

## Information Sheet 11: The geological landscape of Meldon

### Introduction and methodology

Surface processes, such as erosion and deposition by water and ice, acting on geological bed rock over hundreds of thousands of years have created the landscape that we see today. The bed-rock however, still exerts a fundamental influence, controlling the presence of hills and valleys, affecting drainage patterns, vegetational cover and hence landuse potential including agriculture – it ultimately, therefore, determines the position of human settlements. In Wales, this fundamental relationship between landscape and culture has been assessed through the Countryside Council for Wales's multidisciplinary *LANDMAP* system (Landscape Assessment and Decision Making Process). The system records information about the geological, ecological, visual, historic and cultural influences on the landscape, through the identification of discrete *Aspect Areas* with a unifying character for each thematic study (Countryside Council for Wales 2001, 2003; [www.ccw.gov.uk](http://www.ccw.gov.uk)).

This methodology has been very successful in characterising the geological and geomorphological influences in the Welsh landscape but can equally well be applied to the landscape of south-west England – for instance with the inclusion of additional landscape categories or features characteristic of unglaciated uplands and granitic tors. Specifically, the *Geological Landscapes* theme within *LANDMAP* describes the geological and geomorphological – or *physical* - character and evolution of the landscape. Character areas (= '*Aspect Areas*') for *Geological Landscapes* are recognised and described following an assessment of the influence of the *solid* bedrock geology on topography, characteristics of the surface of the landscape such as the presence of rock outcrops or bedrock-related soil characteristics and surface landforms developed within relatively recent surface or *drift* deposits. The methodology consequently emphasises those elements of the original bedrock geology which have had the strongest influence on landscape generation, following later erosion or deposition (i.e. a hard sandstone band producing a distinct ridge or a soft, shaly bedrock unit eroded to form a wide vale, can be mapped and described as distinct landscape character areas).

As well as providing a descriptive characterisation of the geological and geomorphological characters of an area, the *LANDMAP* methodology also allows for the provision of landscape scale management advice and assessments such current condition and a valuation. The latter information is not included here, however, but can be found in the Geodiversity Audit of Okehampton Hamlets Parish (Page 2006).

**Mapping the geological landscape of Meldon:** To assess the geologically influenced landscape features of an area using the *Geological Landscapes* methodology, an initial geological map compilation is used to assess the expression of the area's geological history in its landscape. For the Meldon area, as well as the national Geological Survey Map (IGS, 1969), several other published maps are also available, most importantly that in Dearman and Butcher (1959). Crucially, however, the mapped geology of both these maps requires reinterpretation to conform with the tectonic and stratigraphical model of Selwood and Thomas (1984).

A composite base map was produced at 1:10,000 using Ordnance Survey raster maps overprinted with a 5 m contour set (produced by Devon County Council under licence). The study area was then examined using adjacent 1:10,000 aerial photographs from the 1999-2000 *Getmapping* survey (Devon County Council archive), to assess the landscape expression of the mapped geological units. The overlap between adjacent photographs taken during an aerial traverse allows a 3-dimensional view of the landscape to be examined when using a mirror stereoscope, the inherent vertical exaggeration aiding the resolution of the more subtle landscape features, especially changes in slope angle.

Where the geological map boundaries of significant geological units clearly coincide with topographic features such as valleys or sudden changes in the steepness of hill slopes, landscape units can be readily distinguishable and boundaries plotted on the survey map. In some cases, however, the changes in the landscape do not precisely coincide with the geological boundary but are clearly related to the influence of the geological change – for instance hard sandstones on top of softer mudrocks can form a distinct ridge or escarpment but the major landscape change which is mapped is the base of the escarpment below the ridge (potentially *within* the mudrock unit, but nevertheless still a direct consequence of the sandstone outcrop).

In this way a map is produced which identifies the geological influences *visible* in the wider landscape, but crucially it is not a purely geological map as is available from the British Geological Survey but an integrated geological and geomorphological map, expressing the *evolution* of the contemporary landscape.

