Dorset GA Group

Newsletter Autumn 2020

https://dorsetgeologistsassociation.org/

Contents

Welcome to the Autumn Newsletter!

It's been a challenge for everyone these past 6 months or so and I was hoping it might be possible to start DGAG activities up as planned for the rest of 2020. Sadly, that is not the case as we enter the Covidocene! We have had to cancel our usual Holiday Rocks event but hope to run a virtual one. We do have one socially-distanced field-trip in November to look forward to however! (see page 19)

Kingston Lacy House series

Readers will have enjoyed Pete Bath's series in previous issues. This material is to be updated and re-set under Secular Buildings on the Dorset Building Stone website:
https://dorsetbuildingstone.weebly.com/

All images, both in the Newsletter and website, are included **with the kind permission of the National Trust a**nd a prototype printed DBS Tour Guide to Kingston Lacy Stone is in progress. *Kelvin*

Visit to Godrevy Head, Cornwall 2019. NGR: SW 5827 4223

One of the places I particularly like to visit when we have our annual holiday in west Cornwall is Godrevy Head. It is a designated S.S.S.I., cared for by the National Trust and situated on the north coast of the eastern side of St Ives Bay. Besides being an interesting geological site, it is also a lovely place to visit for the day with seals to watch and beaches to lounge on. The South West Coast Path runs around the cliff edge so the area can be reached from St Ives or Portreath.

An uninhabited island situated 300 metres offshore is the site of Godrevy lighthouse, operated by Trinity House (1). Landings may only be made on the island with the permission of Trinity House. Seaward of Godrevy Island is a submerged reef known as The Stones. It has been the site of many shipwrecks over the years but it was not until the disastrous loss of the SS *Nile* on 30th November 1854, with the loss of all aboard, that Trinity House was pressured to construct a lighthouse on the island. It was built in 1859 and was converted to fully automatic operation in 1939. Godrevy Head is considered to be one of the most important Pleistocene (2,588,000 to 11,700 years ago) sites in the south-west of England. The main geological interest is on the cliffs and beaches on the western side of Godrevy Head. The cliffs at the northern end of the beach are metamorphosed Devonian turbidites of the Mylor Slate Formation overlain with Quaternary ice-age deposits and sand dunes (2).

The turbidites were deformed during the Early Permian and are intensely folded (3). They form multiple sequences of graded bedding (Bouma sequences) with the coarser particles settling first, giving the rocks a banded appearance. In places the rocks are cross cut by quartz veins deposited in cracks by hydrothermal fluids when the Cornubian granite batholith was emplaced in the late Permian (4).


3


4

Above the turbidites are raised beach deposits formed during the Pleistocene interglacials 2,588,000 to 11,700 years ago when sea levels were higher. The beach deposit in the photograph is dated to about 190,000 years ago (5).


5


6


7

It consists of carbonate-cemented, fine-grained sand layers and layers of rounded pebbles, some quite large. The calcium carbonate cement was derived from disintegrated sea shells.

The sequence on the beach boulder shows some sorting of particles with a layer of fine sand at the base and a layer of large pebbles further up the sequence (6, 7). In the cliffs there are levels at the base of the sequence where the raised beach deposits have been cemented by iron oxide (brown) and manganese oxide (black) by water seepage (8). The raised beach is overlain by head deposits formed during periods of periglaciation when the area was subjected to permafrost (9). Loess, a mixture of silty clay deposits and angular rock debris, filled small embayments. They were subsequently overlain by dune deposits about 10,000 years ago (see photo 2).


8

Pat Snelgrove

Soils - A Very Short Introduction

Sometimes there is a moment when something that you have always taken for granted makes you think more closely about it. Such a moment occurred during a visit to the Lilstock area in North Somerset during a field trip as part of a Bristol University geology course (given by Dr Peter Hardy) when the English Universities were encouraged to offer outreach courses.

We had walked along the beach at low tide and studied the very solid rocks on the beach and the cliff. To return to the cars we had to climb the cliff and walk back across the cliff-top coastal path. The cliff and rocks on the beach were very solidly lithified, but the field on the top of the cliff which must have been just above this rock was perfect soil and was under agriculture. Because of the slope of the land, the soil must have been derived from local rocks such as we had seen below because its soils were not blown-in loess and could not have been washed in or transported downslope by gravity from elsewhere. Below is a satellite view of the beach and fields and the contrast is very clear.

The soil clearly predated agriculture, so what would it have looked like and how would it have formed? Some soils do not support vegetation, but the composition of a soil that supports good plant growth is typically about 45% mineral matter and 5% organic matter (decayed plant material, bacteria, fungi etc), about 25% water and 25% air (which forms air spaces).

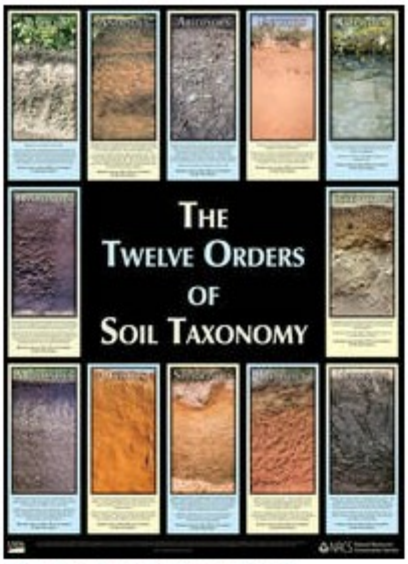
The formation of soils is not a simple subject and depends on the parent rock material and how it weathers, the length of time it has been allowed to develop, the climate (with temperature and precipitation of great importance), the presence of plants and animals and the slope of the land. The formation of soils is usually a very slow process although soils can develop more quickly (under 100 years) in certain volcanic deposits.

A soil with vegetation cover forms a layered structure. The topsoil comprises organic matter (O horizon) together with organic matter mixed with mineral matter (A horizon), below this is often a layer leached by percolating groundwater (E horizon) and this is deficient in minerals because the water that passes through the A horizon becomes slightly acidic. The E horizon is often lighter in colour when seen in a fresh section because the iron oxides and other minerals have been moved to the layer below. Below these layers is the subsoil (B horizon) which is made up of clay minerals, calcite, iron oxides etc. Below the subsoil fragments of mechanically weathered pieces of the bedrock are found (C horizon) and below this is the bedrock. The image above is from: https://en.wikibooks.org/wiki/Historical_Geology/Soils_and_paleosols and shows very clearly the leached area. Horizon O is the grass and vegetation, Horizon A is the dark layer below it. The white layer is the leached E horizon and below this is the B horizon (the subsoil). The C horizon is below the B horizon and contains fragments of the bedrock and it could be that some of this which contains rocky material is also shown. Below the C horizon is the bedrock and this is not shown in this photo.

So what causes the weathering of the bedrock? There are several ways in which this can be broken up and the way in which this is done is very much dependent on the prevailing climatic conditions, for example freeze / thawing of water can fragment the rock, tree roots can break it open, but also the percolating water can cause chemical weathering. It is possible that all of these mechanisms contributed to the soil at Lilstock and that a contribution to it had come from the other rocks in the area (the BGS describes the area as Langport Member, Blue Lias and Charmouth Mudstone (undifferentiated)).

A short YouTube video (10 minutes) summarises soil formation nicely.
See: https://www.youtube.com/watch?v=mg7XSjcnZQM

Not all soils develop as they will have done at Lilstock, the type of soil depends upon the bedrock and the climate. As someone with no knowledge in this area I tried to find out more and I found the United States soil taxonomy the easiest to understand. Essentially there are 12 different types of soil. And they are very well described on their website.



