Farnham Geological Society

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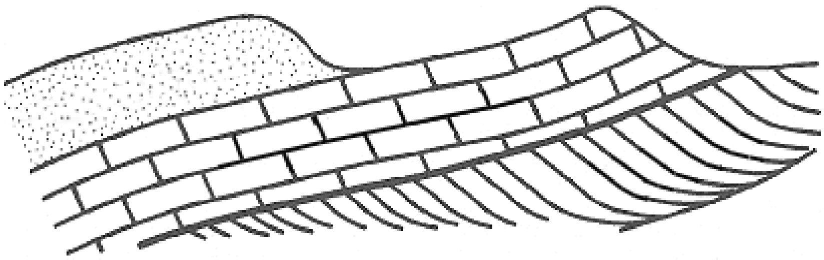

A local group within the GA

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Newsletter

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Editorial

This issue of the newsletter as always covers a variety of topics and I have to thank the contributors for succeeding in getting their articles to me, at one point it looked as though we might not have an October issue.

All members are reminded that the **FGS Annual Luncheon** is to be held this year on Sunday November 6th at Frensham Pond Hotel; tickets can be purchased from Peter Luckham, Treasurer, FGS, at the October meeting or by contacting him via email, at p_luckham@yahoo.co.uk .

Liz Aston

FGS Field Trip to Kinver Edge & Bridgnorth, West Midlands, June 2016
Trip led by Dr Graham Williams

A recent field trip visited Kinver Edge and Bridgnorth, and also Wren's Nest in Dudley, which is the UK's first National Nature Reserve and Geopark. This report covers the trips to Kinver Edge and Bridgnorth. The trip to Wren's Nest is reported separately and can be found elsewhere in this Newsletter.

Itinerary

We visited:

- Kinver Rock Houses to explore the Rock Houses and to study the early Permian Bridgnorth Sandstone Formation. (formation)
- Road sections near St Mary Magdalene Church, Quatford, to study linear (seif dunes) and arcuate (barchan dunes) cross-bedded sandstones of Bridgnorth Sandstone Formation.
- Sections near Bridgnorth Cemetery to study sandstones and conglomerates of the Early Triassic Kidderminster Formation unconformable on early Permian Bridgnorth Formation.
- Rindleford Quarry to study sandstones & conglomerates of the early Triassic Wildmoor Formation.

The Permian and Triassic sediments at Kinver Edge and Bridgnorth were deposited in the Worcester Basin. The area was within Pangaea super-continent, about 20°-25° N of the Equator, and experienced a hot desert climate. This fault basin, to the E of the Malverns, is a result of crustal extension and subsidence; several phases of rifting resulted in a complex series of inter-connected basins. Uplands to the W (Welsh massif) and E (London Platform) provided sediment sources and up to 3km of Permian-Triassic-Jurassic sediment was deposited.

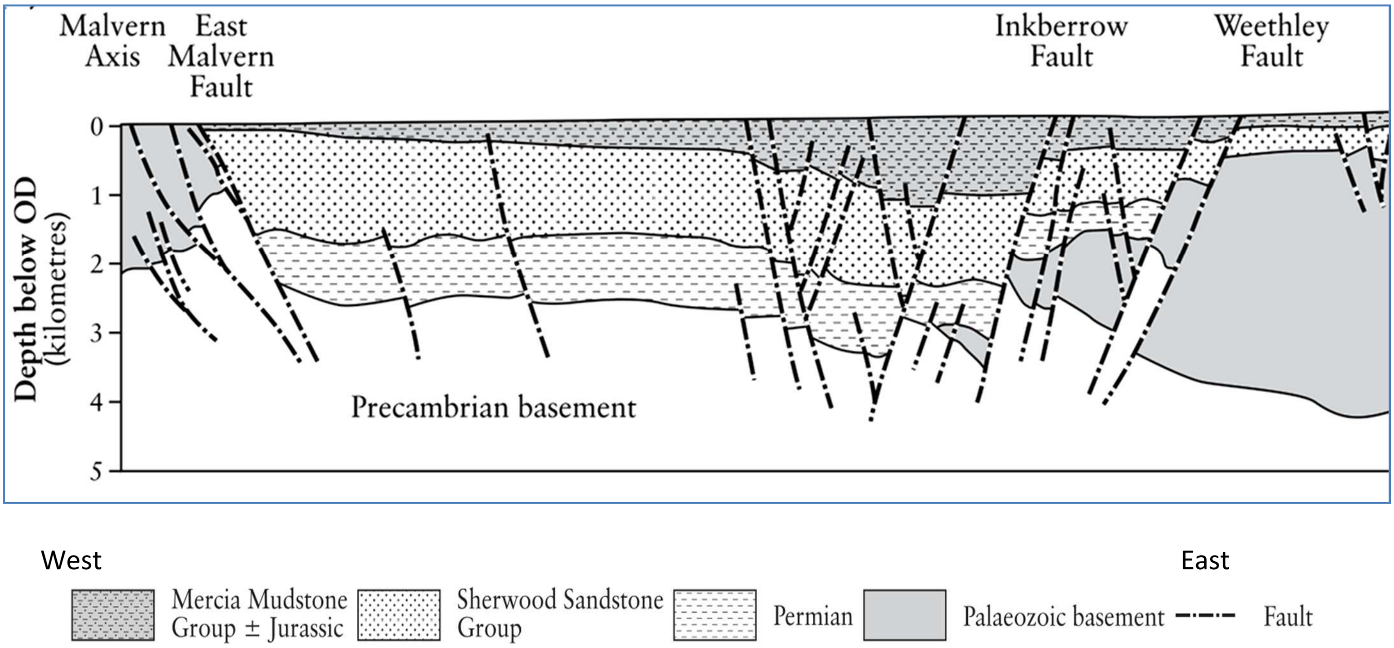

Fig. 1: Structural Cross-section through the Worcester Basin

We studied three units, the Early Permian Bridgnorth Sandstone Formation (up to 250m thick), the Early Triassic Kidderminster Formation conglomerate (up to 200m thick) and its Wildmoor Sandstone Member. The Kidderminster Formation is part of the Sherwood Sandstone Group. The Bridgnorth and Kidderminster Formations are separated by an unconformity of more than 10 Ma.

