Home Counties North Regional Group

Newsletter - Issue No. 4 – June 2016

WELCOME to the fourth edition of the Newsletter of the Home Counties North Regional Group. Once again, I must start with apologies, firstly to Mick McCullough for getting his name wrong in the last issue and secondly to the Group as a whole for the delay in producing this issue. This issue covers events during 2015.

It is pleasing to report the continuation of a successful programme of evening lecture meetings and one-day field trips, though attendance has not been as high as might have been hoped. We have again managed to get around the region, with meetings in Hatfield, Hemel Hempstead and Milton Keynes. The programme has been varied and we hope to maintain that variety in the future.

Art the AGM in January 2015, Dave Brook was elected as Chair, having been acting Chair since the resignation of the previous Chair and Susan Gann and Stuart Wagstaff were elected onto the Committee having previously been co-opted; otherwise the Committee remained as in the previous year. The 2015 AGM saw changes with Stuart Wagstaff elected as Chair, Jessica McDonald as Treasurer and Jonathan Vetterlein as Secretary; Louise Cox, Alastair Dewar, Seamus Lefroy-Brookes and Charlotte Murray resigned from the Committee and their places were taken by Darcy Kitson-Boyce

We present below only the photographs of those elected at the AGM details of whom are in Issue No. 1, together with information on the co-opted members. We will give details of co-opted members in the next Newsletter. While this Newsletter was being prepared, the Chair resigned due to the pressure of work and the position is currently vacant.

Meet Your Committee

Officers

Chair – Stuart Wagstaff Treasurer – Jessica Macdonald Secretary – Jonathan Vetterlein

Ordinary Members

David Brook **Sarah Smart** **John Wong**

Susan Gann

Fema Atinimola

Darcy Kitson-Boyce

Michael McCullough was_born in Leicester in 1947 and got his M Phil from Camborne School of Mines in 1976. He is a Chartered geologist, scrutineer and Chartership Committee member. He worked for Wimpey Laboratories as a field geophysicist, then Exploration Consultants, Pentex and Marathon Oil as Senior Geophysicist in the oil industry before acting as consultant senior geophysicist since 1995, again in the oil industry, for both seismic interpretation and client representative on VSP and site surveys. During downturns in the industry, he has been an associate of M & M Geophysical for geotechnical geophysics and part owner of Blue Diamond Drilling, a geotechnical drilling company and spent several years as second driller and site geologist.

Matthew Rust studied geology at the University of Portsmouth and is currently in the early stages of his career with Soil Consultants Ltd as a Geotechnical Engineer. Having studied geology he developed a keen interest in mineral exploration and engineering geology, and the overall importance of these two sectors in our everyday lives. However, geotechnical engineering and site investigation is his principle current focus along with developing his CPD profile in order to become a chartered geologist.

Ex-Officio Members

David Jones is a member of Council, Vice-President Regional Groups and former Chair of the Southern Wales Regional Group.

Other members of Council within the region are also ex-officio members of the Committee.

Meetings of the Home Counties North Regional Group

1. The current status of geological screening for disposal of radioactive waste

20 January 2015

At the Home Counties North Regional Group meeting at Sir Robert McAlpine, Hemel Hempstead, Andy Parkes of Radioactive Waste Management give his talk on **The current status of geological screening for disposal of radioactive waste.**

THE SPEAKER **–** Andy Parkes is a chartered hydrogeologist with over 25 years of experience in a wide range of groundwater related topics including water resources, environmental protection and construction dewatering. He is particularly experienced in the characterisation of sites to support nuclear safety cases and has been the Head of Site Characterisation at RWM since 2009. His involvement in the Sellafield Geological Investigations in the 1990's and management of the Dounreay Shaft Hydrogeological Investigations in 2000/1 have given him a strong understanding of the unique challenges which such projects pose. He is part of the RWM team undertaking the National Geological Screening exercise.

ABSTRACT – The permanent, safe disposal of higher activity radioactive waste is one of the great challenges facing Earth Scientists. The internationally agreed solution is deep geological disposal. The Government has recently published a revised approach to addressing the issue in this country, in which the geoscientific community have a key role to play. Radioactive Waste Management Limited (RWM) is the Government-appointed developer of a geological disposal facility. Andy Parkes of RWM will explain the new 2-year National Geological Screening exercise, and seek Members' views on it. RWM are keen to ensure the expertise and insights of geologists, engineers and scientists of different disciplines help shape and inform the national screening exercise and its implementation. So please feel free to bring along colleagues, ask questions and make your contribution to the debate. Following an initial technical meeting on the National Geological Screening exercise at Burlington House on 30September 2014, RWM is holding a series of meetings with Geological Society Regional Groups, as part of a programme of public events offering an opportunity for people to engage in the debate. You can read more about the National Geological Screening exercise and the Government's policy for geological disposal at:www.nda.gov.uk/rwm and

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/332890/GDF_White_Paper_FINAL.pdf
If you want to be kept updated on this subject and further events please subscribe to our e-bulletin at www.nda.gov.uk/rwm/subscribe

2. An introduction to quarry design: skills, experience and approaches needed for success

23 February 2015

At the Home Counties North Regional Group Meeting at the Open University, 16 people heard Ruth Allington of GWP Consultants LLP talk on **An introduction to quarry design: skills, experience and approaches needed for success** and received a cd of *A quarry design handbook* produced by GWP Consultants and David Jarvis Associates (a publication which is free to download from www.gwp.uk.com/qdeshbook.html or available on cd by request to info@gwp.uk.com).

THE SPEAKER – Ruth Allington is Joint Senior Partner of GWP Consultants LLP, the firm she joined in 1981 immediately after graduating. In addition to her BSc and MSc degrees, she also has an MBA, and she is a qualified commercial and community mediator. She is an experienced expert witness. Ruth has served GSL on Council (as Vice President and as Professional Secretary) and is a past Chair of the Engineering Group. She is a past President of the European Federation of Geologists (EFG), a member of the Pan European Reserves and Resources Reporting Committee (PERC), and chair of an IUGS Task Group On Global Geoscience Professionalism. Ruth was the 13th Glossop Lecturer (2012), and featured as one of 100 Global Inspirational Women in Mining in a publication produced by Women in Mining in 2013.

ABSTRACT – Drawing on the 2014 edition of A Quarry Design Handbook and more than 33 years of experience specialising in the design of open pit mineral operations in the UK and overseas, Ruth will describe a process for planning mineral operations that achieve a balance between social acceptance, limiting environmental harm, achieving commercial success and ensuring safety. She will describe a process for coordinating and managing the planning and design of new mineral operations, drawing particular attention to the geological and other technical/scientific inputs to quarry design as well as the wider professional skills based on 'joined up thinking' and effective communication with and co-operation between all stakeholders.

The speaker, a specialist in the design of open pits, especially for cement raw materials, explained that she intended to cover 3 aspects of quarry design:

- What is success in quarry design?
- What are the key objectives of quarry design?
- How do we achieve those objectives? – The approaches and professional skills required.

Quarrying involves the extraction and processing of the mineral, restoration and after use of the site and transport and marketing of the mineral. In British planning and regulations, quarrying is a temporary use of land. The life cycle of a quarry involves the design phase, the operational phase and the post-closure phase, along with health and safety management and interaction with stakeholders.



Sand & gravel quarry *Hillside quarry* *Openpit hard rock quarry*

Key success factors

Quarry operators wish to secure planning permission and the relevant licences required to operate, to comply with the licence and planning conditions, to develop a business plan for developing the mineral asset, to establish a new quarry and to implement its improvement plan.

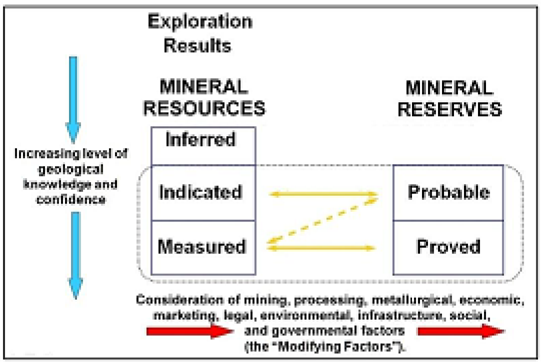
Quarry operators and managers wish to have a safe quarry, a harmonious relationship with the local population and no hassle from the local planning authority or the Environment Agency.

Mineral planning authorities wish to secure a land bank of mineral permissions and to stop quarry operators with adverse effects on the environment or the local population.

The public generally wish to stop quarrying close to their community but, if the quarry is permitted, they want it to be a good neighbour and to provide an after-use that is of benefit to them.

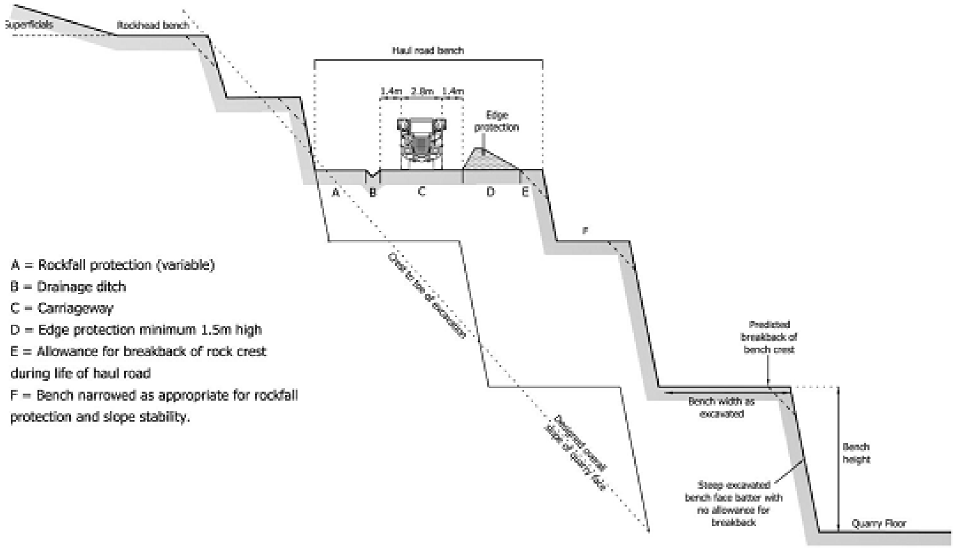
The over-arching objective is to have safe, efficient, profitable extraction of the maximum amount of material with the minimum environmental and social disturbance and beneficial restoration and after-use.

Key issues



General relationship between exploration results, mineral resources and mineral reserves (CRIRSCO).

The commercial aim is to have recoverable mineral at a viable rate, which is costed and the commercial attractiveness assessed and operated as part of business planning, monitoring and management. Geologists need to establish the reserves taking account of the modifying factors (mining, metallurgical, economic, market, legal, environmental, social and governmental) according to the relationship established by the Committee for Mineral Reserves International Reporting Standards www.CRIRSCO.com). (CRIRSCO; A resource is a mineral with a reasonable prospect of economic recovery, inferred resources not being confirmed but moving onto indicated and measured resources with increased knowledge and geological confidence. Reserves are those where extraction could reasonably be justified. In assessing reserves, care must be taken to consider haul roads in benched faces, which can reduce the available mineral, and low-angle discontinuities, which can pose a safety hazard.



