Radioactive Waste Management

Wales

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 Oil and Gas Authority licensing which was updated to include data to the end of June 2018.

Our work shows that we are unlikely to find enough suitable rock to accommodate all of the waste in this subregion, although sufficient suitable rock to host part of it may be found.

Rock are present at the surface over much of the subregion, including the sea cliffs on the Gower peninsula and the Pembroke coast and cliffs in the upland areas such as the Brecon Beacons. Combined with some deep boreholes and geophysical investigations, particularly in the coalfield areas, this gives us an understanding of the rocks present and their distribution.

Our work has identified no rocks in which it is likely that a GDF could be sited under this subregion.

Some of the subregion has been mined for coal resources to depths below 100m, mainly in the South Wales coalfield in the valleys north of Cardiff and Swansea, but also to a much lesser extent in Pembrokeshire. 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.

Parts of this area, related to coal bed methane for parts of the coalfield and its southern margin and along the coastline between Newport and Chepstow, have Petroleum Exploration & Development Licences to allow gas companies to explore for oil and gas. This exploration is currently at an early stage and it is not known whether oil or gas in these licence areas will be exploited. RWM will continue to monitor how this exploration programme progresses.

Parts of this area, associated with the South Wales Coalfield, are Coal Authority Licence Areas allowing companies to explore for coal. It is not known whether coal in these licence areas will be exploited. RWM will also continue to monitor how this exploration programme progresses.

There are thermal springs at Taffs Well, 10km north of Cardiff, which indicate that groundwater is moving rapidly from depth to the surface in these areas. This would need to be considered in the siting of a GDF in this subregion.

Introduction

This subregion extends from St Bride's Bay to the Severn Estuary and extends north, along the border with England to the vicinity of Welshpool. It includes some of adjacent inshore area which extends to 20km from the coast.

Rock type

The predominant rocks in this subregion are sandstones and limestones of the older sedimentary rock sequence, although some basement rocks occur in small, fault-bounded blocks. Across the southern part of the subregion, the predominant rocks are of Carboniferous age (approx. 300 to 360 million years old), but to the east and north older, Devonian rocks predominate. Even older Silurian rocks are also present in parts of the subregion.

No potential Lower Strength Sedimentary Rocks (LSSR), Higher Strength Rocks (HSR) or Evaporites have been identified in this subregion.

A summary of the geological attributes of Wales 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

A wide range of structures are present in this subregion, owing their origin to four completely separate, major episodes of tectonic deformation related to ancient plate collisions. In some parts the rocks are intensely folded and faulted but elsewhere rocks are flat lying and relatively unfaulted (Figure 1). The southern margin of the subregion lies in a zone of intense faulting and folding, related to the "Variscan" tectonic event about 300 million years ago, which extends east into England beneath the inner Bristol Channel and Severn Estuary. The South Wales Coalfield formed during the Variscan event and occupies a large basin-shaped fold structure cut by many minor faults as well as a few major ones shown in Figure 1. The structural complexity arising from this faulting was a factor leading to the end of mining in the late 20th century. 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 information on groundwater in aquifers above 200m. The Carboniferous Limestone aquifer is a principal aquifer where it is present within 400m of the surface in this subregion and the Mercia Mudstone Group in South Glamorgan is sandier than elsewhere and is also a principal aquifer. The Upper and Lower Old Red Sandstone Group rocks also include layers that can act as local aquifers.

[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.

There are no clay-rich rock layers in this subregion to provide hydraulic separation between deep and shallow groundwater. There is some evidence of deep groundwater flow along faults in the Welsh Borderland Fault System, where mineral springs may contain water that has risen up the faults from depth, although there are no thermal springs in this area to indicate rapid flow from greater depth. Groundwater from depths greater than 400m is unlikely to be suitable as drinking water anywhere in the UK [2].

In the South Wales Coalfield a thermal spring at Taffs Well, 10km north of Cardiff, on the south side of the coalfield, appears to discharge water that entered the ground in the upland area to the north, but there is little other evidence for regional scale groundwater movement (Figure 2). Mine water discharges in the coalfield are commonly a few degrees warmer than the mean annual air temperature, suggesting that water now rises from depths of a few hundred metres through mine workings.