Rock Units

The Bridgnorth Sandstone Formation is characterized by mainly brick red, cross-bedded aeolian quartz sandstones (with some feldspar and mica), with fine (to medium), often very well rounded, well-sorted grains; there are occasional thin (mm-cm) beds of coarse 'millet-seed' quartz grains. The Bridgnorth Formation rests on Early Permian (?alluvial fan) breccias. Sand dunes are characteristic; many are linear or seif dunes, others are arcuate barchan dunes which implies periods of abundant sediment, then a relative paucity of sediment available for transport and deposition. Cross bed measurements suggest a dominant wind direction from the NE.

Fig. 2: Kinver Edge

Fig. 3: Bridgnorth Sandstone Formation, Kinver Edge, with dune and planar cross-bed sets

The Kidderminster Formation (ex Bunter Pebble Beds) consists of pebble conglomerates and reddish brown sandstone; the sandstones are cross-bedded and pebbly. The conglomerates have a reddish brown sandy matrix and consist mainly of well-rounded pebbles of brown or purple quartzite, with quartz conglomerate and vein quartz and a matrix of quartz sand. The sediments were deposited by a north-directed braided fluvial system. The sediments form a stacked succession of fining up cycles, each with a conglomeratic lower part and either a sandstone or mudstone top.

Up-section, the Kidderminster Formation becomes progressively sandier, with fewer conglomerates; the sand dominant interval is referred to as the Wildmoor Sandstone Member of the Kidderminster Formation. The Wildmoor Sandstone is a fine to medium grained, sub-angular to sub-rounded quartz sand, poorly to moderately well sorted with occasional pebbles; bedding is irregular, often arcuate, but with occasional first order bedding surfaces indicative of periodic planation.

Fig. 4: Kidderminster Formation showing Upwards Fining Depositional Cycles.

Fig 5: Early Triassic Kidderminster Formation unconformable on Early Permian Bridgnorth Fm, Bridgnorth.

Geological History

All sediments are reddened by iron oxide, which indicates deposition on land rather than in the sea or a deep lake.

The Early Permian Bridgnorth Sandstone Formation was deposited in a very hot arid desert climate, as a series of wind-blown sand dunes, on an eroded surface of moderate topography. The very well rounded 'millet-seed' grains are particularly characteristic of desert dune sands; they form by constant attrition as the grains are bounced across the land surface.

There followed a period of non-deposition and some erosion. It was during this period that the planet experienced the most severe mass extinction in the last 1 Ga – but that is another story !!

Erosion had subdued the topography by the Early Triassic. The climate had moderated - there was some rainfall. The sediments show clear indications of being water lain. The Kidderminster Formation (including the Wildmoor Sandstone) was deposited on an eroded, perhaps peneplained, surface by a succession of ephemeral rivers. The rivers were braided, with very wide zones of deposition; the lack of vegetation mitigated the development of river banks which could constrain flow to discreet rivers. The poorly sorted, pebbly beds are a clear indication of deposition aided by water flow – occasional rain storms resulted in widespread high-energy flash floods. In the Kinver-Bridgnorth area, we see little evidence of alluvial fan sediments or of wadi flash flood sediments, perhaps confirming the almost peneplained nature of the topography.

Graham M Williams

FGS Field Trip to Wren's Nest, June 2016
Trip led by Dr Graham Williams

A recent field trip visited Kinver Edge and Bridgnorth, and also Wren's Nest in Dudley, which is the UK's first National Nature Reserve and Geopark. This report covers the trip to Wren's Nest in Dudley. The trips to Kinver Edge and Bridgnorth are reported separately and can be found elsewhere in this Newsletter.

In Silurian times, around 400Ma ago, the area was a warm tropical sea, which provided good living conditions for coral reefs, trilobites, crinoids, brachiopods and much more. The area is internationally famous for its amazingly well preserved Silurian fossils, the most famous of which became known as the Dudley Bug and in some cases soft tissue has been preserved. There are also some very well preserved ripple marks (Figure 1). The site was originally quarried for limestone and the name 'Dudley Bug' arose when miners found many fossil trilobites looking like bugs. Of the 700 or so types of fossil found here, 186 were first found at Wren's Nest, and 86 of these are found nowhere else. There are fossils from this site in collections all over the world. Miners could sell good fossil samples to collectors for much more than the pittance the earned by quarrying. Mining was discontinued in 1925.

Wren's Nest is in the Black Country, where as well as limestone, coal is found. Limestone was used for building stone, lime mortar and for fertiliser. There are the remains of kilns and evidence old lime pyres for burning the limestone. Many underground workings and caverns were left when mining and quarrying ceased in 1925. There is also a canal, which was used for transport of materials with one man (legging) to propel the boat. The photo in Figure 2 shows the 'Seven Sisters', the entrance to the underground workings, which have since been filled in for safety reasons.

