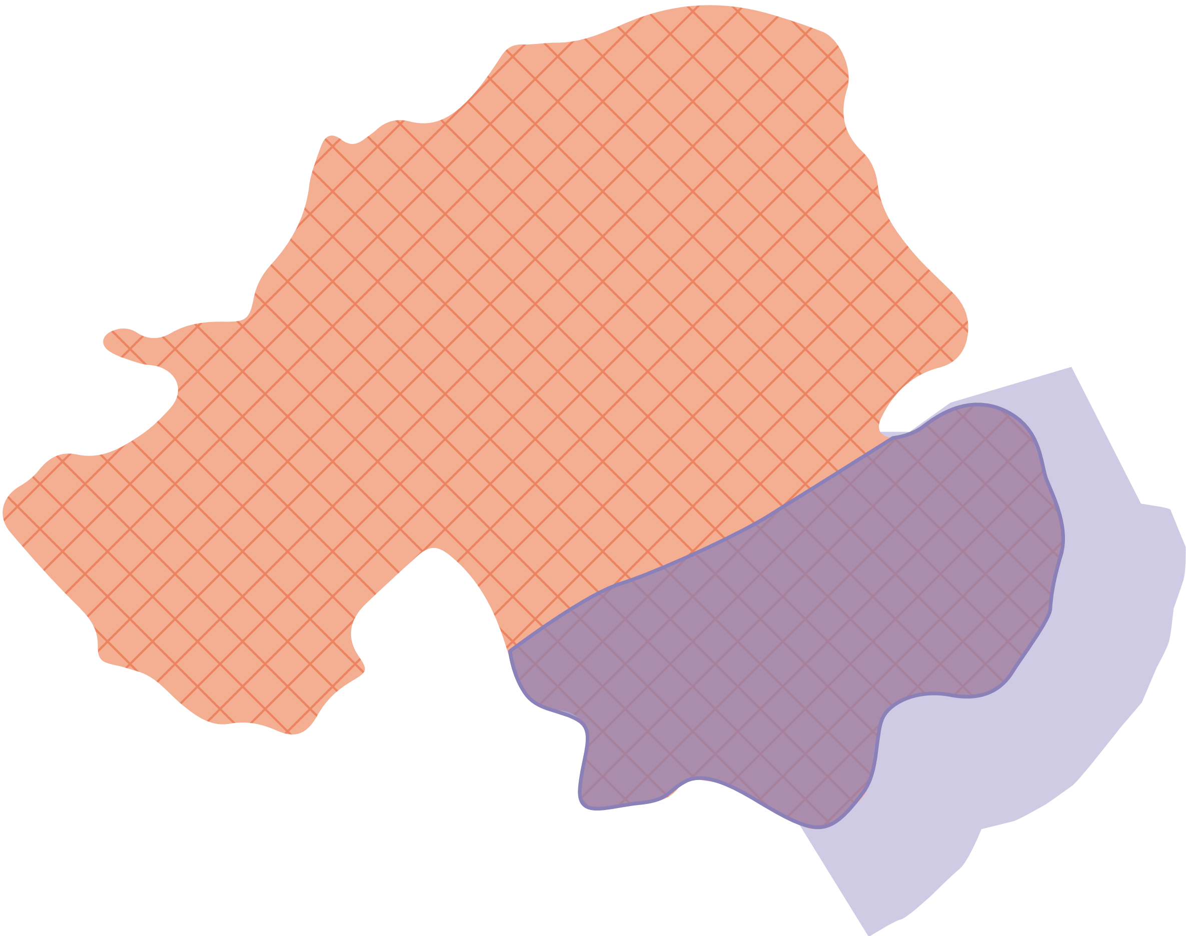
Radioactive Waste Management



Northern Ireland

SUBREGION 2

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 a small part of this subregion.

Rock can be seen at the surface in some of this subregion such as sea cliffs, inland cliffs in the Mourne Mountains and the Ring of Gullion 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 granites and similar strong rocks around Newry, in which we may be able to site a GDF. 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.

Some of the subregion has been mined to depths below 100m for lead resources, around Keady, County Armagh and near Newtownards, County Down. In these areas the mining is likely to have affected the way in which water moves through the rock. Also possible exploration in the future in these areas means that it is more likely that future generations may disturb a facility.

