The National Mineral Resource Map of Wales

A J Humpage, T P Bide and C E Wrighton
British Geological Survey

Introduction

Minerals, especially aggregates, are essential for the development of a modern economy. However mineral resources are finite and can only be worked where they occur at or near the land surface by either quarrying or mining. As their extraction is subject to a number of constraints, it is essential minerals are used in the most efficient and sustainable manner so that they can continue to make a vital contribution to the economy of Wales. However, the extraction of minerals inevitably competes with other land uses and is often contentious. In Wales it is the responsibility of each local government Unitary Authority (or Minerals Planning Authority) to deliver national planning policy through the development of Local Development Plans (LDPs). These plans are documents which set out the individual authority's objectives and priorities for the development and use of land for a set period of time and which provide a basis for rational and consistent decisions on planning applications and appeals. This will include ensuring that adequate mineral resources are available to meet current and future demand, and to balance society's need for minerals against other land-use considerations, such as environmental designations, through the appropriate siting of development and by enforcing mitigation measures.

The Welsh Government has recognised the importance of managing mineral resources at a national level in order to preserve appropriate mineral supply relative to demand, and the lack of information was hindering local authorities in preparing their Local Development Plans. The British Geological Survey (BGS), which has previously published mineral resource maps for parts of Scotland and individual English counties, has undertaken a commission through its Mineral Resources and Policy team, to consider mineral resources across Wales. This commission has been funded by the Welsh Government administered Aggregate Levy Sustainability Fund for Wales with an additional BGS contribution, and led from the BGS Cardiff office. The outcome, the *National Mineral Resource Map of Wales*, will assist local authorities deliver national planning policy by depicting the location and extent of mineral resources throughout Wales in a consistent fashion and facilitate the development of more effective and sustainable management strategies.

The Importance of Minerals

Society is dependent on mineral resources and there is an increasing need to maintain secure supplies of minerals (Tiess, 2010). This is reflected by the European Raw Materials Initiative (EU RMI, 2008) and, at a UK level, the development and delivery of national minerals policies through central government and the devolved administrations. Minerals are key in sustaining the economy (British Geological Survey, 2013), but are also finite and can only be worked where they occur (Highley *et al*., 2004). It is, therefore, essential that society uses minerals in the most efficient and sustainable manner. With the increasing awareness of the importance of these resources and the need to utilise them in a more sustainable fashion, land-use planning systems have a vital role to play in their management and supply.

The Minerals Industry in Wales

The mineral resources of Wales contribute to local, regional, and national needs and the Principality has historically been, and continues to be, a major UK mineral producer, although it is reliant on imports of some minerals. In 2011 Wales produced 12 per cent of Great Britain's coal (2.2 million tonnes) (The Coal Authority, 2012) and 33 per cent of the UK's sandstone (3.1 million tonnes) (Office of National Statistics, 2013) most of which was used for high-specification aggregate purposes, such as road surface products. Approximately 13 per cent of Great Britain's limestone production is sourced from Wales (7.9 million tonnes) (Office of National Statistics, 2013) much of which is suitable for high-grade chemical products.

In 2009, Wales produced 12.8 million tonnes of sand and gravel and crushed rock aggregate (a decrease from 19.3 million tonnes in 2005) of which 9.8 million tonnes was consumed in Wales. It exported 2.9 million tonnes of crushed rock to England, 25 per cent of the country's total production (Mankelow *et al*., 2011) a decrease from 5.7 million tonnes exported in 2005 (Mankelow *et al*., 2007). In 2010 sales of crushed rock alone reached nearly 12 million tonnes, a significant drop from 2007 which marked the highest level for ten years (South Wales Regional Aggregates Working Party, 2011; North Wales Regional Aggregates Working Party, 2011).