The area, once covered by trees, is now a large wildflower meadow which supports many rare flora species. This in turn encourages invertebrates and a varied bird population.

It is hoped that one day, if suitable funding can be found, (it just lost out to a large sum from the EU) the underground workings could be opened up to the public, which with the geology, flora and fauna would make the site even more worth a visit.

Fig. 1: Ripple Marks

Fig. 2: Five of the Seven Sisters

Judith Wilson

FGS Field Trip to NW Highlands and Scotland's North Coast, July 2016
Trip led by Dr Graham Williams

For those of us who were unable to attend, I have first given a very brief introduction to the geology of the area.

The trip examined the N part of the NW Highlands (Figure 1), where the rocks cover almost 3 Ga of the Earth's 4.5 Ga history, and include Europe's oldest exposed rocks (Lewisian Gneiss), and oldest undeformed and undisturbed sediments (Stoer and Torridon Groups) lying unconformably on top. The Great Glen Fault forms the SE margin of the NW Highlands (Figure 1).

The NW Highlands can be divided into two areas, separated by the Moine Thrust. To the W, is the highly deformed and metamorphosed Precambrian Lewisian Gneiss basement with Precambrian Stoer / Torridon Group terrestrial sediments and the younger, the Cambro- Ordovician Ardvreck Group and Durness Limestone Group - shallow marine sand and limestone sediments.

To the E of the Moine Thrust are the folded, faulted, metamorphosed sediments of the Late Precambrian Moine Supergroup. The sequence comprises a number of overlying thrust sheets, thrust from further E. The Moine sediments were deposited unconformably upon Lewisian basement, as evidenced by slivers of Lewisian caught up amongst the thrust sheets.

In the far NE corner Devonian Old Red Sandstone terrestrial sediments outcrop, part of the Orcadian Basin (Figure 1).

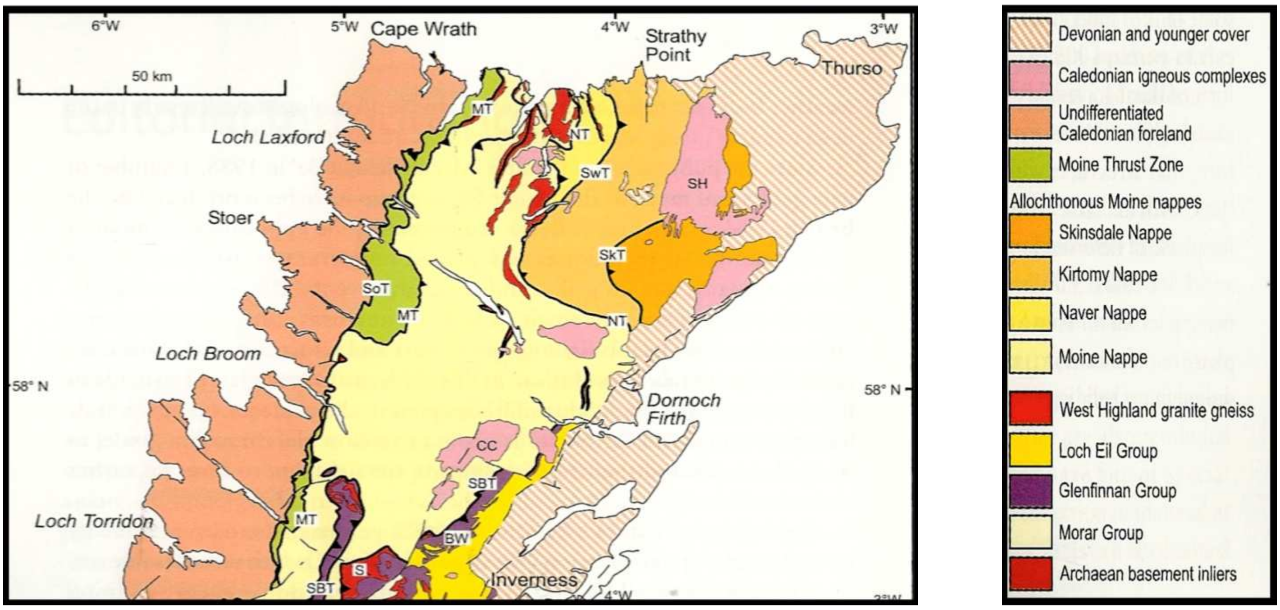

Fig. 1: Geology of the NW Highlands and Legend to accompany map (Figure from Strachan et. al. 2010)

Now to Christine Norgate's account:

Caesar declared Gaul to be in three parts but geological maps suggest that Scotland is divided into four regions, namely (from south to north) the Southern Uplands, Midland Valley, Grampian Highlands and NW Highlands. But on the July field trip, led by the irrepressible Graham Williams, we learned that the NW Highland region can be subdivided into three mini continents or protoliths (*original rocks which have been subsequently metamorphosed*), the Gairloch, Assynt-Gruinard and Rhiconich Blocks separated by the Laxford and Gruinard shear zones the most northerly two being the subject of the trip (Figure 1).

The Lewisian Complex formed at depths of 30+km between 3,100Ma and 1,700Ma when this part of Scotland became part of Laurentia. Three protoliths, or small continents, coalesced and were deformed and metamorphosed in three periods of tectonic activity the Scourian ~2,750Ma, the Inverian ~2,450Ma and Laxfordian ~1,700Ma.