**Characterising the geological landscape of Meldon:** Once the initial characterisation of the Landscape Units has been carried out, the units can be described and classified according to the LANDMAP method. The most important elements of this assessment are:

*General Landscape character and landforms:* The general character of the landscape is classified according to a hierarchy of four levels, from a very broad Level 1 - for instance 'lowland' or 'upland' - to a site-specific Level 4, for instance recognising features such as disused quarries or springs. Landscape Units, however, are recognised at Level 3 in this scheme which recognises a '*Typifying terrain or topography*', such as an escarpment or an active lowland river system.

*Description of Landscape Unit:* A full description of the geological and topographical character of each landscape unit recognised is essential, including a general overall description, plus more detailed listings of key features such as the names and ages of the geological units present, significant geomorphological features, and the presence of mineral workings or geological conservation sites.

## **The geological landscape of the Meldon area:**

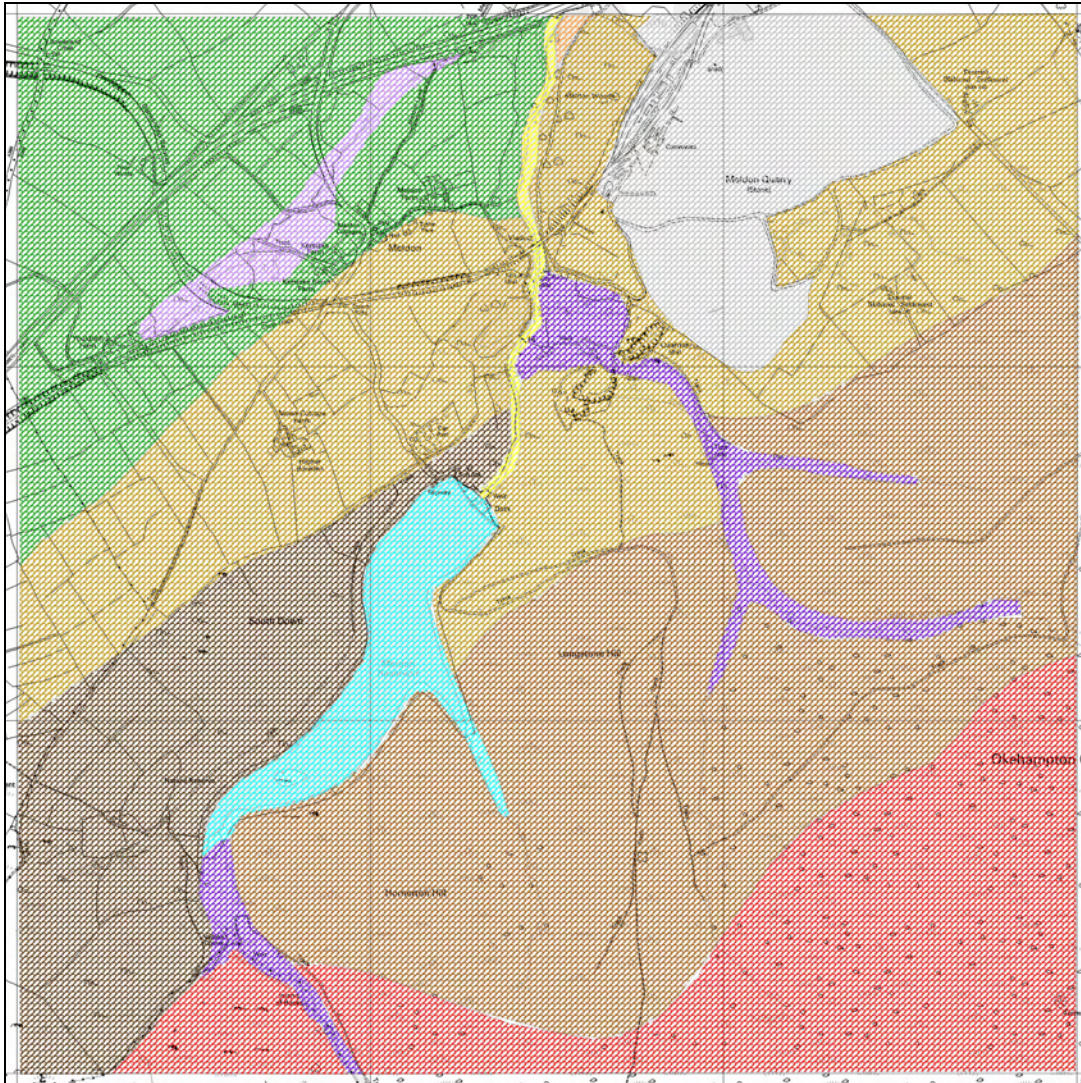
The general results of this assessment for the Meldon area are tabulated below and shown on the included map. For further detail on all aspects of the assessment of each character area see Page (2006), from which the numbering system is taken:

