WGCG

Conserving Warwickshire's Geological Heritage

and enjoying ourselves further afield

The WGCG field party in Parys Mountain copper mine in Anglesey in May

Photo credit: Roger Pinkney

Newsletter

Autumn 2016 Issue Number 32

WGCG

Hidden wonders in the landscape of Warwickshire

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Chairman's Notes Autumn 2016 Brian Ellis

This is the third year of our Rob Holloway Bursaries and the scheme is now well bedded down. I have decided to highlight some of the outcomes of these awards in this Newsletter.

One of Rob's wishes was that we support young geologists early in their career. This has been the most straight-forward to organise and our current partners are the university geology departments at Birmingham, Exeter (Camborne School of Mines) and Leicester, as well as BGS who have students on work placements from various universities. As part of the awards we expect students to send us reports which outline how they have spent the money, how they have allocated their time and the results of their work. Included in this newsletter are examples of reports on undergraduate mapping projects from three Birmingham students - Emily Lyons, Luke Robinson and Richard Cubbitt. The 2016 cohort mapped in a wide range of locations - North Wales, Donegal, Coniston, Church Stretton, Spain and Colorado. The report from Eimear Deady is rather different in that she is the member of BGS staff who is our contact for work placements, but who is herself writing a PhD. She applied for an Award to support a visit to a laboratory in Germany as part of her research, which we happily granted. Her report shows that the path of research is never smooth.

Leicester Geology Department takes a different approach. They offer an open award to all students (preferably in groups) to develop some outreach activity for schools or the general public. This is not part of the formal geology course but is regarded as an opportunity for students to widen their professional and marketable skills. In 2015 the project was to develop and use materials for secondary schools using Ediacaran fossils. In 2016 it was to popularise the results of research on what tooth wear reveals about the diet of animals 100 million years ago. This culminated in a display as part of a Geology Festival at the Scarborough Rotunda Museum in September 2016 which involved half a dozen students – undergraduate and postgraduate.

Rob also wished that money be used to encourage the study of geology in schools. However, developing contacts at school level has proved more problematic, but we have established a successful pattern of field trips to Burton Dassett Country Park for year 5 and 6 primary school pupils. These are led by Norman Dutton ably supported by WGCG members, school staff (most of whom use it as a chance to learn a bit of geology) and parents/grandparents. We cover the costs of transport and other 'odds and ends' including a donation to school funds.

Photos credit: Amanda Poole,
Shrubland Street Community Primary School

Attempts to develop contacts with secondary schools have been a failure, so we have adopted another approach. In 2016 we sponsored two teachers to attend a Summer School on 'Teaching and Learning in Geoscience Education' at Keele University, which is designed for (mainly science) teachers who are non-geologists. It is led by Professor Chris King. We have committed to do this for at least another two years. We received a letter of thanks from one of our bursary holders which included "*I feel very much more secure with the thought of delivering GCSE and Advanced Level Geology courses. This year I will start teaching my first GCSE group (with 33 students) and it is thanks to this amazing Continuing Professional Development (CPD) course opportunity that I feel more confident in its delivery*".

In a broader educational sphere and meeting the Charity Commission requirements for demonstrating that our activities provide 'public benefit' we made a grant of £10,000 in 2015 to Birmingham University's appeal for matched funding to redevelop the Lapworth Museum of Geology. The museum reopened in June 2016 with Professor Richard Fortey as Guest of Honour.

Photo credit:
Lee Allen

Photos credit: Lee Allen

WGCG is named on the plaque listing major donors. The redevelopment has opened up more space for the spectacular displays but at the same time has succeeded in maintaining some of the character of the museums own history. Nearer home WGCG has made a grant towards the redevelopment of Warwickshire Museum, specifically for two pieces of digital artwork related to new geology displays, one based on Cross Hands quarry and the other on Market Square, Warwick. You will have to wait to see the dramatic images of Triassic and Jurassic landscapes, fauna and flora until the museum reopens in February 2017 as for the time being they are embargoed.

The newsletter is the vehicle for carrying reports on our residential field trips. This issue has Mike Allen's report on the May 2016 visit to Anglesey. There is now a list of reports on the website of field trips going back to 2007. These can be found in the section of the website – *'Publications'* – and the list is on the dropdown box – *'Field Trip Reports'*. If you open that and click on the report you want, it will open up directly to the relevant pages of the appropriate newsletter. This is one of the many handy features of Ben Steer's redesigned website.

These are my last notes before I retire as Chairman. You can't argue that there isn't plenty of variety in the job. Many thanks to all the people who have helped me to try to keep most of the balls in the air – trustees, members, people in other groups we work with, unanticipated senders of emails with random geological questions, etc. All have made the job interesting and worthwhile. Special thanks must go to the two honorary secretaries – Frank Wells and Roy Johnston for keeping things in order, to Jim Watts for keeping us solvent and to Barry Dale for helping get the Holloway Awards off the ground. I look forward to doing more geology now. One of my last, but most pleasurable acts, as Chairman is to present the Group's *Outstanding Service Award* to Ian Fenwick recognising the immense contribution he has made to our continuing success.

