Geology of the Llanidloes area: Applied geology

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This page is part of a category of pages providing a summary of the geology of the Llanidloes district (British Geological Survey Sheet 164).

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Geological knowledge is essential for efficient planning and development on both a regional and site-specific scale. Consideration of earth science issues early in the planning process can help ensure that site and development are compatible and that appropriate mitigation measures are taken prior to development. Exploitation of natural geological resources often conflicts with agricultural land use, pre-existing development and the environment. Potential geological hazards may present a risk to public health and require costly remediation. Engineering ground conditions and designated sites of geological conservation strongly influence the location and design of any new development.

Mineral resources

Mineral resources are natural concentrations of minerals or bodies of rock that are of potential economic interest. The Llanidloes district lies within the north-eastern part of the Central Wales Mining Field (Jones, 1922[1]; Nutt, 1974[2]), an area of historic importance for the exploitation of metalliferous minerals, notably lead (galena) and zinc (mainly sphalerite) but also barytes and copper (chalcopyrite) locally. Silver was also found in association with the lead-zinc ore, in concentrations which, in places, made extraction of the ore economically viable. Mining within the district dates back certainly to Tudor, and probably pre-Roman times, but most took place during the mid 19th century. The peak period of production occurred between 1840 and 1880, but ended abruptly when the price of lead dropped sharply thereafter. There was a short-lived renewal of interest in the ore field during the 1914-18 war, and sporadic exploitation continued until the early 1930s when mining activity ceased altogether.

The majority of recorded mineral occurrences within the district are of lead; a list of the principal mine sites is given in the table below. The lead-zinc mineralisation mainly occurs along a number of veins (‘lodes’) in the central and north-western part of the district, with some minor vein development to the south of Llanidloes (P930913). The eastern part is largely devoid of mining, with the exception of two small sites near Aberhafesp. The principal lodes are mostly located along the east-north-east-trending faults and connecting relay structures (James, 2006[3]; Jones, 1922[1]), and the mineralisation tends to be developed where the faults intersect the hinges of second- and third-order folds (Hughes, 1959[4]). The main productive lodes are found in close association with the Ordovician inliers and surrounding early Silurian (Rhuddanian to Aeronian) rocks, whereas the orefield in the north of the district lies within an area of later Silurian (Telychian) strata.

List of lead-zinc and other mines within the Llanidloes district

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<td>Bacheiddon</td>
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<td>2</td>
<td>Rhoswydol</td>
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<td>3</td>
<td>Ceulan</td>
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<td>Llanerchyraur</td>
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Although the ore within the Central Wales Mining Field was of high grade, it was largely confined to the zone of fracturing, and therefore limited in its extent and tonnage. Only in a few places was it worked from ‘flats’ extending beyond the vein and, even here it occurs in fissures and other lines of weakness (Hughes, 1959[4]); there is no evidence of extensive disseminated mineralisation. In terms of production, the most important vein within the Llanidloes district was the Van Lode, along which a number of mines were located (Jones, 1922[1], Plate P775122). The Nantyricket and Nantygwydy (or Wye Valley) lodes appear to be situated along relay faults that may link the Van Lode with the important Castell Lode of the adjacent Aberystwyth district. Second in importance to the Van were the Dylife and Dyfngwm lodes, which possibly represent an eastward continuation of the Camdwr Fault that crosses the Plynlimon range. The closely spaced Cae Conroy, Llanerchyraur and Rhoswydol lodes in the extreme north of the district were also significant economically, although less so than those further south.
The historic Bryntail Mine, located on the Van Lode, now restored as a site of special archaeological interest, Clywedog Valley below the reservoir and dam (in background) [SN 9138 8682].

Lead isotope analyses from elsewhere in the Central Wales Mining Field suggest the mineralisation took place in two distinct periods (Fletcher et al., 1993[5]). A late Acadian event of 390 Ma was probably associated with the development of the dominant east-north-east faults, the fracturing producing a network of fissures allowing penetration of the mineralising fluids. These zones appear to have been exploited by a second phase of mineralisation in the early Carboniferous (360 to 330 Ma), when extension of the former Avalonian plate led to reactivation of Acadian structures during the early phases of the Variscan Orogeny.

The commercial extraction of hard rock for aggregate currently takes place at Penstrowed Quarry [SO 0680 9100], which works the thick sandstone of the Penstrowed Grits Formation. Many of the other sandstone divisions have been exploited in the past for a variety of purposes, notably as local sources of building stone, particularly in the remote areas. The mudstone formations in general are not sufficiently durable as building materials, and the presence of pyrite-bearing (anoxic) mudstones
at intervals throughout the succession limits their use as a fill or bulk aggregate; on weathering such material may release sulphates that can attack concrete. For many settlements the predominant building material was brick, readily supplied via the Montgomery Canal to Newtown and by rail to the mining field; bricks were also manufactured locally, utilising the lacustrine clays around Caersws.