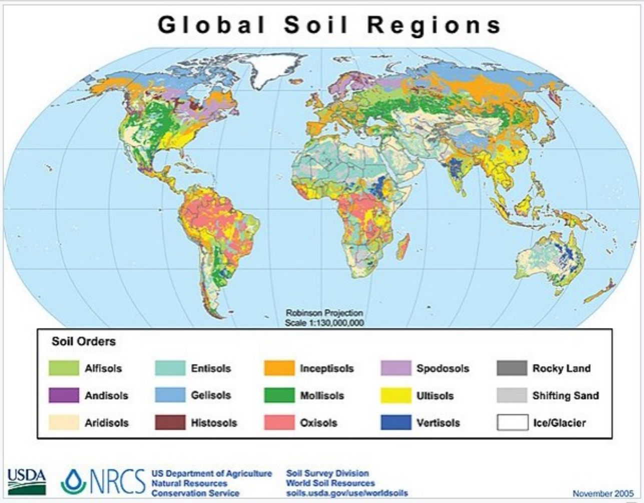
The Twelve Orders of Soil Taxonomy

The image (left) is from the Food and Agriculture Organisation of the United Nations Soils Portal at:

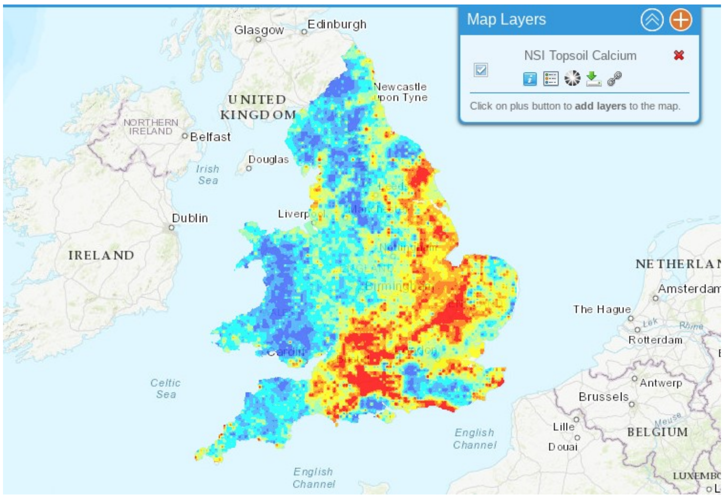
http://www.fao.org/soils-portal/soil-survey/soil-classification/usda-soil-taxonomy/en/ which provides considerable information on the world's soils.

The global distribution of the soil types is shown on the map below (the map is from: https://en.wikipedia.org/wiki/Soil_fertility)

If anyone is interested, there is considerably more information at the website of the United States Department of Agriculture at https://www.nrcs.usda.gov/wps/portal/nrcs/site/soils/home/ which includes a link to "Illustrated Guide to Soil Taxonomy, version 2" available as a .pdf download at: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/class/taxonomy/?cid=nrcs142p2_053580



Global distribution of soil types of the USDA soil taxonomy system. Mollisols, shown here in dark green, are a good (though not the only) indicator of high soil fertility. They coincide to a large extent with the world's major grain producing areas like the North American Prairie States, the Pampa and Gran Chaco of South America and the Ukraine-to-Central Asia Black Earth belt.



Clearly this is a very large and important subject. There is a considerable amount of information on the UK and a good starting point is the interactive map produced by the United Kingdom Soil Observatory and hosted by the BGS at http://mapapps2.bgs.ac.uk/ukso/home.html and an example is shown above - the concentration of Calcium in topsoil, but there is very much more to be seen with this app.

The soils of the UK can not be taken for granted:

Soils take a long time to develop and can be damaged very quickly. The **UK** is 30 to 40 years away from "the fundamental eradication of **soil fertility**" in parts of the country, the environment secretary Michael Gove has warned. "We have encouraged a type of farming which has damaged the earth," Gove told the parliamentary launch of the Sustainable **Soils** Alliance (SSA):

“Countries can withstand coups d’état, wars and conflict, even leaving the EU, but no country can withstand the loss of its soil and fertility”.

“If you have heavy machines churning the soil and impacting it, if you drench it in chemicals that improve yields but in the long term undercut the future fertility of that soil, you can increase yields year on year but ultimately you really are cutting the ground away from beneath your own feet. Farmers know that.” 24 Oct 2017. The quote is from:

https://www.theguardian.com/environment/2017/oct/24/uk-30-40-years-away-eradication-soil-fertility-warns-michael-gove#:~:text=The%20UK%20is%2030%20to,Sustainable%20Soils%20Alliance%20(SSA).

Are we really 30 or 40 years away from a disaster?

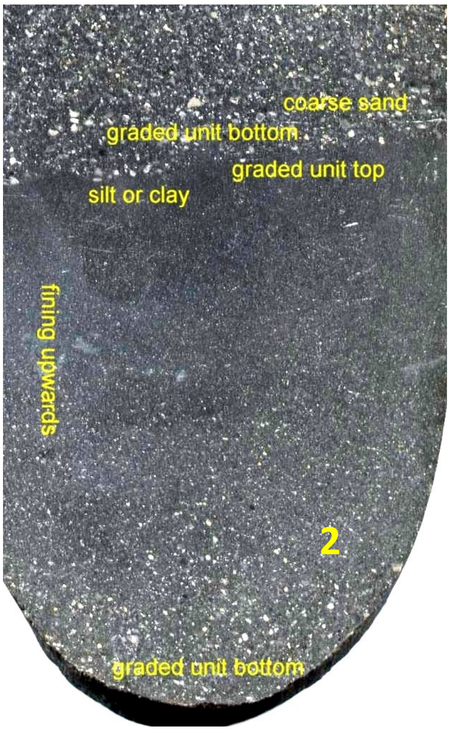
Such a short time sounds alarming. The 30 to 40 years is a figure that has been mentioned several times in different countries of the world, sometimes with 60 harvests and 100 years mentioned. The BBC More or Less program at https://www.bbc.co.uk/programmes/m000jmm3 looked into the science behind the short time and asked if it is true. They found the idea behind the number of years seems to derive from a study published in 2014 by Sheffield University that looked at allotments, council roundabouts, forests and gardens in Sheffield and that no dates were given in their report! *Leon Sparrow*

Way-up structures

Way-up structures are used to determine the original orientation of strata and in which way the beds young i.e. which is the top of the succession. This illustrates the Law of Superposition on Strata. Some of the way-up structures occur in sedimentary rocks and some are seen in volcanic lavas and ash. Determining the way up is important in strata which have been complexly folded as in the Caledonian structures of the Grampian Highlands of Scotland or Variscan structures in S.W. England.

If rocks contain fossils the way up can be determined in two ways. The fossils may enable relative dating of the rocks but not all fossils are sufficiently sensitive indicators of time but Jurassic ammonites in Dorset are clearly a good examples of zone fossils. Not all rocks contain fossils. Some fossils may also be in position of growth preserved as a life assemblage e.g. corals, brachiopods, burrowing bivalves, plant roots. However, some fossils are transported and form a death assemblage which is less useful (e.g. Ringstead Coral Bed). Some fossils, e.g. brachiopods may contain sediment inside the shell with a space above filled later by crystalline material typically calcite (geo-petal structures).