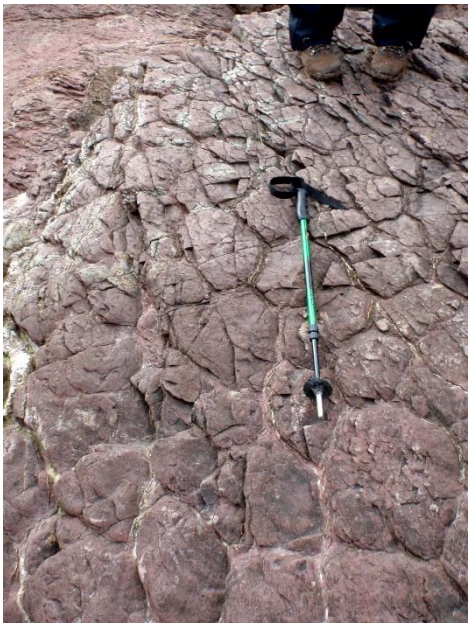
Field Excursion to Anglesey Mike Allen

Twenty two members filled the Gadlys Hotel, Cemaes Bay, between 20th and 22nd May 2016 for a weekend under the guidance of Dr Charlie Bendall (of Aberystwyth University). Three additional non-resident members completed the numbers for a comprehensive and welcome introductory talk on the geology of Wales before dinner was taken on the Friday evening. Charlie's easy style and manner was much appreciated by all and several people commented on his ability to discuss themes at all levels and his willingness to spend time explaining basic principles to those less familiar with the subject.

Saturday morning began with an unfavourable forecast, and so it proved as we arrived in steady rain at our first location, the celebrated site of the former copper mine on Parys Mountain, near Amlwch. The rain attained downpour proportions by the time we reached the main viewpoint across the large opencast pit, which occupies most of the site. In these trying conditions the general history and geological significance of the mine was explained, with the additional help of on-site information boards. Fortunately, the rain eased as we made progress around the pit, such that by the time we returned to the viewpoint on our way out, something of the colourful nature of the site could be seen to greater advantage in the developing sunshine.

Parys Mountain is a site of volcanic metal sulphide (VMS) mineralisation, the principal ore being chalcopyrite, associated with sea-floor spreading of the opening Iapetus Ocean. The host rocks are Ordovician volcanics interbedded with mudstones, preserved in a tight syncline, which can be seen on the southern wall of the excavation. The site has been worked since the Bronze Age, and so thoroughly extracted during the main period of working (1768-1883) that few traces of the copper ore can be found these days. Once in the bottom of the pit, we were treated to several chemistry demonstrations showing the extent to which the site has become a huge toxic headache for the authorities in trying to deal with the legacy of highly acid mine waters. This was amplified by a visit to a nearby area of mine water discharge into a series of treatment ponds via the local brook.

In much improved conditions, the group transferred to Lligwy Bay for the rest of the afternoon; first taking lunch in the car park before heading to contrasting exposures on the two sides of the broad, sandy beach. On the northern side of the bay lie “Old Red Sandstone” style rocks of Devonian age. These have taken on more interest than purely their sedimentary features since relatively recent insight into their structural significance has been described in the literature. Careful examination provides evidence for a series of tight, flat-lying folds, probably of Acadian (mid-Devonian) age. These were identified by various criteria, including overturned sedimentary features and bedding-cleavage relationships. Particularly impressive were desiccation cracks on some bedding surfaces, which could be directly compared with nearby modern “mudcracks” seen in small patches of Devensian till.



On the southern side of the bay, presumably having crossed a fault, lie beds of the Carboniferous Limestone sequence that extends southwards unbroken as far as Red Wharf Bay. Evidence of contemporary karst surfaces abound in this sequence of rocks, with some of the details being far from obvious, but better understood with suitable guidance from our leader. (Unfortunately there was insufficient time to visit the celebrated “fossil pot-holes”, so admirably exposed in the cliffs of Red Wharf Bay.

Sunday's fare began close by the hotel in Cemaes Bay itself, where we were introduced to the iconic Gwna Mélange, the most spectacular part of the Mona Complex for which Anglesey is renowned. The name “Greenly” cropped up a few times – he being the geologist who first coined the term “mélange” in the course of his monumental mapping of the island around a century ago. An old nearby quarry excavated in a single block of limestone within the “mélange” illustrated the concept rather more forcibly. The age of this deposit has been much debated, and current opinion is divided on whether Greenly's original Pre-Cambrian age is sustainable.

The presence of vague stromatolitic structures and general absence of all other fossil evidence in the limestone no longer has the same force it once held, and a Cambrian or Ordovician age has been suggested.

After travelling south across the island to Rhoscolyn, lunch was taken on the gentle contours above the southern coastal cliffs of Holy Island. This was designed, I presume, to get up strength for the 'real' geology ahead – trying to sort out the complex geology of the oldest part of the Mona Complex, the South Stack Group. This area is classic stamping ground for many undergraduates cutting their teeth on field mapping in highly folded rocks, in this case the "Rhoscolyn Anticline". Again, our leader's expertise gave us all some degree of understanding of the various factors that control rock behaviour, fold geometry, patterns and styles in such highly deformed strata. It also introduced us to some of the practicalities of expressing three-dimensional geology on a two-dimensional map or cross-section.

