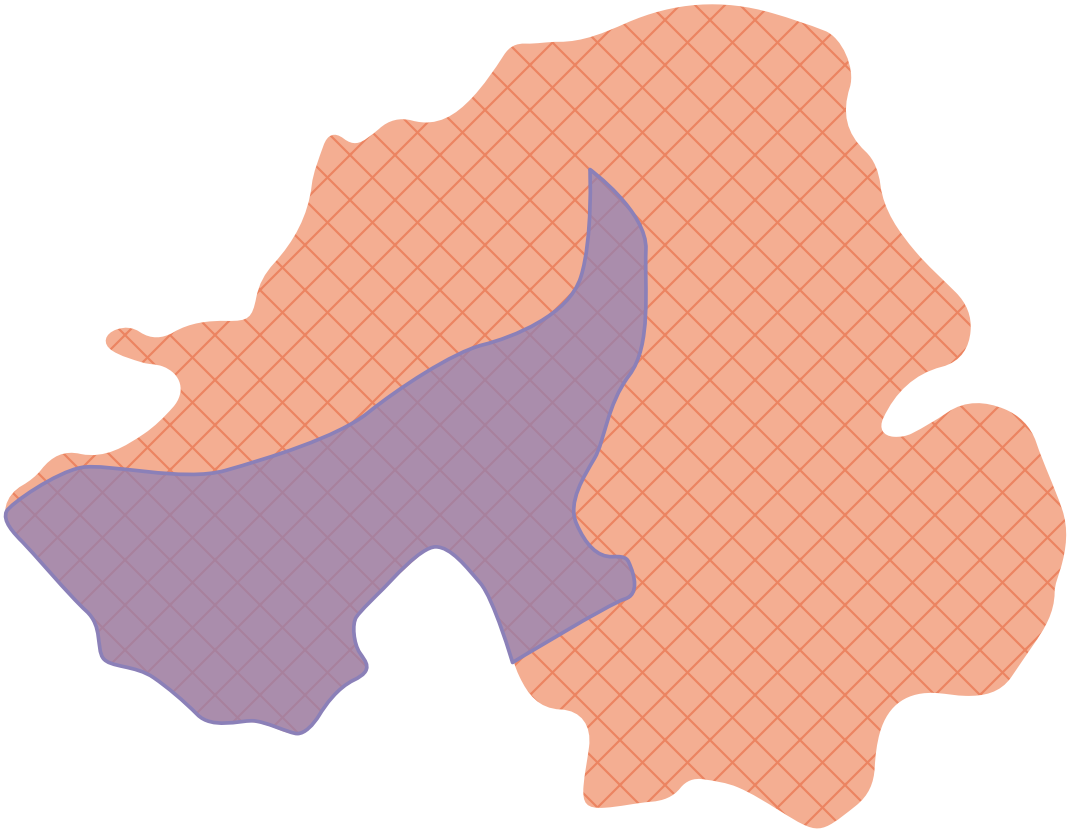
Radioactive Waste Management



Northern Ireland

SUBREGION 3

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 inland cliffs, river beds and in man-made excavations such as quarries and 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 between Omagh and Cookstown, 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.

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 most of County Fermanagh, southern County Tyrone and County Londonderry and northern County Armagh.

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 predominantly comprises older sedimentary rocks of Carboniferous and Devonian age (approx. 300 to 420 million years old) throughout the depth range of interest. None of these rocks are considered to be potential host rocks because the mudstones which are present are only thin layers within the other rock types.

In the area between Omagh and Cookstown a block of metamorphic basement rock is present from the surface through the depth range of interest (the Tyrone Central Inlier and Tyrone Igneous Complex). It comprises a complex mix of metamorphosed igneous and sedimentary rocks. The Tyrone Volcanic Group to the north-west consists of weakly metamorphosed volcanic rocks interleaved with slaty and cherty sediments. The Tyrone Plutonic Group to the south-east includes gabbros, locally metamorphosed to schists, and is associated with nearby granitic intrusions. There is also a fault-bounded wedge of gneiss that has been correlated with similar rocks in the Lough Derg Inlier. All of these rocks are potential HSR host rocks if they have sufficient volumes with uniform properties.