Design principles for haul roads incorporated in benched quarry slopes, showing loss of reserves

For safety and operational efficiency, the quarry design must be capable of being practically implemented with inherently safe and secure operations and structure. For this purpose, the quarry must be designed from cradle to grave with strict compliance with regulations and best practice based on adequate and reliable information and analysis and operated in accordance with the quarry design and regulations.

The Aberfan tip failure in 1966 was a key moment in British safety legislation relating to mine waste safety and was important in the early years of geotechnics and professionalism in geoscience. It resulted from technical failures and institutional failure to act on warning signs on the grounds of coast. The failure of the St Aidans opencast coal working resulted from a failure in competence in the operation design and training/management failures. Other examples cited were the Bingham Canyon failure, which caused multi-billion dollar losses and a tailings dam failure in Hungary. The Quarry Regulations 1999 now provide a pro-active approach to hazard appraisal and an Approved Code of practice. In particular, Regulation 6 imposes a general duty on the operator that quarries be designed and the Regulations define what is meant by a geotechnical specialist – 3 or more years relevant experience and competence to perform geotechnical analysis to determine hazard and risk.

The environmental aim is to minimise harm and to secure effective environmental management and environmentally sustainable final restoration and after-use. Environmental assessment is integral to quarry design, involving environmental/planning specialists, the quarry manager, estate managers and geoscientists. The Environment Agency operate on the source-pathway-receptor principle so if there is no pathway to receptors, there is no environmental hazard. Topics covered include architectural and cultural heritage, soils, agricultural soil, amenity, traffic/mineral transport, dust, emissions and air quality, landscape and visual impact, noise and vibrations, surface and ground water and ecology. In this, geoscientists concentrate on the potential pathways between pollutant sources and receptors.

Making it happen

A successful mineral extraction operation requires technical commercial and scientific competence and professional qualification, continuing professional development and experience, with particular importance given to project management, general management and communication. Quarry design is the best way to bring together the commercial aspects, safety, operational efficiency and environmental impact and needs interaction between all the relevant disciplines.

Site selection and strategic issues include the control of land, resources, demand, planning status/cycles, human and environmental constraints, technical constraints, restoration options, after-use and long-term asset value together with design risk assessment in the light of environmental, operational and commercial uncertainties. All are considered in the design of the quarry excavation and the restoration scheme. Conceptual design and feasibility study lead to the selection of the preferred option for working up into a planning application and/or detailed operating and restoration phases. The design stage is then in 2 parts, the detailed design of the final void and restoration scheme and the phased working and restoration scheme.

Securing a social licence is of vital importance. The impacts of the quarry must be bearable (socially and environmentally), equitable (socially and economically) and viable (environmental and economic success). The starting point is the local residents and must involve the company and the environmental assessment team. It is important to recognise, however, that experience has shown that these often speak completely different languages.

In summary, the attaining of a safe, profitable and environmentally and socially acceptable quarry requires a range of different professional skills and perspectives other than technical, commercial and scientific, including:

- problem definition;
- dispute resolution;
- communication;
- respect for the views of others;
- flexibility; and, generally,
- listening more and talking less.

At the Home Counties North Regional Group meeting at Sir Robert McAlpine in Hemel Hempstead, 26 people heard Helen Nattrass, Sir Robert McAlpine talk on **3 weeks in the Scotia Arc: a snapshot field trip in Antarctica.** After a break for curry, Dave Brook, Acting Chair of Home Counties North Regional Group spoke on **A geologist in Antarctica: reflections after 50 years.**

Report by Dave Brook

3. Did the earth move for you? From great earthquakes to silent slip

Thursday 23 April 2015

At the Home Counties North Regional Group meeting at Affinity Water, 16 people heard Dr Rebecca Bell of Imperial College give her talk on **Did the earth move for you? From great earthquakes to silent slip**. This talk covered what the speaker considered to be one of the most exciting discoveries in earth science in the last 15 years, the discovery of a new form of earth movement, and how the use of technology originally developed for the military – global positioning system (GPS) – is helping us to learn more about seismic hazard and earthquake risk.

THE SPEAKER: Rebecca Bell began her career in Earth Science by completing a MSci degree at the University of Oxford. She then undertook a PhD in Marine Geophysics at the National Ocanography Centre Southampton before moving to New Zealand to work as an Active Source Seismologist at GNS Sceince. Rebecca is a now Research Lecturer in the Department of Engineering and Earth Science at Imperial College, London.

ABSTRACT: Where one tectonic plate slides beneath another, motion in the subduction zone is controlled by the plate boundary fault zone. Although some plate boundary faults

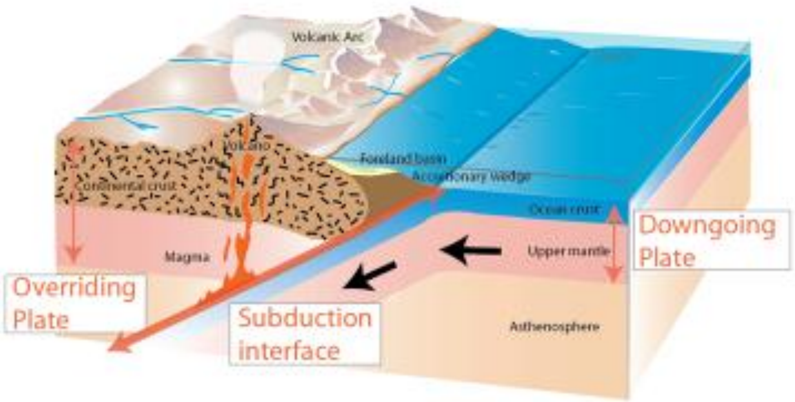
fail in catastrophic earthquakes, such as the 2011 Tōhuku-oki, Japan and the 2004 Sumatra-Andaman earthquakes, at some subduction margins the plates creep past each other effortlessly with no stress build-up along the fault and no large earthquakes. Determining the controls on how the fault moves is fundamental to assessing the seismic hazard and to our understanding of the earthquake process itself. In the last 15 years a completely new type of seismic phenomena has been discovered at subduction zones – "silent earthquakes" or slow-slip events. These release as much energy as a large earthquake, but do so over several weeks or even months with no ground-shaking at all. Determining whether such events may trigger highly destructive earthquakes and why they occur at all are 2 of the most important questions in earthquake seismology today. This talk discussed the various types of fault-slip behaviour that have now been discovered at subduction margins and looked at the new techniques being used to learn why some subduction megathrust faults slip in devastating earthquakes and others slide silently.

The speaker started by asking the audience what they would do if there was a Magnitude 7.5 (M7.5) earthquake. Earthquakes can be big and are often catastrophic. Since the 1930s, they have been measured on the Richter scale based on the amplitude of the ground waves, which is a measure of the amount of shaking. The largest recorded reach M9.0, such as the 2004 Sumatra-Andaman earthquake and the 2011 Tohoku earthquake in Japan, both of which produced large tsunamis and together resulted in over 250,000 deaths. The Richter scale is logarithmic, so each unit increase in magnitude is a tenfold increase in the size of the earthquake. Generally, earthquakes above M8 will produce complete destruction while those of M7-8 will cause serious damage; the earthquake in Haiti in 2007 was, for example a M7.

Aftermath of the Tohuaku earthquake and tsunami, Japan, March 2011

Earthquakes happen when slabs of rock slide past each other, with the pressure building up until the frictional resistance is overcome and there is rupture along a fault line. This rupture happens at about the speed of a bullet (2km/sec). Many of the faults are known but the Christchurch, New Zealand earthquake happened on an unknown fault that was buried beneath sediments. A good example of a fault in the UK is the Blue Anchor Fault at Minehead, Somerset, where the cliffs show Triassic and Jurassic rocks abutting each other. The displacement along faults does not occur in a single earthquake but in hundreds or even thousands of events, each of which may only displace about 1m. The area of the fault plane that slips forms the basis of the modern method of earthquake measurement using the Moment magnitude scale, which has been designed so that a Moment M7 is about equivalent to a Richter M7. Other faults were illustrated by an air photograph of the Tien Shan region of China with a 5km displacement along a strike-slip fault and a satellite photograph of the South Island of New Zealand, where the Southern Alps suddenly stop against the strike-slip Alpine Fault, which has a displacement of hundreds of km.

Tectonic plate boundaries are the areas of greatest movement where the plates move apart, as at mid-ocean ridges, slide past each other, as at the San Andreas Fault in California or one plate dives beneath another – subduction zones – such as around the Pacific "rim of fire". The UK is relatively aseismic, with the largest earthquake in the last 30 years being the 2008 Lincolnshire earthquake at M5.2, The Pacific Ocean is surrounded by earthquake zones outlining the tectonic plates, along with associated volcanism due to partial melting as the plates descend in subduction zones. In the North Island of New Zealand, for example, the Pacific plate is subducting beneath the Australian plate and there is a zone of volcanism associated. The boundary between the plates – the subduction interface – is known as a mega-thrust fault and can be thousands of km long and tens of km wide. In the Sumatra-Andaman earthquake in 2004, the rupture was 1,000km long and displacement was 20m, while the 2011 Tohoku earthquake resulted in 50m displacement. The question is what controls the size of subduction earthquakes.



Subduction zone megathrust fault

The example was given of the coastal town of Gisborne in the North Island of New Zealand, where, in 2010, a M6.8 earthquake occurred on a shallow fault 15km beneath. However, nothing happened in Gisborne, life continued without interruption, no-one felt it and seismometers did not detect it. Attention continued to focus on New Zealand, which has the Pacific plate subducting westwards under the Australian plate in North Island and the Australian plate subducting eastwards under the Pacific plate in South Island with a complex strike-slip region between. There is concern as to what size of earthquake needs to be catered for in building design and whether a M9 earthquake could occur along the subduction margin fault. There is certainly no recorded historical example of an earthquake that big and examination of Maori legends provides no evidence of a large earthquake or tsunami in the last 1,000 years or so. Palaeoseismologists are looking for evidence in cores from lakes etc but there is still no evidence. Geophysicists are, therefore, using new technology – GPS – to study plate movements.

Silent earthquakes

Up to 30 years ago, mega-thrust faults were believed to behave in one of two ways. Either the fault gets stuck, pushing the over-riding plate along with it at about 4cm/year until rupture suddenly occurs in a large earthquake or there is passive subduction along a virtually frictionless interface and the over-riding plate stays where it is. A network of GPS receivers has been installed on the over-riding plate in New Zealand, the results from which indicate that, in North Island at Gisborne, the fault is locked with jumps at earthquakes, such as that in 2010. However, it is not a sudden rupture but the movement takes place over 4 weeks at a speed of about 1cm/day, as a result of which there is no shaking. Such events, known as slow-slip events or silent earthquakes, were first discovered in 2002 and have occurred every 2 years since. Further instrumentation on the sea-bed was installed in May 2012, a year when an event was expected and one occurred in October 2012.