The final location of the weekend was, once again, across the other side of the island, beneath the monument to the Marquess of Anglesey, near Llanfair P.G. The crags forming the foundations to this edifice are yet another of Anglesey's iconic rock types, the famous 'blueschists' representing the so-called Penmynydd zone of metamorphism. The bluish colour is due (mainly) to the amphibole mineral glaucophane, which is only stable at relatively low temperatures but high pressures. It is generally taken to represent rocks from the upper (shallower) parts of a subduction zone, a clear indicator of a destructive plate margin. Blueschists are quite rare in the geological record, and particularly so in such ancient rocks, where they usually revert to greenschists or other rock types due to the inherent instability of 'the blue minerals'. Indeed, this occurrence is one of only two well documented examples in late Pre-Cambrian rocks worldwide.

At this point time was pressing for those heading homeward at the weekend (including our leader), so our final expression of thanks to Charlie (by now accompanied by his wife and dog) rounded off proceedings in the warm evening sunshine that often seems to appear at the end of field trips!

Several members stayed on overnight, and Monday morning was occupied by a visit to Hen Borth, a cliff section to the west of Wylfa power station. This site reveals an excellent longitudinal cross-section through an "Ice Age" drumlin, with what are taken to represent two contrasting tills of early and late Devensian age. These, in turn, rest upon lustrous, cleaved phyllites of the New Harbour Group, the third of the Mona Complex Groups (intermediate in age between the South Stack and Gwna Groups) not previously seen during the course of the weekend.

Several members stoically made it to Red Wharf Bay to visit the aforementioned "fossil pot-holes" only to find the tidal conditions unsuitable for sensible progress. Only two members were able to wait for the falling tide, but were rewarded with an excellent close up view of these remarkable features.

Capel Curig Mapping Project Emily Lyons

The £250 Rob Holloway Bursary from WGCG contributed towards the expenses during my second year 5-week geology mapping project to Capel Curig, North Wales. The award helped to fund travel, subsistence and materials for the trip. On previous trips, I managed without a weather writer but knowing that the climate in this area of Wales was particularly wet I used some of the bursary to purchase one- it was invaluable as it rained throughout the trip. I also bought a geological hammer which was very useful as every rock weathered the same grey colour.

For the full 5 weeks in Wales, almost every day was spent in the designated mapping area. My group would typically leave the rented cottage in Llanrwst at about 9 am to drive 20 minutes through Betws-y-Coed to Capel Curig at the heart of Snowdonia. Capel Curig is deemed one of the wettest and windiest places in the UK. We were regular visitors of the Ogwen Mountain Rescue Centre because they would issue detailed daily weather forecasts which normally covered the next 48 hours. This helped us manage our time efficiently and safely; for example, if there were forecasts for low cloud or strong winds we would not attempt an area which involved climbing the highest ridges. We could not work to a set timetable due to the changeable weather conditions and we regularly had to do half day in the field, followed by half day report writing. Although this was not a great issue, it meant that there were less rest days as we had to get out to the field at every opportunity we could. On the odd day when the rainfall was less, my group of four girls would often stay out all day till about 4:30 pm completing objectives which would not be achievable otherwise. For example, on the only sunny day of the 35 days we were there, my mapping partner and I (we worked in pairs for safety) climbed to the 842m peak of the Moel Siabod mountain to explore the large sill intrusion which forms the mountains spine.

The trip has contributed to my professional development as a geologist in many ways. Most significantly this was my first independent mapping trip outside of university course time. Prior to the trip, we had to write a report, which included the geology of the area, the regional history, the logistics i.e. finance and budget and a work plan to ensure we covered all the area in the five weeks. We had to source our own accommodation in a suitable location near the area, which was booked 6 months in advance of the trip. The cost of the cottage was approximately £2,000 shared between four students which we funded ourselves. During the trip, our group worked totally independently and only had a one day visit from a geology university lecturer who checked the progress of the work.

Working without guidance from lecturers has given me increased self-reliance in the field. In my first year, my experience when on field trips was quite daunting due to my lack of knowledge and not having much practice. Although I won the WGCG award for getting high grades in previous field work based projects I now feel that the Snowdonia mapping trip has developed my abilities as a geologist even further.

Capel Curig is an area where bedrock is dominantly volcanic comprising of several consolidated ashy tuffs dating back to the Ordovician Period. Before the mapping trip I had no idea what a tuff looked like- we did not study a volcanics module. However, I can now confidently say that not only can I identify them through my observations but I am also able to make interpretations on their origins, linking them to different types of volcanic eruptions.

Working for such an extended period, then returning every evening to a cottage full of geologists was occasionally tiring and group feedback on interpretations of sites/rocks was not always consistent. This sometimes led to spirited debate, however, and the variety of interpretations within my group illustrates how most of geology is not black and white and that there is not always a definitive answer. It also made me aware of how important it is to take precise observations as the smallest of details can be the most significant. I had not really considered a career in exploration geology before the Capel Curig trip, however this experience made me revaluate my options and has opened my eyes to a possible profession in the future.

