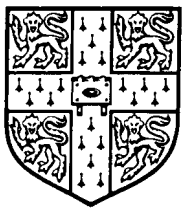
Department of Earth Sciences
University of Cambridge



PART II EARTH SCIENCES
PROJECT GUIDE 2019-20

You will need to refer to this manual during all stages of your project, until you submit your report in the Lent Term of your Part II year. **Please read it carefully**. It contains a wealth of advice from the accumulated experience of the teaching staff and a generation of students. Let Nick Butterfield (Director of Teaching) or Helen Averill (Teaching Support Manager) know if you think that this advice could be improved in any way for future years.

1 OBJECTIVES

1.1 PROJECT SPECIFICATION

The Part II Earth Sciences report is based on a field project. Exceptionally, say for reasons of disability, students may apply to substitute laboratory work for field work. The project must be given Departmental approval in advance, on the basis of a written proposal. The proposal should address the scientific value, the logistic feasibility, and the safety of the project.

- Each project should involve a minimum of 28 days in the field. It is therefore usually done in the Long Vacation preceding the Part II year.
- Every student will be expected to attend a course on safety in the field, organised in the Easter Term preceding the project.
- The field project should primarily document the general geology of a chosen area by geological mapping, construction of cross-sections and stratigraphic logs, and collection and analysis of relevant field data. The study is also encouraged of selected more specialist aspects of the geology as a component of the project.
- The normal procedure for project mapping is for students to work in pairs. Paired students must keep within sight or earshot of each other, as conditions allow. They must keep independent field notes and maps, but may freely discuss observations and interpretation. Any shared data must be explicitly identified in the notebook and final report.
- Departmental approval will not normally be given for solo mapping unless the student can arrange to be accompanied by a field companion. Groups of three may need to be formed, though they are not encouraged. All mappers must ensure the provision of adequate check-in procedures for the end of each day.
- Each student will be given guidance on safety, strategy and science by an appropriate advisor, enough to ensure that they can competently address the problems involved in the project. Students will be given advice on the structure and format of their project report but should not expect help with its writing, editing or compilation.
- The report should comprise **an abstract** of not more than 250 words and the **main text** of not more than 6000 words, in 12 point Times Roman and at 1½ line spacing. The length of the main text should be clearly stated at the beginning of the report. The 6000 word limit includes appendices and acknowledgements but excludes the table of contents, references and figure captions. Figure captions should be short and should not contain material that properly belongs in the main body of the text.
- The report should be illustrated with relevant figures and, or, photographs, and accompanied by a geological map and at least one cross-section.
- The report should also be accompanied by original field maps and notebooks. If field data have been transferred into fair-copy form, both these and the originals should be submitted.
- A digital copy of the report text, appendices, references and figure captions must be submitted on CD-ROM or memory stick. The examiners reserve the right to check this material for possible plagiarism using Turnitin (for information see part II booklet or http://www.esc.cam.ac.uk/teaching/general-information).

- All material for assessment should comply with the Department of Earth Sciences statement on plagiarism (available in the Part II Course Guide). Obey the rule that there should be no doubt as to which parts of your work are your own original work and which are the rightful intellectual property of someone else. In particular, areas mapped or data collected by, or jointly with, another student must be clearly identified.
- All submitted material must be, or be folded to, A4 size or less, and securely contained in a folder or box-file. The file must contain the following signed statement: "I declare that the submitted work is my own, except where acknowledgement is given to the work of others or to work done in collaboration. I declare that I have read and understood the Department of Earth Sciences statement on plagiarism and that my work could be tested using automated plagiarism software."
- Throughout the project, all electronic files of the map and of the report text and figures must be backed up daily, for instance to a network server, a CD-ROM or a memory stick. Failure to back up files is not a valid reason for delaying submission.
- The report must be submitted by 4.00 p.m. on the second day (Wednesday) of the Lent Full Term. Five per cent of the maximum mark available for the report will be subtracted for each day or part of a day that submission is delayed.

1.2 ASSESSMENT CRITERIA

Equal weighting is given by the examiners to work conducted in the field (field slips, notebooks) and the final map and report.

The project report will be independently assessed by at least two internal examiners and one external examiner. It counts for about 25% of the marks for Part II Earth Sciences. The report is likely to be a focus of the oral examination with the external examiner, and to be particularly influential in decisions about candidates who fall on the borderline of two classes.