Introduction

This subregion comprises most of County Down, southern County Armagh and the adjacent inshore area which extends to 20km from the coast.

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 comprises basement rocks and younger igneous rocks which have been intruded into them.

Most of the basement rocks in this subregion comprise Silurian to Ordovician (approx. 420 to 485 million years old) weakly metamorphosed sandstones and mudrocks referred to as the Southern Uplands-Down-Longford Terrane. These rocks are not considered to be potential host rocks because the mudrocks which are present are thin and often interbedded with sandstones.

In the vicinity of Newry (from Slieve Gullion to Slieve Croob), the basement rocks comprise a sequence of granite masses, several kilometres deep, which were emplaced into the Ordovician and Silurian rocks about 400 million years ago. These Newry Igneous Complex rocks range from granodiorite to granite and are potential HSR host rocks.

The younger igneous rocks in this subregion comprise the granite and related rocks of the Mourne Mountains and Slieve Gullion Complex which were formed as large masses hundreds of metres thick from the solidification of molten rock below ancient volcanoes about 55 to 60 million years ago. The total thickness of the Mourne Mountains Complex is uncertain, however a borehole located in Silent Valley passed through approximately 600m of granite without reaching the base. These younger igneous rocks are potential HSR host rocks.

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

The metamorphic basement rocks in this subregion are affected by numerous major faults and in many places are steeply dipping due to tight folding (Figure 2). The Southern Upland–Down–Longford Terrane is composed of broadly north-east to south-west aligned slices of tightly folded and steeply inclined Silurian and Ordovician rocks. It formed where muddy oceanic sediments were scraped off an ancient plate margin. The individual slices are bounded by faults, also broadly aligned north-east to south-west. Individual fault systems are spaced approximately 1 to 5km apart and are typically longer than 90km. The closely spaced faults and tight folding are likely to complicate the search for a volume of rock with sufficiently uniform properties. Faults may act as barriers to or pathways for groundwater movement, depending upon their characteristics, and the siting of a GDF would need to take account of them [1].

There is considerably less faulting and no folding associated with the igneous basement rocks and younger igneous rocks of the Mourne Mountains, Slieve Gullion and Newry areas.

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. There are no significant aquifers as the low permeability basement and younger igneous rocks are present from the surface throughout the subregion. Groundwater is encountered in weathered rock and fractures in the upper 50m, although evidence suggests that the frequency of permeable fractures decreases with increasing depth. There are no low permeability clay-rich rock layers to act as barriers to vertical flow between the surface 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].

[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.

Throughout the central part of this subregion the presence of Palaeogene dyke swarms (approximately 40 to 65 million years old), which were intruded into the older basement rocks, has complicated the local movement of groundwater. Although generally the dykes have consistently low permeability and act as barriers to groundwater movement, there is some evidence that they can have fractures and joints which permit storage and lateral transport of water.

There are some areas in this subregion, such as to the south of Belfast, 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 the surface.

Resources

Lead was mined in the 18th and 19th centuries around Keady, County Armagh and near Newtownards, County Down, where the Conlig Mine deposits were mined down to about 350m below NGS datum (Figure 4a). In these areas the mining is likely to have affected the way in which water moves through the rock. Also possible exploration in the future in these areas means that it is more likely that future generations may disturb a facility. These known resources would be taken into account in the siting of a GDF.

Recent exploration has identified gold mineralisation associated with the Orlock Bridge Fault south of Belfast and gold intersections have been recorded from the area near Clay Lake, County Armagh (Figure 4b).

The high heat production from the younger granites of the Mourne Mountains Complex may have geothermal energy potential which would need to be considered in the siting of a GDF.

There are no other known mineral or hydrocarbon 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 2 where Higher Strength Rock Types of Interest are present between 200 and 1,000 m below NGS datum.