Landscape Unit	Level 3 Classification / [Level 4 features]	General description	Localities / geo-conservation sites
<b>OnHs8 – Southcott – Hook Hills</b>	Lowland Plateau [hill top, slope, valley slope, stream, disused quarry, marsh, road/railway cutting]	Section of regionally significant dissected plateau developed on Upper Carboniferous, Crackington Formation shales and sandstones (autochthon/parautochthon). Ridges within the outcrop are frequently controlled by sandstone-rich units within the formation. Valley/hillsides typically rounded to plateau level. Periglacial head deposits widespread. Extreme, south-westernmost corner of area crosses the boundary of the Dartmoor metamorphic aureole.	CF1
<b>OnHs18 – West Okement River</b>	Active lowland river-floodplain systems [river channel (natural), floodplain]	River channel with narrow floodplain in upper part, which has a more upland character, with boulders in channel and bedrock exposures (including Lower Culm Group (Greystone Nappe) and Crackington Formation (autochthon/parautochthon)). Passes through narrow gorge-like feature cut through Carboniferous rocks of metamorphic aureole into broad Estrayer Park basin beyond (OnHs17). Floodplain remains narrow until it suddenly broadens to fill the narrow steep sided valley near Okehampton Castle.	LC2, LC12, CF5.
<b>OnHs19 – Meldon Quarry</b>	Mineral Workings [cliff/quarry face (artificial), mineral waste tips, pond (artificial), mine adit/shaft]	Large working quarry complex showing superlative exposures through the contact metamorphosed Lower Culm Group (Lower Carboniferous, Greystone Nappe), including the Meldon Shale and Quartzite Formation and the 'Firebeacon Chert Formation'. Also includes lower mylonitic unit (= 'Meldon slate-with-lenticles'). Large dolerite bodies also present. Quarry is a Site of Special Scientific Interest for its structural geological features, but also shows metamorphic mineralogical features of at least regional importance.	LC3; Meldon Quarry SSSI.
<b>OnHs23 – Red-a-Ven Brook</b>	Upland fluvial/periglacial stream valley deposits [stream, waterfall, mine shaft/adit, mineral waste tips, terrace deposits, boulders]	Section of stream/river valley developed within metamorphic aureole of Dartmoor granite. Steep sided upper part includes broad, level, ?alluvial fill developed where Red-a-Ven Brook crosses the Bealsmill Formation outcrop (Upper Carboniferous, Blackdown Nappe). Downstream, course steepens dramatically and associated terrace/alluvial features narrows as the Brook crosses the Lower Culm Group (Greystone Nappe) outcrop. Bedrock well exposed in latter area, with waterfalls. Junction with West Okement river marked by boulder rich fan. Includes waste tips and site of shafts of Meldon/Red-a-Ven Mine (nationally important for mineralogical studies and included within the Meldon Aplite Quarries Site of Special Scientific Interest).	LC4, LC2, BF4, Q14; Meldon Aplite Quarries SSSI (part).
<b>OnHs24 – Okehampton Park Ridge</b>	Upland escarpment [hill slope, hill top, valley slope, disused quarry, natural rock outcrops]	Prominent ridge dominated by contact metamorphosed Lower Culm Group (Lower Carboniferous, Greystone Nappe), forming the steep, middle, NNW-facing escarpment of the Dartmoor massif. Lower part of escarpment includes Crackington Formation (autochthon / parautochthon). Top of escarpment includes level platform, which is especially well developed in the area around Okehampton Camp (OnHs 22). Disused quarries frequent. Western part of ridge includes Meldon Quarry (OnHs 19) and Area also includes eastern aplite quarry beside Red-a-Ven Brook, with unique mineralogy (part of Meldon Aplite Quarries Site of Special Scientific Interest). Eastern extent of landscape area cut by very steep sided East Okement Valley (including East Okement River RIGS).	LC8, LC21, LC22, A1; Meldon Aplite Quarries SSSI (part).
<b>OnHs25 – Meldon</b>	Artificial water bodies and channels	Reservoir and dam in steep sided V-shaped valley of West Okement River. Includes small area of stream/periglacial fill in similarly steep sided tributary valley between Homerton and	LC2, BF5, M2, G8.