In marking reports, the examiners are looking for evidence of:

- Competence in making geological observations in the field, particularly those relevant to discriminating rock types and mapping units, to diagnosing geological structures, and to dating geological events with respect to each other.
- Technical skill at recording observations and representing geological relationships, specifically by compiling a geological map, cross-sections and lithological logs.
- An aptitude for displaying geological field data on appropriate graphs, charts and stereoplots, and for using simple statistical methods for data analysis.
- The intellectual ability to recognise the important geological problems posed by the area, and the range of possible interpretations allowed by the available evidence.
- An appreciation of previous geological work in the area and the critical ability to assess how it compares with the observations made.
- The discipline and flair to write concise and lucid prose, to draft neat and legible

maps and diagrams, and to integrate these into a well-designed report.
- The organisational skill to work to a deadline and to deliver the report on time.

A successful project involves other skills which, whilst not formally assessed, will contribute indirectly to obtaining a good mark:
- The intellectual ability to plan and execute a piece of research work.
- The organisational ability and initiative to arrange the logistic components of a field project, and to cope safely and efficiently with the problems of travel, terrain, weather, wildlife or human activity that field work presents.
- The capacity for independent research work.

The examiners will NOT be looking for any preconceived 'correct' answer to the geology of an area. Maps that resemble previous maps of an area will only be rewarded to the extent that they are demonstrably based on original observations and analysis.

The examiners will allot 50% of the available marks to the field maps and field notebooks, and the other 50% to the final map and report.

The Reekie Prize of approximately £500 will be awarded for the project submission judged the best by the examiners in each year.

1.3 NON-ASSESSED VALUE OF THE PROJECT

The value of your project in terms of examination marks is augmented by other, equally important, benefits:
- The report is one of the few concrete products of your geological work that you can show at interviews for jobs, research posts, or higher degree places. If your third year is your final year, you will need to make an extra copy for this purpose, because the Department will retain your main copy during the Lent and Easter terms.
- In particular, your report will demonstrate your presentational and organizational skills, equally relevant to jobs outside geology.
- The project is a valuable opportunity for you to test your own capacity and motivation for geology, and for geological research in particular.

1.4 DISTINCTIVE FEATURES OF THE CAMBRIDGE PROJECT

There is no national specification for geological mapping projects. In talking to students from other departments, for instance in your field area, you will find considerable variations in objectives, duration, mapping techniques, assessment criteria and supervision arrangements. Always remember that you need to *follow the project specifications in this guide*, rather than necessarily conform to practice in other universities. Listed below are the main ways in which your project differs from the average UK mapping project. These differences are fully recognized by the Teaching Committee and the Internal and External Examiners.

- You are not assigned a field area, but instead are expected to research possible

areas yourselves and **write a project proposal** for approval or modification.

- You are not formally visited in the field by a member of the teaching staff, although you are assigned a project advisor who acts both before the field work and during writing-up.
- The last two factors mean that your own ability to plan and execute the project are rated highly, if indirectly. This system also permits a wider range of field venues than would be possible under a scheme of field visits.
- Although you are guided by your advisor whilst preparing your report, and encouraged to consult more widely, you are not assisted by any preliminary editing or proof-reading of your report. Again we want to test your ability to do this independently.
- The level of supervision for the Part II Mapping project is 4 hours, but this may vary according to the nature of the project.

2 PLANNING

There will be a **Mapping Project Information evening** on **Tuesday 8 October, 5pm** in the Common Room. Hosted by the Sedgwick Club, and John Maclennan will be providing information regarding planning your project, what to expect, and also details of departmental support. You will hear from current Part II students about their recent travels and experiences.

2.1 PRELIMINARY QUESTIONS

The success of your project depends on proper planning during your IB year as well as competence in the field. The range of possible projects may initially seem overwhelmingly large. Answers to a few key questions will help to constrain your choice:

- *What kind of geology* do you want to map? Do you like sedimentary, igneous or metamorphic rocks? Would you prefer them to be weakly or strongly deformed? Are fossils an attraction? Perhaps varied geology is more important to you than its precise flavour?
- *What sort of terrain* would you prefer? Lowland regions rarely make good mapping areas. But will you enjoy exertion on high mountains or settle for more modest hills? Are coastal cliffs an incentive or not?
- *Britain or abroad?* British projects tend to be cheaper and offer fantastic geology locally. A foreign project gives a chance to see a new country and different geology, but will require more planning to ensure success. FUNDING and PROJECTS ABROAD are covered in later sections.
- *Which companions?* Finding compatible partners is crucial to the success of your project. Finding colleagues at an early stage may itself focus attention on particular areas.
- *Which part of the summer vacation?* Your choice of areas may be restricted in some months. Examples are parts of Scotland after the grouse shooting starts in early August, and anywhere more equatorial than the Mediterranean in the July/August heat. Approval of some foreign areas might be conditional on your having time to return to a contingency project in Britain before term starts.