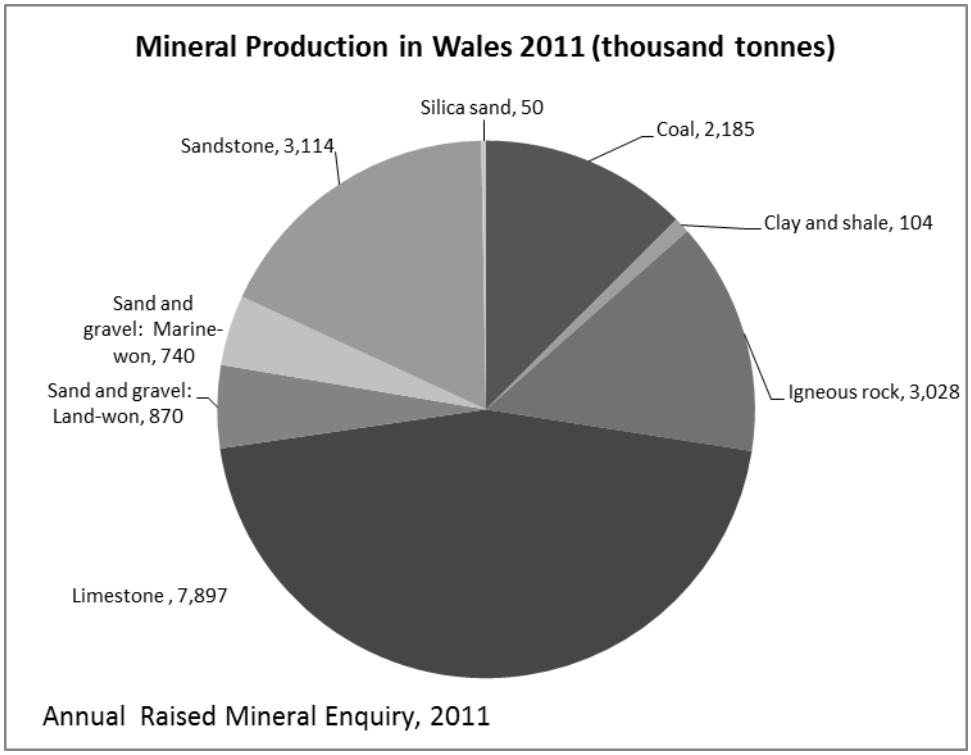

Figure 1: Mineral production in Wales

The minerals industry and those industries supported by it generates significant revenue within Wales; over 2,100 people were employed by the minerals industry in 2011 (Office of National Statistics, 2013). It is therefore essential to the economic strength of Wales to not only continue to support these operations, but also to manage and maintain a steady supply of minerals to meet current and future demand not only from the Welsh economy, but also the economies of countries which benefit from receiving exports from Wales.

The current planning system in Wales

The planning system in Wales provides a framework within which sound and consistent decisions can be taken on development proposals. The system is governed by European and UK legislation through development plan policies which are implemented at the local level, consistent with strategies and policies that are set at the regional and national level.

National policy with respect to minerals related development is provided by *Minerals Planning Policy Wales* (MPPW), which is supplemented by Minerals Technical Advice Notes (MTANs) and Circulars issued by the Welsh Government. National policy and guidance is material to decisions on individual planning applications, and as such is taken into account by Planning Officers, the Welsh Government and by the Planning Inspectorate in the making of decisions on

development proposals (Welsh Assembly Government, 2000; Welsh Assembly Government 2004).

Regional Technical Statements (RTS's) for North and for South Wales have been developed in line with the requirements of *Minerals Technical Advice Note 1: Aggregates* (MTAN1), paragraph 50. The objective for production of the RTS series is to create a comprehensive regional framework within which decision makers at a local level can operate when concerned with the future provision of aggregates. Every Mineral Planning Authority (MPA), which in Wales are the 22 Unitary Authorities plus the three National Park Authorities, is required to implement each RTS through the development plan process, and they too will be material in any planning consideration for development decisions and in the development plan-making process (South Wales Regional Aggregates Working Party, 2008; North Wales Regional Aggregates Working Party, 2009).

The policies and guidance set at a national and regional level are incorporated into local policies in Local Development Plans (LDPs). A LDP is produced by every authority on usually 10 or 15 year cycles, and used as the basis on which planning decisions are made (Welsh Assembly Government, 2005). Until recently, the Mineral Planning Authorities have not had the required level of information detailing the type and extent of mineral resources within their areas. This has led to several authorities delaying the publication of their LDPs in order to collect further geological information. By providing a comprehensive, relevant and accessible information base, the National Mineral Resource Map of Wales addresses these issues.