In the South Wales coalfields mining is likely to have changed the original patterns of water movement and shallow groundwater may now circulate to greater depths within the depth range of interest than it did before mining. Deep exploration boreholes may influence the connectivity between shallow and deep groundwater which would also need to be considered during the siting process (Figure 3).

Resources

Coal was mined extensively below 100m in the South Wales Coalfield and to a smaller extent in Pembrokeshire (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.

There are Petroleum Exploration and Development Licences related to coal bed methane for parts of the coalfield and its southern margin and related to shale gas along the coastline between Newport and Chepstow (Figure 4b). There are also Coal Authority Licence Areas in the in the South Wales Coalfield (Figure 4a). It is not known whether coal, oil or gas in these licence areas will be exploited, but they would need to be considered during the siting process.

An area of historical iron ore mining is also shown in Figure 4c but is not relevant to the siting of a GDF as the mines are shallower than 100m.

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.

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

Figure 1 Major faults and areas of folding in Wales subregion 3.

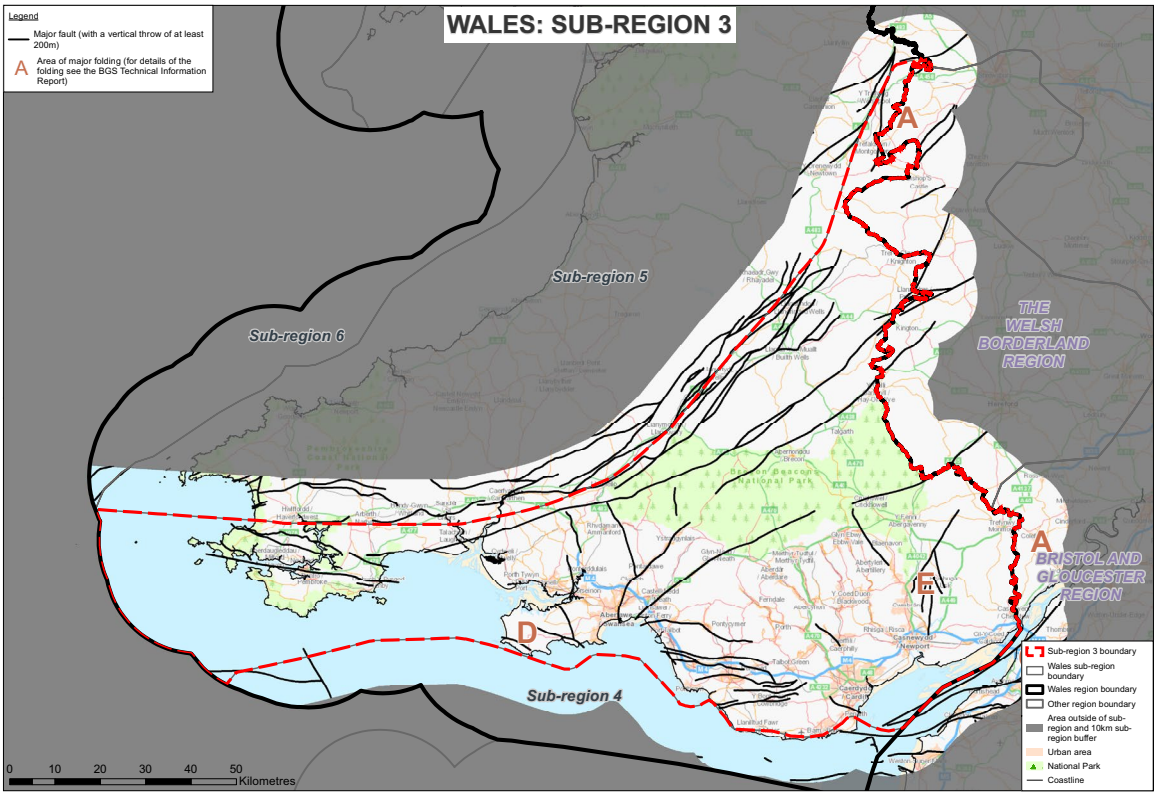


Figure 2 Thermal springs in Wales subregion 3.