2.2 SHORTLIST OF PROJECTS

Guided by answers to the questions above, your next aim should be to identify one or two possible projects for more detailed research. Ideas can be trawled from any of the following sources:

- Your Supervisor or Director of Studies.
- Earth Sciences teaching staff listed by their knowledge of a geographic area or a subject area (Appendix 2).
- Research students. Many will have done an undergraduate field project themselves and have other field trip experience.
- The present Part II and III undergraduates. The department website is a good resource for mapping project information, specifically regarding areas that have been used in recent years. These are particularly valuable for projects abroad, where the local social and political climate may change rapidly. Please come

along to the Information Evening on 8 October!

- The Web. Try searching for specific geographic areas or geological features. National tourist office websites are a good place to start for information on terrain and climate.
- Your own experience on field trips or in holiday areas. Do you have family or friends with accommodation in a geologically suitable area?

Each project on your shortlist now needs a more detailed feasibility study before a final choice is made. Consider all the factors detailed in sections 2.3 to 2.7.

2.3 FEASIBILITY: GEOLOGY

The key questions to ask about the geology of an area are:

1. Is there enough *variety* of rock types? The most important elements of your own map will be contacts between rock units, and any scarcity of these will need to be compensated by some internal structural complexity to each unit.
2. Is there adequate *exposure* of solid geology? Without this, your map will lack raw data and look too speculative. In most areas, mapping of the drift geology will not adequately compensate for the lack of solid rock. Use Satellite imagery such as Google Earth, aerial photos or local knowledge to assess this.
3. Is there a large enough *area* of suitable geology, both for you and any colleagues planning to map in the same region? There is no minimum or maximum area laid down, because the area covered depends on its complexity, relief and exposure and on the scale of your mapping. As a very rough guide you might map up to half a square kilometre of upland Britain each day at 1:10,000 scale, so that you would need to demarcate about 15km^2 to last four weeks.

To answer these questions, you need the most recent detailed geological map and report of the area that you can find. This may require a time-consuming search. Detailed strategy varies according to the location of your area, but there are some general guidelines:

- Your main resource will be the Earth Sciences Library and its on-line catalogues and databases. There will be a lecture session on using these resources in the Michaelmas Term. Ask for other assistance from the librarians as you require it.
- Your initial informant about the area may be the best guide to available maps and reports.
- The web site of the Geological Survey of the country concerned may list relevant maps. Many are available only in hard copy, not digitally.
- For British areas try first the 1:50,000 sheets and memoirs or sheet descriptions of the British Geological Survey. Simplified versions of the 1:50,000 mapping is available digitally on the British Geological Survey website. However, these may not be the most up-to-date information available.
- The digital geological map of the world can be found on the One Geology website, and may be a useful first guide to the geology of a target area.
- For areas abroad, the library may have published geological survey sheets, but these are unlikely to be the most recent editions.
- The most recent maps for any area, British or abroad, are often published in books or journals rather than as geological survey sheets. *Web of Science, Scopus or Google Scholar* allow you to search by geographical area.

- The on-line University Library catalogues cover most of the material in the Earth Sciences Library and also allows searches by geographical keywords.

The *variety* of the geology and its available *area* should be easily visible on a suitable map. The level of *exposure* may be more difficult to determine. Some clues are the density of dip/strike symbols and the level of certainty of the contacts. Google Earth may have high enough resolution images to judge the terrain. Scenic views of the area on tourist-oriented websites can be useful. However, talk to someone who knows the area if at all possible.

Once you have researched possible areas yourselves you will **write a project proposal** to be given to the project advisor assigned to your group for approval and/or modification and handed in by **mid-way through the Lent Term**.

2.4 FEASIBILITY: LOGISTICS

- What *accommodation* will you use? Hotel or B&B rooms may prove too expensive. In the UK, a youth hostel is often ideal. A rented cottage or caravan can be cheap enough for a group to use: check on the web. A tent may be the only possible option in more remote areas, but can be unsatisfactory in wet climates.
- How will you *travel* to and, more important, within the area? Most people will be restricted to walking to and from their field area each day. This will largely determine where you stay. How will you transport food supplies if you are staying in a remote location?
- If you are staying with one or more colleagues, can you all map an area which is accessible from your accommodation?