This type of movement may occur because of a weak fault with lots of fluid around and seismic reflection imaging has been used to examine the subduction interface at depth. In 2005, a seismic reflection survey was undertaken off the east coast of New Zealand. A 100km-long seismic profile 15km deep shows the Gisborne Knolls (offshore volcanic sea mounts), ocean floor sediments, the accretionary wedge on the over-riding plate and the subduction interface between the Pacific and Australian plates. Areas of slow-slip have higher amplitude reflections than elsewhere, which indicates stronger contrasts, possibly as a result of sediments being trapped and subducted with the Pacific plate, increasing fluids on the interface. There are now proposals to drill through the International Ocean Drilling Programme and a decision is expected next month on when drilling will be planned (probably in 2017). The first phase will be the drilling of shallow instrumented holes and 5-10 years later it is hoped to drill to 5-6km depth to penetrate the mega-thrust fault in the slow-slip zone.

Controversy remains as to whether slow-slip events make large earthquakes less likely or whether they increase stress elsewhere and trigger great earthquakes. For example, a headline in the *Straits Times* earlier this year read "Years-long silent quakes unleashed Fukushima tsunami", based on a paper by Yohota and Koketsu in *Nature communications*.

Tsunami earthquakes

In March 1947, a Richter M5.8 earthquake occurred on a shallow fault 50km out to sea off North Island, which produced an anomalously large tsunami. A second similar earthquake occurred in May 1947. The minor earthquake caused shaking and, 30 minutes later, a 10m-high tsunami hit Gisborne, fortunately with no casualties. The tsunami advice at that time was – "in the case of a strong earthquake, move inland (1.5km) or to high ground (35m) and do not return for at least one hour" but this was not a strong earthquake.

We used to think that 14-15km was the seismogenic zone but tsunami earthquakes (as opposed to the large tsunamigenic earthquakes) occur at <5km depth and can rupture all the way to the surface. Van Heuner et al, 2004 (*Geology*, **32**, 913-916) suggested subducting seamounts give sticking points. On the seismic reflection profiles, the reflections are low amplitude suggesting little difference in rock properties but there are sloping reflections which suggest they are the sides of structures. Tsunami earthquake rupture happens very slowly, at 1km/sec to 300m/sec.

As a result, the tsunami advice has been changed to – "in the case of an earthquake lasting longer than one minute or too strong to stand in, move inland…

Conclusions

30 years ago we knew of 2 types of earth movement related to subduction mega-thrust faults – passive (frictionless) subduction at 4cm/year or sudden movement of locked plates at 2km/sec – then tsunami earthquakes were discovered moving at 1km/sec to 300m/sec. 15 years ago, slow-slip or silent earthquakes were discovered moving at 0.5-1.0cm/day. Further development of seismic hazard and risk assessment requires a fuller understanding of the whole spectrum of seismic behaviour. More information can be obtained from a paper by Bell and others, 2014 in *Earth & planetary science letters*.

Report by Dave Brook

4. What can meteorites tell us about the earth?

17 June 2015

At the Home Counties North Regional Group meeting at Sir Robert McAlpine in Hemel Hempstead, 21 people heard Professor Hilary Downes of Birkbeck College, University of London talk on **What can meteorites tell us about the earth?**

THE SPEAKER – After graduating in geology at Durham University, Hilary Downes obtained an MSc in igneous petrology from the University of Calgary and a PhD in igneous geochemistry from the University of Leeds. She held a Post-doctoral Fellowship at the University of Edinburgh before joining Birkbeck College, University of London, as a Lecturer. She has since progressed through Senior Lecturer, Reader and she is now Professor. Hilary's research interests range from intraplate magmatism, to mantle xenoliths, to meteorites. Her field investigations have taken her from Greenland to Russia and the Cape Verde islands.

ABSTRACT – *Meteorites are fragments of material from the early Solar System. They are mostly derived from asteroids (although some have been identified as coming from the Moon or Mars). As messengers from the deep past, they can shed light on the formation of the Solar System, the condensation of dust and rock from the Solar Nebula, and the accretion of terrestrial planets. This talk will consider what information can be derived from a study of meteorites to understand how planets such as the Earth formed. Some meteorites are formed of material collected on the surfaces of asteroids over billions of years and thus act as a repository of solar system material that cannot be obtained in any other way.*

The speaker explained that she had long had an interest in the earth's mantle and that this had inspired her interest in meteorites. While specimens from the mantle are not available for study, meteorites are very similar in some ways but also very different in others.

What are meteorites?

Meteorites are mostly left-over bits of the early solar system – ancient pieces of material that preserve information from the distant past. The different types include:

- chondrites, stony meteorites that were the ingredients that formed the planet;
- metal iron meteorites from the core of some unknown small asteroid; and
- stony irons which were part of a planetisimal, comprising iron and olivine crystals

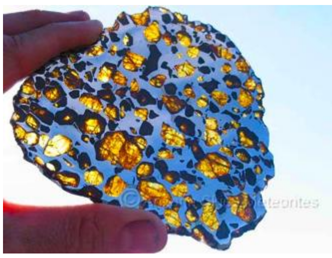
Most meteorites are sourced from the asteroid belt, having been ejected from their parent bodies by co0llision with other asteroids. They arrive on earth because the fragments have been disturbed from their orbits by the influence of gravity from Jupiter into earth-crossing orbits. There are also meteorites on the moon and on Mars.

October 2008 was the first occurrence of an earth-colliding asteroid (2008TC3) being detected before impact, fortunately a small one. It landed in Sudan and the meteorite was collected by American and Sudanese scientists. It is a ureilite consisting of over 600 individual pieces and largely composed of olivine and pyroxene, like the mantle, with up to 7% carbon.

Why study meteorites?

Meteorites are an important study area because they are common enough to get a picture of the parent asteroid. They look like the mantle and regolith of another planet from right on the surface of the parent body. They are universally old (4.563Ga) and formed very early in the development of the Solar Syatem, the age of which is 4.567Ga.

Ureilites are ultramafic rocks consisting of olivine, pyroxene (pigeonite), graphite and diamond with rare Fe-Ni metal and Fe sulphides. They look like fragments of mantle from another planet. Many show shock features due to impact, such as mosaicised olivine formed by extreme impact shock. They contain graphite and diamonds formed by shock – microdiamonds a few microns across. They also contain metals with compositions similar to those that have been proposed for the earth's core – Fe/Ni sulphides and Fe/Ni silicides – probably representing left-over bits from core formation. They have about the same amount of silicon as has been suggested for the earth's core. The olivine (Fo80) has Mg-rich (Fo100) rims full of iron blebs due to sudden reduction of hot silicate minerals in the presence of graphite, which indicates sudden pressure loss while the asteroid was very hot.



It would appear that a major impact catastrophically disrupted the ureilite asteroid and actually preserved evidence that is lost from other planetisimals that went on to the magma ocean stage. The terrestrial planets (Mars, Earth and the moon) went through this stage when the whole or a large part of the silicate part of the planet was completely molten. The ureilite asteroid never got that far but re-accreted into a new daughter asteroid. They also contain some breccias which were parts of the regolith of the re-accreted rubble-pile asteroid similar to the surface of the asteroid Eros (NEAR – Shoemaker) and they are in fact sedimentary rocks made out of pieces of asteroid.

One Antarctic ureilite breccia meteorite has lumps of ureilite and exotic clasts – flakes of graphite and clasts from a more iron-rich asteroid, which arrived on the parent ureilite asteroid as a meteorite. We can even see how the rubble-pile asteroid was stuck together with fine-grained veins. Breccia meteorites thus represent the soil of the asteroid.

Electron microprobe analysis of 2 Australian, 2 Antarctic and 2 Namibian ureilites gives the precise chemical composition of the constituent minerals and metals, eg the Fe/Mg and Fe/Mn ratios. All indicate a common variation trend for ureilites and some foreign bits that do not belong to the parent asteroid, including an R-chondrite clast in a ureilite meteorite.

Secondary ion mass spectrometer (SIM) analysis measures the isotope ratios for ^{16}O, ^{17}O and ^{18}O. Most oxygen on earth is ^{16}O but different parts of the solar system have or had different ratios of $^{18}O/^{16}O$ and $^{17}O/^{16}O$. All materials from earth plot on one line for $^{17}O/^{18}O$ but CAI and chondrites plot on a different line. SIM analyses of ureilites show some similarities to carbonaceous chondrites so it may be that ureilites formed from the same part of the solar nebula as carbonaceous chondrites or perhaps formed from them. Enstatite chondrites plot on the earth – moon line. Unlike the mantle, ureilites are heterogeneous in olivine composition and oxygen isotope composition. This indicates that the ureilite asteroid never experienced a major homogenising event such as the magma ocean stage. It is thus a failed planet, which failed because of impact from another body.

Summary

The early solar system from which the earth formed can be studied via meteorites. Ureilite meteorites tell us about the differentiation of planetary mantles and cores as they represent early solar system bodies that were disrupted by major impacts and then reassembled by gravity. Brecciated ureilites tell us about the regolith of asteroids and are a collecting ground for strange micrometeorites.

Finally

If you look very carefully at ureilite meteorites you can see that they contain some very strange items. For example, one Antarctic meteorite contains a strange fragment of granite. Microprobe x-ray maps show phenocrysts of feldspar grading from a calcic core to a sodic rim in a matrix of albite feldspar and quartz polymorphs and it looks like a granophyre. It must have come from a planet big enough to produce granite, possibly from Mars. One ureilite contains opal (hydrated silica with 80%SiO_2 and 20%H_2O) but where did the water come from? Opal has never been found before in meteorites except in Australia, where it was thought to be a weathering product. In one example, the opal replaces olivine.

Report by Dave Brook

Wednesday 30 September

5. Double event and curry night

At the Home Counties North Regional Group meeting at Sir Robert McAlpine in Hemel Hempstead, about 40 people heard Bill Gaskarth, Chartership Officer for the Geological Society, talk on **Chartership in the Geological Society**, followed, **a**fter a break for curry, by Brian Barrett of Zenica on **Geophysical methods for ground investigation.**

Chartership in the Geological Society

THE SPEAKER – Bill Gaskarth is the Chartership Officer for the Geological Society.

ABSTRACT – This talk will cover the system for applications and provide advice generally or individually for those looking to apply. The application and assessment procedures are being changed somewhat so he will have information for Applicants, Scrutineers and Sponsors. The speaker will also be looking for CGeols to hold their hands up and apply to be Scrutineers.

The Society runs 5 sessions per year for interviews for chartership. Some times are popular, others not so, the variation in recent numbers being from 24 to 42. 3 professional qualifications are offered, CGeol, EuroGeol and CSci. Achieving CGeol automatically qualifies as Eurogeol, provided the money is paid, while CSci within the Society is to cater for the large number of people who graduate in geology (up to 1,000 new graduates each year) when there are not nearly so many jobs in geology; a lot of scientific jobs, however, are in the periphery of geoscience.

The benefits of chartership are that it is a mark of achievement of a high level of competency assessed by your peers, a title of equal standing with those of other chartered professions, which is governed by an enforceable code of conduct and competency is maintained through CPD. CGeol is for the practising professional geologist, CSci for geological work on the periphery.