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

There are a number of major faults in the block of Midland Valley Terrane rocks between Omagh and Cookstown and most of the boundaries between rock types are faulted (Figure 2). 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].

The older sedimentary rocks are faulted and gently folded by a tectonic event about 300 million years ago. This has resulted in some zones of more intense deformation adjacent to the Omagh Thrust Fault along the northern edge of the subregion and in the area west of Dungannon (see Figure 2). This is likely to complicate the search for a volume of rock with sufficiently homogeneous properties in these 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 information on groundwater in aquifers above 200m. The Tyrone Group of the Carboniferous Limestone aquifer is a major aquifer within 400m of the surface over much of this subregion. Some parts of the Carboniferous Limestone aquifer are karstic, where weakly acid groundwater has dissolved the limestone leading to enlargement of natural fracture systems and the formation of a connected network of fissures and caves, resulting in fast movement of groundwater near the surface. Throughout the central part of this subregion the presence of Palaeogene (approx. 25 to 65 million years old) dyke swarms, which were intruded into the older sedimentary 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. Groundwater from depths greater than 400m is unlikely to be suitable as drinking water anywhere in the UK [2].

Neither the Carboniferous Limestone aquifer nor the dyke swarms are present in the area between Omagh and Cookstown where potential HSR is present in the depth range of interest. There are no low permeability clay-rich rock layers in this area to act as barriers to vertical flow between the surface and any groundwater present at depth in the basement rocks.

There are some areas in this subregion, around Dungannon in particular, 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.

[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

In County Fermanagh, in the Irish Northwest Carboniferous Basin, gas has been recorded in exploration wells drilled since the 1960s, but no commercially viable flows have been discovered. The Mullaghmore Sandstone Formation and the Bundoran Shale Formation may have some shale gas potential, respectively, within a depth range of about 900 to 1,500m below NGS datum; however, there are no current Petroleum Licences in this subregion.

There are no other known mineral, hydrocarbon or geothermal resources in the 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 3 where Higher Strength Rock Types of Interest are present between 200 and 1,000 m below NGS datum.