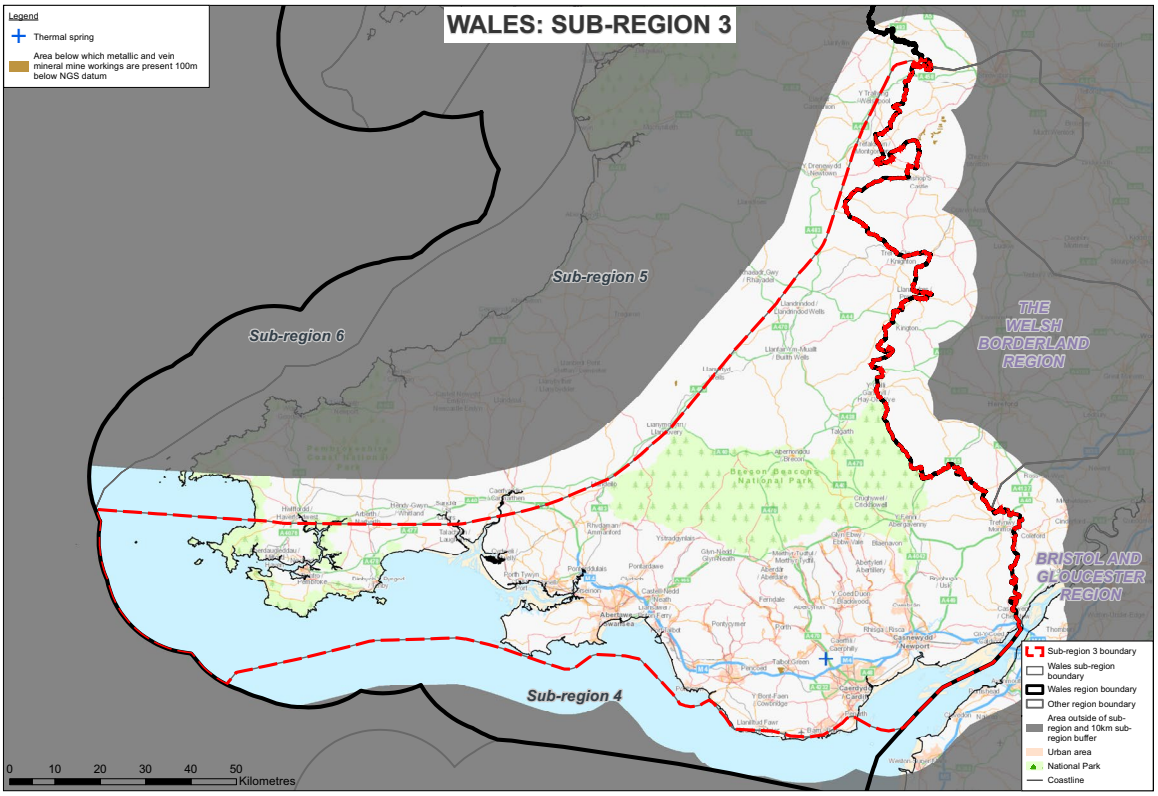


Figure 3 Areas of Wales subregion 3 with concentrations of deep exploration boreholes.