Eligibility for chartership is through a degree in geoscience and a number of years of relevant professional experience. The number of years needed depends on the degree and its accreditation but it is stressed that applications need to be made when the sponsors consider the applicant to be ready for chartership and not just when they are eligible to apply, since the latter leads to up to 15-20% of deferrals when applications are assessed.

The application consists of the application form, the professional report giving an overview of competency, the CPD record, 2 sponsors' statements and supporting documents. In the initial assessment, scrutineers are asked if the application is strong enough to take for interview and they may ask for more information before recommending interview or deciding the interview should be postponed or they may accept that an application should go straight to interview. A postponed interview will not incur an additional application fee. Scrutineers are then asked to record their assessment of the written application and indicate areas to question, interview the applicant and write a post-interview report.

On the application form, contact detail – e-mail and telephone – are essential, as is the area of work so that the Society can select appropriate scrutineers with education and experience details to judge eligibility. Sponsors should be professionally qualified (preferably CGeol) and known to the applicant for at least 3 years and they should comment of the breadth and depth of the applicant's knowledge, the quality of their work and professional standing. They also need to advise an applicant if they feel that they are applying too early or that the application is not properly focused. We need to be assured that they believe that an applicant is 'ready' for Chartership as well as being eligible.The professional report should describe the experience, skills and competence of the applicant emphasising competence to the level that the applicant now claims qualifies them to become CGeol. Emphasis is on an applicant's <u>geological</u> competence.

and refer to the supporting documents. Each part should be signed off by the relevant line manager,

Supporting documents should be a maximum of 6 which have been carefully selected to demonstrate particular facets of the applicant's skills, experience and competence. They should showcase the work and focus on demonstrating how the requirements of the criteria for chartership have been met. They should emphasise the applicant's work in team productions and it is important not to submit large documents with non-relevant information. They may be in various forms, such as reports, interpreted cross-sections, 3-D ground models, maps etc. It is important to remember that company reports address the needs of the client and not necessarily the chartership criteria. Much of the geological information and thinking will be in the field notebook. The supporting documents should each have a cover sheet pointing to the relevant parts.

Confidentiality can clearly be important. All documents are seen by the Chartership Officer and the 2 scrutineers and any conflicts of interest will be resolved by changing the scrutineers with major problems being resolved by the Chartership Officer. If it is impossible to submit a piece of work because of confidentiality, employers ay provide a written explanation of the work.

The CPD record should be for at least one year and should show understanding of te different type of CPD and a commitment to it. It is important to show a Plan – Act – Reflect cycle. It can be recorded on the Geological Society website or using a company or personal scheme. It would be useful to re-introduce he Geologist's Diary to record all the jobs undertaken.

For the competence overview there is a form to complete with a short statement on how the applicant fulfils the competences. Sponsors have a similar form to complete.

The interview is scheduled for 2 hours and normally lasts about 1.5 hours. It should start with a presentation of no more than 15 minutes and it is important not to simply repeat what the scrutineers have already read but it is an opportunity to showcase the work an applicant is proud of and demonstrate why they should be chartered. It is commonly done on a laptop with a powerpoint display.

Scrutineers are geologists who have been chartered for at least 5 years or who have had many years of experience prior to chartership. An applicant may ask for a change of scrutineers if there is a conflict of interest. They are interested in what an applicant has to say and are looking for reasons to approve rather than reject an applicant. After the interview the scrutineers' report will recommend either to accept or defer chartership or a conditional acceptance subject to the provision of further information. If the is to accept, the report is forwarded to the Chartership and Professional Committee. If deferral is recommended, the application and report are sent for review. If the review agrees with a recommendation to defer, the applicant is sent a letter explaining the reasons and giving advice on what is needed to achieve chartership. If the review disagrees with the recommendation the decision may be overturned or another interview held with different scrutineers.After acheving chartership, a retrospective application can be made for CSci up to 2 years after achieving CGeol. It needs to address the diffeences in criteria between the two and to provide CPD records for the intervening period. Conversely CGeol can be applied for following attainment of CSci.

Post-chartershiop, a CGeol becomes eligible for EurGeol and for ROGEP at the professional grade. The SILC award is also available for specialists with added experience.

Report by Dave Brook

Geophysical methods for geotechnical ground investigation

THE SPEAKER – Brian was trained as a geophysicist in Adelaide, Australia before undertaking a PhD in Glaciology at Leeds University. He started at Zetica as Senior Geophysicist in 2009, and was made Technical manager in 2012. He works with Zetica's geophysicists and technicians to deliver on a wide variety of sub-surface investigation projects, ranging from geological and environmental studies to infrastructure condition and brownfield site characterisation surveys.

ABSTRACT – *This talk will present a selection of recent case studies, focussing on the role of Geophysics in sub-surface investigations. Examples will include seismic refraction surveys, electrical resistivity imaging, and borehole seismic measurements.*

The speaker, technical manager for Zetica explained that the company was 23 or 24 years old and works globally in engineering, ground characterisation, rail, utilities and site safety. Most of the site investigation work is in UK, while rail work is international.

Geophysics is the study of the earth through measurement of its physical properties, or geology without getting the hands dirty. The properties involved include density, elasticity, magnetic susceptibility, electrical conductivity and the use of geophysical techniques requires a measurable contrast between a target and the background.

Geophysics is used in site investigation for site characterisation, to determine physical properties, to detect voids and other hazards, to detect and map geological features and to detect and map structures.

For site characterisation, geophysics is a rapid reconnaissance method used without breaking the ground and having a manageable impact on present land use. It can help with targeting site investigations eg for pipeline routes, to detect possible UXO (unexploded ordnance) targets, archaeology and the cultural heritage and utilities and to determine trafficability etc.

For material properties, ground conductivity is very useful, though there is a problem of non-uniqueness. Clay and water increase conductivity and if combined with natural γ radiation from potassium in clays there is a correlation between conductivity and clay content.

Geotechnical parameters such as bulk density, shear modulus etc are tied to seismic wave velocity. While it deals with very low strains, it is possible to correlate shear stiffness and shear strain from the literature. Seismic methods use compression (P), shear (S), Love and Rayleigh waves, Love waves being surface waves and Rayleigh waves the equivalent of ocean swell, with elliptical motion at 0.9 X S-wave velocity. P-wave methods use direct, reflected and refracted waves.

The speaker used case studies of borehole methods to demonstrate the uses of seismic refraction, vertical seismic profiling and cross-hole seismic. The latter needs 2 or 3 holes as a minimum and much depends on the accuracy of the initial time of the source; the use of 2 receivers gives the time difference to eliminate that error. A directional source is uses for P wave and shooting sideways generates S waves in the right direction. Results are improved using reverse polarity, with horizontal propagation and horizontal (S_{hh}) or vertical (S_{hv}) polarisation. On the first site, with made ground to 2.5m, alluvium to 4.5m and sandy gravelly clay to 21m underlain by mudstone, travel-time difference and borehole separation gives the P-wave geology. On a second site. S_{hh} had high signal/noise ratio but S_{hv} showed distinctly slower S-wave velocity. Down-hole profiling at 6 boreholes on the same site found a slow P-wave shallow layer at 2 locations and cross-hole tomography with source and receivers the full depth of the boreholes can identify heterogeneities.

3 case studies illustrated the detection of voids/hazards. On a site where ironstone mining ceased in the 1960s, the workings were flooded. Cross-hole tomography was used in 3 boreholes and found 3 panels with collapsed mine-workings so a number of water-extraction boreholes were used instead of a single one. On another site with gypsum mining near the rail track, the survey targeted infill material from collapsed mine workings. Electrical resistivity imaging and seismic refraction were used using various arrays of electrodes for surface and depth measurement. There were 2 seismic lines and the rest just used resistivity. Mineshafts can be detected using gravity, with air-filled voids giving large contrast, water-filled voids giving medium contrast and back-filled voids giving small contrast. Capping may be detected by magnetic survey, which is much faster and more cost-effective.

Case studies were given of investigation of geological features/structures. On a new road with cut and fill, the geological model indicated a horst structure with dividing strike-slip faults. Electrical resistivity and seismic refraction showed the weathered zone associated with faulting and a fault to the south of the horst zone, along with variations in rippability. The results could have been better with more seismic refraction and the survey line did not intersect the boreholes. Extending the line to the north might have revealed the northern edge of the horst. On the site of a proposed ??, a fault was visible in the river bank and electro-magnetic surveys built up a picture of where the fault might be. It was found to be at 14m depth, despite the theoretical penetration of only 4-6m. EM31 was used first and then EM34 confirmed the depth.

For the investigation of structures, parallel seismic is commonly used. It relies on a competent structure, access to the top of the structure, a borehole close enough to resolve the change in velocity at the base of the structure, deep enough to survey more than 5 points below the structure and sufficiently grouted for acoustic coupling and a geophysicist to swing a sledgehammer all day. Borehole magnetics can detect ferrous structures such as reinforced piles, sheet piles or pile toe cap. It requires a borehole close enough to detect and more than 5m below the structure and some knowledge of the anticipated structure.

Report by Dave Brook

6. Virtual palaeontology

At the Home Counties North Regional Group meeting at Sir Robert McAlpine in Hemel Hempstead, 8 people heard Dr Mark Sutton of the Department of Earth Science and Engineering at Imperial College London talk on **Virtual palaeontology.** He explained that virtual palaeontology had grown in importance over the last 15 years and represented a genuine revolution in palaeontology.

THE SPEAKER – Mark Sutton did a degree in Natural Sciences at Cambridge, specialising in Geology and Palaeontology. then did a PhD in Cardiff, in Welsh Ordovician Inarticulate Brachiopods, followed by a 3-year stint in Lampeter (darkest Wales) lecturing in IT. In 1999 he started 6 years in Oxford, working on the 3-D fossils of the Herefordshire Lagerstatte, where he became interested in 3-D reconstruction and virtual palaeontology. Since 2005 he has been a lecturer at Imperial College, researching a range of palaeontological subjects centred around the origin and early evolution of major invertebrate groups, often using virtual techniques.

ABSTRACT – Virtual palaeontology is a powerful (revolutionary?) new approach to the study of fossils, which opens new possibilities for computational palaeobiological analysis, recovery of difficult material and dissemination of morphological data. A broad group of techniques are suitable for nearly all fossils and virtual palaeontology will be a mainstay of palaeontology for the 21st century. It entails the study of 3-dimensional (3-D) fossils on screen as digital interactive screen models. Reconstruction is directly from single real specimens as a medium for palaeobiological study. It requires 3-D fossils, which are not uncommon and even 3-D soft parts are not too rare.

Introduction

Animals are 3-dimensional (3-D) objects but many fossils are 2- dimensional (2-D), especially those with soft tissues. Reconstructing from 2-D to 3-D is not easy and it has led to many mistakes, one particular example being *Hallucigenia* from the Burgess Shale, which was figured by Simon Conway Morris as having spine-like legs, which later turned out to be spines and the animal had been figured upside down.