Results of the Capel Curig Independent Mapping Project 2016/2017

The aim of the project was to study and map the solid geology within a 14km² of Capel Curig and interpret the geological features and structures in regional and global context. The fieldwork component was focused on the stratigraphy within the Capel Curig Anticline (Fig. 1) which comprises a number of rock units representing the development of the Welsh Basin during the Silurian and the influence of past volcanic activity throughout the Ordovician. Later glaciation in the Devensian has scoured a valley into the landscape leaving steep ridges where the rock layers which form the anticline can be easily seen and environment of deposition within the succession can be deduced.

Fig. 1. Capel Curig Anticline with the Llynnau Mymbyr lakes following trend of the fold's axial plane

Folding which created the Capel Curig Anticline is the result of the closure of the Iapetus Ocean, the subsequent collision of Avalonia with Laurentia and the Caledonian Orogeny. The objective for this structure was to examine the fold geometry and lithological changes through the succession with a view to developing a model for evolution of the environment of deposition through time. Because the fold is anticlinal, the oldest rock units are in the core of the structure. This was located at the valley floor, so the sequence was logged up each valley side.

In order to investigate the geological history in this way, a number of techniques were used such as landscape topography analysis, sedimentary logs, as well as detailed observations of lithological changes within individual units and also in surrounding units.

Fig. 2. Sandstone showing cross and planar bedding

Analysis of the local stratigraphy indicates that the rocks were formed in shallow seas with mainly siliclastic sediments which were deposited as mud, silt, sand and gravel. There is an overall shallowing of the sequence shown clearly by the Capel Curig Anticline, from a coarse sandstone to a fine mudstone. The sandstone shows cross and planar bedding (Fig. 2) with a fine to medium matrix, which indicates a marine environment with generally high energy levels. A range in sedimentary structures does suggest that the energy in the environment was variable; however, cross bedding predominantly at the top of the unit marks storm-weather wave base, so can assume overall shallowing.

Working up through the succession cutting through younger rocks noted a change in lithology to a sequence of volcanic tuff units, belonging to the Capel Curig Volcanic Formation. Such units indicate phases of explosive eruptions of viscous and highly gaseous magma. The source of the ash layers has been linked to subduction related volcanic arcs, with rising magma accompanied with sudden pressure release producing fragmentary pyroclastic material (ash).

The youngest tuff member of the Capel Curig Volcanic Formation contains vesicles which represent gas bubbles which were trapped in the rock during rapid cooling of a gas-rich frothy magma. Rapid cooling could be through contact with water, indicating marine, or through the air column, indicating sub-aerial. Accretionary lapilli form in the air but the ones seen in the unit also follow similar orientations suggesting reworking in a high energy marine environment. Not only this, but the presence of mud clasts within the unit and fining to muddy tuffite then to a mudstone also reinforces the idea of later marine influence in shallow waters.

Local scale deformation features were also studied and hand specimens collected. The abandoned Moel Siabod slate mine, for example, shows first hand evidence of increasing metamorphic grade of mudstone and its alteration to slate nearing the intrusion. When back at university I will conduct further lab work using self-produced microscope slides to assess the varying degree of metamorphism surrounding the intrusion. I will also use the microscope to undertake minerology analysis to examine how lithologies change in composition through the anticline succession, looking for patterns and making more complex interpretations.

Mapping of the Llyn Ogwen Area Luke Robinson

I chose Snowdonia as the location for my undergraduate geological mapping project for its incredible geological history and evolution. It tells a story of shallow seas, volcanic island arcs and eruptions, abundant marine life, episodes of orogeny and, more recently, intensive glaciation. The remnant evidence for all of these events was waiting out there; all I had to do was go and find it.

In early June, I set off for Wales with two other undergraduates from the University of Birmingham, egged-on in my mind by the prospect of five weeks of hard work in the picturesque mountains and valleys of Snowdonia. An area of fourteen square kilometres was my mapping target, with the tranquil Llyn Ogwen at its centre, flanked by the distinctive craggy peak of Tryfan to the south and the rolling mass of Pen Yr Ole Wen to the north. Beginning with abounding optimism, we began to try and unravel the story being told by the rocks in front of us, and were hit with a sudden realisation: Everything was grey!

A period of intense back-arc volcanism in the Caradoc age (Late Ordovician, ~461 – 451 Ma) flushed huge volumes of volcanic ash and other debris into a shallow marine basin, which itself was subject to active terrigenous sedimentation. The subsequent mixing, reworking and diagenesis of these volcaniclastic and siliclastic deposits produced the complex sequence of tuffs, mudstones, siltstones and thick sandstones,

which can be found through the Ogwen and Nant Ffrancon valleys. I found these sequences to be highly variable laterally; mappable units thicken and thin out over short distances, and then disappear altogether where they should be expected to crop out. These units also appeared to interdigitate with each other to form complex repeated sequences lying conformably atop one another. This was the main challenge presented by the rocks – identifying the subtle changes in lithology between tuffs and silts, muds and sands, and separating them out into 'Fifty Shades of Grey'. It soon became apparent that the shallow marine basin into which these sediments were deposited was subject to intense palaeocurrents and high energy, reworking the sediments into one another and creating indistinct boundaries between lithologies.