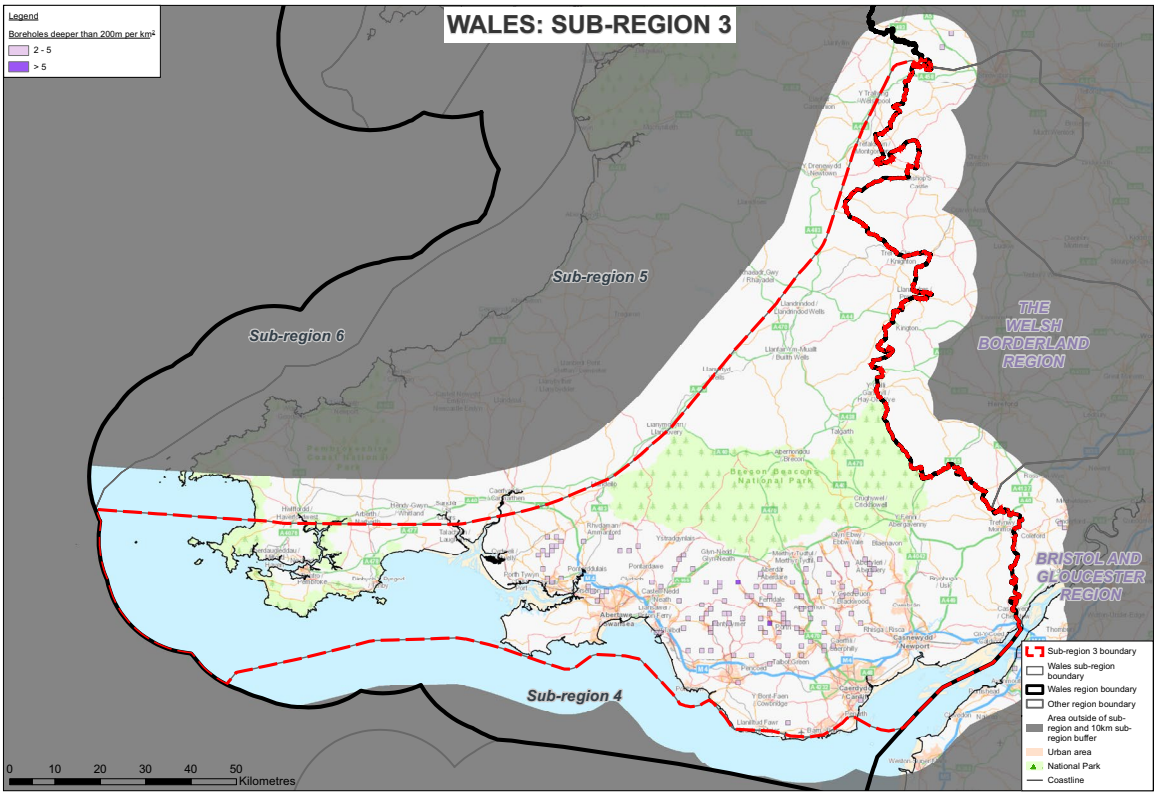


Figure 4a Areas of Wales subregion 3 with coal mines present below 100m and Coal Authority Licence Areas.