The National Mineral Resource Map of Wales

The National Mineral Resource Map of Wales provides spatial information on all mineral resources in Wales at a national level. This information is essential in allowing each Unitary Authority to visualise the extent and distribution of mineral resources in their area and to relate them to other forms of land-use (such as urban areas or designated environmentally sensitive areas) or to factors (such as transport infrastructure and conservation information). Planners can then use this information to adequately consider the importance of such mineral resources relative to the other factors in land-use planning in accordance with the principles of sustainable development. These maps have also fed into the 'aggregate safeguarding maps of Wales' which

provides information on mineral safeguarding areas, aimed to prevent the sterilisation of important mineral resources by competing developments.

What is a Mineral Resource?

For the purpose of producing the National Mineral Resource Map of Wales, the PERC code (Pan-European Reserves Reporting Committee, 2008) has been used to define mineral resources:

> *a mineral resource is defined as a concentration or occurrence of material of intrinsic economic interest in or on the Earth's crust in such form, quality and quantity that there are reasonable prospects for eventual economic extraction.*

Generally, a mineral resource is known to exist within the boundaries outlined by geological mapping and the known locations of past and current mineral workings. The National Mineral Resource Map of Wales shows the surface extent of mineral resources *inferred* from available geological information such as boundaries outlined by geological mapping. It is not derived by evaluation through drilling or by other sampling methods on any systematic basis, although supplementary data has been considered where available. The mineral resource polygons presented on the map define the geological distribution of all onshore (above low water mark) mineral resources in Wales within which potentially workable minerals may occur. What may be of economic interest can change over time, and is dependent upon a number of factors, such as mineral markets and extraction technology.

Criteria for mineral resource definition

The mineral resources defined on the map show areas within which minerals have suitable chemical and physical properties to be potentially workable. Non-geological factors, such as anthropogenic sterilisation (largely urban development), relationships to environmental designations and economic factors, such as proximity to markets, end-uses and extraction technology have not been considered. Although these factors greatly influence the development and exploitation of mineral resources, they can be subject to change with changing economic conditions and planning legislation. As such, the mineral resources highlighted by the National Mineral Resource Map of Wales, as specified by the Welsh Government, are primarily focussed on geological constraints as to what may or may not constitute a mineral resource and the map is thus intended to be timescale independent.

The mineral resources shown by the National Mineral Resource Map of Wales include a wide range of minerals, many of which have been exploited for some time and include:

- unconsolidated sediments, primarily sand and gravel deposits such as river terrace deposits, glaciofluvial deposits and wind-blown sand;
- sedimentary rock resources such as limestone, high-purity limestone (>98% $CaCO_3$) and sandstone;
- clay resources suitable for brick making
- igneous rock resources with high specification aggregate uses, such as those suitable for road surfacing materials;
- coal resources, together with associated brick clays and fire clays;
- salt resources.

To further supplement the spatial data on the geological distribution of all onshore (above low water mark) bedrock and superficial mineral resources in Wales, as listed above**,** the National Mineral Resource Map of Wales also contains information showing:

- the locations of mineral extraction sites which were active or have the necessary permissions to undertake extraction at the time of compilation of active mineral extraction sites (2010);
- the recorded occurrences of metalliferous minerals;
- the recorded location of former slate quarries and significant areas of slate waste;
- the recorded location of significant historic building stone quarries.

By including this wide range of minerals information in an easily accessible Geographical Information System (GIS) format, much of which is otherwise scattered and not always available in a convenient form is brought together. The inclusion of former and current extraction sites gives a rapid overview of the minerals industry of Wales. The inclusion of metallic minerals occurrences and historic building stone quarries aid the user to gain an understanding of the distribution of these resources which are not readily shown by mapped geological formations.