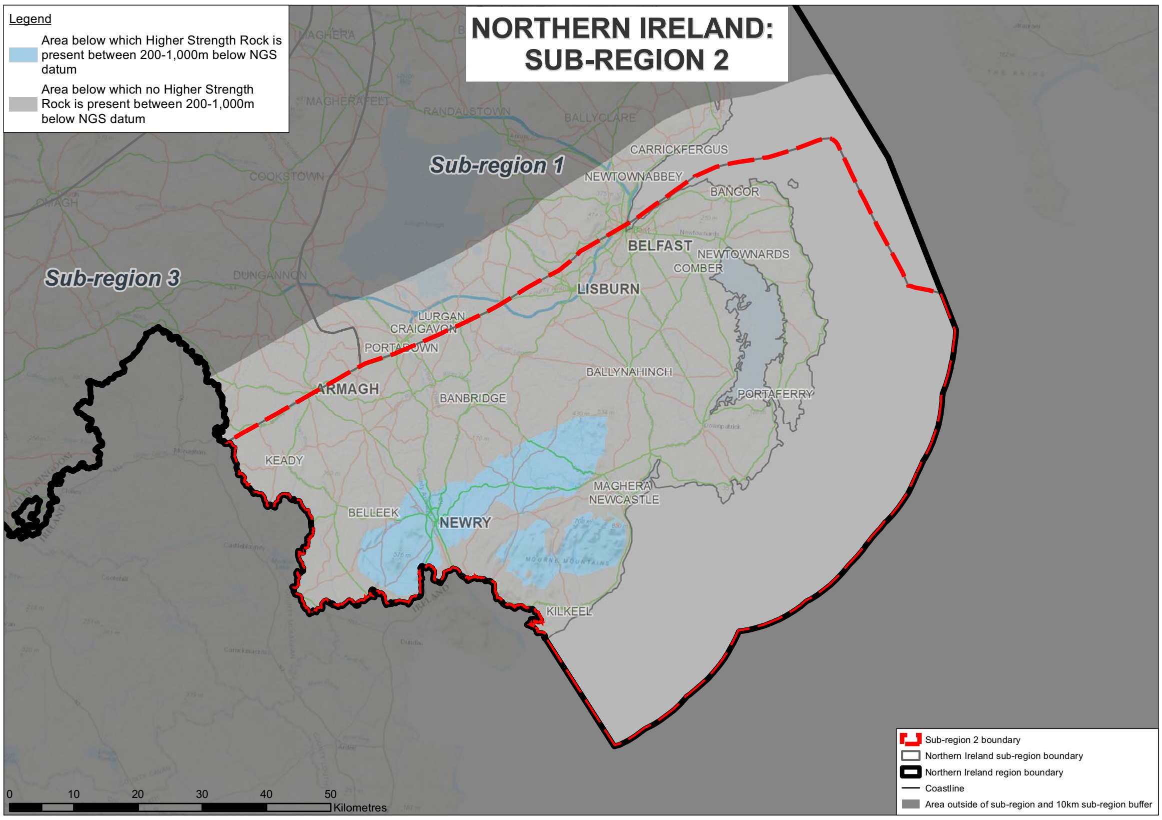


Figure 2 Location of major faults in the Northern Ireland subregion 2.