We started our exploration at Oldshoremore beach in the Rhiconich Block where the pink granodiorite protolith has been metamorphosed to amphibolite by the Inverian event, intruded by dark grey mafic Scourie dykes which were then metamorphosed by the Laxfordian event. This sequence of events is demonstrated dramatically by the exposed road cuttings near Laxford Bridge, Figure 3.

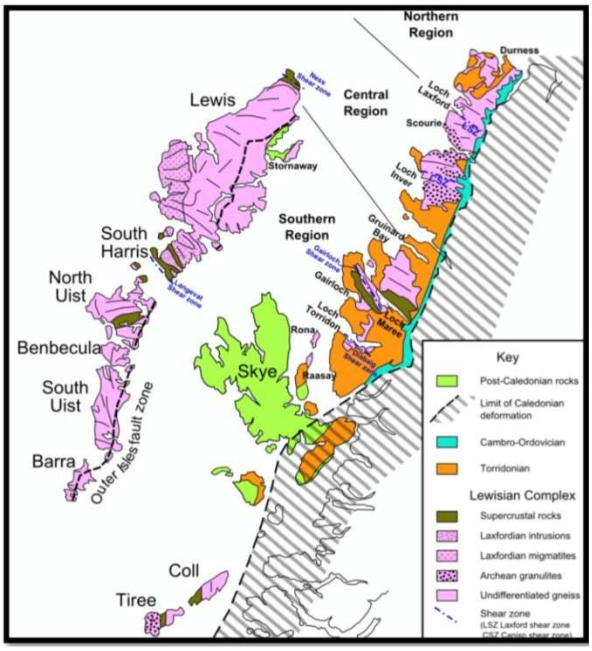

Fig. 2a: The Caledonian Foreland, West of the Moine Thrust. (From Wikipedia: https://en.wikipedia.org/wiki/Lewisian_complex)

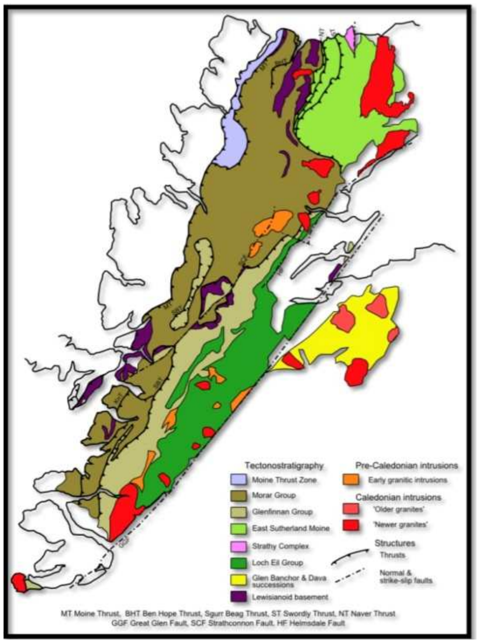

Fig. 2b: Moine Supergroup, East of the Moine Thrust (from Wikipedia: https://en.wikipedia.org/wiki/Moine_Supergroup)

Fig. 3: Roadside Cutting near Laxford Bridge

Fig. 4: Glencoul Thrust

Next day we were at Clachtoll looking at a sequence of gravels, sandstones and muds within which are very small layers of limestone, which could be algal and thus evidence of the oldest life form in Britain. On the other side of the beach we looked at a unit which recent research suggests to be molten debris produced by a massive bolide or meteorite which landed near Lairg / Stoer.

Next we looked at red Torridonian Sandstone outcrops of great thickness; these formed in desert conditions on the older, and heavily eroded, Lewisian basement. In dry desert conditions, outcropping rocks are weathered and degraded to quartz and clay minerals ready to be transported and deposited by flash floods and rivers.

Then, on Monday, we came to Knockan Crag, historically the scene of tremendous argument when the established theory of geological giants, Murchison and Geike, that the youngest rocks must be on top was challenged by upstart geologists Nicol and Lapworth who declared that the Moine schists were older than the Durness Limestones beneath them. Only in 1907 was the matter resolved by the work of Peach and Horne who explained it as a thrust fault – i.e. when older (and often deeper) rocks are pushed (thrust) up and over a younger (and often near surface) sequence of rocks during continental collision.

We examined a continuous roadside cutting which climbs uphill on the Loch Assynt foreshore and saw a sequence from Durness Limestones, down through the Salterella Grit with its cross bedded sandstones to the orange-brown dolomitic siltstone of the Fucoid Beds, then to the memorable Pipe Rock sandstone with its particularly visible vertical and cross-sectional burrows. At this point the rain gods gained supremacy and geology was abandoned for the day. However, on the journey back, sunlight defined the Glencoul Thrust (Figure 3) with successive Lower Cambrian sediments and Lewisian Gneiss bands but the E end was shrouded in mist. And in the Rock Shop an up market sand pit allowed us to study the effect of topological changes.

Fig. 5: Boudins in the Cliff at Ceannabeinne Beach

Fig. 6: FGS Members Examine the Unconformity at Knockan Crag

On Tuesday at Balnakiel we walked beside a golf course to look at striped, wavy layers in the Durness Limestone cliffs; these rocks formed on shallow marine, subtidal flats. Stromatolites formed large hump structures on the beach further along. On to Sango Bay, a fault zone. A well-known feature at the eastern end is the Oystershell Rock where Lewisian rocks have been deformed to a green chlorite mylonite by movements of the Moine Thrust Complex.

At Ceannabeinne Beach a spectacular cliff of almost vertical bands of Lewisian rocks incorporate both pink granite hour-glass and black mafic gneiss boudin structures (Figure 5), signs that the rock was stretched at great depth when it was hot and plastic.