Producing the National Mineral Resource Map of Wales

The production of the National Mineral Resource Map of Wales was overseen by a Steering Group comprising members of the Welsh Government, Mineral Planning Authorities,

representatives from the minerals industry, and environmental organisations. In May 2009, a consultation event was held which provided an opportunity for stakeholders and the wider planning community to state their views and concerns, and to present options for the Steering Group to consider, prior to developing the map which was delivered in 2010.

The first phase of the resource assessment involved an appraisal and study of the geology of Wales to determine those geological formations that have been or are currently worked, or have the reasonable potential to be worked in the future. Geological criteria used in identifying resources included resource quality, variability, extent and suitability for a particular application.

Mineral resources were defined within a GIS environment, using digital geological linework at 1:50 000 scale (the BGS *DiGMap50* dataset) as the basis for all mineral resource polygons. The mineral resource dataset was constructed by identifying those lithological units, from the DiGMap50 dataset, which were considered to be mineral resources based on their geological properties. As many sources of information as possible were consulted when considering which geological units constitute a mineral resource, ranging from historic publications to consultation with geologists with specialist knowledge of particular stratigraphies. The majority of decisions were based on existing BGS publications such as memoirs for geological map sheet areas, mineral assessment reports together with advice from geologists with area–specific knowledge. The BGS-hosted 'BritPits' database of former and current mines and quarries provided data on lithologies which had been historically worked, had the possibility of being worked again under current consents, and which were economically workable at present. When assessed together, these data identified those lithologies which had the potential to be worked in the future.

After the relevant sources of information have been consulted, the lithologies identified in the DiGMap50 dataset were assigned to the relevant mineral resource classification, e.g. Quartz dolerite = high specification aggregate (HSA). Once the lithologies from DiGMap50 were attributed with resource information, they were then separated out and extracted in a GIS environment, geological lines within resource polygons, such as faults, were removed, and the final mineral resource dataset was created.

The mineral resources shown on the maps produced have been constrained by the best available geological information held by BGS. This has important connotations for understanding the map.

As the map is based on surface geology only, all identified mineral resources polygons correspond to mapped lithological units.

Figure 2 shows how the original geological map for part of Wales has been modified by the process described above to provide a mineral resource map which now only shows those units considered to be a mineral resource.

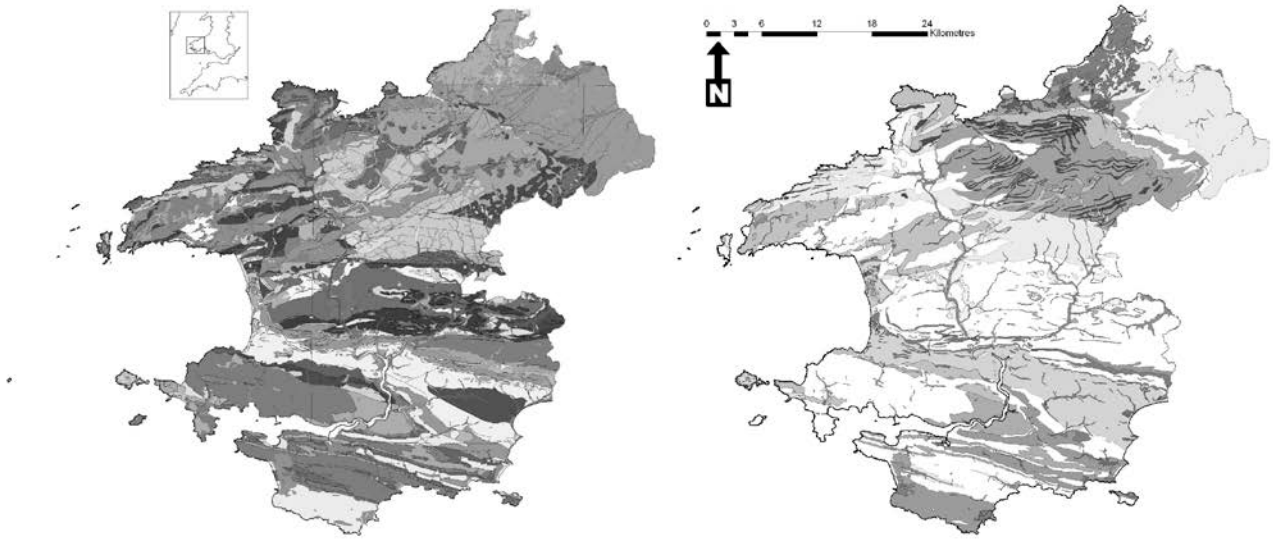

Figure 2: The original geological map (DiGMap50) for Pembrokeshire (left) and the completed mineral resource map of Pembrokeshire (right) showing only those geological units with mineral resource potential.