It took a couple of weeks to wrap our heads around how the different units lie in relation to one another. After this, our attention turned to the large-scale deformation caused by the Acadian Orogeny, which produced the dramatic scenery of Snowdonia. To help visualise this, we spent a few days gathering data in the spectacular Cwm Idwal. The back wall of the Cwm, climbing into the "Devil's Kitchen", shows the Idwal Syncline in cross-section, a product of folding during the Acadian Orogeny (pictured below).

Structural data including dips and strikes of bedding, cleavage and joints was taken across the mapping area, and reveals evidence for historic compressive stress running north-northeast to south-southwest. This is supported by a predominance of apparent dextral strike-slip faulting through the area, with faults also generally striking north-northeast to south-southwest. These strike-slip faults, along with cleavage which has transected bedding planes at a slightly different strike, provide evidence for simple shear in the region, as opposed to pure shear. I believe that this likely represents some aspect of rotation during the Acadian Orogeny.

While the area is dominated by volcaniclastic and ash-rich siliclastic sediments, there is also a great quantity of igneous material to study. The area's diverse geology continues here, with both felsic and basic igneous intrusions present in quantity. We found evidence for dolerite dykes criss-crossing through the area, aligned in roughly the same manner as the aforementioned faults. Basalt lavas and tuffs are interbedded in the Nant Ffrancon Valley, and a great volume of flow-banded 'rhyolite' (named as so before petrographic analysis to confirm classification) forms the angular peak of Tryfan. The picture left shows Tryfan under the sun (a rarity in the Ogwen Valley), and from this distance the boundary between the 'rhyolite' intrusion above and tuff below (rich in accretionary lapilli) is clear to see, dividing Tryfan into its upper and lower halves. This creates the infamous 'Heather Terrace' scrambling route, easily traced along Tryfan's east flank.

Overall, my undergraduate mapping project was an incredibly valuable experience, and is something which every student geologist should have the opportunity to undertake. If you're going to be doing your mapping project next year, I would certainly recommend this area of Snowdonia; it will teach you a lot. Just make sure you pack a coat.

Geology of Gállego Gorge, Spain. Richard Cubbitt

June/July of 2015 saw myself and my many other peers take on what was probably the biggest educational challenge of our lives so far. I, along with 3 other close friends, set off from Birmingham in a trusty Fiat Panda on the 3rd of June, prepared to take on our independent mapping projects in Gállego Gorge, Spain. After an arduous 30-hour journey we finally arrived in the small municipality of Murrilo de Gállego and set up our tent. Home for the next 6 weeks.

Figure 1 – The Panda accompanied by our accommodation for the next 6 weeks.

The primary aims of the project were: to produce detailed 1:10000 maps and cross sections through macro and micro analysis of rocks in the region, to undertake critical palaeoenvironmental analysis and relate this to plate tectonic context, to quantitaively determine a value for the extent of crustal shortening, qualitatively analyse syn-tectonic tertiary alluvial fan deposits and to relate these to the structural evolution of the area.

The first week of the project was allocated to making primary lithological observations and trying to make sense of some of the stratigraphical relationships. However, this was an incredibly difficult task given the extensive deformation this region has undergone. Luckily, micro-observations such as geopetal fills within the chambers of small gastropods were able to shed some light on the younging direction of strata, which in turn allowed me to determine a complete sequence (Fig, 2)