2.5 FEASIBILITY: SAFETY

Come to the *Planning your Mapping Project Safety* meeting 1-2pm Thursday 20 February 2020 - for 1Bs going on to Part II

Your *safety* during your fieldwork is of over-riding importance to the Department, as it should be to you. Projects in areas that put you at unacceptable risk will not be approved. We will need to establish:

- What the nature and severity of the hazards in your area are, and
- That your ability and experience are sufficient to cope safely with these hazards.

A checklist of hazards is given on the risk assessment form which can be found on the Department website.

Refer to this checklist at the planning stage to assess the general feasibility of your target areas. You will need to outline the safety factors in your area when you submit your proposal. Later, you and your project advisor will need to complete the detailed risk assessment form. Note: When you have completed your risk assessment, make two copies of it. Give one to your advisor, and one to Lucy Matthews (lhm29).

The normal procedure is to map in pairs, where you are in sound or sight contact with your partner but not constantly working side by side. Trios may prove necessary but are not encouraged.

If you are going abroad, you must take out full insurance cover, including third-party liability cover and ensure you have an EHIC card if you are in the EU. In the UK you have the usual NHS health cover, and are covered by the University for limited third party liability whilst engaged in your project work. Insurance for other risks, such as disablement or baggage loss, you must arrange yourself. Remember if you hire or borrow a vehicle you need additional insurance. You must indicate your insurance arrangements on your risk assessment form. If landowners, quarry or mining companies ask you to sign any form to release them from their legal responsibilities, refer them directly to the Department and University. Never sign a waiver form. Always check the wording of your insurance policy, particularly the exclusions, to ensure that it meets your requirements.

You must have had appropriate safety training and first-aid instruction before you go in the field. The department will expect you to attend a half-day course that we provide for this purpose in the Easter Term.

Field safety courses for 2019-20:

Fieldwork Safety and First-aid Training for IA students going to Sedbergh and for IB students in preparation for Part II Mapping Projects will take place on **Friday 12 June 2020**.

2.6 FEASIBILITY: FUNDING

The core funding for your project comes from the Department, which is typically able to make a contribution of around £400 towards your costs. This will offset the majority of your additional expenses for a UK project based in a youth hostel. The funds we have available are not sufficient to provide additional help for overseas projects. It is your decision how to balance the opportunity of a project abroad against the extra expenses that you will incur.
If during the course of the summer you decide not to continue to Part II Earth Sciences this grant will have to be returned to the department.

Details of other funds and sources of funding will be circulated by Helen Averill in Lent term.

Note: The cost of base maps for your project is normally borne by the Department. See BASE MAPS OR PHOTOS below.

2.7 FEASIBILITY: PROJECTS ABROAD

Several extra questions apply to projects outside Britain:

- Do you have a good enough idea of the sort of *geology* to expect? Some areas lack even outline geological reports.
- Will you be able to get adequate *base maps* of the area? Availability of 1:10,000

scale maps is a luxury enjoyed in few other countries outside Britain. Even elsewhere in western Europe the best available scale may be 1:25,000. In many countries, detailed maps are regarded as classified material and only available through official contacts, for instance in government geological surveys. However, the situation is changing fast in that an increasing amount of digital map data is available on the web.

- Are you prepared for the different style of *rock exposure* in the area? Mapping in arid terrain with 50% exposure demands a modified technique from that in a British area with 5% exposure. In some arid areas the exposures have a 'desert varnish' or calcrete cover which makes identification difficult. Telling *in situ* exposure from surface float may be tricky. In tropical areas, thick vegetation and soils may severely restrict exposure. Even many temperate forest areas may be impenetrable
- Will you be able to get access to the ground you want to map. Most countries have more complex and restrictive access laws than in the UK, and local advice is essential.
- Will the *weather* or *wildlife* make fieldwork difficult or impossible? The Mediterranean in summer has as idyllic image, but one created by someone lying on a beach rather than walking ten miles a day on the hills. Heat will make most areas more equatorial than this impossible to map at any time during the Long Vacation. Some areas in northern latitudes may be insufferable because of summer blackflies or midges.
- Will local *political or social factors* prevent safe fieldwork? Terrorist or criminal activity, tribal disputes or social taboos; any such impediments to mapping must be fully investigated. Women need to be particularly careful to get reliable advice.