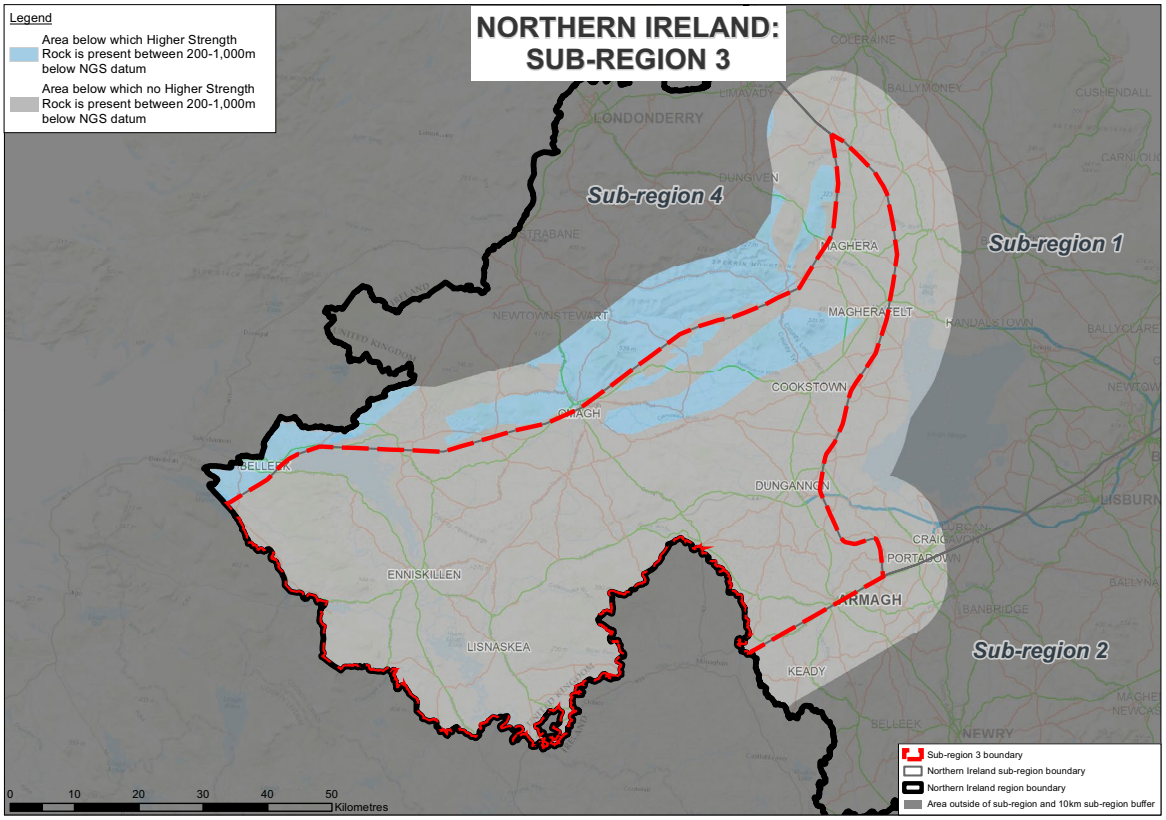


Figure 2 Location of major faults in the Northern Ireland subregion 3.