Wednesday was a fairly unpleasant day as we waded upwards through boggy, rough grass to view where Lapworth first demonstrated the thrusts that placed Precambrian above Cambrian rocks and where successive 'couplets' of orange-coloured Fucoid Beds and Salterella Grit have been repeated by minor thrusts. This was yet another world famous geological site.

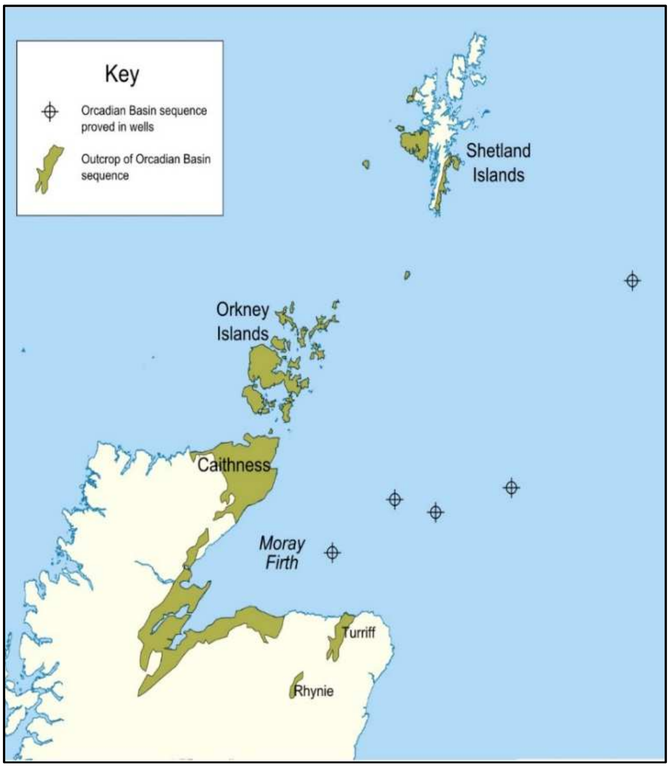

Fig. 7: Devonian Palaeogeography showing the extent of the Orcadian Basin. (From Wikipedia, by Mike Norton, https://en.wikipedia.org/wiki/Orcadian_Basin)

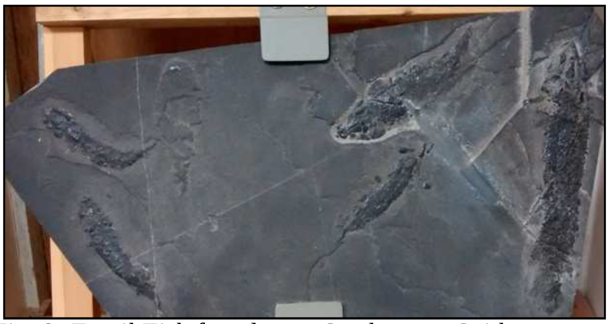

Fig. 8: Fossil Fish found near Castletown, Caithness, now in the local museum.

Fig. 9: Graham Explains Layering due to Successive Thrusting and Jack looks on impressed.

At Portvasco the thin beds show tight isoclinal folding and comprise mostly quartz particles, which appear to be flattened. But Moine sediments have formed from erosion of Lewisian rocks and there are few mud layers so where did the clay minerals go?

Then, at Talmine, at last, a gemstone. In a wet mafic intrusion on the beach, many garnets were clearly visible. For bird watchers, also success, a Great Northern Diver fishing at sea. Wild flower enthusiasts had already seen many interesting species including the ever-present bog asphodel.

Thursday morning and we set off, W from Tongue, stopping at Coldbackie Bay to observe mullion structures which look like clustered columns in the roadside cutting. On the beach at Farr Bay we saw tight isoclinal folds and even a possible dyke. And an isolated piece of protolith dated to 2,900Ma.

At Port Skerra, Old Red Sandstones sit unconformably on an irregular Moine basement. Viewed from above the sandstone appears to be more abundant than it actually is.

Friday was the last day of the expedition and we moved up the sequence to Middle Devonian in the form of Caithness flagstones, many of which can be seen in local field boundaries. The well-bedded sandstones were deposited in the Orcadian Basin and fish fossils have been found in surrounding quarries. A heritage trail and a small museum at Castletown show the rise and fall of the flagstone industry from early C19th to early C20th. Slates were exported to fashionable London and even as far as Australia and the USA from the port developed nearby. The work was arduous and the workers subject to the usual debts associated with a Company Store. And there was a Merlin engine from a Hurricane, which came down in a bog during WW2!

On a visit to Weyland quarry, we were unable to discover any of the rare fish fossils but at Pennyland we looked at the sequence of sandstones and mudstones and observed some of the features such as slumping, water escapement structures, honeycomb weathering, cross- and trough cross-bedding which can be found in Old Red Sandstone deposits.

An early return to our base in Tongue meant that Peter and I were able to cross the valley and climb to the ruin of Castle Varrich of unknown origin. I was delighted to find that some of its massive building blocks featured larger garnets than we had seen and looking at the adjacent cliff did we detect a couple of thrusts?

David Walmsley was part of the group. Early in his career he successfully mapped an area in Africa on his own and without the modern aids that current geologists can access. He shared with us his approach to his work.

Once again we are greatly indebted to Graham. His field notes for the expedition are detailed and informative and his enthusiasm for geology seems endless. As ever we enjoyed the company of Susan and Jack who especially likes diagrams drawn in the sand. Thank you Graham.