Presentation of the Mineral Resources Data

The mineral resources data for Wales is presented on six maps at the 1:100 000 scale which collectively cover the whole country. The six map areas and the Mineral Planning Authorities which they cover are:

South-east Wales, covering Blaenau Gwent, Brecon Beacons National Park Authority, Bridgend, Caerphilly, Cardiff, Merthyr Tydfil, Monmouthshire, Neath Port Talbot, Newport, Swansea, Rhondda Cynon Taff, Torfaen, Vale of Glamorgan, eastern Carmarthenshire and southern Powys;

South-west Wales covering Pembrokeshire, Pembrokeshire Coast National Park Authority, Carmarthenshire and southern Ceredigion;

Mid Wales (South) covering southern Powys, north-east Carmarthenshire and Ceredigion;

Mid Wales (North) covering northern Powys and southern Gwynedd;

North-west Wales covering Anglesey, Gwynedd, Snowdonia National Park Authority, and western Conwy;

North-east Wales covering eastern Conwy, Flintshire, Denbighshire and Wrexham.

The mineral resource maps show both the superficial deposit resources and the bedrock resources. Where superficial deposit resources overlie bedrock, the outline of the bedrock resource is shown through the superficial deposit resource polygon (Figure 3).

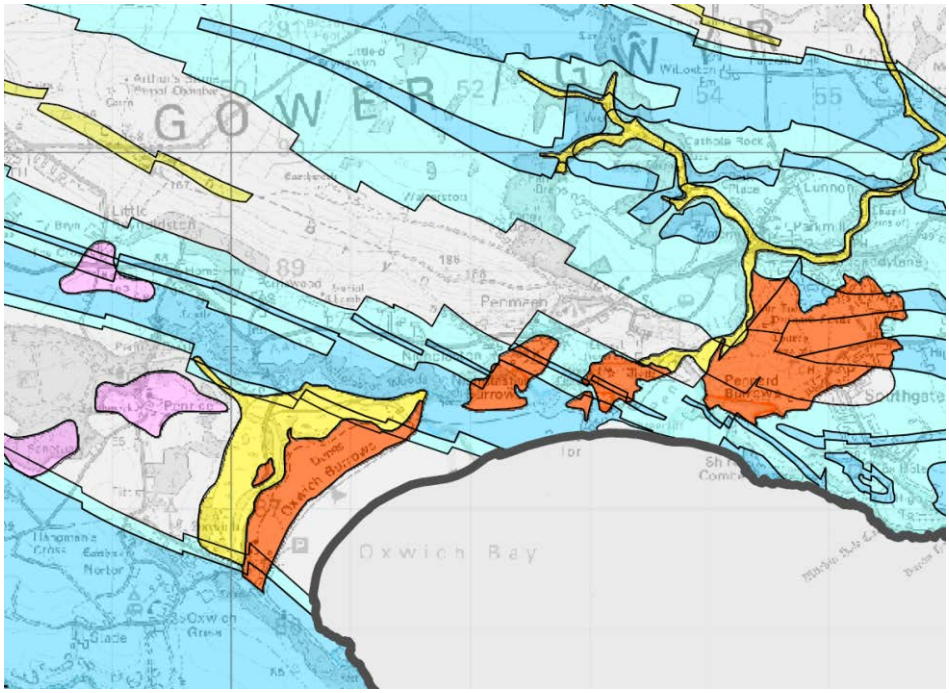

Figure 3: Illustration of bedrock resource (blue colours) underlying polygons of superficial deposit resource (orange, yellow and pink colours), showing the bedrock resource outline through the superficial deposits. Example taken from the South east Wales Mineral Resource Map, north of Port-Eynon; the outline of limestone mineral resources can be seen beneath superficial sand and gravel resources. Ordnance Survey Topography © Crown Copyright.