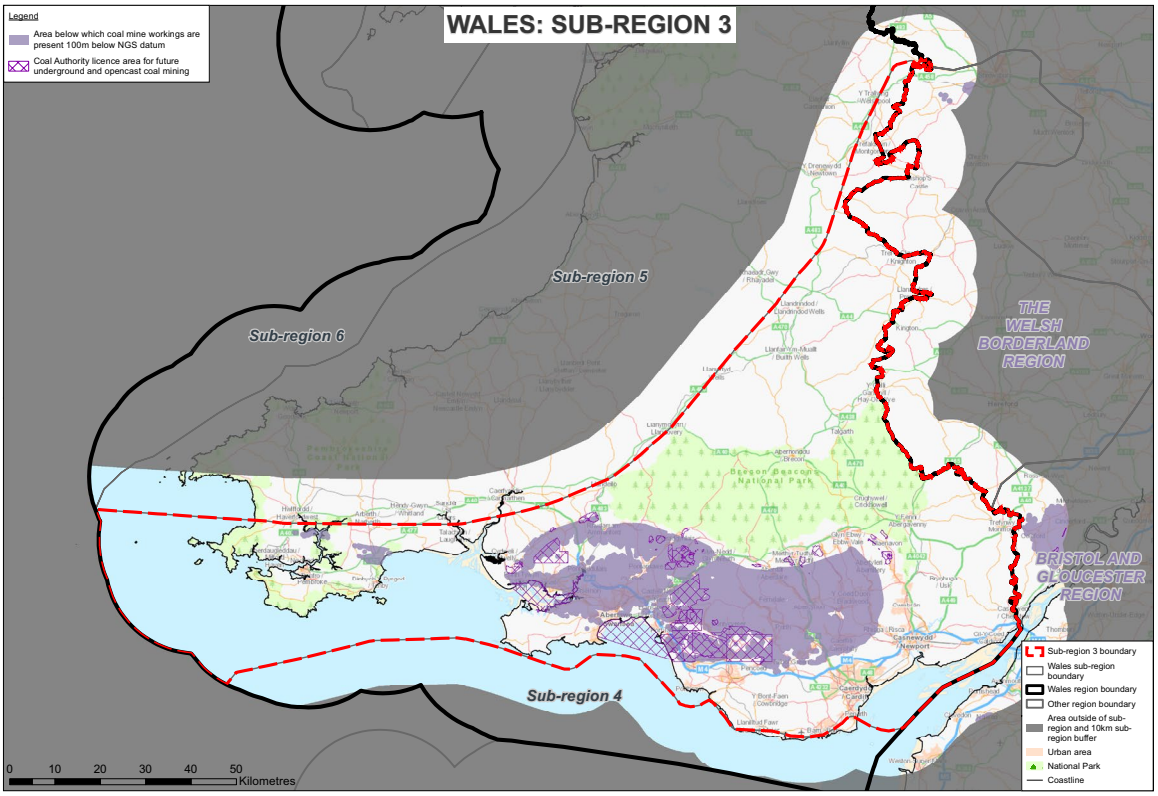


Figure 4b Areas of Wales subregion 3 with Petroleum Exploration and Development Licences.