**Sand and gravel** has not been widely exploited within the district, although potential resources of glaciofluvial gravel may be present in the Afon Carno valley north-west of Caersws. However, there is limited information on the thickness of these deposits, and their heterogenous clast content together with their variable clay content may limit their commercial value; the more localised hummocky glacial deposits likewise represent a poor to intermediate quality resource due to their heterogeneity. Alluvial fans and river terrace deposits may offer some potential, but hitherto have only been worked on a small scale as a source of farm aggregate; the variable clast size and content of certain alluvial fans may further limit their quality as aggregate.

**Water resources**

The high annual rainfall of the Cambrian Mountains, in association with the relatively impermeable bedrock, results in significant surface run-off within the river catchments. In the upper reaches of the Afon Clywedog this is collected by the Clywedog Reservoir, whose function is to balance water supply to the River Severn and regulate flow during the summer months. The alluvial and glaciofluvial sand and gravel of the Severn (Afon Hafren) are the principal aquifer of the district, from which groundwater is currently abstracted by boreholes at Llandinam [SO 0212 8939]. It was previously thought that the Lower Palaeozoic rocks of mid Wales were not a significant aquifer, but studies have shown that modest amounts of groundwater can be abstracted from fractured and weathered rocks in the near-surface zone as well as from the permeable superficial deposits (Robins et al., 2000[6]). Outside the main settlements, many dwellings and farms rely on private supply from boreholes and springs, and in the extreme north-east of the district a mineral spring (chalybeate) has been recorded at Black Well [SO 0880 9403].

**Potential geological hazards**

Low-lying parts of the district may be prone to flooding during periods of high river flow. At particular risk are certain reaches of the Severn valley in the east of the district and parts of the Wye valley near Llangurig. An indication of those areas that are prone to flooding is given by the extent of the alluvial floodplain deposits; however, flooding may also affect the lowermost river terraces and some alluvial fans. Areas lying outside the mapped limits of the alluvial deposits may also be at risk during anomalously large floods or when flooding is caused by blocked drains and culverts. Maps of those areas regarded as at risk of flooding are maintained by the Environment Agency.

Migration of toxic leachate from underground workings of metalliferous mines, or from spoil associated with mining, presents a significant pollution potential, leading to contamination of local surface or groundwater resources. Poorly planned remediation or exploitation of mine waste may release soluble or atmospheric contaminants to the surrounding area and watercourses. Moreover, alluvial deposits in proximity to mine sites may contain concentrations of ore from washings, dating back to the main period of mineral exploitation in the 19th century. The risk and consequences of disturbing these contaminated layers should also be considered when undertaking remedial work, or planning excavations for gravel extraction or construction. Contamination of groundwater by leachate may also occur from sources such as poorly engineered landfill sites, agricultural waste and active or former industrial sites including sewage works, gravel pits or quarries.
**Natural gas** emissions are a hazard associated with the accumulation of methane or radon. Both are capable of migrating through permeable strata and accumulating in poorly ventilated spaces such as basements, foundations or excavations where they may present a health risk. **Methane**, which is both an asphyxiant and explosive in high concentrations, is likely to be generated by the decomposition of organic material in landfill sites and unconsolidated organic-rich deposits such as peat. Methane emissions are not thought to pose a significant hazard; currently, Bryn Posteg [SN 972 822] south-east of Llanidloes is the only large operational landfill site within the district, and this is monitored by the Local Authority and Environment Agency. **Radon** is a naturally occurring ionising gas produced by the radioactive decay of uranium-bearing minerals. Although these are present in small quantities in all natural rocks and soils, they occur in higher concentrations in certain igneous rocks and black (anoxic) mudstones. Radon is a carcinogen, but does not normally present a hazard as it is normally dispersed within the atmosphere. However, high-level accumulations of radon are known to be associated with an elevated risk of cancers of the respiratory tract. Therefore, in areas at risk of radon accumulation, protective measures for new buildings (homes, workplaces etc) and remediation of existing buildings should be carried out. Advice about radon and its associated health risks may be obtained from the National Radiological Protection Board, Chilton, Didcot, Oxfordshire OX11 0RQ; further advice about radon levels within mid Wales is provided by Miles et al., (2007). **Slope instability** is typically revealed by the presence of landslip. About 78 landslips were identified during the present survey, most of which were located on drift deposits, particularly till. A number of landslips sited on steep valley slopes mapped as bedrock are shallow structures in undifferentiated head deposits; however, one of the larger slips, near Pontdolgoch [SO 0061 9388], appears to be located on steeply dipping bedrock. The principal influences for landslip within the district are a reduction in strength of the material, usually through high fluid pressures caused by an excess of water, and oversteepening of the slope commonly by erosion at the toe of the slip. Most of the landslips are located in rural areas although pressures on development for housing or infrastructure increase the possibility that building or engineering work will encounter them or create conditions under which instability may occur. The most effective strategy for dealing with landslip relies on the recognition of these problem areas in advance so that suitable remedial or preventative measures can be employed.