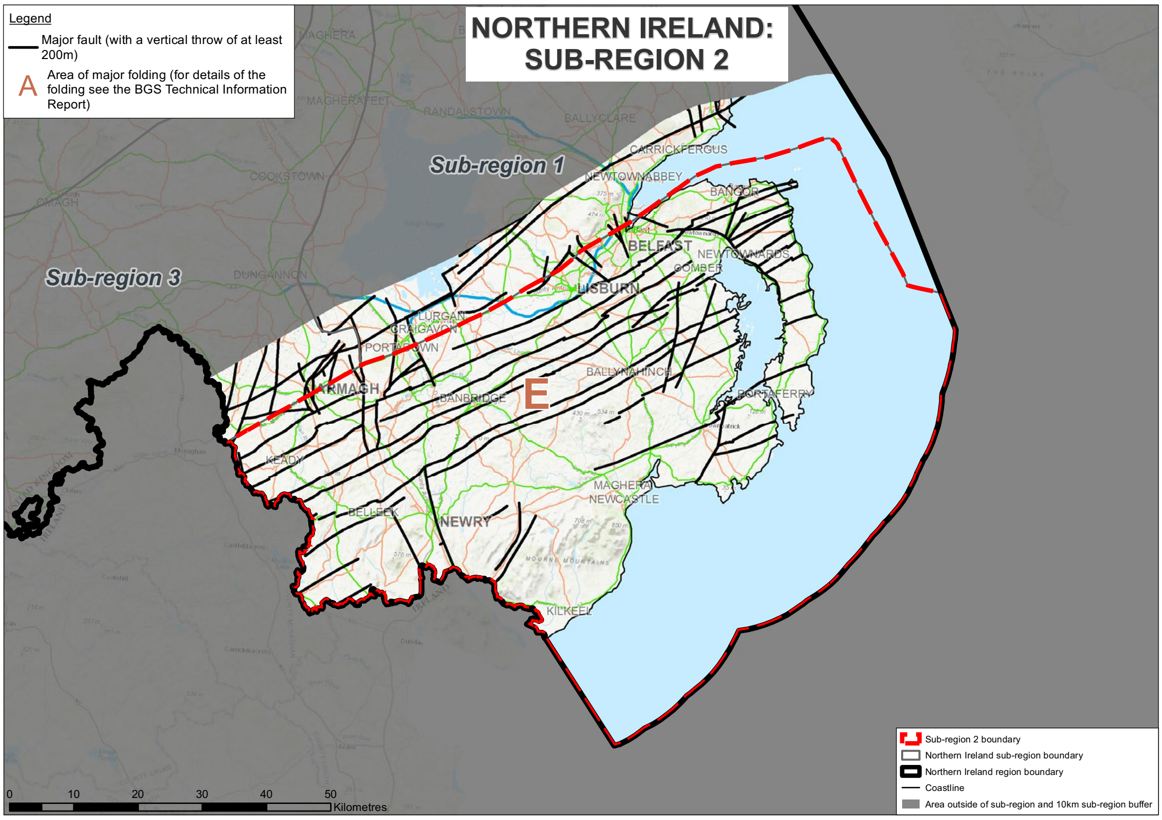


Figure 3 Areas in the Northern Ireland subregion 2 with concentrations of deep exploration boreholes.