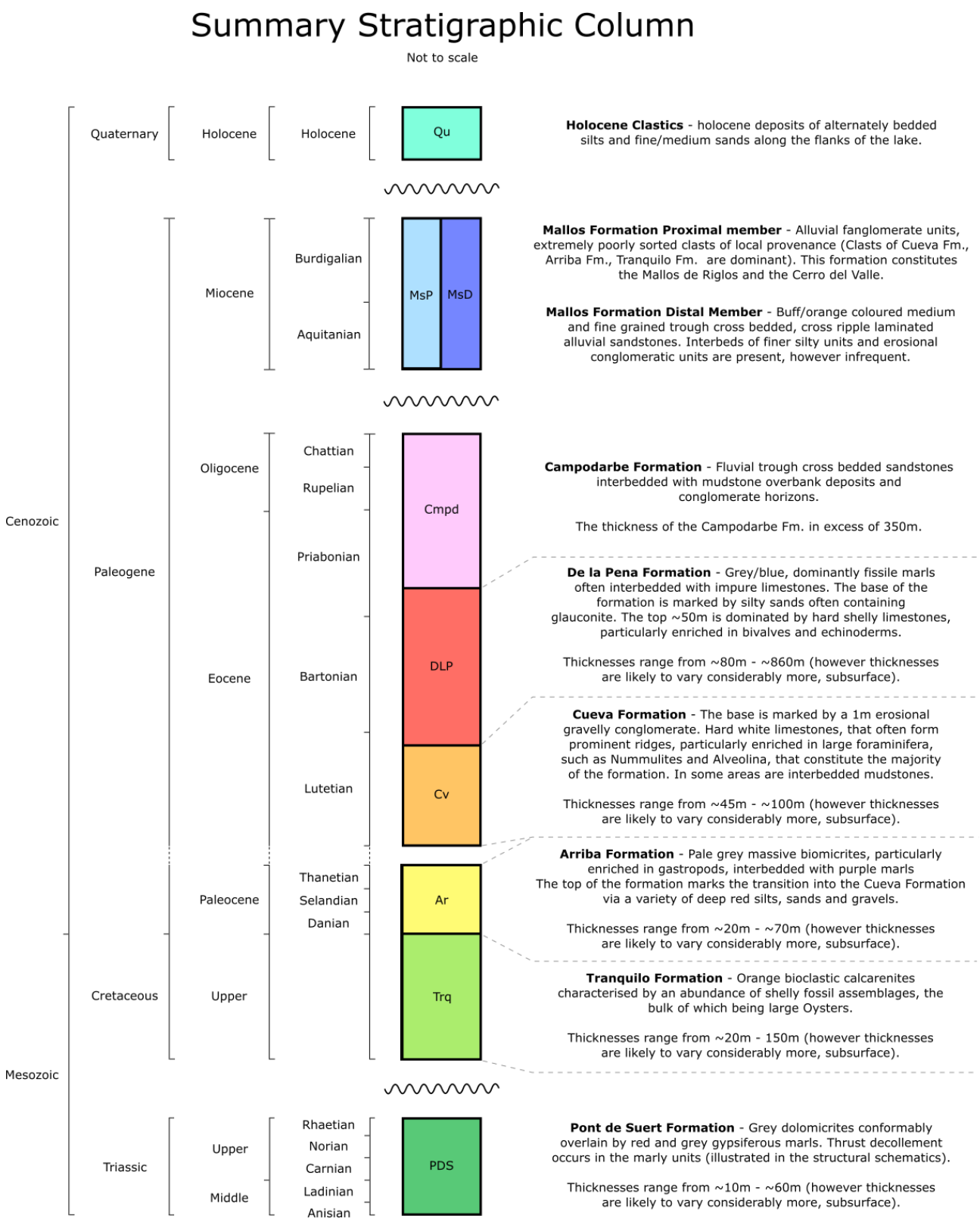


Figure 2 – Complete stratigraphic column for the area. (ages were determined from literature in the report writing stage of the project)

The next couple of weeks were then simply dedicated to marking on outcrop across the mapping area across some very challenging terrain in equally challenging weather (very hot, sometimes approcahing 40°C, accompanied by the occasional intense rainstorm!). A hugely useful technique used throughout in order to deduce the structural history of the region was to make wide angle observations of large scale structures (figure 3). This perspective allowed me to develop various models (and a lot of them) for the development of the area

Figure 3 – Making observation and making field sketches of large wavelength parasitic folding across the gorge.

Another vitally important part of my fieldwork, that proved very useful in my report for placing relative time constraints on the structural evolution of Gállego Gorge, was the completion of a provenance study on the extensive fanglomerate bodies. The presence and ratio of different clasts allowed me to determine how, if and when the formations were exposed within the drainage basin.

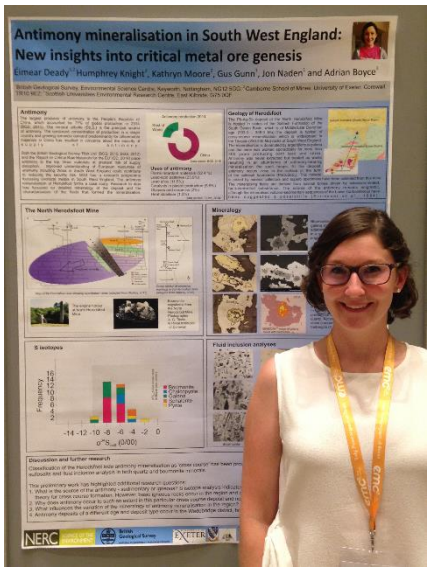
After the acquisition of a very large amount of data and the production of my final maps, it was possible to fine tune my structural interpretations. The final interpretation I came to is as follows:

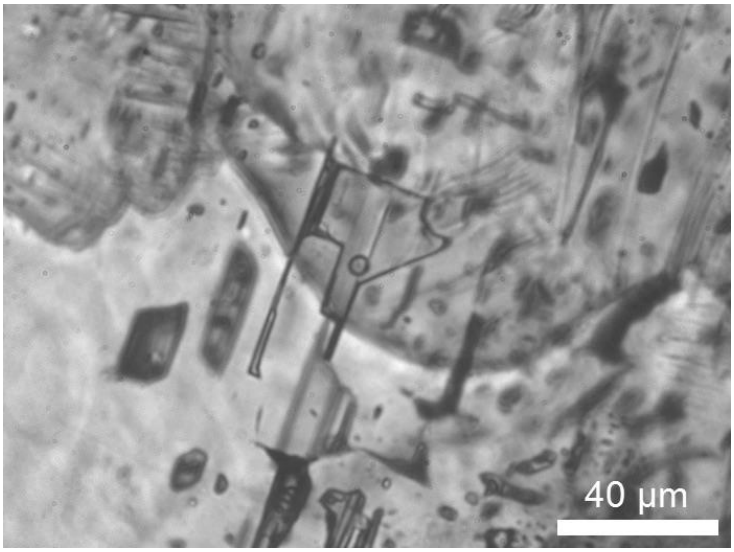
- The initial stages in the development of the Western External Sierras begin with the formation of a symmetrical anticline in the Late Oligocene.
- Progressive compression gradually overturns said anticline into a recumbent anticline.
- Décollement occurs in the mechanically weak Triassic evaporitic sequences of the Pont de Suert Formation.
- The fault bisects the recumbent anticline and a nappe thrust forms.
- Movement along the thrust plane is retarded due to increase in frictional resistance.
- Continued compression results in re-folding of the thrust nappe into an antiformal syncline. The youngest formation (the Campodarbe Formation) is found at the core of the new antiform.
- Compression continues and the folded thrust nappe is progressively overturned towards the foreland.
- Reactivation of the original fault plane occurs and further southwards translation of strata in the hanging wall occurs forming a new over-thrust. (The previous sequence of deformation events occurred continuously from the Late Oligocene through the Miocene).
- Miocene molasse deposits of the Mallos Formation along the northern margins of the Ebro Basin record syn-depositional deformational characteristics.