This can also show the way up. Trace fossils with tracks, trails and burrows left by organisms may also be preserved on bedding planes or with a bed. Good examples of these can be seen in the Forest Marble and Corallian in south Dorset. U-shaped burrows in the Corallian at Bowleaze Cove are a classic example (*Diplocraterion*, Photo 1). Sedimentary structures associated with the bedding planes can also be used, such as rain prints, desiccation cracks (e.g. some of the limestone beds in the Purbecks), tool marks caused by bouncing stones, etc.



Symmetrical ripple marks show way up with the cusps (ripple crest) pointing up. However, asymmetric ripples are less useful because they look the same the right way up or inverted. Sole structures produced by turbidity flows are also useful way up structures. Good examples of these can be seen in the Silurian strata in mid-Wales (Aberaeron) as in Photo 2 and in the Southern Uplands of Scotland.

Features within beds such as graded bedding and cross-bedding are useful way up structures. Again, good examples of cross-bedding can be seen in the Corallian at Bowleaze Cove and Osmington Mills (Photos 3 and 4).

Unconformities and the Law of Included Fragments can indicate the way-up of rocks. Rocks below the unconformity are normally more folded, tilted or metamorphosed. Those above the unconformity tend to be horizontal or gently tilted. A good example of this can be seen at Portishead where the Triassic breccia rests on top of dipping Devonian strata (Photo 5).

A conglomerate, breccia or quartzite arenite normally occurs *above* the unconformity with fragments of rock from below the unconformity included in the rudaceous sediment (conglomerate or breccia).

In volcanic rocks some way-up structures can also be seen. Gas bubbles or vesicles tend to be at the top of the flow and the top may also be weathered and often reddened due to the oxidation of iron rich minerals. Pipe amygdales tend to occur at the bottom of the flow and branch downwards. Pillow lavas sag down into the spaces between adjacent older pillows as seen at Strumble Head (Photo 6).

Volcanic ash (tuff) may also show graded bedding as well impact features where volcanic blocks or bombs impact on layered ash causing sag structures as seen in Photo 7 from Lipari in the Aeolian Islands, Italy, which also shows fining upwards cycles.

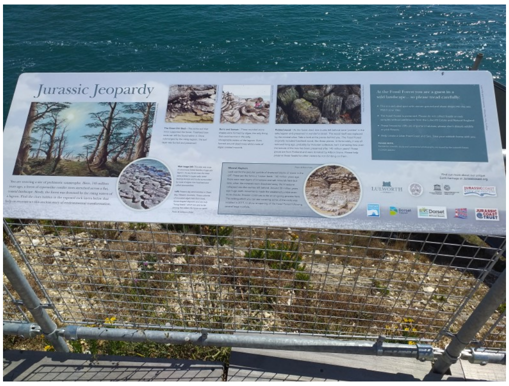
The relationship between cleavage and bedding can also be used in rocks which *have* been folded and overturned if slatey rocks are present. The bed is the right way up when the dip of the cleavage is steeper than the dip of the bedding, but if the bed is overturned the dip of the cleavage is less steep than the dip of the bedding. This is well shown in folded Devonian rocks at Gunwalloe Church Cove in Cornwall (Photo 8). *Alan Holiday*

Lulworth Fossil Forest

Mimi Spencer provides an update on the Fossil Forest renovations, from this summary of press releases.

“The 145 Ma. ‘forest’ is part of the Jurassic Coast and although no actual trees can be seen, round shapes known as ‘algal burrs’ are clearly visible; these would have surrounded the base of the tree trunks. The site was closed in 2015 when a large rockfall damaged the steps leading from the South West Coast Path down to the site. The rockfall also left a dangerous ‘overhang’ which has now been partially removed and rock-netted by geo-technical experts Vertical Technology Ltd has been installed, with the addition of a catch-fence. Local Dorset company, Aileen Shackell Landscape Design, was responsible for the design of the new access and seating area which has stunning views out to sea. Bournemouth Christchurch Poole Council donated the recycled timber decking from Bournemouth Pier. Albion Stone generously donated two large pieces of fossilised wood (Photo 1) which were transported by helicopter (Photo 2) by the Naval Air Squadron in September 2019 as part of an Exercise. These very heavy specimens are on display in the seating area near the entrance gate. Dorset Council Highways undertook the work to repair the 97 steps of concrete and oak (Photo 3), updated and replaced the railings and created a new seating area, with safety signage and an interpretation board also near the top of the steps.(Photo 4) James Weld, Lulworth Estate said: “We are delighted the Fossil Forest is accessible once again and were pleased to work closely with all parties involved, to ensure the visitor experience will be of great value, both as an educational tool and as somewhere to visit on this unique and stunning UNESCO World Heritage Site.” James Nevitt, Senior Access & Recreation Advisor said; “The MOD is committed to protecting our heritage and is always keen to engage in positive collaborative working to deliver a positive outcome.

We recognise the significance of this site and it is fantastic to see it reopened after what has been a complex project to deliver." The work was funded in the main by the Coastal Communities Fund, with additional funding from Lulworth Estate, the Defence Infrastructure Organisation (part of the MOD), the Arts Development Company, the Geological Association and Dorset Council. The Dorset Area of Outstanding Natural Beauty team led on the Fossil Forest project in partnership with Lulworth Estate, Defence Infrastructure Organisation, The Arts Development Company, Dorset Coast Forum and the Jurassic Coast Trust. As with the rest of the Ranges, the Fossil Forest is open most weekends and school holidays but always check before visiting.



https://www.gov.uk/government/publications/lulworth-firing-notice

More pictures and a full press release can be viewed here:
https://www.dorsetcoasthaveyoursay.co.uk/fossil-forest-welcome-hub1

Mimi writes: "This is the best access to the Fossil Forest ever - the hand rails go all the way and although the 97 steps (down and up) are mentioned many times they are evenly spaced. So I guess my message is ...take a walk and see for yourselves." *Mimi Spencer*

Bob Alderman (13.07.1949—10.07.2020) RIP

Bob died on the 10th July at home with me. His end of life was as he wished. Bob was born in Northampton and liked trains! In his Mum's things we found a little book he'd made when he was about 5 years old with a picture of his favourite toy...a train.

Bob moved with his family to Yeovil in 1965, left school and became an apprentice at Westlands. We met at folk club in 1969 while I was still at the High School. We married in 1971. I was already aware of Bob's passion for model railways as he took me to the original Yeovil Model Railway Club at what was the Lodge of Hendford Manor. We moved to Montacute in 1985 with our children David and Ruth.

Bob left Westlands in 1995 and took on commissions to build model railway locomotives for others. Bob loved reading and was a prolific writer. He has had numerous articles published in the model railway magazines and has written a book for railway modellers about how to make bridges and viaducts. He used to teach people to make models at an annual summer school and also demonstrated techniques at various model railway exhibitions.

He also liked steam trains and was involved in going through the archives at York Railway museum to reproduce the blue prints for an A1 steam locomotive. The Tornado locomotive is now running rail tours 20 years later. When Bob was a child the open-cast ironstone quarries were still operating in Northamptonshire. He found them fascinating. He also used to go through piles of stones and find sharks' teeth and fossils. He could not remember where but was a bit put out when his family moved to Yeovil and his fossil collection disappeared. My interest in geology sparked his, so he started to come on field trips with me. He always asked pertinent questions. We studied A level Geology with Alan Holiday in 1999. Fortunately we got the same marks although Bob's project scored higher than mine because he was so good at drawings. I relied on photos for mine but my theory was better! Bob combined his interest in model railways and geology by modelling a Portland Stone Quarry. This was sold and is now in Vancouver. Bob was a determined, witty, knowledgeable man with a great sense of humour. We knew, after he was diagnosed with MND in 2017, that there was no cure and his time was limited but he still kept his humour, determination and wit even when he lost the ability to move or speak.