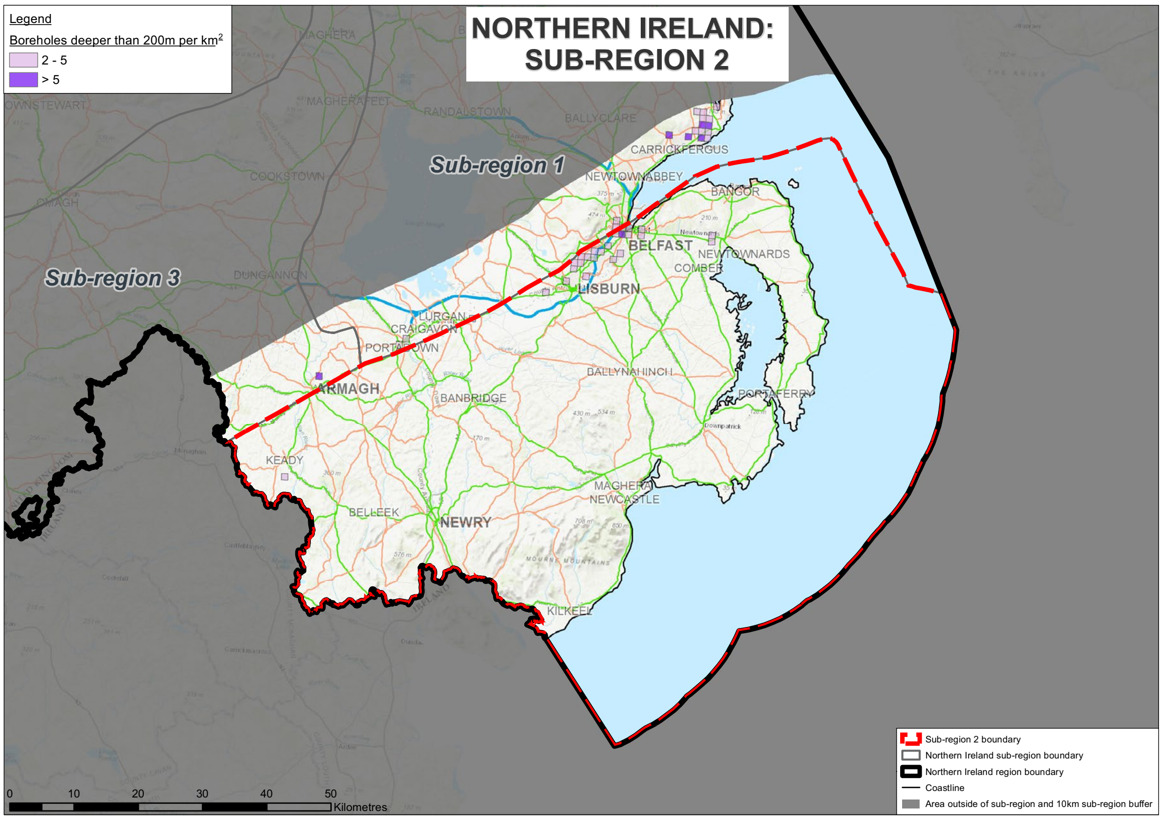


Figure 4a Areas of the Northern Ireland subregion 2 with lead mines present below 100m.

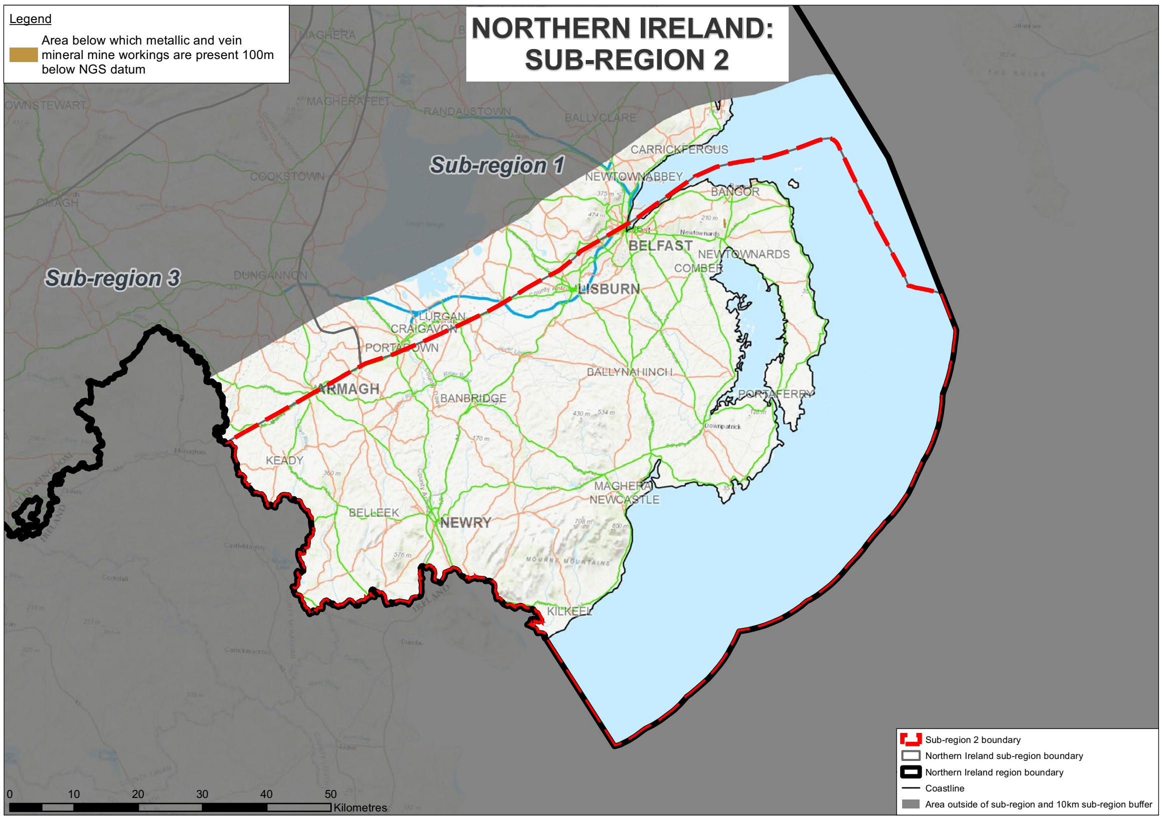
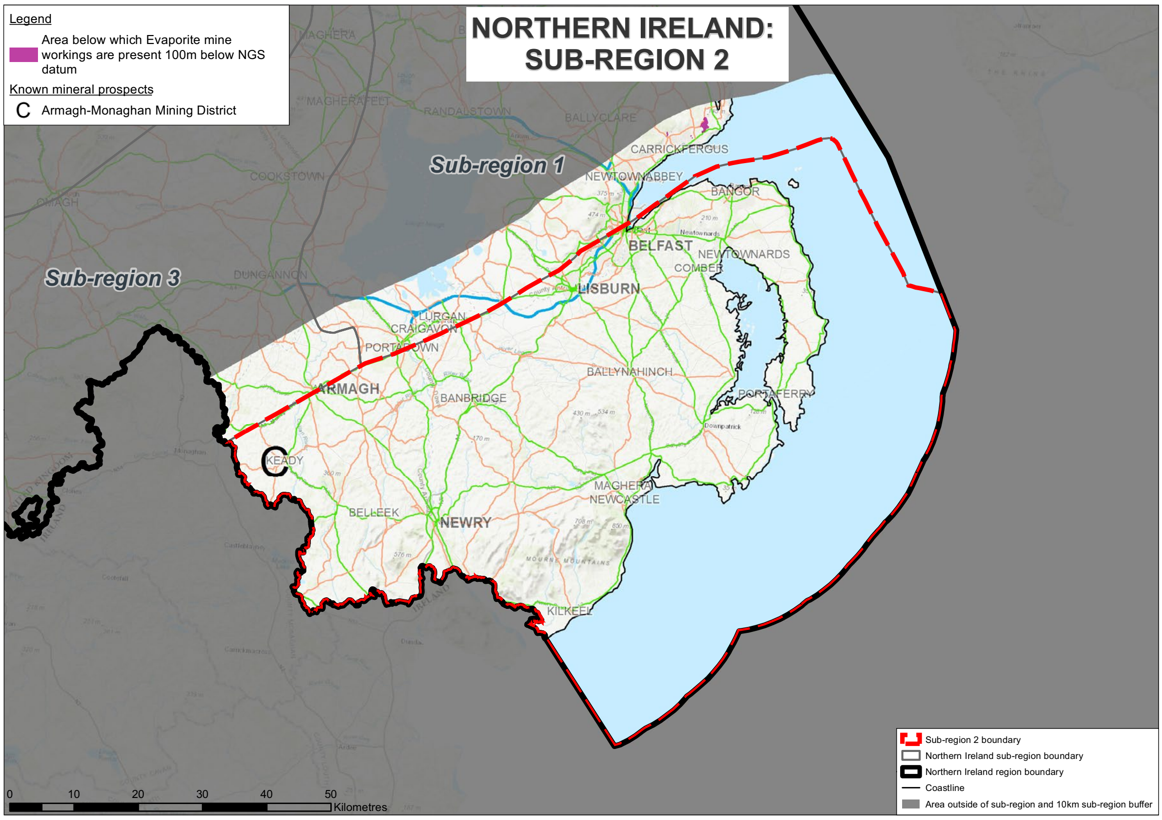


Figure 4b Known mineral prospects in Northern Ireland subregion 2.



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.

Dyke
Vertical or sub-vertical planar sheet of igneous rock intruded as hot magma along cracks and fractures in the earth's crust.

Dyke swarm
A large geological structure consisting of numerous vertical igneous intrusions (see 'dykes'), usually in a radial or linear pattern.

Fault
A fracture in the earth's crust across which the rock layers each side of it have been offset relative to one another.

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

Granite
Pale-coloured, coarse crystalline igneous rock rich in silica, sodium, calcium and potassium.

Granodiorite
Darker coloured granite richer in iron and magnesium than normal granite.

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

Igneous
One of three main rock types (the others being sedimentary and metamorphic), consisting of hard, dense rocks made up of interlocking crystals. They form due to cooling of magma deep within the crust beneath volcanoes, or as lavas erupted at the surface.

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

Radioactive Waste Management

Building 587
Curie Avenue
Harwell Oxford
Didcot OX11 0RH

T 03000 660100
www.gov.uk/rwm