The calculated extent of crustal shortening for the area came in at ~7.8km, which is close to estimates in various literature.

The trip in all was a huge success and great fun I must say thank you very much for being awarded with the WGCG Holloway Award Bursary which was used to partly fund the travel expenses as well as providing essential field equipment that was used extensively during my trip, such as my compass clinometer.

A Visit to Potsdam, Germany Eimear Deady





I have gratefully received a sum of £450 from the Warwick Geological Conservation Group Holloway Award for travel to the Helmholtz Institute, Potsdam Germany. The aim of this trip was to use their InfraRed microscopy equipment for fluid inclusion analysis (IRFI) of critical-metal ore mineralisation (bournonite and wolframite) in South West England for my PhD research. The IRFI analytical equipment is unique to two intuitions in Germany, one of which is the Helmhotz Institute.

Expenditure:

1. Travel- flights £187 return and transfers in country were approximately £20
2. Accommodation- £180 (6 nights)
3. Bike hire- £25 for the week – best way to get around!

The remainder contributed to the costs of subsistence while in country.

My original application included using the InfraRed microscope at the Open University; however, this was not possible due to technical issues. The overall available laboratory time was reduced from 10 to 5 days due to a major backlog of work, due to an earlier software failure on the microscope computer. This also delayed my departure from June to August. As a consequence of this I was unable to complete my planned analysis. In order to complete this work, a second trip is proposed. I plan to use funds from the Santander Award from the University of Exeter to support this later trip.

Time:

In preparation for laboratory analysis, I spent a significant amount of time reading relevant literature. I also reviewed the earlier fluid inclusion work, undertaken last summer (2015) by M.Sc. student Humphrey Knight, who was also a recipient of the Holloway Award. While in the laboratory, I worked 9-10 hour days to make the most of my time in Potsdam.

Continuing Professional Development:

The opportunity to use the facilities in Potsdam has had a significant impact on my research on antimony in the South West. I have been able to analyse fluid inclusions in both bournonite (an Sb-bearing sulfosalt from the North Herodsfoot mine) and wolframite from the Drakelands (Hemerdon) deposit. Most significantly, this data fills an important gap in the understanding of the fluids that directly form critical ore minerals, in allowing us to distinguish between the fluids that bear ore and those that form the veins that host them. This work will directly contribute to the first publication from my PhD, which I hope to submit early 2017.