Gosh I'll miss him. Thanks again to everyone for all your support.

Sheila Alderman

THE HOT ROCK SLOT

ECLOGITES

Eclogites are amongst the most spectacular and beautiful silicate rocks on account of their colourful mineralogy. They are also highly significant on account of the very high pressures required for their formation, and hence of the dramatic tectonic implications for the rock units in which they are found. It has become almost axiomatic that eclogites in orogenic belts are products of subduction. As an indication of the scientific interest in these rocks, roughly 2,600 research papers with "eclogite" or "eclogitic" in the title have been published in mainstream journals since 1970 according to the 'Web of Science' database.

Eclogites have been known about for almost 200 years, having been first described by R.J. Haüy in 1822 from a locality in the Saualpe region of the Austrian Alps, but it is only since the advent of the theory of plate tectonics in combination with experimental petrology that their significance has been appreciated.

Definition and Mineralogy:

An eclogite is a metamorphic rock consisting essentially of **omphacite** and **garnet**. Omphacite is a green clinopyroxene containing substantial amounts of **jadeite** ($NaAlSi_2O_6$) in solid solution with other components, mostly **diopside** ($CaMgSi_2O_6$); its name comes from the greek 'ωμφαξ' meaning 'unripe grape'. The garnet is typically a solid solution of **pyrope** ($Mg_3Al_2Si_3O_{12}$) with **almandine** and **grossular**, its Fe and Ca counterparts. The combination of bright green omphacite and red garnet makes for very attractive rocks (Figs. 1-3).

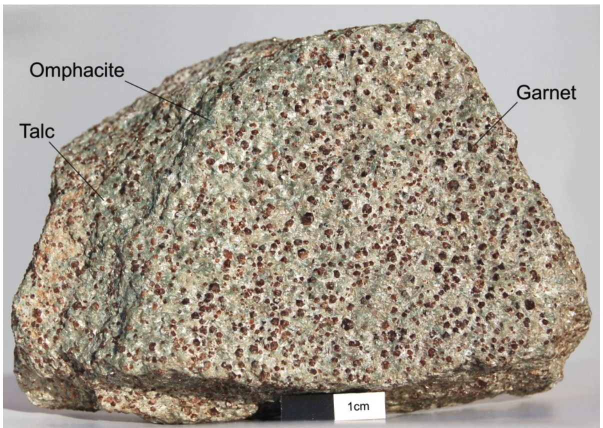


Fig.1.Hand specimen of meta-basaltic eclogite, Dorfertal, Austria. Photo: Giles Droop.

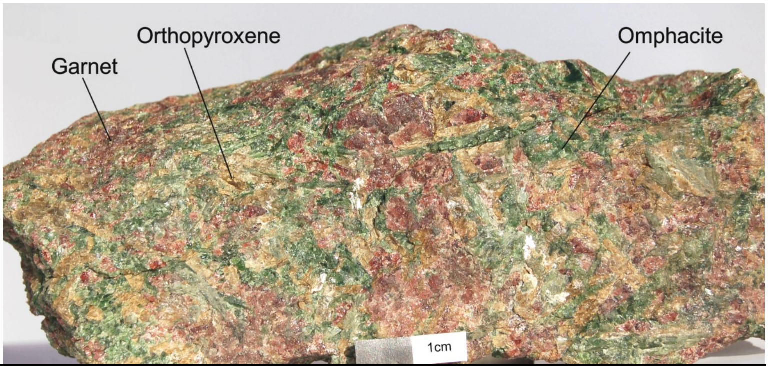


Fig.2. Hand specimen of coarse-grained orthopyroxene eclogite,Grytting, W Norway. Photo: Giles Droop.

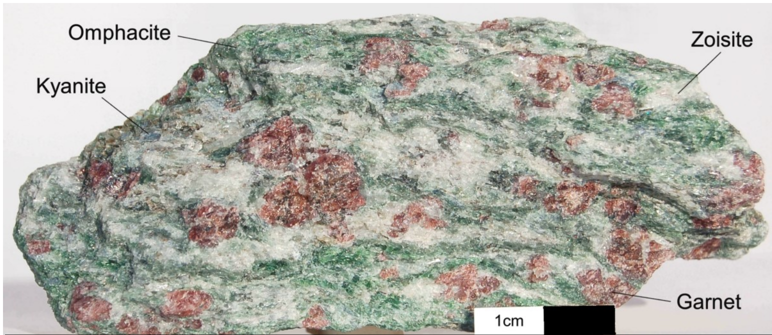


Fig.3.Hand specimen of zoisite kyanite eclogite, Verpeneset, W Norway. Photo: Giles Droop

Additional minor minerals that may be present in various combinations include kyanite (Figs. 3 & 4), orthopyroxene (Fig. 2), glaucophane (Fig. 5), talc (Fig. 1), white micas, zoisite (Fig. 3) quartz, coesite (a dense polymorph of SiO_2 – Fig. 6), epidote (Fig. 7) and carbonates. Rutile (TiO_2) is the most usual accessory mineral.

Plagioclase feldspar is totally absent, as usually is biotite, though both minerals commonly occur as products of late-stage alteration (**retrogression**) at low pressure and temperature. Hornblende is another common retrograde alteration product (Fig. 8).

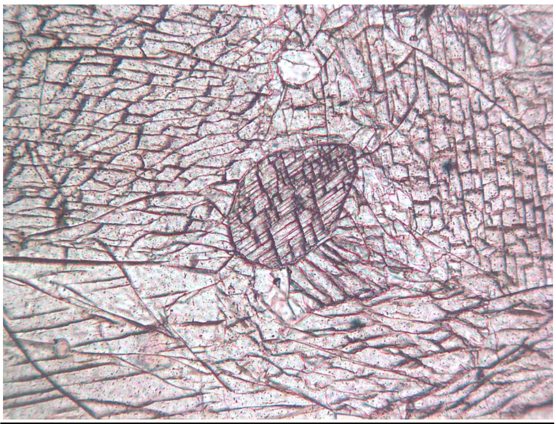


Fig.4. Photomicrograph showing kyanite crystal (centre) surrounded by omphacite in a kyanite eclogite. Note contrasting cleavage patterns. Field of view 2mm across. Photo: Giles Droop.

The bulk chemical compositions of eclogites correspond to those of basic igneous rocks (basalt or gabbro), and most eclogites have probably formed by high-pressure metamorphism of such rocks. Some eclogites provide good evidence of a basic igneous **protolith** (precursor rock) in the form of e.g. relict pillow-lava structure. But whereas basic igneous rocks have densities close to 3.0 g/cm^3, those of eclogites are in the range 3.4–3.6 g/cm^3. Converting basalt (or gabbro) to eclogite therefore corresponds to a density increase of between 13% and 20%. This densification is a function of the high pressures experienced by the rocks during their formation, which in turn reflects enormous depths of burial. At high pressure, the stable assemblage of minerals that can crystallise within a given bulk chemical composition (i.e. a particular ratio of elements) is invariably denser than that possible at low pressure.