**Subsidence** due to the collapse of **shafts, adits** and **underground workings** is a feature of most mining areas. The Llanidloes district contains many underground workings and surface entries, mainly concentrated along the mineral veins. Although the sites of many shafts are known there may be other unrecorded mine entrances. This is particularly the case with trial shafts which did not work any quantity of ore. Many mine entries are recognisable by the spoil generated during their excavation, whereas others may have been obscured by mine waste. Careful site investigation, including a review of historical records, is necessary before any development takes place on previously mined areas.

### Engineering ground conditions

Knowledge of ground conditions is a primary consideration in identifying land suitable for development, and underpins cost-effective design. Engineering ground conditions vary, depending on the physical and chemical properties of the local materials, the topography of the area, its hydrogeology (i.e. the behaviour of groundwater and surface water), and the nature of past and present human activity. The most significant development problems likely to be encountered in the district are due to the variability of the natural superficial deposits, weathering of the solid rocks and landslips. These can be effectively dealt with by first obtaining adequate information, including properly focussed site investigation to confirm the properties of individual sites.

Geotechnical details of the strength of materials within the district are sparse. Bedrock generally
has high bearing capacities except in the weathered zone. The pyritic mudstones that are common in
the Cwmere Formation, but occur also at intervals throughout the succession, may heave on
weathering, and react to form sulphates that can chemically attack concrete. Glaciolacustrine
deposits and peat have low bearing capacities that can give rise to moderate settlement. Till and
hummocky glacial deposits generally have moderate bearing capacities but are highly variable by
nature. Head deposits, alluvial fans and alluvium all have low to moderate bearing capacities.
Glaciofluvial and river terrace deposits embrace a variety of foundation conditions, but generally
have high bearing capacities. Artificial (made and landscaped) ground may be highly variable and
can include contaminated land such as mine waste that would require remediation. It is important to
note that the distribution of superficial deposits is complex, both in a vertical and lateral sense, and
the geological map only depicts those at the surface where a thickness of more than a metre can be
reasonably supposed; thus, deposits with moderate bearing capacities may conceal materials with
low capacities that could pose problems during construction.

**Geological conservation**

The geological and mining heritage of the district forms a resource for tourism, education and
scientific research, and is also a key issue in planning and development. Geological localities
considered to be of national importance are protected as Sites of Special Scientific Interest (SSSIs).
These are statutory designated conservation sites which have some protection under the Wildlife
and Countryside Act (1981). Non-statutory conservation sites are designated as Regionally
Important Geological Sites (RIGS), and listing of these is currently underway. Further information on
the on the extent and designation of RIGS and SSSIs can be obtained from the Countryside Council
for Wales, Plas Penrhos, Penrhos Road, Bangor, Gwynedd LL57 2LQ.

**References**

1. ↑ ሩ ሮ ር ር ሬ ራ Jones, O T. 1922. Lead and zinc: the mining district of north Cardiganshire and west
   Mineral Resources. No. 20.
   Sciences.)
3. ↑ ሬ ራ ሮ ሬ ቮ James, D M D. 2006. Lode geometry in the Plynlimon and Van Domes, Central Wales, UK:
   the relative importance of strike swing and relay linkage. British Mining, Vol. 80, 60–87.
4. ↑ ሬ ሮ ራ ሬ ር ሬ ራ Hughes, W J. 1959. The non-ferrous mining possibilities of Central Wales. 277–294 in
   The future of non-ferrous mining in Great Britain and Ireland. (London: Institute of Mining and
   Metallurgy.)
5. ↑ ሬ Fletcher, C J N, Swainbank, I G, and Colman, T B. 1993. Metallogenic evolution in Wales:
   77–82.
   Palaeozoic bedrock: the Afon Teifi valley in west Wales. 123–131 in Groundwater in the Celtic
   regions: studies in hard rock and Quaternary hydrogeology. Robins, N S, and Misstear, B D R
   Indicative atlas of radon in England and Wales. (Didcot, Oxon: British Geological
   Survey/Health Protection Agency.)