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Christine Norgate

Earth's Deep And Ancient Waters
Summary of September 2016 lecture given by Prof. Chris Ballentine – University of Oxford

We think of water in the ground as a resource for consumption and agriculture, but on geological time scales fresh water is ephemeral. Saline water deeper in the ground represents by far the biggest proportion of water occupying the fractures and pore-space in the rock beneath our feet. It is old saline water that oil and gas migrates through to form economic hydrocarbon deposits. Nuclear waste and proposed anthropogenic CO^2 disposal sites are located in this water. Metal-ore mines encounter highly saline water and the dangerous gases, which the water has released from the rock. Understanding how old the water is and how it moves or interacts with oil, gas and rock is an essential component in hydrocarbon resource exploration and waste disposal safety cases. In the deepest mines in the world, we find surprising evidence for just how old this water can be and how these environments can support life in the deepest darkest and most extreme parts of the Solar System.

There is not only the ephemeral water cycle at the surface and upper subsurface of the Earth, but also, a very deep subsurface cycle of brine, carrying gases and minerals under pressure. These brines not only contain hydrogen H_2, methane CH_4, carbon dioxide CO_2 and nitrogen N_2 but also radiogenic products (from fission and radioactive decay): helium He, argon Ar, neon Ne, krypton Kr and xenon Xe. These radiogenic products are still being produced by the decay of unstable isotopes but at a slower rate than when the Earth was formed. The very lighter gasses He and Ne diffuse more quickly through the systems from their source than the heavier gases Kr and Xe. When brines reach the surface, or lower pressure areas, dissolved matter is released as precipitates and gases, e.g. travertine $CaCO_3$ and carbon dioxide CO_2, into lethal caves or maybe black smokers.

Brines rich in N_2, H_2, CH_4 and He, hosted within Precambrian crustal rocks, are known to sustain microbial life; gas levels within the system are being used as time markers. The calculated volume of Precambrian (saline) water is 11 million km^3 compared with fresh groundwater, which is 10.6 million km^3 (estimated total water on Earth – 1.386 billion km^3).

One of the gases that is most useful in determining the age is xenon; it has 39 isotopes, but only isotopes ^{128}Xe, ^{129}Xe, ^{130}Xe, ^{131}Xe, ^{132}Xe, ^{134}Xe, ^{136}Xe are stable and used. Xenon radiogenic isotopes in closed systems can be used to date the brine in deep-mine high-pressure water fracture pockets; examples were given from the Michigan Basin, Witwatersrand Gold Mine and Timmins Sulphide Mine in Sudbury, Canada.

The Michigan Basin has a sequence of Cambrian to Devonian rocks, sitting on ancient Precambrian gneiss basement. Analysis of radiogenic gases indicated a decrease in levels upwards, through the sedimentary column. The longer the brine system had been 'closed', so the higher the retained radiogenic gas levels are and the closer to the actual enclosing rock's age. Noble gas concentrations and isotopic ratios for deep (0.5-3.6 km) brine samples in the Basin contained quantities of ^{4}He, ^{21}Ne, ^{40}Ar, and ^{136}Xe, which indicated the presence of a strong vertical gradient along the sedimentary strata of the basin. The ^{4}He, ^{21}Ne, ^{40}Ar, and ^{136}Xe components point to the presence of a deep, external source for the crustal noble gases, e.g. the Precambrian crystalline basement beneath the Michigan Basin.

The saline fracture fluids from boreholes in the deep gold mines in South Africa and the sulphide mine in Ontario, were found to contain living organisms. These organisms do not require light energy; the extremophile bacteria are able to extract energy and live in these extreme environments.

The brines from the Witwatersrand Gold Mine have been dated by the xenon method and gave dates of 10 to 200Ma and contain just one type of bacteria (99.9%). Candidatus has ability to spontaneously release spores, and is a sulphate reducing organism, which requires temperatures of 45°-80° C and which is able to gain energy from inorganic reactions of simple compounds; it can fix its own N_2 and C. Life needs both energy and nutrients:

- Catabolism – metabolic pathways that break down molecules to release energy or used in anabolism;
- Anabolism – metabolic pathways that synthesise complex molecules used in cellular structures.

Nutrients in modern biomes are dominated by photosynthetic sources and sophisticated metabolic routes which might not been available to early/primitive bacteria.

Brines containing H_2 and CH_4 do not necessarily mean biological activity as rocks can react with water and generate these gases.

Fayalite + water → magnetite + aqueous silica + hydrogen ($3Fe_2SiO_4 + 2H_2O \rightarrow 2Fe_3O_4 + 3SiO_2 + 2H_2$) Olivine + water + carbonic acid → serpentine + magnetite + methane ($(Fe,Mg)_2SiO4 + nH_2O + CO_2 \rightarrow Mg_3Si_2O_5(OH)_4 + Fe_3O_4 + CH_4$)

The change from non-biological chemical repetition to carbon biological repetition, might be defined as the possible start point of life. This is expected to be after the late heavy bombardment, 4.1-3.8 Ga ago. Fluids, from 2,400m depth in a Cu-Zn mine in the Timmins region of Ontario, Canada, had compositions rich in H_2, He, N_2, CH_4, in closed systems with a noble gas mean residence age >1 Ga; there are also indications of bacterial activity.