<b>Reservoir</b>	[Reservoir, river terrace, island (artificial), natural rock exposure, boulder]	Longstone hills. Small island towards southern part of reservoir likely to be part of outcrop of granitic dyke. Reservoir covers site of Forest Mine, formerly worked for copper, and associated waste tips. Lowered water levels reveal boulder-rich slopes on valley sides.	
<b>OnHs27 – Meldon Aplite Quarries (West)</b>	Upland escarpment [hill slope, hill top, valley slope, disused quarry, natural rock outcrop]	Small segment of ridge of contact metamorphosed Lower Culm Group (Lower Carboniferous, Greystone Nappe), which includes Okehampton Park (OnHs24) and South Down (OnHs36). Forms steep-sided promontory of Longstone Hill between West Okement and Red-a-Ven valleys and includes the western of the two famous Meldon Aplite quarries, with their unique pegmatitic mineralogy (part of Meldon Aplite Quarries Site of Special Scientific Interest).	LC5, A2; Meldon Aplite Quarries SSSI (part).
<b>OnHs30 – Black Down</b>	Undulating upland terrain [hill top, hill slope, disused quarry, stream, spring]	Undulating belt of rounded hills rising above platform of Lower Culm Group to the NNW and below the steep slopes of the granitic massif of High Willhays to the SSE. Dominated by contact metamorphosed Bealsmill Formation (Upper Carboniferous, Blackdown Nappe), immediately adjacent to the granite contact and locally may include granite clitter transported downslope from the latter.	LC22.
<b>OnHs31 – Kerslake Streams</b>	Fluvial/periglacial stream valley deposits [stream, meander, marsh]	Broad marshy area with small streams/springs between Youlditch and Kerslake farms which feeds a stream tributary of the West Okement valley, flowing into the broad alluvial basin of OnHs17 (Estrayer Park Terraces). Area probably underlain by alluvium and head. Valley now separated from OnHs17 by A30 dual carriageway works and modified in upper part by railway embankment.	
<b>OnHs32 – Upper West Okement River</b>	Upland fluvial/periglacial stream valley deposits [stream, river terrace, weir, floodplain]	Narrow levelled base of steep sided upland river, including terrace-like features and, locally, narrow floodplain with alluvium. Distinctive, straight NNW-SSE course tectonically controlled by Pewsey Fault.	G7, Q9.
<b>OnHs35 – High Willhays Massif</b>	Tor-clitter dominated hilly terrain [tor, clitter slope, stream, hill slope, hill top, mineral workings]	High granitic massif, rising very steeply as an escarpment above Carboniferous rocks of the metamorphic aureole to the NNW. Comprises several N-S platforms or ridges, in increasing altitude from east to west (Rough Tor platform, West Mill Tor platform and High Willhays-YesTor ridge respectively). Platforms and ridge have extensive peat deposits. NNW edge of massif includes 3 distinctive tors (Yes, West Mill, Rough) with well developed clitter stripes and garlands. High Willhays is the highest Tor on Dartmoor.	G1, G2, G6, 15.
<b>OnHs36 – South Down Ridge</b>	Upland ridge [hill slope, hill top, natural rock outcrops, disused quarry, valley slope, stream, mine shaft/adit]	Distinctive ridge dominated by volcanic units within the Lower Culm Group (Lower Carboniferous, Greystone Nappe), contiguous with Sourton Tors to the SW, and lying within the metamorphic aureole of the Dartmoor granite. Includes area of Bealsmill Formation (Upper Carboniferous, Blackdown Nappe) on platform to south with slopes rising up to granite contact beyond.	LC10, M3.
<b>OnHs37 – Meldon Slopes</b>	Upland escarpment [hill slope, disused quarry, road/railway cutting]	NW face of escarpment of granite massif, underlain by Lower Culm Group (Lower Carboniferous, Greystone Nappe) and within the metamorphic aureole of the Dartmoor granite. Dominated by Meldon Chert Formation, and includes disused limestone quarry. Cut on SE and E by steep sided West Okement valley.	LC1, LC7, LC13.
<b>OnHs41- Wigney Terrace</b>	Ancient river-flood plain system [river terrace]	Small area of 1 <sup>st</sup> Terrace feature on south side of West Okement river (Quaternary, including pre-Devensian?).	