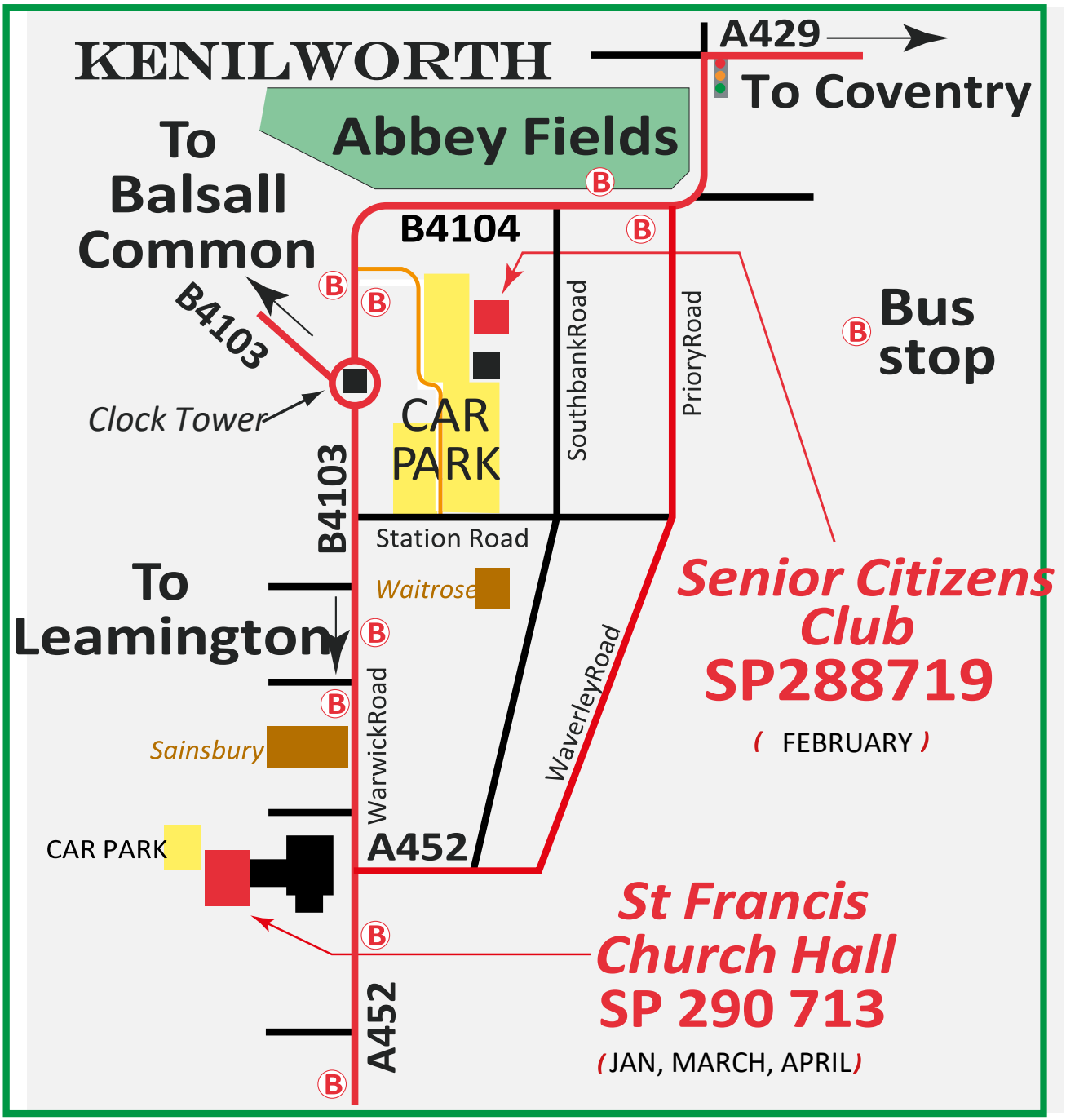
I presented the results of the analysis at the European Mineralogical Congress in Rimini in September as a poster presentation in the session "The future of critical metals: mineralogy, metallogenesis and geometallurgy". This poster (in the photograph above) was well received, as this work is relevant to the development of mineralisation models for antimony. As a result, I have been invited to submit a paper to the special Open Access edition of Mineralogical Magazine in early 2017. This would be a significant achievement if my paper were accepted.

Visiting the Helmholtz Institute was very interesting as I met many different researchers, who provided fresh discussion of my research. Additionally, it gave me the opportunity to develop a professional working relationship with Dr. Volker Ludders who is one of the only researchers in the world working on fluid inclusions in ore minerals. Furthermore, in collaboration with Dr Marta Sośnica, we are currently working on a second publication on the fluid inclusions in wolframite from the Drakelands (Hemerdon) deposit in Devon.

A final additional impact of winning the bursary is the implication it has for my own professional career development. Winning a grant, whatever the size, is an excellent addition to my CV and has been included in my application for promotion, which is currently under review.

A senior colleague at the BGS, Jon Naden, is currently training me. Through a knowledge transfer exchange, he is training me to use the fluid inclusion equipment we have at BGS. The visit to Potsdam has reinforced my ambitions to develop these skills further and perhaps pursue a research line that applies these skills. Additionally, I have discussed with Jon the possibility of applying for funding to purchase similar equipment for BGS, which would be of a significant benefit to the ore mineralogy community within the UK.

Our Venues


KENILWORTH
A429
To Coventry
To Balsall Common
Abbey Fields
B4104
B4103
Clock Tower
CAR PARK
SouthbankRoad
PrioryRoad
Bus stop
B4103
Station Road
To Leamington
Waitrose
Senior Citizens Club
SP288719
(FEBRUARY)
WarwickRoad
WaverleyRoad
Sainsbury
CAR PARK
A452
St Francis Church Hall
SP 290 713
(JAN, MARCH, APRIL)
A452

WGCG Lectures Programme: Early 2017

All meetings are on Wednesdays
Meet at 7.00pm for coffee before a 7.30pm start.
Venue: St Francis Church Hall, Warwick Road (Kenilworth main street), Kenilworth CV8 1HL (See map on previous page).

January 18th 2017	Dr. Ralf Gertisser (Keele University) "The volcano that changed the World: Tambora and the great eruption in 1815"
February 15th 2017	Jan Zalasciewicz (Leicester University) "The Earth after Us" **To be held at the Senior Citizen's Centre**
March 15th 2017	Dr. Monica Price (Oxford University Museum of Natural History) "The Corsi Collection of decorative stones: where science meets the arts"
April 19th 2017	Dr. Phil Wilby (British Geological Survey, Keyworth) "New insights into old fossils: the Ediacaran biotas of Charnwood Forest and Newfoundland"

Publisher's note:

The WGCG newsletter can be printed off for ease of reading as A4 sheets but it can also be printed as an A5 booklet but with smaller print. When setting the pdf file to print, look for **Paper Sizing & Handling** and, using the **Multiple** tab, select 2 pages per sheet. The trick is now to print off one A4 page at a time, starting with 24,1 then 2,23 then 22,3 etc. They can be printed back to back to make the booklet.