Helium

Helium (He) is now a much sought after gas but most of it that reaches the atmosphere quickly dissipates into space. It was a byproduct of oil and gas extraction, so, in anticipation of airship travel, large reserves were put by in the early C20th but this expected use didn't materialise. Since then no further reserves of sufficient quantity were found that could compete on price with He in store, but stocks are dwindling and the usage is increasing dramatically as it is used for a refrigerant in superconductors such as those used in medical CT scanners.

Recently a He source in Tanzania has been found where it is being released due to volcanic activity, the release of deep-seated, disseminated, He in the local craton, is being released and trapped in 'closed systems'; shallower gas fields. If commercial yields are achieved, CT scanners can continue to be manufactured and the use of super conductors in various other markets will not be at risk.

Radiogenic gases

The relationship between solar volatiles and those now in the Earth's atmosphere and mantle reservoirs provides an insight into the processes controlling the acquisition of volatiles during planetary accretion and their subsequent evolution. Whereas the light noble gases (H and Ne) in the Earth's mantle preserve a solar-like isotopic composition, heavy noble gases (Ar, Kr and Xe) have an isotopic composition very similar to that of the modern atmosphere, with radiogenic and (in the case of Xe) solar contributions. Mantle noble gases in a magmatic CO_2 natural gas field have been previously corrected for shallow atmosphere/groundwater and crustal additions.

New data show that the elemental composition of non-radiogenic heavy noble gases in the mantle is remarkably similar to that of sea water. The popular concept of a noble gas 'subduction barrier' is not clear-cut, as the convecting mantle noble gas isotopic and elemental composition can be explained by subduction of sediment and seawater-dominated pore fluids. This accounts for ~100% of the non-radiogenic Ar and Kr and 80% of the Xe. Approximately 50% of the convecting mantle water concentration can be explained by this mechanism. Enhanced recycling of subducted material to the mantle plume source region then accounts for the lower ratio of radiogenic to non-radiogenic heavy noble gas isotopes and higher water content of plume-derived basalts.

Analyses of Xe from well-gas, rich in CO_2, reveal a large excess of radiogenic ^{129}Xe from the decay of extinct ^{129}I. Smaller excesses observed in the heavy Xe isotopes are from fission. These results place narrow limits on any age difference between the Earth and the oldest meteorites. The occurrence of excess radiogenic ^{129}Xe in well-gas also suggests that any quantitative degassing of existing solid materials to form the atmosphere must have been limited to a very early period of the Earth's history, approximately the first 10^8 yrs. This observation is consistent with a model of the Earth's continuous, but still incomplete, degassing since its time of formation.

The isotopes ^{129}Xe, produced from the radioactive decay of extinct ^{129}I, and ^{136}Xe, produced from extinct ^{244}Pu and extant ^{238}U, have provided important constraints on early mantle outgassing and volatile loss. The low ratios of radiogenic to non-radiogenic xenon ($^{129}Xe/^{130}Xe$) in ocean island basalts (OIBs) compared with mid-ocean-ridge basalts (MORBs) have been used as evidence for the existence of a relatively non-degassed primitive deep-mantle reservoir. However, low $^{129}Xe/^{130}Xe$ ratios in OIBs have also been attributed to mixing between subducted atmospheric Xe and MORB Xe, which obviates the need for a less degassed deep-mantle reservoir.

Studies of the Iceland plume show that the Earth's mantle accreted volatiles from at least two separate sources which neither the Moon-forming impact, nor the mantle convection over the last 4.45 Ga, has erased the signature of Earth's heterogeneous accretion and early differentiation.

Atmospheric noble gases

Atmospheric noble gases (^{22}Ne, ^{36}Ar, ^{84}Kr, ^{130}Xe) which occur in crustal fluids are sensitive to physical processes common in the subsurface. Loss of atmospheric noble gases in groundwater from boiling / steam separation identifies a thermal event and will therefore provide information on the thermal history of cratons.

Microbial Life

The Precambrian crystalline basement of South Africa includes H_2, He, N_2 and CH_4-rich brines associated with mineral deposits, which have been shown to support microbial life. Similar hydrogen production in other cratonic areas suggests that large regions of the Earth are capable of supporting microbial life. The details of how microbial life evolves and develops into communities requires extensive further analysis, but it is noteworthy that fluids with similar compositions occur at ca. 2,400m depth in a Cu-Zn mine in Timmins Mine, Ontario, Canada, and are consistent with an atmospheric Xe age close to that of the mineral deposit, i.e. ca. 2.7Ga.

Microbial biofilm communities were discovered to be coccoid-shaped, vibroid, rod-shaped, and filamentous bacteria together with a group of larger vibroid to rod-shaped bacteria. Many of the bacteria appear to be Fe^{2+}-oxidizing bacteria others appeared to be sulfate-reducing and denitrifying bacteria, suggesting that diverse populations of biofilm-forming bacteria exist in deep groundwaters.

Recent studies demonstrate that the Precambrian crust which accounts for ~70% of the entire crustal surface of the Earth, has a global hydrogen production similar to marine systems, although the exact H_2-producing reactions and the role these play in the global H_2- and C- cycles is poorly understood.

These studies show that ancient pockets of water can survive in the cratonic crusts for billions of years.

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John Stanley

Wealden Petroleum Production, Past, Present & Prospective

Summary of May 2016 lecture given by Richard Selley, Emeritus Professor of Petroleum Geology at Imperial College & an Aboriginal Inhabitant of the Weald

The surface expression of the Wealden anticline is plain for all to see. It is composed of Cretaceous sediments with Purbeck (Upper Jurassic) sediments cropping out in the core. Seismic imaging of the subsurface, confirmed by boreholes, reveals that the Weald is a biconvex lens of Cretaceous, Jurassic and older sediments. These include the organic-rich shales of the Lias and Kimmeridge Clay Formations. Reconstruction of the evolution of the Weald shows that it was a subsiding basin that was inverted at the end of the Cretaceous Period. Thus the organic-rich shales matured to generate petroleum at greater depths and temperatures than they are today.