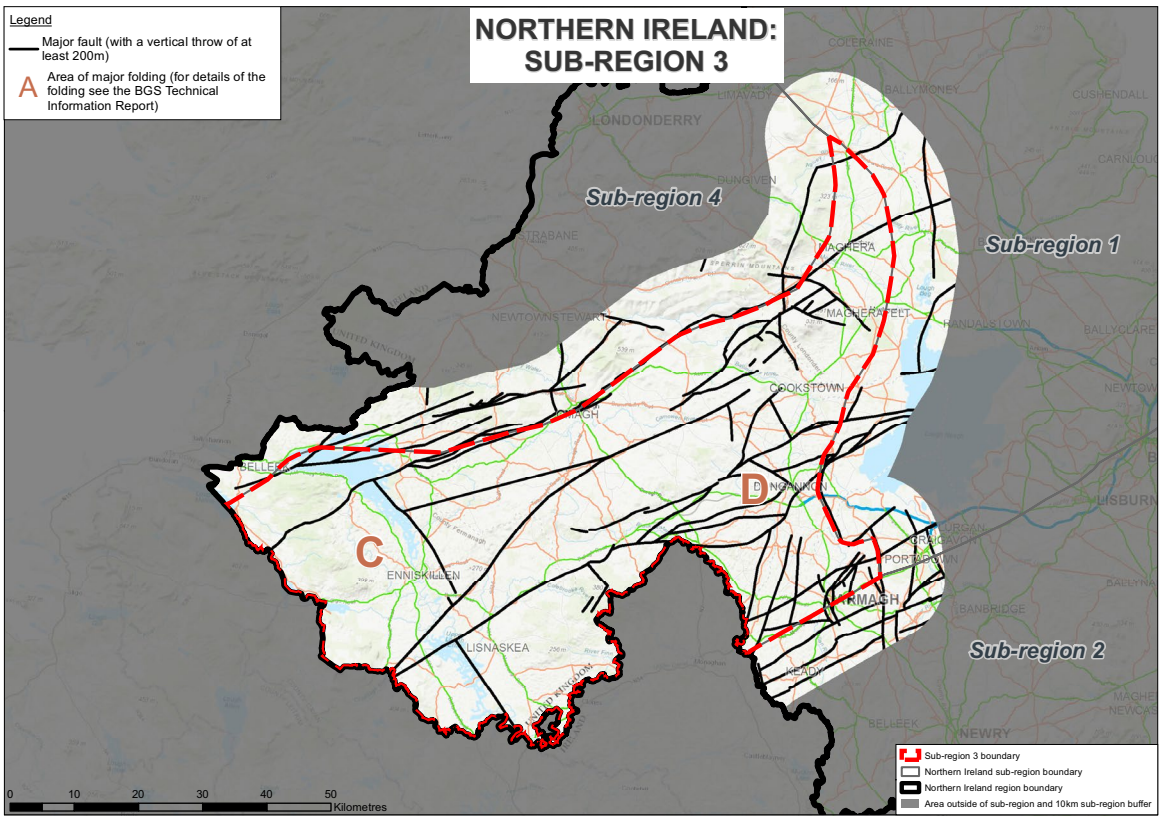


Figure 3 Areas in the Northern Ireland subregion 3 with concentrations of deep exploration boreholes.