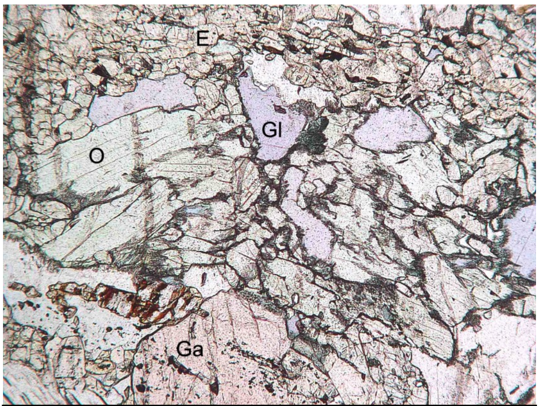


Fig.5.Photomicrograph of a glaucophane eclogite from Dorfertal, Austria. Ga: garnet; O: omphacite; Gl: glaucophane; E: epidote. Field of view 2mm across. Photo: Giles Droop.

(This is an illustration of **Le Chatelier's Principle** which states that if a system at equilibrium is subjected to a change in conditions then the system will alter in such a way as to counteract the change.) With the exception of quartz and white mica, the eclogitic minerals listed above all have densities >3.0 g/cm^3 and crystal structures with relatively close-packed oxygen atoms. In contrast, plagioclase feldspar, a low-pressure mineral with a density in the range 2.6–2.8 g/cm^3, has an open framework-like crystal structure in which the oxygen atoms are not close-packed. When basalt is transformed to eclogite, the albite component of the igneous plagioclase is represented by a combination of jadeite (in omphacite) and quartz, and the anorthite component ends up mainly as grossular in garnet and/or as zoisite or epidote.

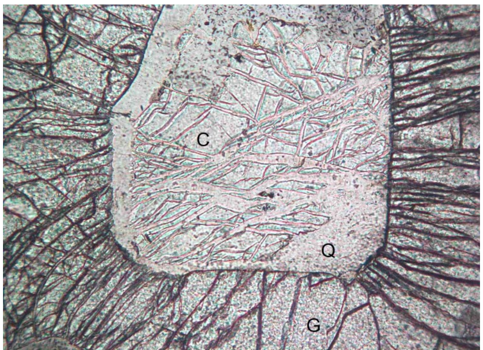


Fig.6.Photomicrograph showing an inclusion of coesite (C), partially transformed to quartz (Q), inside pyrope garnet (G). Note the expansion cracks in the garnet. Field of view 2mm across. Photo: Giles Droop.

Distribution and field occurrence of eclogites:

Eclogites are relatively uncommon rocks in the Earth's crust but are widely distributed. They have two main modes of occurrence: (i) as layers or pods within other rock types in collisional orogenic belts, such as the Alps, and (ii) as xenoliths in kimberlite diamond-pipes. Orogenic eclogites are virtually restricted to young orogenic belts, and almost all are Phanerozoic. Some are very young indeed: those of Woodlark Island (Papua New Guinea) are only 2Ma old.

Compared to most other metamorphic rock types, eclogites are extremely **competent** (resistant to deformation) so usually occur as pods or disrupted layers within more ductile rocks (Figs. 9, 10 & 11).

Fig.7. Hand specimen of epidote-rich meta-gabbroic eclogite, Lanzada, N Italy. Photo: Giles Droop.

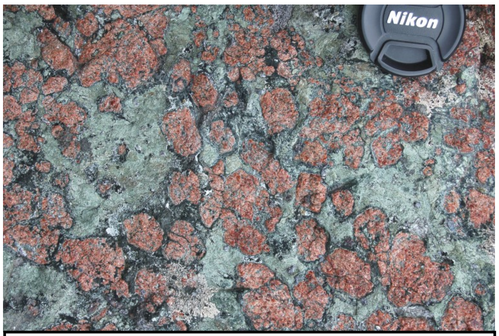


Fig.8. Close-up of an exposure of altered coarse-grained eclogite, Remøy, W Norway, showing hornblende rims (black) around garnets. Photo: Giles Droop.

Compared to most other metamorphic rock types, eclogites are extremely **competent** (resistant to deformation) so usually occur as pods or disrupted layers within more ductile rocks (Figs. 9, 10 & 11). Relict high-pressure mineral assemblages are being increasingly recognised in these associated rocks, and it is becoming clear that many of the eclogite-bearing nappes in collisional orogens have undergone high-pressure metamorphism in their entirety. (More on other high-pressure rocks in a later issue). The competence of eclogites is one reason why they commonly escape retrogression. Another is that they are relatively impermeable; conversion of eclogite to **amphibolite** (hornblende-plagioclase rock), which is stable at lower pressures, involves wholescale addition of aqueous fluid which is not always able to penetrate.

Conditions under which eclogites form:

Fig.9.Oval pod of eclogite (middle distance) within gneiss, Remøy, W Norway. Photo: Giles Droop.

Since 1970 many laboratory experiments have been carried out to determine the pressure-temperature stability limits of eclogitic mineral assemblages. It is now known, for example, that the lower pressure limit of omphacite (50% jadeite) + quartz with respect to diopside + albite is ~14 kbar at 600ºC, ~18 kbar at 800ºC and ~22 kbar at 1000ºC corresponding to depths of burial of ~50km, ~65km and ~80km, respectively.

Although many eclogites contain quartz as part of their 'peak' mineral assemblages, relics of coesite (Fig. 6) have been found in a few, and at least ten coesite-stable ('ultra-high-pressure', *aka* 'UHP') terrains within collisional orogenic belts are now recognised. Examples include the Dora Maira Nappe in the Western Alps and the Western Gneiss Unit in the Norwegian Caledonides. (Relict coesite is most often found as inclusions within garnet, and usually shows evidence of decompressive transformation back to quartz (Fig. 6); because this transformation involves expansion, the surrounding garnet typically shows radial tension cracks around the inclusion.) Coesite is not stable below about 28 kbar at realistic temperatures, so UHP eclogites imply subduction to depths of at least 100km. Diamond has been reported from a couple of UHP terrains implying even greater depths.

Fig.10. Small pod of orthopyroxene eclogite within gneiss, Bortnes, Otrøy, W Norway. Photo: Giles Droop.

In addition to these stability-limit arguments, estimates of eclogite crystallisation conditions have been obtained from various mineral equilibria using the same principles as outlined in my Hot Rock piece in the Winter 2019 Newsletter. For example, the distribution of Fe and Mg between garnet and omphacite is temperature-sensitive and can be used as a geothermometer. What such studies have shown is that whereas the pressures recorded by orogenic eclogites are dramatically high, the temperatures are not. The eclogites of the Tauern Window in the Austrian Alps (e.g. Fig. 1), for example, have been shown to have crystallised at ~600ºC and ~22 kbar. Results such as these imply very low average geothermal gradients (~8ºC/km in this case), which are much lower than that thought to be representative of stable crust, and more in keeping with the thermal regimes thought to prevail in subduction zones. Diamond-bearing eclogite xenoliths from kimberlite pipes record much higher temperatures and pressures (>1000ºC and >40 kbar) that probably reflect past thermal conditions in the lower parts of ancient 'cratonic' lithospheric roots.

Eclogites in the UK and Western Europe:

Fig.11. Eclogite layer (originally a mafic dyke?) in chlorite-peridotite, Raudkleivane, Almklovdalen, W Norway. Photo: Giles Droop.

The only true eclogites in the UK are those of the enigmatic Glenelg Inlier of NW Scotland, which is one of the outcrops of 'Lewisianoid' basement to the Moine Supergroup. Being of Neoproterozoic age, this is one of the oldest eclogite occurrences known to science; radiometric ages cluster around 1000Ma, indicating that the eclogites were formed during the Grenvillian orogeny. Fresh examples of quartz-eclogite are exposed on the south shore of Loch Duich near Totaig.