Summary of the geological and geomorphological Landscape Units recognised in the Meldon area.

## Topographical map



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Topographical map of the Meldon area, showing the expression of the bedrock geology in the modern landscape. 'Geological Landscapes' Level 3 classification as follows: Active lowland river-flood plain system (yellow), Ancient lowland river-flood plain system (orange), Fluvial/periglacial stream valley deposits (mauve), Lowland plateau (green), Undulating upland terrain (brown), Upland escarpment (pale brown), Upland ridge (dark brown), Upland fluvial/periglacial stream valley deposits (violet), Tor-clitter slope dominated hilly terrain (red), Mineral workings (grey), Artificial water bodies and channels (pale blue).

Level 1 - General landscape character	Level 2 - Large-scale terrain or topography	Level 3 - Medium-scale typifying terrain or topography (Land Unit)
Lowland hills and valleys	Lowland river and drainage systems	Active lowland river-flood plain system: OnHs18 (West Okement River). Ancient lowland river-flood plain system: OnHs41 (Wigney Terrace). Fluvial/periglacial stream valley deposits: OnHs31 (Kerslake Streams).
	Dissected lowland plateau	Lowland plateau: OnHs8 (Southcott-Hook Hills).
Upland and upland valley	Undulating upland terrain and dissected plateau	Undulating upland terrain: OnHs30 (Black Down).
		Upland escarpment: OnHs24 (Okehampton Park Ridge); OnHs27 (Meldon Aplite Quarries (West)); OnHs37 (Meldon Slopes). Upland ridge: OnHs36 (South Down Ridge).
	Upland river and stream	Upland fluvial/periglacial stream valley deposits: OnHs23 (Red-a-Ven Brook); OnHs32 (Upper West Okement River).
Constructed Landscapes	Constructed Landscapes	Tor-clitter slope dominated hilly terrain: OnHs35 (High Willhays Massif). Mineral workings: OnHs19 (Meldon Quarry).
		Artificial water bodies and channels: OnHs25 (Meldon Reservoir).

Level 3 classification of the Geological Landscapes of the Meldon area.

In summary, the Meldon area shows three distinctive landscape features controlled by its bedrock geology:

**Culm Plateau:** To the north of Meldon, the landscape is dominated by a plateau developed across the outcrop of the Upper Carboniferous shales and thin sandstones of the Crackington Formation (the 'Culm'). The plateau is dissected by narrow stream valleys, often with flattened bases floored by periglacial head and minor terrace deposits - the latter, in part at least, periglacially modified – into which the modern stream has cut, locally developing a narrow active floodplain.

Where larger river systems are developed, in particular the Okement rivers, a clear 1<sup>st</sup> Terrace may be developed with possible traces of higher terraces, again dissected by the contemporary river system and with only a local development of a clear active floodplain. Such terraces are well developed where the West and East Okement rivers widen rapidly after leaving their distinctive deep, steep valleys within the metamorphic aureole and then converge in Okehampton.