The completed National Mineral Resource Map of Wales was delivered at the end of June 2010 and complements the existing maps of English regions as well as the recently completed central belt area in Scotland. In addition to the published map outputs described above, each MPA has been provided with a GIS dataset, with separate GIS layers provided for each of the resource types, thus allowing planners to include the minerals resources data alongside other digital datasets when necessary (Figure 4). In addition, Adobe pdf files of the six maps and a report on the maps and mineral resources depicted thereon (Humpage and Bide 2010) are available to download through the BGS-hosted website, www.MineralsUK.com .

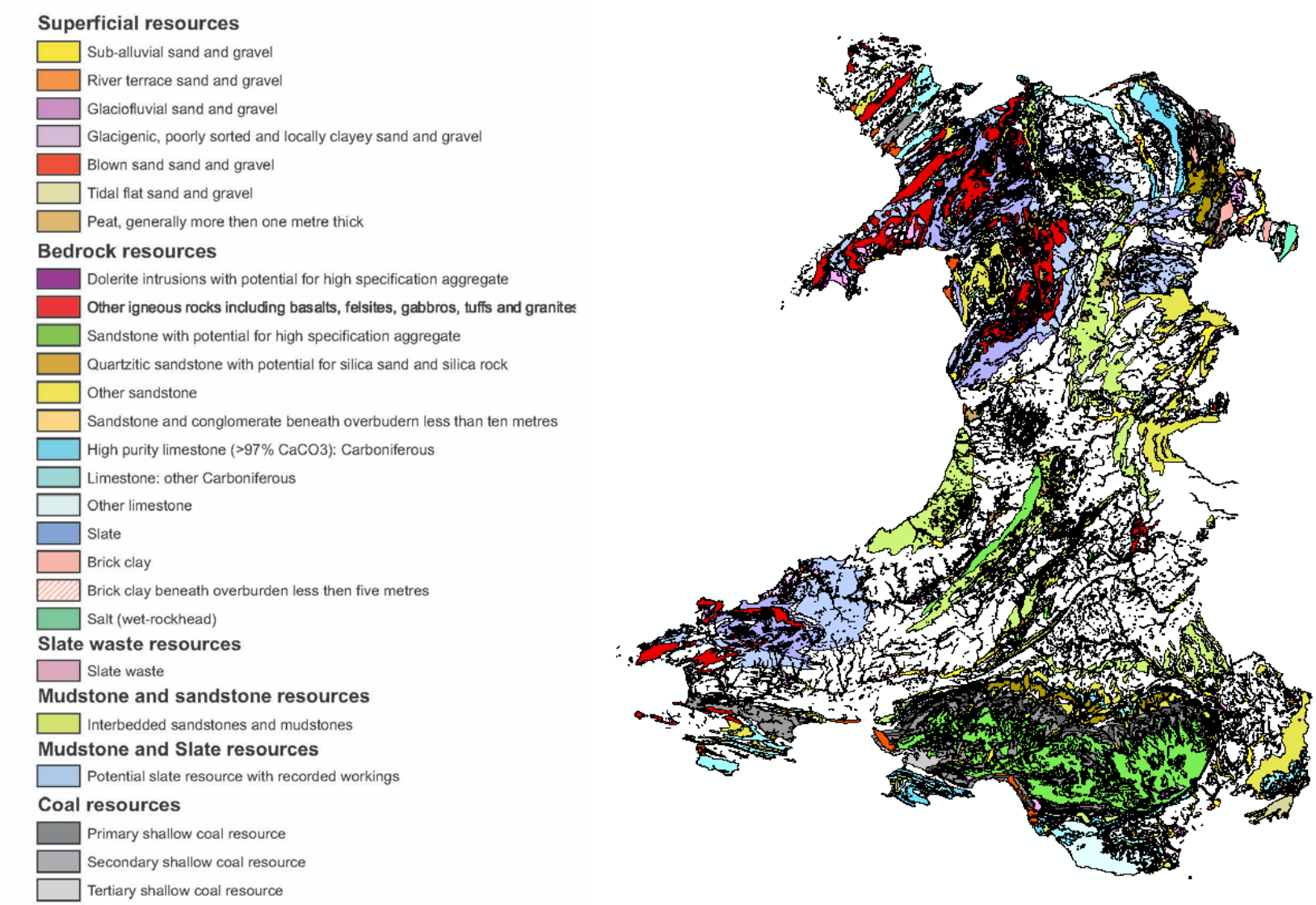

Figure 4: The National Mineral Resource Map of Wales

Summary

Minerals make a vital contribution to the economy of Wales. However, mineral planning in Wales has been hampered by a lack of information regarding the type and extent of mineral resources at both a local and national scale.

The location and extent of mineral resources data as depicted by the National Mineral Resource Map of Wales will assist national and local government throughout Wales to meet policy requirement for minerals planning. This work enhances the sustainability of mineral resources in Wales by providing a comprehensive, relevant and accessible information base, enabling Mineral Planning Authorities in Wales to make the best and most sustainable use of mineral resources, thus ensuring that minerals are protected by the planning process and facilitate the conservation of land-won primary aggregate resources for future generations.

Acknowledgements

This paper is published by permission of the Executive Director, British Geological Survey (NERC).

References and Further Reading

British Geological Survey. 2013. *UK Minerals Yearbook 2012* [Internet]. Available from: http://www.bgs.ac.uk/mineralsuk/statistics/UKStatistics.html

European Commission. 2008. *The Raw Materials Initiative – Meeting our Critical Needs for Growth and Jobs in Europe*. (EU RMI).Council of Ministers. 699pp.