Elsewhere in Western Europe, eclogites are found in all three of the major orogenic belts: Caledonian, Hercynian and Alpine. Caledonian eclogites occur in the Western Gneiss Region of Norway and the Seve Nappe of Sweden. Hercynian eclogites occur locally in Brittany (in the Champoceux Nappe and on Île de Groix) and NW Spain (at Cabo Ortegal) and abundantly in the Bohemian Massif (notably in the Münchberg Massif and Erzgebirge of E Germany). Alpine eclogites occur in Syros and Sifnos in the Cyclades, in the Sierra Nevada of southern Spain and, of course, in many of the structural units of the Alps including the Zermatt-Saas Zone, Voltri Complex, Sesia Zone, Adula Nappe, Tauern Eclogite Zone and Saualpe Complex. I can supply locality details to anyone interested in seeing eclogites in outcrop. *Giles Droop*

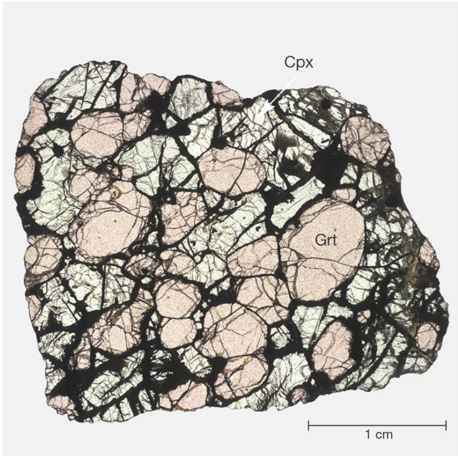
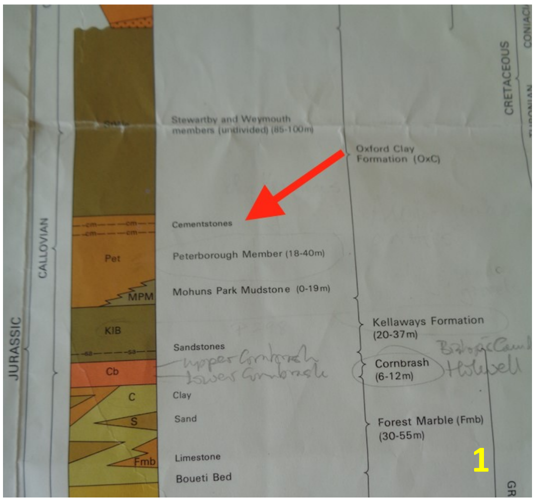


Fig.12. No, not a stained-glass window! Thin section of an eclogite xenolith from kimberlite. Locality unknown. Photo: Bing.

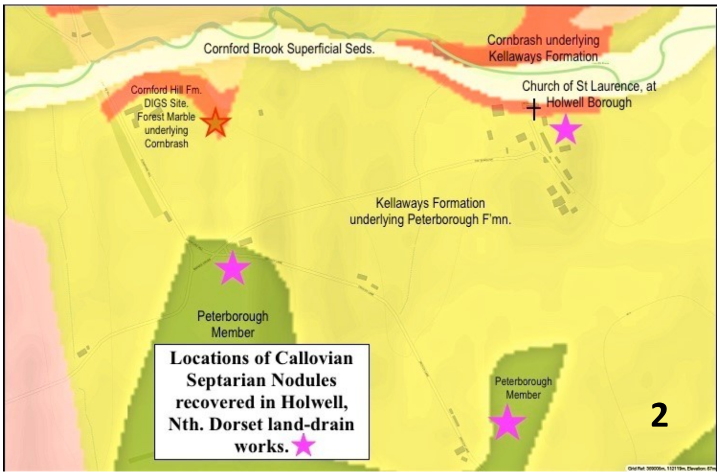
Calcareous Concretions local to DGAG members

Perhaps others amongst us have had incidental opportunities to learn more about local Septarian nodules and can enlighten us all a little further? I'm based at rural Holwell, DT9 5LA on the Oxford Clay and not far from the Blue Lias of south Somerset. My BGS Shaftesbury Memoir Stratigraphical digital image (Image 1) indicates the most probable locations for this natural feature of the Peterborough Member.



I was first alerted to the Holwell nodules by spotting broken nodules in the local land drainer's yard. These had been obstructing drainage channel dredging between 4' and 6' deep in both the Kellaways Formation and Peterborough Member. (Presumably due to erosion of the softer deposits of the latter).

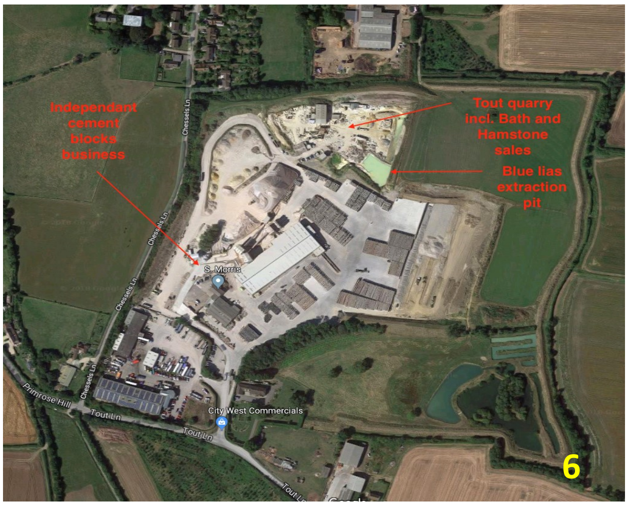
The concretions here tend to be elongate but not compressed (Image 2). Veining can be quite radial as many of us have noticed in the Blue Lias nodules of the Black Ven. The iron dissemination is predominantly a uniform blue and the oxidisation is most evident in the calcitic septa. Porosity seems to be greatest along the veining and once exposed to weathering, these nodules are seen to crack up and decay. Nevertheless, whilst taking a very good polish, this rock can easily be sawn and cavities filled with resin if one is attracted to decorative stone. Bookmarks are simply sawn dimensional stone blocks.

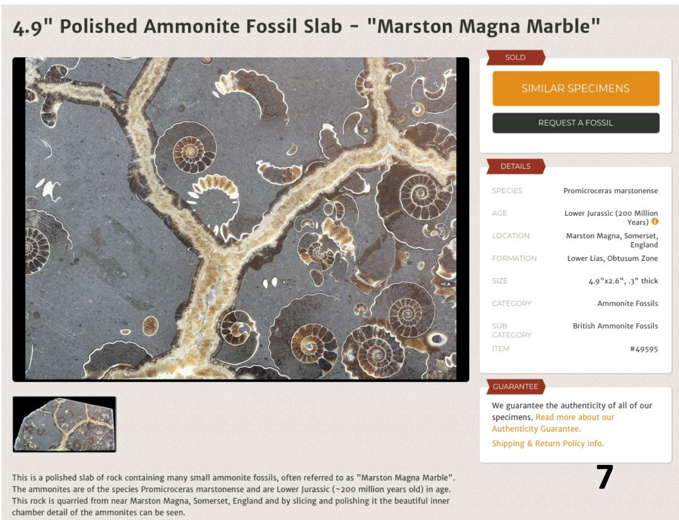


Although septarian nodules of North Dorset are occasionally recovered during land drainage for modern arable use of dairy-land farms, it is probably easier to by-pass them than have a digger extract them from the trenching machine's path. They are not rare but are uncommonly seen.