3-D fossils are better in that they provide more information and reconstruction is easier and they are not rare. 3-D preservation is quite common, especially with hard-shelled creatures and 3-D preservation of soft tissue does also occur but they are hard to work with. Fossils in a 2-D plane are easy to study but 3-D ones may be difficult to extract from the rock. Some drop out of the rock but it is hard to look inside them and they may have lost poorly attached bits. Dissolving limestone to extract fossils is one solution but there may be breakages and the loss of associations. Some can be physically dug out but this is laborious, skilled work, which can break fragile structures and only really reveals one surface.

Virtual palaeontology is an entirely new method involving the study of 3-D specimens as digitised interactive 3-D models. It has developed as a radical new approach and the fossils can be rotated, zoomed, dissected and sectioned at will. There are no issues with damage, movement of elements or loss of associations. They can be marked up to aid interpretation and can be copied/disseminated at will for the purposes of collaboration, teaching and publication. Significantly, it allows access to otherwise impossible fossils. It can also be used as the basis for computational analysis such as the use of finite element analysis to model stress transmission in skulls or computational fluid dynamics to model flow over marine invertebrates.

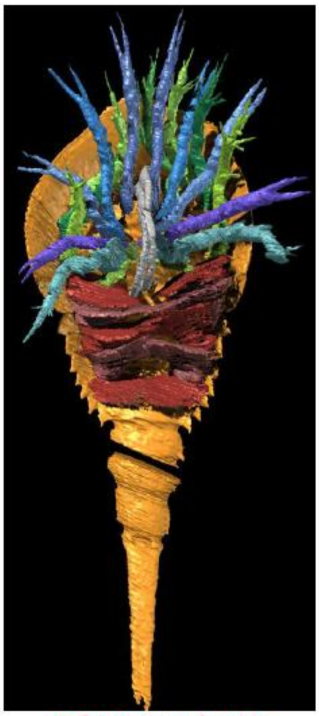
Tomography

This is a means of 3-D imaging using a set of parallel 2-D cross sections, which can be done by various means, including X-ray computer tomography and physical-optical tomography. The latter has been around since the beginning of the 20th century when William Sollas published on the technique of serial sectioning by sawing, grinding or peeling. He achieved sections at 20µm intervals and this was the state of the art for a long time. In 1927 Stensiö uised serial sectioning to produce a wax model of fish brain casts. Serial sectioning was still being done in the early years of the 21st century but generally they did not produce models.

Stensiö *Cephalaspis* brain – wax model from serial grinding

The Herefordshire Lagerstätte

A lagerstätte is any good fossil deposit, usually including soft tissues. The Herefordshire Lagerstätte contains soft-bodied fossils of Silurian age (425Ma) in a volcanic ash layer on top of a subsiding patch reef formed in deep water. Within the ash are concretions containing the fossils. The site has been known for about 150 years but it was not really capable of study until the development of virtual palaeontology techniques. Breaking the concretions open reveals the outline of uncrushed 3-D marine creatures. There is no easy way to extract them and they are not amenable to non-destructive techniques. Physical-optical tomography has been used with high-resolution serial grinding to give datasets of hundreds of tomograms capable of resolving structures down to 10µm or less. The fauna contains over 70 species about 25% of which are arthropods, plus graptolites, brachiopods, gastropods, echinoderms, hydroids, radiolarian, crinoids, annelid worms, molluscs and sponges, with about 25% unidentified. Sponges, about 17% of the species are very diverse with 25+ species and many of the unidentified specimens are probably sponges too. There is a fairly broad range of taxa of a very diverse, low-abundance kind, especially the arthropods. The fauna is dominated by benthos with a reasonable number of nektonic benthic but almost no infauna.



Dibasterium durgae

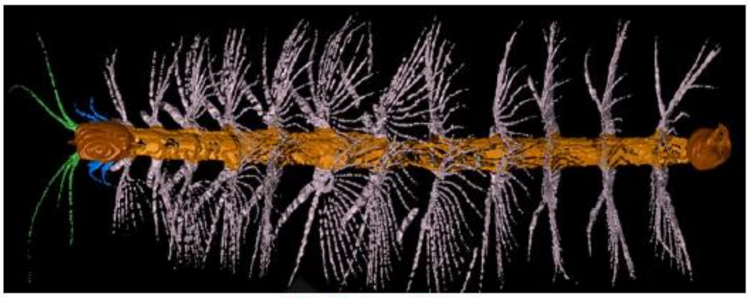
3 examples

The speaker gave 3 examples to illustrate some of the material that has been developed using virtual palaeontology.

Dibasterium durgae looks shrimp-like and similar to the horseshoe crab. It has a typical chelicerate carapace but the appendages are unexpected. It has chelicerae, little pincers, which in modern chelicerates are small and simple but in this species are long and bendy with their segmentation possibly indicating they developed from antennae. Other arthropods have biramous (2-branched) appendages but chelicerates don't. The walking legs are like those of living forms but they have new outer branches too (exopods) and this species has the first convincing exopods in a chelicerate, disproving the theory that exopods are restricted to crustacean and their relatives.

Enalikter aphson is a toothbrush worm. It has some primitive characters such as a disc-like mouth, the gut is not bent posteriorly, it has a simple 3-segmented head and is weakly sclerotised. It also has some advanced characters, such as biramous appendages, crustacean-like first antennae and a head-capsule like some crustacean. Unique features include pincers on the tail and an anterior head-spine, possibly a sting. It was previously known only from the Cambrian so finding it in Herefordshire extends its range to the Silurian. It classes outside the true arthropods with the Megacheirons, close to the split of modern arthropods from a common ancestor.

A molluscan story was the third example, related to the evolution of molluscs as a group right at the base of their evolution. There are 3 groups of molluscs today, the Polyplacophora (chitons), the Aplacophera (shell-less molluscan worms) and the Conchifera. They are the third biggest group of animals. Palaeoloricate 'chitons' appear in the Upper Cambrian but Aplacophora are not known as fossils. It has been assumed that palaeoloricates were chiton-like but some recent fossils suggest that this is not so.


Enalikter aphson

Acaenoplax hayae is an armoured molluscan worm. It has chiton-like characteristics with dorsal shells (valves), though odd ones, and the soft tissues show serial repetition. It also has aplacophoran characteristics with a tubular body, no foot and a posterior respiratory chamber. *Phthipidochiton* is a worm-like chiton from the Ordovician of Girvan with typical palaeoloricate valves, a spicule coating which probably is probably complete ventrally and no foot - but the preservation is too dubious to be certain.

A new Herefordshire chiton, *Kulindropax perissokomos* has spicules, shells and a posterior breathing apparatus. It forms an almost perfect missing link between aplacophorans and polyplacophorans. The valves are unambiguously palaeoloricate but the body is unambiguously aplacophoran. The traditional model of molluscan evolution has aplacophorans as the primitive ancestral naked molluscs. In the alternative Aculifera model, aplacophorans evolved from shelled molluscs. Most genetic studies produce this model and the fossil evidence now supports this model. The conclusion is that modern shell-less molluscs evolved from shelled ancestors and aplacophorans are shell-less remnants of a big Palaeozoic group.


Kulindroplax perrisokomos

Methods

Returning to the methods of virtual palaeontology, the speaker commented that there was now a huge toolkit. Including:

- Physical – optical tomography, which can be high-resolution, for which there are large historical datasets and it can be the only practical method but data reconstruction is difficult and time-consuming and the method destroys the fossil;
- Computed tomography is based on rotational transmission radiography which covers 360˚ with several thousand photographs. It is relatively fast and cheap to perform (costing about £100 for ½-day scanning), covers a range of scales from laboratory-based microCT to engineering-scale macroCT and produces relatively clean datasets but some material has low X-ray contract and there are issues with the shape of blocks;

- X-ray CT using a synchrotron source produces very high resolution, normally with less noise and there are phase-contrast tricks which enable imaging of low-contrast data but it is not appropriate for day-to-day work;
- Serial focusing using a confocal microscope can produce very high resolution (down to 0.1μm) and is fairly easy but it requires translucent material and cannot penetrate very deeply;
- Magnetic resonance imagery scanning is readily available, gives quick scans and can potentially recover chemical composition but there are difficulties with geological materials and this is a niche technique;
- Neutron tomography uses neutrons instead of X-rays is good for organic material but relatively low resolution and it is another niche technique;
- Surface methods such as laser scanning, photogrammetry etc are portable, work over a big scale range, can capture surface colour and are cheap but they cover the surface only and there are some data-quality issues.

The speaker indicated that virtual palaeontology uses not just one old-fashioned way but uses lots of methods and almost all 3-D specimens can be digitised by at least one method and this is changing the way we do palaeontology.

Publishing data

Palaeontological publications have traditionally used drawings or photographs to illustrate the fossils described. While using published images is hugely convenient, they do not capture the full 3-D morphology. In the early years of virtual palaeontology, the same approach was followed but there is potential to do much more if workers just published datasets alongside their papers. This would assist in achieving repeatability and make new studies of new data easier and is potentially an analogue to the gene bank of genetics.

The reasons it does not happen yet include:

1. Cultural issues – the "why should I when no-one else does" attitude may be overcome by unilateral data-release groups and insistence on data-release by journals and funders;
2. Technical issues – there is no perfect file format but many data formats and standardisation issues;
3. Lack of a single centralised repository.

Conclusion

In conclusion the speaker commented that the Herefordshire fauna is a palaeobiological treasure trove which is a showcase for virtual palaeontology, now a mature set of technologies and techniques which are already revolutionising the subject and with great potential.

Report by Dave Brook

Field meetings

Reports have not yet been received for some of the field trips so to ensure there is a full record I have included the information from the flyers for those for which there is no report. I have slightly edited these to include the number of people attending each trip. Should further reports be received, they will be included in the next issue of this Newsletter.

1 Stratigraphy, sedimentology, economic geology, hydrology and archaeology of Watford, Aldenham, Letchmore Heath, and Aldenham Country Park, Hertfordshire.

29 March 2015

On a very wet and windy Sunday morning, 12 people met John Wong at a car park in Whippendell Wood, North Watford. John Wong distributed maps and handouts to explain the geology and formation of the area and the features of note that could be seen during this trip. He explained that the geology of the wood comprised Thames Terrace, Pre-Anglian, Gerrards Cross Gravel and showed an example of the distinctive 'quartz potatoes' that could be found. However, it was far too wet for a comprehensive examination of the surrounding ground and a rudimentary search for the 'potatoes' involved only a cursory examination of any likely outcropping pebbles.

Analysing "funky" bricks on a front house wall near Cassiobury Park.

Journeying downhill we left the Gerrards Cross Gravel to cross the river Gade cutting down into the Chalk, where a change in vegetation was noted. As we climbed from the Chalk and river gravel on to comparatively easier dug flood plain alluvium, it was noted that molehills were mainly present only in the flood plain alluvium and they became absent again as we climbed higher back on to the Gerrards Cross Gravel at Cassiobury Park.

The rain had now ceased but the wind had increased and the uphill walk terminated at a café, where lunch was taken, which gave an opportunity to dry our gear and revive us with a hot drink. After lunch, there was a short walk to an unusual wall which included fragments and bits of broken porcelain, broken tea-cups, pottery and occasional pieces of shell.