Highley, D.E., Chapman, G.R., Bonel, K.A., 2004. *Economic Importance of Minerals to the UK.* British Geological Survey Commissioned Report. CR/04/070N. 32pp.

Humpage, A.J. and Bide, T.P. 2010. The Mineral Resource Maps of Wales. *British Geological Survey Open Report*, OR/10/032. 49pp.

Mankelow, J.M., Sen, M.A., Highley, D.E., Hobbs, S.F., Edwards, C.E. 2007. *Collation of the results of the 2005 Aggregate Minerals Survey for England and Wales*. British Geological Survey.

Mankelow, J.M., Sen, M.A., Wrighton, C.E. and Idoine, N. 2011. *Collation of the results of the 2009 Aggregate Minerals Survey for England and Wales*. British Geological Survey. 156pp.

North Wales Regional Aggregates Working Party. 2011. *Annual Report 2010*. North Wales Regional Aggregates Working Party.

North Wales Regional Aggregates Working Party. 2009. *Regional Technical Statement*. North Wales Regional Aggregates Working Party.

Office of National Statistics. 2013. *Annual Minerals Raised Inquiry (AMRI), Business Monitor PA1007*. Office of National Statistics.

Pan-European Reserves Reporting Committee, 2008. "Code for Reporting of Mineral Exploration Results, Mineral Resources and Mineral Reserves", *Institute of Materials, Minerals and Mining*, London.

South Wales Regional Aggregates Working Party. 2010. *Annual Report 2010*. South Wales Regional Aggregates Working Party.

South Wales Regional Aggregates Working Party. 2008. *Regional Technical Statement for the area covered by the South Wales Regional Aggregates Working Party*.

The Coal Authority. 2012. *Production and Manpower returns for 12 month period January 2011-December 11*. The Coal Authority.

Tiess, G. 2010. *Introduction to Mineral Resources Policy*. Springer-Verlag. 250pp.

Welsh Assembly Government. 2000. *Mineral Planning Policy, Wales*. HMSO, Cardiff.

Welsh Assembly Government. 2004. *Minerals Technical Advice Note (Wales) 1. Aggregates*. Cardiff, The Publications Centre.

Welsh Assembly Government. 2005. *Local Development Plans, Wales*. Welsh Assembly Government.

Mineral Planning Factsheets prepared by the British Geological Survey for a range of minerals produced across Britain are available for free download from www.MineralsUK.com .