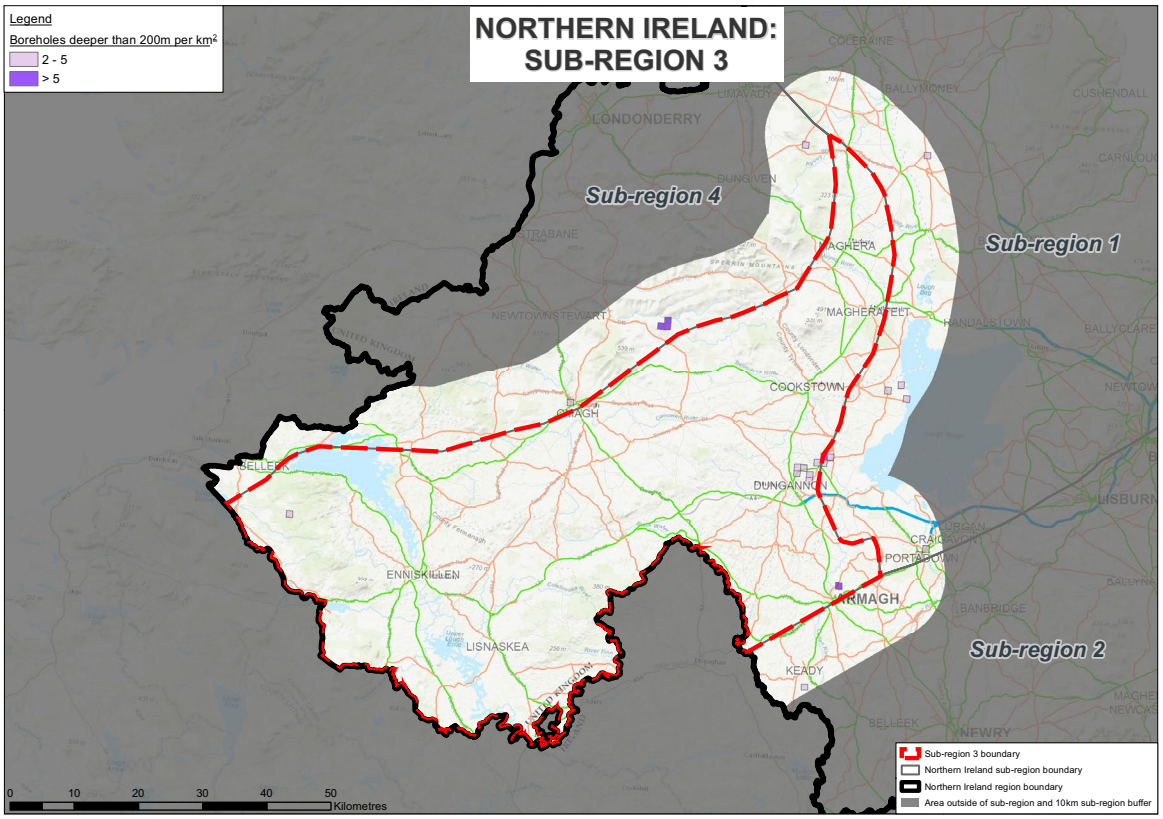
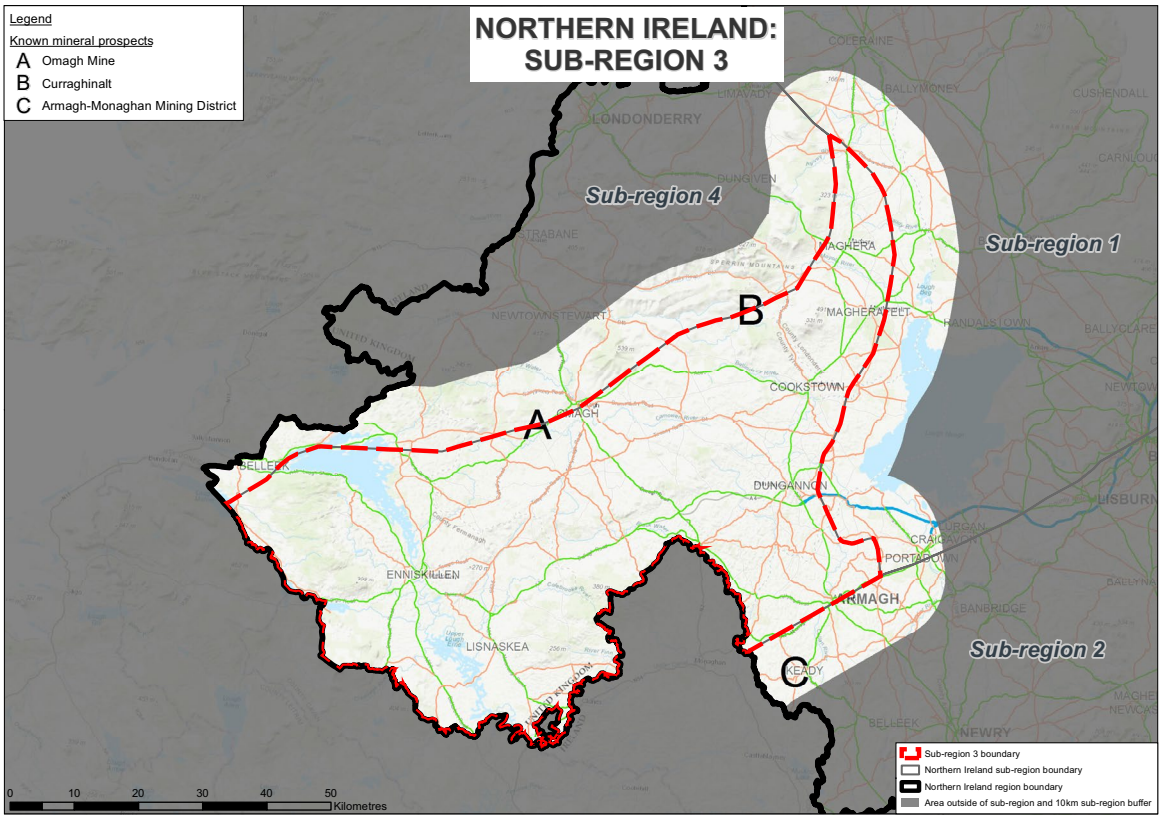


Figure 4 Known mineral prospects in Northern Ireland subregion 3.



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.

Chert
A hard rock made of microscopic silica crystals.

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.

Gabbro
Dark-coloured, coarse crystalline igneous rock rich in iron and magnesium.

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.

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

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.

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.

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.

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.

Shale gas

Gas that is naturally generated and trapped within shales that contain a high amount of organic material. Shale gas can be extracted for use as a fuel in heating or power generation by a technique known as hydraulic fracturing or 'fracking'.

Slaty

Distinctive way in which slate rocks split into very fine sheets.

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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