After this intermission, the group sojourned through Cassiobury Park, first crossing the river Gade again and then the Grand Union canal. On the banks of the Gade, outcrops of present day river gravel could be seen in the bank-side alluvium, overlying the Seaford Chalk. Then back to the car park at Whippendell Wood and the car for the journey to Aldenham village to look at Aldenham church. Only at the front of the church had blocks of Puddingstone been used in the construction. 2 main types were pointed out, those with large pebbles compared to that with smaller pebbles. It was also noted that pebbles in the Puddingstone were never in contact with each other, and some blocks of Puddingstone shown graded bedding and current bedding.

Group photo at Aldenham Church – Puddingstone wall at right, flint wall at centre

There had been a possibility that the rector of the church would be on hand to give a talk about the church history but he was unavailable for a church tour and talk and so none took place.

The group then travelled first to Battlers Green farm for a rest break, afternoon tea and then a quick walk to look at more blocks of Puddingstone that had been used in the construction of a farm wall.

However, there was no direct access to examine the part of the wall with the Puddingstone blocks. This was probably a good thing as numerous geologists taking samples would have meant the wall would have soon disappeared.

At Letchmore Heath, John pointed out that there was now a structural geological change and we were now on the Palaeocene Lambeth Group. However, this could not be seen as vegetation had now obscured the outcrop, but there are exposures in the road cuttings north of Letchworth Heath, on the west side of the road to Battlers Green.

Farm wall built entirely of local cobble-size puddingstone near Battlers Green.

The group was due to travel to Aldenham Country Park, which was the inspiration in A.A. Milne's book for Winnie the Pooh's Hundred Acre Wood. The park is located on a change in the geology to Eocene London Clay Formation and Quaternary head deposits, shown by a change in the lithic clasts seen. However, it was getting late and there was concern that there was insufficient time to see and do everything that could warrant the rather large car park fee before the park closed. A vote was taken and the field trip was terminated at Letchmore Heath.

Many thanks for an interesting and informative day go to the group leader John Wong.

Report by Mick McCullough with photos by John Wong

2. Geology and Stratigraphy of the Grey Chalk Subgroup (former Lower Chalk) and the White Chalk Subgroup (Former Middle Chalk and Upper Chalk), and building stones in Dunstable/ Houghton Regis and Totternhoe in South Bedfordshire.

26 April 2014

13 people met John Wong outside Tesco Supermarket side entrance next to bus stop shelter, Skimpot Road, Dunstable.

In the morning, the party went up to near the highest elevation in Dunstable at the top of Blows Downs S.S.S.I. Nature Reserve to see the panoramic view of north Dunstable and north Luton and the low lying hills of glacial sand and gravel deposits perched on the Gault Clay vale. The geology at Blows Downs Nature Reserve is the former Upper Chalk; to the south of the north-west-facing Blows Downs escarpment is the dip slope of the Chilterns covered with a thick layer of Quaternary, silty clay-with flints deposits, there are also gully combe deposits in the disused quarry.

John explained the development from 1833 to the present day of the terminology applied to the stratigraphy of the chalk in the field trip area, the distribution of the concealed chalk onshore and offshore, and the major structural elements influencing chalk sedimentation during the Upper Cretaceous period in the area.

The second locality was Dunstable Priory where the annulment of Katherine of Aragon's marriage to King Henry VIII was announced in 1533. The effects of weathering on the 12th Century Norman building stones and the 15th Century Medieval building stones of the Priory are well seen here.

In the afternoon the party travelled to Totternhoe village for lunch at the Cross Keys pub. The inn is regarded as an ancient monument because it has a fireplace, which dates back to 1433. The heavy oak beams are so hardened that nails cannot be driven in their dowelled joints and irregular lines depict the medieval carpenters' skill.

After lunch the party travelled to Totternhoe Knolls Nature Reserve S.S.S.I, a disused quarry; the geology there is the Grey Chalk Subgroup with the Melbourne Rock Formation at the boundary between the former Lower Chalk and the former Middle Chalk. There are some tectonic faults to be seen as well. Many people in the group found brachiopods, gastropods, ammonites, shark teeth, and fish scales and bones.

The party then went to the highest point at Totternhoe, the summit of Castle Hill, where the remains of a late 11th or early 12th century Norman motte and bailey castle are enclosed by ditches >4m deep. On a clear day, the 'gap' towns such as Wendover and Tring, which developed close to the spring line in the valleys formed by glacial meltwater are visible.

The last locality was Houghton Regis Nature Reserve S.S.S.I. where the upper sequence of the former Lower Chalk, Totternhoe Stone, Melbourne Rock and Plenus Marl are exposed. There is also a limestone outcrop in the quarry.

Edited from the flyer by Dave Brook

3. Geology of St Paul's Walden area, Hertfordshire.

31 May 2015

15 people met John Wong opposite the church in this Hertfordshire village and, having ensured that our cars would not obstruct worshipers at the Church (it being a Sunday morning), we set off down a lane to the South.

The first locality was a disused quarry, which had apparently been an estate quarry, in a small wood to the left off the lane. Despite being clearly long disused, the quarry still had about 3m or so of relatively clean face. Evidently it has been the subject of continuing geological interest. Below the soil at the top of the face, was a layer of dark brown, sandy gravel with an irregular base up to 1.5 m deep. Below this, was a lighter-coloured and thicker layer with somewhat finer gravel with flint chalk and Bunter quartzite pebbles and with coarser material at the base.

Group at Quarry near St Paul's Walden – Quaternary glacial-fluvial deposits behind.

Searching for erratic fossils and flint tools

John pointed out that the brown colour of the face was due to post-exposure oxidation and that the true colour of the deposits in a borehole would be bluish-grey. The deposits indicated a pro-glacial lake and John produced a hand-out showing the advance and retreat of the Anglian Glacier in the area, with the presumed position of a pro-glacial lake during the main Anglian advance. John also showed us a cartoon from a sedimentology text book by Professor Dick Selley, which illustrated somewhat similar processes to those which formed this deposit, but which would have occurred in a glacio-marine environment. Apart from the exotic Bunter quartzite pebbles, the site is known to contain erratic Mesozoic fossils and, indeed, we found some examples ourselves, *Gryphaea* and what may have been belemnites.

We then walked back to All Saints Church.

As the main Sunday service was still in progress, we did not go inside, but noticed the monument in the churchyard to the late Queen Elizabeth, the Queen Mother. Her late Majesty's family, the Bowes-Lyon family, were and are the local landowners. She was, herself, probably born in their nearby house, St Paul's Walden Bury House, which the family have owned since 1725, and she was christened in All Saints Church. The monument sets out her various titles during the different stages of her life and career.

We looked at the building stones round the tower of the church, which were quite diverse, with much flint, as would be expected in this area, but also some clunch. The wall also contained an oolitic limestone, probably from north of this area; and some of the Hythe Formation Lower Greensand. Apparently, there are architectural features in the church which suggest a Saxon foundation and excavations in 1973 showed that the church was built by the south side of a pagan Saxon graveyard.

Having met up with a couple of members of the party who had missed us on the way back from the quarry and gone astray, we then drove off to lunch at a tearoom on the premises of a rare-breed animal farm at the nearby village of Whitwell. The tearoom evidently represents economic diversification on the part of the farm, which also has a riding school, built on river terrace gravels, and adapted for the purpose by the addition of “anthropocene” rubber tyre deposits!

After lunch, we drove to the Hill End Farm Chalk Pit at Langley End, which is the type locality of the Hitch Wood Hard Ground. This forms part of the Chalk Rock Member, a key marker bed feature of the local geology, which consists of a series of hard grounds due to breaks in sedimentation. The Chalk Rock was previously regarded as marking the boundary between the Middle and Upper Chalk in the traditional classification of the Chalk in Southern England, which seems to have owed much to work in the Chilterns, where the Chalk Rock is extensively present. That classification was used in the BGS mapping of Hertfordshire in the 1990s and, therefore, it is the one used on the Hitchin 1:50 000 sheet.

The traditional classification has now been replaced by a new lithostratigraphy, considered more useful over a wider area, and also more generally useful for engineering and hydrogeological purposes. Under this scheme, the chalk of Southern England is divided into nine formations, each with their own characteristic lithological assemblage. In terms of the new scheme, the Chalk Rock is part of the Lewes Nodular Chalk Formation. Where it is present, as here, it generally forms the base of that formation. However, on more generalised stratigraphic sections, it is shown as being some way above the base of the Lewes Nodular Chalk. The Hitch Wood Hard Ground is the highest and most widespread of the six main hard grounds found in the Chalk Rock in this area.

According to the BGS memoir for the Hitchin sheet, the Hill End Farm Chalk Pit is "famous as a fossiliferous locality, most notably for the impressive ammonite fauna" It has apparently provided specimens of 22 out of 24 of the recognised Chalk Rock ammonite species and is the type locality of the siliceous sponge genus *Hillendia*. However, many of the fossils found have been removed to the Natural History Museum in London or to BGS at Keyworth. No doubt others have also taken fossils from the site, so that the locality has become denuded and has lost its previous SSSI status.

It is, however a RIGS and is managed by the Herts and Middlesex Wildlife Trust. Unfortunately, it is much overgrown and proved disappointing as a geological locality. We picked through the vegetation and found a piece of tabular flint here and what might have been a piece of echinoid there. One of our party was able to console himself by finding a species of snail which we had seen on a recent previous HCN field trip to the downlands above Dunstable. We then looked westward over chalk downland, capped with a wooded area on clay-with-flints, part of the Hitch Wood which gives its name to the Hard Ground.

We then moved on to see the nearby ruins of Minsden Chapel, a 14th century former chapel of ease hidden in wood across a field. The ruin is approached by a path which runs over "head" (periglacial solifluction deposits) across the field and then alongside the wood. The chapel is a scheduled ancient monument and Grade II listed. The ruined walls were of flint rubble cemented by mortar. High in one of the walls was a brick structure. The ruins are not very safe, and, indeed, have been unsafe for a long time. Apparently, services were discontinued in the 18th century, by which time the chapel was mainly used for occasional weddings. The story goes that services finally ceased after a piece of masonry fell down during a marriage service, and knocked the prayer book out of the curate's hand!

Close by the Chapel, half hidden in the undergrowth, was what appeared to be the gravestone of one Reginald Hine. Mr Hine was a local solicitor and historian/antiquary of Hitchin, who was very much attached to the ruined chapel, and for some time took a lease of the site from the Vicar of Hitchin. Unfortunately, he was prone to depression, and eventually committed suicide by throwing himself in front of a train in 1949. Subsequent research on the internet suggests that the tablet is not in fact a gravestone, but a memorial tablet to Mr Hine, whose body was cremated, and the ashes scattered at the chapel. Since the BGS sheet shows the chapel as built on the Chalk Rock, the surrounding land would not be at all easy to dig and therefore not very suitable as a burial ground! Apparently, the tablet was originally erected at the chapel, but subsequently laid flat like a gravestone after being damaged by vandals.

Examining the geoarchaeology of the haunted Minsden Chapel.