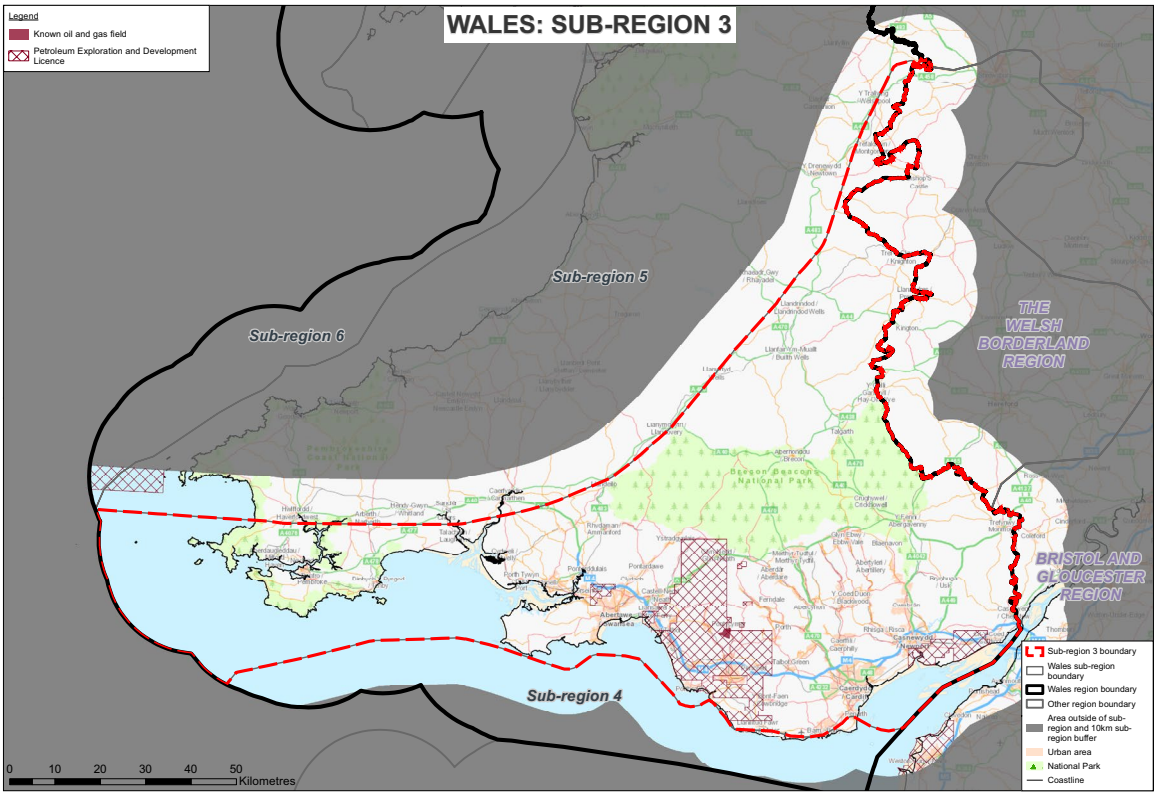
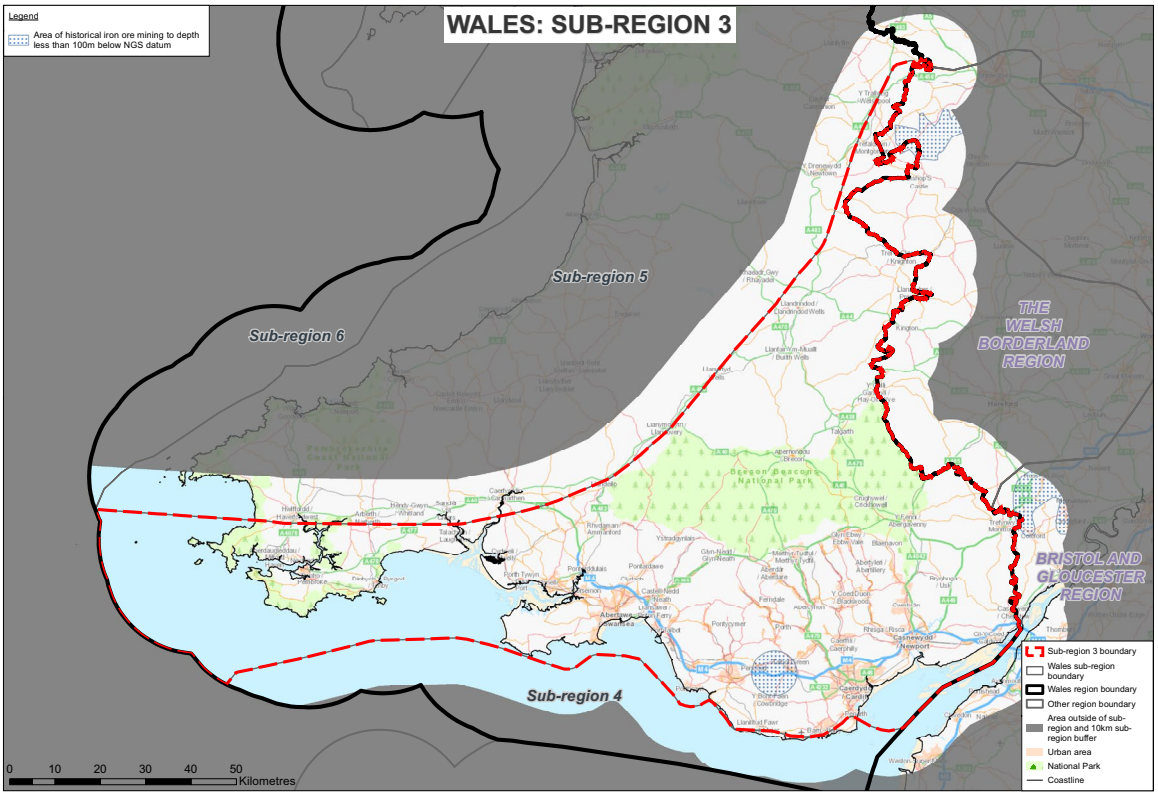


Figure 4c Areas of Wales subregion 3 with historical mining less than 100m deep.



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.

Coal bed methane
Natural gas trapped in underground coal seams and extracted using boreholes without the need for a coal mine.

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

Principal aquifers
An aquifer classified by the Environment Agency as: "rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage." They represent the most important aquifers in terms of water supply or base flow.

Variscan
An episode of mountain-building during the Carboniferous period that led to deformation of the basement rocks of much of the southern UK.

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