Blue Lias nodules

Only one piece of polished Blue Lias cement-stone has attracted my camera in the field. (Image 5) It is displayed by Bath & Hamstone Ltd at their Tout Quarry (Image 6) hidden away in Charlton Adam and has been visited by appointment for Dorset Building Stone website group interest.





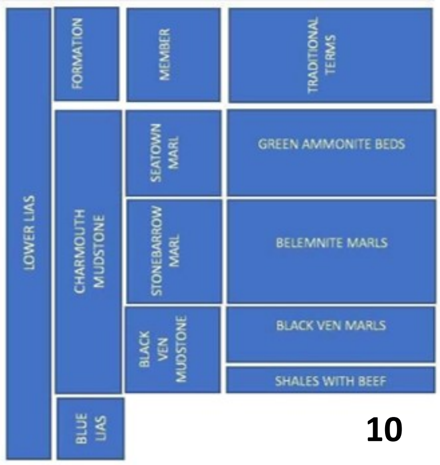
Marston Magna Marble was described and illustrated in 20th century textbooks. It was used worldwide, from the few known pieces retrieved from damaged tombstone rock in that village. Then, new septarian nodule finds of this 'ammonite graveyard' deposit were reported on the web in 2016. I bought a slice similar to that now available at a wide range of prices on web-sites. Well preserved fossils of *Microderoceras birchi* in septarian nodules at Black Ven are reported in vast numbers on this website (Image 7) with currently 184 posts: https://www.picuki.com/tag/Microderoceras

A Jurassic Coast ammonite cluster from a birchi nodule (Image 9). The species is *Microderoceras birchi* and has been prepared rather than cut and polished.

9

"The new stratigraphy has not entirely replaced the traditional terms, which will undoubtedly be referred to by many and is best reflected in Images 10 and 11 below.
It is often the case that landslips at Black Ven will expose these beds and regular tides will keep them fresh. Searching the ledges at low tide is especially worthwhile."
(from : https://ukfossils.co.uk/2008/08/07/charmouth-dorset/)

Stratigraphy at Black Ven, Charmouth-Lyme Regis



10

11

This article follows on from that featured in the previous Newsletter, written by Alan Holiday. It has hoped that further articles will appear on this theme. We also look forward to hearing Professor Jim Marshall's talk on 'Carbonate concretions in the Dorset Jurassic', hopefully when lectures resume. *Peter Bath*

Roaming round Melbury Hill and Melbury Bottom

If you are looking for a day out in the north of the county with some geomorphology as a bonus, why not climb to the top of Melbury Hill (263 metres) (1). From the top of the hill there are excellent views in all directions.

1. Melbury Hill viewed from Hambledon Hill

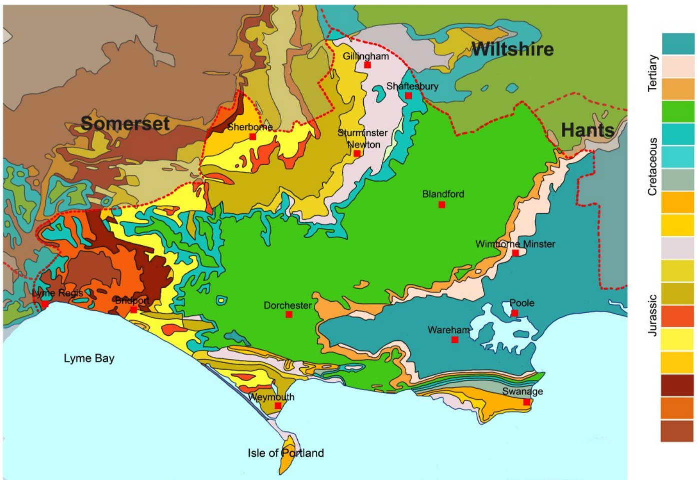
Then perhaps have a look at Melbury Bottom, a text book example of a dry valley. Both are listed as Sites of Local Geomorphological Interest.

We parked at the small National Trust car park at the top of Spread Eagle Hill (ST886 187) to the south east of Melbury Hill. Hay making was in progress in the adjacent fields making superb patterns in the fields (2). We were also treated to an aerobatic display by small planes taking off from Compton Abbas airfield nearby. Melbury Hill is also called Melbury Beacon as it formed part of a chain of Armada beacons from Plymouth to London in 1588. It is one of the highest points on the Dorset Chalk Escarpment.

2. Melbury Hill (NGR ST 873197) viewed from the N.T. car park

The Chalk is the most widely outcropping of all of the surface rocks of Dorset (3). From the western end of Cranborne Chase it underlies the Dorset Downs from north east to south west where they turn south-eastwards towards White Nothe, Bat's Head and Swyre Head.

To the east of West Lulworth the Chalk becomes increasingly narrow forming the ridge of the Purbeck Hills. The highest parts of the Downs represent the remnants of a once extensive chalk platform. Much of the high chalk downland of north Dorset remained as land when the sea swept over most of Dorset 50 million years ago towards the end of the Eocene. Since then the landscape has been shaped to its present form of scarps, dip slopes and valleys by the action of water and weather. The White Chalk (Middle and Upper Chalk) has given rise to rolling downland in a series of rounded hills and ridgelines.



3. Geological map of Dorset showing the Chalk (PAS 2009)

Erosion of the Grey Chalk (Lower Chalk) beneath has given rise to prominent steep escarpments. Melbury Hill, therefore, represents a landform that has been sculpted by weathering for nearly 50 million years.

The Chalk in this area rests conformably on the highest member of the Upper Greensand, the Melbury Sandstone. The lower slopes of Melbury Hill are formed of various divisions of the Grey Chalk. It is capped by an outcrop of the Blandford Chalk, a division of the White Chalk. The BGS Memoir describes the Blandford Chalk as white, flinty and fossiliferous.

4. The chalk quarry

Melbury Hill stands out above the general surface of the Chalk escarpment and thus it is likely to be a remnant of the erosion surface that was sculpted by water and weathering during the Palaeocene. It is bounded to the north by the valley of the Cann stream and to the south by a deep dry valley that separates it from Fontmell Down. It is linked to Compton Down by a narrow escarpment. Its particular dominance suggests that it may be a 'monadnock', a residual hill rising abruptly from an erosion surface or peneplain due to being more resistant rock.

To reach the hill, we followed a trackway on the right-hand side of the car park which leads onto Compton Down. There is a small chalk quarry (ST 885 191) part way down on the right (4). The chalk is packed with flint nodules some quite large (5). A lithological section (BGS Memoir 313 p.130) places it in the Lewes Chalk.

We continued down the track until we reached a stile on the right-hand side, well hidden in the hedgerow, and came out onto the escarpment of Compton Down. There is a good view looking towards Gourd's Farm (6). The flat valley floor is made up of Head deposits from the last ice age. 'Head' is a term used by De La Beche for sediments formed by a range of slope processes under periglacial conditions. They are generally composed of a clay matrix with a wide range of sizes of angular rock fragments.

5. A flint nodule (approx. 30 x 25cm) enclosing a sponge?

6. Looking towards Gourd's Farm. The Dorset Gap is just visible on the skyline.

In the trees near Gourd's Farm the late 15th century tower of Compton Old Church (ST87559 18800) can be seen (7). It is a Grade 1 listed building. The rest of the old church was demolished and the stone used in the new church. The main building stone of the tower is Shaftesbury Sandstone.

7. Compton old church

8. Looking down on soil creep in a dry valley

Further on there is a good example of soil creep in a small, steep, dry valley amphitheatre (8).