Discussing the aquifer at the Almshoebury swallow hole

Our final geological locality was the Little Almshoebury swallow-hole, which is also a RIGS. This is situated in a depression in a dry valley in the Chalk. Nearby, we noticed a capped borehole, evidently used for measuring water levels and pressure in the aquifer beneath. John told us that fairly recently (some two years previously), when river levels had been very high in the area, water had been running like a surface river in the dry valley. Apparently at high river levels, the depression can fill with water to a depth of 4m! However the course of the stream near the swallow-hole runs over fairly permeable glacio-fluvial sands and gravels, which form infill for the chalk dry valley, so the effect is very temporary. The swallow-hole itself, into which, when it runs, the stream disappears, proved initially difficult to locate. What we first thought was the swallow-hole appeared to be blocked by clay. However, we then found what must in fact be the swallow-hole further down, in a small depression preceded by reeds.

At the end of the field trip, some of us drove over to see the Welwyn Roman Baths.

The Welwyn Roman Baths form a small part of a 3rd-century Roman villa complex, which was, apparently, discovered and then forgotten about on a number of occasions in recent times. However the site of the baths themselves was comprehensively excavated in 1960, in advance of the construction of the A1(M), which now runs overhead. The site of the baths is now conserved in a museum vault constructed under the motorway. Only a part of the original baths survive, but what is left gives a good impression of their construction and use.

We had the benefit of an informal discussion with the custodian on duty, a young military historian, who pointed out the high costs involved both in the construction and running of the baths, which were similar to but in some respects more elaborate than, Turkish baths. He told us that, at the time of their construction, the technology was already outmoded in terms of satisfying the requirements for cleanliness (the need for a high temperature environment to induce perspiration having been made unnecessary by the invention of soap). The practice of building and using baths therefore clearly survived largely for reasons of social custom and prestige.

Thanks are due to John Wong for having taken considerable trouble to organise a varied, interesting and instructive trip**.**

Report by Richard Trounson with photos by John Wong

4. Sequence Stratigraphy, Carbonate Sedimentology, Palaeontology, Reservoir Characterisation, and Building Stone of the 'Oundle Stone' of the Middle Jurassic Blisworth Formation in Oundle village and in Churchfield Quarry, Northamptonshire.

14 July 2015

16 people met John Wong outside the W.H.Smith shop in the McDonald's Peterborough Services, where John gave an introduction on the geology of the Oundle area and showed a variety of limestone and fossil specimens collected from Churchfield Quarry.

The party travelled to Qundle for a walking tour to see the most beautiful and award-winning stone village in Northamptonshire. More than 90% of the buildings in the village , including churches, schools, hotels, and public houses, are built of Oundle Stone,a variety of fossiliferous limestone building stone.

In the afternoon, the party travelled to Churchfield Quarry yard in the west of Oundle village near Lyveden, the quarry manager described the stone-cutting process and he led a tour of the stone-cutting workshops.

The party then went to the nearby Churchfield Quarry; a working quarry, which has been in operation for less than 5 years, as a result of which its location is not shown on any current Ordnance Survey maps. The geology in the quarry is predominantly Middle Jurassic Blisworth Limestone Formation of the Great Oolite Group, an analogue to the offshore West Sole Formation in the Southern North Sea.

The sequence stratigraphy in the quarry is a lowstand-regression sequence of different types of limestone formations - pelmicrite wackstone, biomicsparite packstone, and oosparite grainstone. There are also Quaternary limestone tills and recent floodplain river terrace deposits. John explained the diagenesis of the limestone, in particular the evolution of its permeability and porosity through time and geological processes. John discussed the reservoir zonation and the possible effects of the impermeable layers sandwiched between the limestones. An unconsolidated unimodal oyster bed, which occurs near the top of the regression sequence of the limestone was an interesting palaeecological study. The faunal assemblages change from predominantly benthonic communities within the cement-supported limestone near the bottom of the sequence to the shallow marine communities within the bioclast-supported limestone in the upper part.

Overlying the limestones and beneath the till is a thick layer of clay with petrified plant branches and leaves, thought to have formed in a swamp environment.

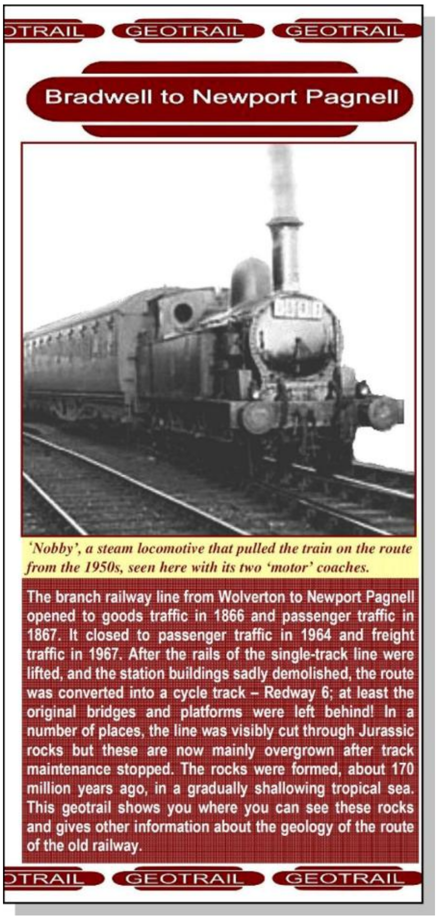
Post-limestone normal faulting and horst structure are present at the northern end of the quarry.

Edited from the flyer by Dave Brook

5. Jurassic geology & railway history – Bradwell to Newport Pagnell Railway Geotrail

1 August 2015

19 people met Tom Hose at New Bradwell Windmill, Nightingale Crescent, New Bradwell, Milton Keynes. The Bradwell to Newport Pagnell Railway Geotrail is a self-guided route which was originally developed by the walk leader in 2012, using the cycleway built over the old railway trackbed.



The geology of north Buckinghamshire is dominated by Jurassic age Cornbrash, Blisworth Clay and Blisworth Limestone which will be seen in a series of railway cuttings and old quarries along the route of an abandoned railway line; from this can also be appreciated aspects of local Quaternary geology. The railway engineering and architecture shows the use of these materials and variously imported stones and locally made bricks and lime. The 5.5km walk will look at the interplay between stratigraphy/economic geology and railway/local history over some 150 years.

The Wolverton to Newport Pagnell Line was a branch railway off the old London and North Western Railway, today's West Coast Main Line. It fully opened to freight traffic in 1866 and to passengers in 1867. The line was included in the infamous 'Beeching' report of 1963 and scheduled for closure. The last passenger service was in 1964. The line was closed to freight traffic in 1967 after which the track was quickly lifted; part of the line's trackbed is now incorporated into the Milton Keynes 'redway system', a network of cycle and pedestrian routes.

Edited from the flyer by Dave Brook

6. Geology and hydrology of the dip slope of the Chiltern hills south of Kensworth, Bedfordshire to Redbournbury, Hertfordshire (including Kensworth Lynch, Markyate Cell, Flamstead and Redbourn) and building stones of Norman churches, and Iron Age and Roman archaeology.

20 September 2015

On a fine sunny morning in late September a group of some 7 enthusiastic geologists met John Wong at the Redbourn Common public car park in the leafy and sedate village of Redbourn, Hertfordshire. After a quick run through the plan for the day and some necessary health and safety information, we converged on a plaque overlooking the cricket pitches that detailed the history of the ancient tree line that runs the length of the common

After some brief introductions we began short walk southwards along West Common to the River Red which runs parallel with Chequer Lane. The River Red, a reedbourne from which Redbourn derives its name, is a main tributary of the chalk stream the River Ver. Since the River Red catchment area has none of its water abstracted, it keeps the River Ver flowing from its confluence southwards; to the north of Redbourn village, the channel of the River Ver is winterbourne and generally only flows after heavy rainfall or thawing of snow.

After taking stock of the surroundings John enthusiastically questioned the group on the provenance of the deposits on the stream bed. Following an initial inspection and after a review of a collection of pebbles John had careful removed and cleaned from the stream previously it became apparent that the clasts within the water body had not been locally derived. The well rounded clasts of quartz, sandstone, limestone, granite and flint appeared symptomatic of source rocks many miles to north of our location and not the locally eroded more angular flint from the White Chalk Subgroup that may have been expected. John went on to explain that the environment of deposition was most likely glacial in origin, hence the variable nature of the deposits found, the distance which they had travelled and the well rounded/eroded nature of the pebbles.

We followed the watercourse westwards to what appeared to be the source of the River Red, however, it was explained by John that this was not indeed the source but a culverted section which was emerging from beneath Hemel Hempstead Road. The reputed source of the River Red was to be discussed in due course.

Marching back up to the cars the convoy continued westwards and parked outside St Mary’s Church to inspect the building stone of the impressive Norman Church. On closer inspection the light brown/tan/off white corner stones revealed a Jurassic Oolite, as pictured. The calcium carbonate deposit was observed to be rich in bioclasts and with both ooids and shell fragments clearly visible. The formation of the rock types is generally associated with warm intertidal shallow marine environments where strong currents in carbonate-saturated waters allow broken shell fragments to accumulate a carbonate coating and eventually form the rounded ooid grains visible in the image.

John was very keen to show us some of the original Norman arches on the churches interior but the presence of 8 geologists at a christening did prove a little conspicuous and so we moved on.

A short drive from the church along Gaddesdon Lane and we parked below the M1 at our next stop. Peering over the fence the reputed source of the River Red (Red Circle noted on Figure 1) could be spied through the undergrowth and amongst the reeds. At the boundary of the Lewes Nodular Chalk Formation and Seaford Chalk Formation (undifferentiated) and the overlying Quaternary Head deposits a spring emerges within the bed of a former river valley.

John went on to discuss how the construction of the M1 influenced the local topography as it carved it way through the landscape.

Crossing the road and talking a short walk along a footpath eastwards we traversed a number of ridges/ditches rising up to an open plateau to the location of an Iron Age fort, "The Aubreys". There is little signage, if any, to suggest this is the location of an ancient archaeological area of interest. However, on consulting the local Ordnance Survey (OS) map it is apparent that this plateau is not simply a geomorphological coincidence but part of a much larger man-made development which comprises at least two ditches rising up to the elevated platform of the former fort.

Back in the cars we moved on to Redbourn High Street where we briefly stopped on a section of the Roman Watling Street to consult a sign which described how this road has more public houses than any other High Streets of the same length in the U.K. Sadly numbers have declined over the years and only a few remain.

Driving out of Redbourn we stopped on a section of the Roman road, Old Watling Street, adjacent to Friars Wash. Out of the cars and we moved to the side of the road to inspect some exposed deposits of Clay with Flints in a farmer's field. John went on to discuss the obvious merits the BGS maps have for the identification of materials present across the UK, but also the issues associated with relying solely on these maps. One of the pitfalls discussed was that, due to the lack of detailed mapping in the area, more often than not geological boundaries often follow contours and as such cannot pick up local variations in the sequence.

After a lunch stop just outside Kensworth we travelled up Lynch Hill before turning right on to Kensworth Lynch and the source of the River Ver. Although noted on the OS map, the source of the River Ver was explained to be some 300m further up stream and, despite the culverted section at Church End under the road appearing to suggest a source, a shallow ditch was clearly visible on the other side of the road which continued upstream. As the River Ver is a winterbourne it was not surprising there was an absence of water at the time of our field trip and, in other conditions, it may have been possible to trace the source by following the limited flow.