Oil seeps out of the ground at several locations across the Weald and water wells have been notorious for emissions of 'foul gas' (methane) for centuries. In 1899 the discovery of methane bubbling in a water well at Heathfield lead to the first commercial production of petroleum in the Weald. Towards the end of the last century, 13 oil and gas fields were found in an arc around the feet of the North and South Downs. The petroleum is trapped in faulted anticlines and produced from Jurassic limestones and sandstone reservoirs.

In recent years there has been much enthusiasm for producing gas and oil from fractured shales. The principal target has been naturally fractured limestones thinly interbedded with the Kimmeridge Clay. At the time of writing no company has requested permission to hydraulically fracture a well in the Weald basin.

Whether or not recent enthusiasm for exploring for unconventionally trapped petroleum in the Weald is justified depends on the drilling of several wells followed by prolonged flow tests, with or without hydraulic fracturing. Meanwhile exploration for conventionally trapped petroleum continues, as at Bury Hill. Some of the vast figures for Wealden petroleum are vastly exaggerated. There is a common misconception in the media and among financiers of the difference between in place resources and economically producible reserves. Opposition to petroleum exploration and production is often based on ignorance coupled with failure to appreciate the imminent energy 'Trilemma' facing the UK.

Index of Contents of the Farnham Geological Society's Newsletters 1970 to February 2016 - Composed by John Stanley, Memeber FGS

John Stanley, a member of FGS, has kindly put together an index of every article ever published by the Society in its Newsletters, so it dates back to 1970. A sample from the Index is shown below – The Newsletter from October 1972.

Item	Key Word	Event Type	Lecturer / Leader	Author	List of Contents	Year	Issue	Vol	No	Pg
28	Sussex - Bracklesham Bay	Field Trip - 1972 September			Bracklesham Bay - 17th September	1972	Oct	1	8	2
27	Avon - Gorge	Field Trip - 1972 October	Finch, Ted		Avon Gorge	1972	Oct	1	8	1
26	Cornwall	Lecture - 1972	Butler, Mr R		The Geology of Cornwall	1972	Oct	1	8	1
25	Lectures	Note		Ashcroft, Roger	Future events	1972	Oct	1	8	1
24		Editorial		Ashcroft, Roger	Editorial	1972	Oct	1	8	2
23	exhibition	GA Reunion			GA Reunion display November 4th	1972	Oct	1	8	3
22	Sussex W - Bracklesham Bay	Field Trip - 1972			Bracklesham Bay Field Trip Report (Sunday ????)	1972	Oct	1	8	2
21	Surrey - Lapidary	Note			Invite to Wessex Impex Ltd - November 5th (Invite from Surrey Lapidary Society)	1972	Oct	1	8	3
20	Iceland	Lecture - 1972 November	Sowan, Mr P		Icelandic Geology - November 10th	1972	Oct	1	8	4
19	Lunch	Note			Wine and Cheese Party - December 8th	1972	Oct	1	8	4

John has developed it so that one can search for authors / topics at will. You will be surprised what you can find. As you can see, the topics and activities covered within one issue and thus during the year have always been very varied and plentiful. A reflection of the hard work of the committee members throughout the years.

The index is worth perusing, and can be found online by following the link to the Newsletter page on the FGS website, www.farnhamgeosoc.org.uk

From the Archive - FGS's Very First Newsletter circa 1970

To accompany the above index of all FGS Newsletters, readers may be interested to see a reprint of the very first FGS Newsletter from the Summer of 1970 – it has come a long way since this first edition! Please read and note the final paragraph, as relevant today as it was then.

FARNHAM GEOLOGICAL SOCIETY

Newsletter Vol 1 — 1.

The first field meeting of the Society was held on Sunday 12th. July 1970, when twelve members met at Burrington Coombe in the Mendips. Eleven localities were visited and although the majority were Carboniferous exposures, Jurassic and Silurian rocks were also examined. Fossils were collected from the Carboniferous and Jurassic rocks and included some fine plants from a coal tip near Radstock. Most of the exposures showed evidence of the Armorican earth movements and at Vobster Quarry a remarkable Upper/Lower Carboniferous reversal was seen. Thanks are due to Mr. E.M. Finch for organising a most informative and enjoyable trip in such splendid scenery. One party was so impressed by the scenery in and around Radstock that they thought it worth more than one circuit of the same route and lead a motorcade in a sort of "Turkish Shepherds' Dance" for a few miles.

Although no formal programme has been finalised, the following topics for lecture meetings are proposed:-

The Folkstone Beds.
Vulcanism.
Geology of South East England.
Continental Drift.

The first of these meetings will be held on Thursday 6th. August at 7-30 p.m. at the Adult Education Centre, Potters Gate, Farnham. Mr. E.M. Finch will talk on the subject of the Folkstone Beds and will detail the Society's research project in this area. This project will require the active support of as many Members as possible so please make a special effort to attend this meeting. If you are unable to attend but will be available for field work, please inform the Secretary so that Mr. Finch can select the various teams on the sixth.

This News Letter is optimistically numbered one as it is proposed to make a regular feature of a News Letter. As the Society ages no doubt Members will wish to contribute items of interest and if the Secretary's typing finger holds out, the Letters will grow.