The *Culm Plateau* of mid Devon, with Okehampton in the middle distance, viewed from the road to Okehampton Camp as it rises up the prominent *Lower Culm Group Escarpment* (see below) of the Okehampton Park-Meldon area (Photo: Kevin Page 2005)

**Lower Culm Group Escarpment:** Thermal metamorphism associated with the intrusion of the Dartmoor granite has so hardened the belt of varied Lower and Upper Carboniferous rocks flanking the north-west edge of the Moor that they form a steep sided ridge or 'shelf' between the granite upland to the south and the lowland dissected plateau of the 'Culm' to the north. This belt of ridges and platforms is dissected by deep, steep sided valleys occupied by fast flowing upland-style sections of the Okement rivers which rapidly open-up and widen when the softer rocks beyond the metamorphic aureole are reached.



The *Lower Culm Group Escarpment* rising above Okehampton, with the *Dartmoor Granite Massif* behind; viewed from the Culm Plateau to the north (Photo: Kevin Page 2005).



The *Lower Culm Group Escarpment* forming a broad undulating platform, with the *Dartmoor Granite Massif* (see below) behind; viewed the road to the Meldon Dam carpark (Photo: Kevin Page 2005).

**Dartmoor Granite Massif:** South of Meldon is the high, granitic upland of Dartmoor, with its distinctive rocky tors and extensive developments of clitter, especially around the former. Blanket bog is widely developed on the ridges and gentler slopes of this area. Streams often initiate in broad level areas on distinct platforms within the massif and locally have developments of terrace deposits – probably periglacially modified - which have been worked for alluvial tin. Typically however, where their course steepens as the edge of the massif is crossed, such deposits are absent. Only in the west, is a well-developed, steep sided river valley present, where the West Okement River has cut down along the line of the Pewsey Fault.



Yes Tor and the high plateau of the Dartmoor Granite Massif (Photo: Kevin Page 2005)

## References

- BRITISH GEOLOGICAL SURVEY 1994. Tavistock, Sheet 337 (Solid and Drift Edition). *England and Wales, 1:50,000 Provisional Series*, NERC.
- BRITISH GEOLOGICAL SURVEY 1995. Dartmoor Forest, Sheet 338 (Solid and Drift Edition). *England and Wales, 1:50,000 Provisional Series*, NERC.
- COUNTRYSIDE COUNCIL FOR WALES 2001. The LANDMAP Information System (handbook). Revised and updated June 2003.
- DEARMAN, W.R. 1959. The structure of the Culm Measures at Meldon, near Okehampton, North Devon. *Quarterly Journal of the Geological Society, London* **115**: 65-106.
- DEARMAN, W.R. and BUTCHER, N.E. 1959. The geology of the Devonian and Carboniferous rocks of the North-west border of the Dartmoor granite, Devonshire. *Proceedings of the Geologists' Association* **10**: 51-92.
- EDMONDS, E.A., WRIGHT, J.E., BEER, K.E., HAWKES, J.R., WILLIAMS, M., FRESHNEY, E.C. and FENNING, P.J. 1968. Geology of the Country around Okehampton. *Memoir of the Geological Survey of Great Britain (England and Wales)*, HMSO, 256pp.
- GOUDIE, S. 1981. *Geomorphological Techniques*, George Allen and Unwin.
- INSTITUTE OF GEOLOGICAL SCIENCES 1969. Okehampton: Sheet 324 (Solid and Drift Edition), One-Inch Series, Institute of Geological Sciences.
- PAGE, K.N., WIMBLETON, W.A. and BULLEN, J. (in press). The LANDMAP Information System (System Wybodaeth LANDMAP); Wales, UK – A new multidisciplinary approach to evaluating and managing 'Geological Landscapes'. Submitted for inclusion in the Proceedings of the International Symposium on the Conservation of the Geological Heritage, Braga, Portugal, September 2005.
- SELWOOD, E.B. and THOMAS, J.M. 1884. A reinterpretation of the Meldon Anticline in the Belstone area. *Proceedings of the Ussher Society* **6**: 75-81.

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