Stopping again John explained that since the nearby Friars Wash Pumping Station was opened in 1956, it had resulted in 2/3 of the River Ver being almost permanently dry. This ongoing groundwater abstraction has had its impact on the local environment, evidence of which includes the creation of a large dry valley present to the north of Markyate.

Back in the cars and we periodically stopped where the River Ver intersected various roads to see if we could track how the river was increasing in size as it moved south eastwards.

Once through Markyate we continued on to Flamstead where we parked outside St Leonards Church. Walking round the church it became apparent that the construction materials for this structure were not all locally derived, much like the Oolitic Limestone of earlier. A mix of “Clunch” of the Lower Chalk Subgroup, flint, Puddingstone and Roman tile construction materials were all observed around the perimeter. The Clunch, being part of the Lower Chalk Subgroup is not a locally sourced rock and as such was postulated to have been imported from quarries further to the north in Bedfordshire during construction. The Puddingstone, which comprises very well rounded, often red-stained, flint pebbles in a hard silcrete matrix, was identified in a number of locations, but was sporadic in use and not as abundant as the black flint over the external wall of the church.

Hertfordshire Puddingstone, unlike the white-rinded flint pebbles sourced from the nearby outcrops of the White Chalk Subgroup, is often present within local Hertfordshire Pleistocene glacial tills. Records indicate that a dozen large blocks of Puddingstone were recovered from Palaeogene sediments during recent construction of the A10 bypass from Thundridge to Puckeridge, suggesting possible erosion and redeposition during former periods of glaciation. Inside the church the deposits of Clunch take centre stage with each of the rising columns and arches constructed from this stone. In addition to the columns and arches the majority of the decorative elements have been carved from this easily worked stone. Once inside we took a few moments to enjoy our surroundings and admire the numerous medieval paintings that adorn the walls.

From Flamstead we travelled back to wander round the Redbourn Village Museum. The Redbourn Experience describes the history of a Hertfordshire Village over the centuries through local finds, pictures, maps and objects. The exhibitions are presented in a small house which was the home of the manager of a former Silk Mill, later becoming one of the largest tea and coffee packing factories in the country. Medieval stones from Redbourn Priory and items from the Stone Age to the 19th Century can be seen.

Redbourn water mill is one of few operational mills along the River Ver that can be explored today. After a self-guided tour of the mill we stopped to study the two mill stones on display – one of Millstone Grit from Derbyshire and the other of French Burrstone. Not only is the mill still operational and utilising the waters of the River Ver but it also sources all of its wheat from a local farms enabling it to sell to local people following the grinding of the flour and baking of bread at the weekends.

After a walk around mill we strolled up Redbournbury Lane where John drew our attention to the flood plain that spreads out downstream of the mill. In the field we observed the meandering track of the Ver with the differing shades of flora. These varying shades of green were explained to be due to the differing organic contents and permeability of the underling deposits. The lighter shades of green and brown more likely associated with predominately free draining, granular soils and the darker shades associated with less permeable, largely more organic-rich soils. The varying nature of the deposits was explained to be the result of differing environments of deposition. The coarser-grained soils are the subject of higher energy fluvial processes depositing sands and gravels in river channels during the Quaternary Period some 3 million years ago. The more organic-rich soils forming the clays and silts arise from overbank floods forming floodplain alluvium.

A quick trip back over the bridge and we were able to inspect the river-bed deposits of the River Ver, which comprised coarse, angular, rinded-flint gravel. The absence of significant rounding of the clasts and the presence of the rinds to the flint gravel indicated that the environment of deposition was of a lesser intensity and had travelled a reduced distance compared to those glacial deposits observed within the River Red earlier on the in the day.

In summary the trip was well worth attending and proved to be a very useful method of learning more about the geology of the local area in addition to seeing and experiencing previously overlooked pieces of the Hertfordshire countryside in the company of a very enlightening and enthusiastic team leader.

Report by Andy Tyler

7. Pymmes Brook Part 1 – From the shore of Beechwood Lake (Locally known as Jack's Lake) in Monken Hadley Common to New Southgate, north London. Pleistocene geology, recent flooding deposits, geomorphology, palaeontology, Palaeolithic geo-archeology and industrial archaeology of the Pymmes Brook and its catchment area

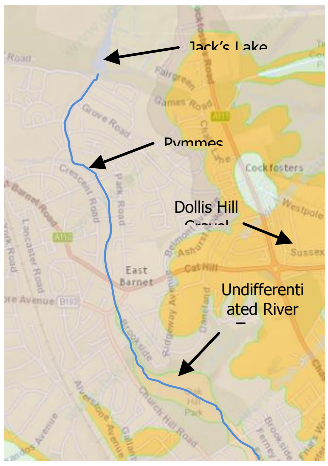
25 October 2015

On another fine Sunday morning in October 9 people met John Wong at the junction of Castlewood Road and Northfield Road in the London Borough of Barnet. Following introductions and a run through the itinerary for the day John led the group down onto the Pymmes Brook trail. Walking along the trail, we would occasionally stop to inspect the flood deposits beneath our feet and discuss the different flooding events that could lead to the materials we were encountering. In addition to discussing the soils John debated the source of the Pymmes Brook, which is a tributary of the River Lea, and the impact of flooding on the local environment around the upper course of the Pymmes Brook, in the spring of 2014.

The reputed source of Pymmes Brook (left), which is fed by Beech Hill Lake, known more locally as Jack's Lake (right)

Pymmes Brook mostly flows through urban areas and it has been culverted in many places because it is prone to flooding; part of the brook is a Site of Borough Importance for Nature Conservation (not for geology).

Following the flow of Pymmes Brook we arrived at Oak Hill Park where the Pleistocene river terrace deposits in the catchment area are the only geologically undifferentiated river terrace deposit in Greater London north of the Thames, as shown on the BGS geology map No. 256 (see extract at right).



The Pleistocene periglacial Head deposits formed by solifluction show uniform thickness in each formation horizon. The younger Head deposits observed in the field are generally thinner than the older Head deposits beneath. Solifluction is a process most commonly associated with colder climates where the recurring periods of freezing and thawing causes the downslope creep or mass movement of water-saturated sediments due to gravity. The process is typical of periglacial environments and can often result in clast alignment or imbrication. Imbrication fabric was observed at the base of the Head deposits (Photo). The clastic components of the Head deposits in the Pymmes Brook area are predominantly derived from the Dollis Hill River Terrace Deposit (see map).

Pymmes Brook yields a small number of Mesozoic glacial erratic fossils among the river gravels, such as gryphaea, brachiopods and, belemnites; there are also small flint tools and strike-flint fragments thought to be of Palaeolithic age.

Large amenity boulders of gneiss (left, from Brunswick Park) and red sandstone (right, from Oak Hill Park) can be examined in the public parks along Pymmes Brook

Geomorphological interest along Pymmes Brook includes the 'upper course' floodplain which comprises Oak Hill Park and the 'middle course' gorge which can be found in Brunswick Park. There are also man-made waterfalls although these are not spectacular.

The 'upper course' floodplain, Oak Hill Park

The 'middle course' gorge, Brunswick Park

The day was concluded at the southerly most extent of Brunswick Park, where all those involved spent some time foraging through the river bed deposits of the Pymmes Brook in search of the previously mentioned Mesozoic glacial erratic fossils and Palaeolithic flint tools and strike-flint fragments. Following a brief hunt a number of the members of the group managed to find some echinoid and bivalve fossils in clasts of flint.

In summary the trip proved a worthwhile excursion and allowed the group to benefit from John's knowledge and understanding of the sometimes complex geological processes that have shaped this part of North London.

Report by Andy Tyler

Future Programme of the Home Counties North Regional Group

Your Committee has developed a full programme of events for 2016, which will be of interest to members of the group. We will continue to vary the venues and if anyone knows any other venue that would be available and would suit members of the Group then please let your Committee know the details.

Evening meetings

Following the AGM, David Shilston of Atkins and past-President of the Geological Society give his talk on **LUSI: the geology and engineering of a mud volcano** and in March we had Dr Paul Taylor of the Natural History Museum on **A brief history of life in 10 fossils**. Both these talks will be reported in the next issue of this Newsletter. On 2 June, Simon Kelly gave a talk entitled **From polar bears to seep sea seeps: a Mesozoic palaeontologist's view of Greenland** at Affinity Water, Hatfield. The Double event and curry night at Sir Robert McAlpine in Hemel Hempstead on 22 September will feature Tim Atkinson of University College on **Karst hydrogeology in Malaysia** and Owen Green on **William Smith.** Our final meeting on 27 October will be at the Open University in Milton Keynes for a talk by The President of the Geological Society, David Manning.

Field meetings

John Wong led field trips in March looking at **Geology, stratigraphy, Roman geoarchaeology, Medieval building stones, geomorphology and hydrology of River Ver in St Albans City,** in April to the **River Thames foreshore – geology and archaeology walks at South Bank foreshore in London Borough of Southwark and Fulham Palace foreshore in London Borough of Hammersmith and Fulham** and in May to the **Gault Clay Vale in mid-Bedfordshire – stratigraphy, periglacial geomorphology; building stones of Norman and Medieval churches; geoarchaeology of Iron Age hill fort and Norman motte; economic geology of glacial erratics; and the Greensand Ridge in northwest Bedfordshire - stratigraphy, paleogeography and sedimentology of the Lower Greensand; also fluvio-glacial deposits and periglacial landforms**

John will also be leading a field trip on 15 July for a **Laboratory visit to Soil Consultants followed by a tour of Hell Fire Caves – Stratigraphy of the local chalk and talk on the Chalk Provinces in the U.K, possibly also including local sarsen and Buckinghamshire Puddingstone**. We also hope to arrange field trips in Northamptonshire in June and in Essex in September

Other events

The Schools Geology Challenge was run at Sharsbrook School, Bedford in February and will be reported in the next issue of the Newsletter. No entries were received for the **Early Career Geologist's Award.**

Your Committee, most of whom have full-time jobs and put in a great deal of effort on a voluntary basis, will continue to develop events to meet the needs of the Group and will up-date the programme on the website and keep you informed on what is happening.

Thanks are due to the speakers (who again provide their services on a voluntary basis) for presenting their talks, particularly to those who have confirmed that the reports in this Newsletter represent a reasonable summary of what they said and provided appropriate illustrations, and to those members of the Committee who have organised individual evening and field meetings and to those who provided reports on them. On this point, I would make a plea to those attending the field trips, which I know you have found to be extremely useful. It would be helpful if one of the attendees would volunteer to produce a brief report of the field meeting within a month or so of it taking place. It does not have to be very long – a couple of pages of A4 with 3 or 4 illustrations – and it can be an important element in your CPD.

If you have any comments on the content of this Newsletter or suggestions as to events the group should consider holding, please let your Committee know by e-mailing homecountiesnorthregionalgroup@gmail.net and keep checking the website http://www.geolsoc.org.uk/hcnrg.

Dave Brook

Newsletter Editor