As we started our climb up to the beacon, there was a good view to the north east of Melbury Abbas in the valley below with the tower of the Church of St Thomas visible in the trees (9). The church is of interest as it is an example of the use of two building stones from local quarries in the Upper Greensand. In the photograph (10), the buttress has quoin stones of the darker Shaftesbury Sandstone with white Melbury Sandstone blocks in the centre. The church walls are Melbury Sandstone on a foundation of Shaftesbury sandstone. The dressings are Corallian limestone, probably grey when first quarried but now oxidised to a dark orange. *(see next page)*

Left-
9. View of Melbury Abbas

Right-
10. Buttress of St Thomas church

We then started the slog up Melbury Hill. However it is well worth the climb as the 360° views are superb, extending from the Purbeck Hills in the south to the Mendips in the north-west. There is a toposcope at the summit to help with landmarks and directions. A couple of views are included, the rest you should see for yourselves.

11. Looking towards the NNW and Shaftesbury

12. The wooded slopes of Duncliffe Hill to the west of Shaftesbury

Shaftesbury (11) itself is built on Shaftesbury Sandstone but the area around it is Cann Sand resting on Gault. Cann Sand is a poorly cemented sandstone and the lowest member of the Upper Greensand. Much of the area is landslip (BGS Shaftesbury sheet 313). Of particular interest is Duncliffe Hill (12). It is an outlier comprising of Cann Sand. The hill is surrounded by landslips in the underlying Gault. The area around Melbury Hill is free access. From the top it is easy to drop down to either Melbury Abbas or Compton Abbas to look at the picturesque buildings and the churches mentioned above.

A dry valley on Melbury Down

A feature of both chalk and limestone country is the existence of dry valleys or coombes. In chalk country, dry valleys seem to form a pattern very much like that of a normal river system, and some even have gravel and alluvium patches on their floors. Melbury Bottom is a textbook example of a dry valley. The north side of the valley is extensively wooded while to the south it is largely pasture which accentuates the interlocking spurs. The high ground on this side is occupied by the relatively flat and open Compton airfield. The valley itself displays an outstanding set of interlocking spurs when seen from the minor road running from Compton Abbas Airfield to Ashmore Down (approx. NGR ST 914 195, see photograph 13).

13. The valley looking west towards Melbury Hill

It may also be viewed from the footpath along the road near the N.T. car park (approx ST 886 188, see photograph 14). The valley can be walked as there is a public footpath which runs between the two points.

It is likely that this valley system was cut during the glacial period when North Dorset was experiencing a periglacial climate (similar to that in Northern Canada and Siberia today). Different theories have been put forwards to account for these valleys. Two of the more widely debated scenarios are briefly explained here.

14. The valley looking east

The first is that they were formed towards the end of the Quaternary Ice Age. In our present climate water is able to drain freely through chalk strata but at that time there would have been a layer of permafrost beneath the surface which would have prevented melt water from percolating through the chalk in the summer thaw. Instead seasonal vigorously flowing streams gradually cut their way through the Chalk forming deeply incised valleys. When the climate warmed and the permanently frozen ground thawed, water could drain freely through the Chalk.

The second theory is that their origin is due to the gradual lowering of the water table in the chalk which is controlled by UGS/Gault junction escarpment springs. Water erosion with back dipping strata will result in the retreat of the escarpment and the lowering of the UGS/Gault base level. Valleys that once contained streams when the water table was about 30 metres higher now stand high and dry above the present water table. In addition, if there is a period when escarpment erosion is low, the springs may sap headwards forming the steep rounded ends common in many dry valleys such as the dry valley seen on the Melbury Hill walk - see photograph 8. *Pat Snelgrove*

Rory Mortimore

Rory has visited us in Dorset on many occasions, leading field-trips and as a guest speaker at our annual dinner. I thought members might be interested to learn that Rory has received the 2020 Richardson Award from the GA. The Richardson Award was established in the names of Doris Maud Richardson, John Victor Richardson and James Alfred Richardson and is awarded in recognition of an important research project within the geosciences. It is awarded for the best research-based paper in the 2019 volume of the Proceedings of the Geologists' Association. For his 2019 contributions: Late Cretaceous stratigraphy, sediments and structure; Gems of the Dorset and East Devon Coast World Heritage Site (Jurassic Coast), England. PGA 130, 3-4, 406-450; Late Cretaceous to Miocene and Quaternary deformation history of the Chalk: Channels, slumps, faults, folds and glacitectonics. PGA 130, 1, 27-65.

The photograph shows Rory receiving his award in his home town of Lewes. *Kelvin Huff*

Virtual Holiday Rocks

This year’s event has been cancelled owing to Covid restrictions. As an alternative, perhaps members could send me their ‘Geo-Holiday’ PowerPoint presentations so they can be made available to view via the DGAG website. *Kelvin Huff*

DGAG Field Trips and allied events 2020

Please note that most events have been postponed until further notice owing to Coronavirus restrictions.

To book a place on our field-trips, contact Val Fogarty using the details below. £2.00 day trip fee.

Saturday 24th October: Holiday Rocks

'Virtual meeting' with PowerPoint presentations. Details to follow.

Sunday 8th November: REAL Urban Geology Walk in Weymouth

This is a 7 km walk which includes the geology of Newton Cove, Nothe Fort and Gardens, the Outer Harbour, the shops in St Mary's Street and St Thomas Street, the Rodwell Trail and Sandsfoot Castle. As things stand at the moment we will do this walk in small groups of six or less. The cost will be £2. Please get in touch with our field Officer Val Fogarty if you wish to come on this trip. Her e-mail address is listed below.

Saturday 28th November:

DGAG Annual Dinner, Weymouth. **Cancelled**

Saturday 12th December:

Winter Workshop, Broadmayne. **Cancelled**

Saturday 9th January: AGM, Broadmayne. **Awaiting confirmation.**

https://dorsetgeologistsassociation.org/

DIGS (**Dorset's Important Geological Sites)**

The group welcomes anyone wishing to help with conservation work on Local Geological Sites. Please contact Alan Holiday if you are interested. Working parties go out on both weekdays and weekends.
alanholiday@btinternet.com

Wessex OUGS events

Please contact Jeremy Cranmer on: wessexdaytrips@ougs.org or telephone 01305 267133 to book a place. £2.50 day trip charge.

All OUGS Wessex fieldtrips have been postponed until further notice.

Book news:

Trev Haysom's book, **Purbeck Stone**, is due for publication in mid-October and signed copies can be now ordered, free of postage and packing, either from the Dovecote Press website or by telephone or email. Price:£35

Reminders: Contributors' deadline for the Autumn Newsletter is: **Monday, November 28th, 2020.**

Committee news:

We **still** need an Events Officer (not a very onerous job at the moment!)

Kelvin

DGAG Committee Members			
Chairman/Librarian/GA	Alan Holiday	01305 789643	alanholiday@btinternet.com
Secretary, Newsletter Editor, Events and Sales	Kelvin Huff	01305 265527	kelvinhuff30@gmail.com
Treasurer and Membership Secretary	Alison Neil	01305 832937	alison.neil@madasafish.com
Fieldtrip Officer	Val Fogarty	01935 814616	grittipalace22@btinternet.com
Website Manager	Geoff Rowland		rowland.geoff@gmail.com
Events Officer	*Vacant*		
Lectures and OUGS Liaison	Jeremy Cranmer	01305 267133	jeremydorset1@hotmail.co.uk
Ordinary	John Larkin		jalarkin3@yahoo.co.uk
Ordinary	John Scott		johnandsuescott16@gmail.com
Ordinary	Robert Chandler		aalenian@blueyonder.co.uk