The only reliable way to answer many questions about mapping abroad is to contact someone with recent experience of the region. They may be:

- within the Earth Sciences Department,
- a field scientist in another Cambridge department, perhaps contacted through the Cambridge University Expeditions Society.
- a geologist in another UK university or in the British Geological Survey probably identified from the institution's website.
- a member of the geological survey, a mining company or a university department in the region concerned.

Whoever you contact, be sensitive about the demands that you are making on their time. Specific queries are more likely to be answered than general requests.

Additional notes:

- A local contact within the host country, who can assist you in case of emergency, must be named as a safety requirement. Even if you have managed to get information for planning your project from British sources, establishing a personal contact in your mapping area can be very helpful. They may also be able to cut red tape, obtain maps, and give you access to facilities such as a library, drafting office or even accommodation and transport

- Any overseas project will be scrutinised particularly carefully before getting Departmental approval. In particular, a member of the teaching staff may need to discuss the geological and safety feasibility of your proposed area with your UK or local expert. You should arrange this at an early stage in the approval process, ideally before you submit your written proposal.
- If your project involves a strong component of exploration, because it is remote or offers a complex logistic challenge, you may consider applying for approval from the Cambridge Expeditions Committee. The committee will also value effective collaboration with the host country. Approval confers the use of CUEX charitable status, access to the Cambridge Expeditions Fund, and the availability of the CUEX medical schemes. Details are at www.srcf.ucam.org/cuex/.
- Whether or not you obtain Expeditions Committee approval, you must NOT include the words 'Cambridge University' within the title of your expedition, nor use the University's coat of arms on your literature. A title such as 'Cambridge Earth Sciences: Gomorrah Mapping Project' is recommended.

2.8 THE PROJECT PROPOSAL

The procedure for approving your chosen project is in two stages. **By the middle of the Lent Term** you must let us know the location of your chosen area, what sort of geology it contains, who you have consulted so far, and which other students plan to map in the same region. A form is provided for this purpose. to be returned to the Teaching Support Manager, Helen Averill. On the basis of the information you provide, you will be assigned a Project Advisor from amongst the teaching staff.

The form for notification of a Part II project can be found on Moodle and also on the Department website.

In the second half of the Lent Term you must prepare a more detailed project proposal, between one and two A4 sides in length, for discussion with your project advisor. The proposal should include:

- A simplified geological map of the region, showing the outlines of your area and those of other members of your mapping group if appropriate.
- A stratigraphic column for the area. This might serve as the key to the map units.
- A brief description of the main mapping units, particularly to establish that there is enough variety to make a satisfactory map.
- Any highlights of the geology that particularly interest you and might form a focus of the project.
- A description of the likely terrain and weather, and any limitations these impose.
- The availability of base maps.
- An outline of logistics: accommodation and transport to and within the area.
- Proposals for dividing up the area between adjacent pairs.
- An initial assessment of safety issues.

If several pairs are mapping adjacent areas in the same region, then one project proposal will suffice for all. The geological map within it should delimit the proposed mapping areas for each pair.

When you have prepared your proposal and ***not later than the end of the Lent Term*** you should meet with your project advisor. The advisor will:

- Discuss your proposal with you and suggest amendments before approving it.
- Agree with you a Risk Assessment of your area which must be signed by you and the advisor.
- Meet with you again during the writing-up of your project in the Michaelmas Term of your Part II year.
- Be your first contact if problems arise with your project at any stage.

If your proposal relates to an area (usually abroad) with which no member of the teaching staff is familiar, you may be asked to outline a contingency plan in case the project fails to produce usable results. This plan will usually entail mapping an area in Britain at your own expense at the end of the Long Vacation.

3 PREPARATION

This section describes the preparations that you must make after your project has been approved and before you go into the field.

3.1 OBTAINING BASE MAPS OR PHOTOS

The Department has built up a collection of topographic maps for commonly used field areas. These are available for copying. The Department will normally buy the maps that you need for your area, if they are not already held. You are encouraged to acquire free digital mapping if at all possible, but you pay the cost of making copies of the maps for field slips and the final version. The detailed procedure is:

- When you have decided on your mapping area, research the specific topographic base maps that you will need. For hard-copy maps, try to minimise the number of map sheets that you need by choosing appropriate boundaries to your area.
- Consult the librarians to see whether the maps you need are already held in the Departmental collection.
- *If they are,* you need do nothing until you want to make copies for field slips.
- *If they are not,* the librarians will order the maps for you as soon as your project area has been approved. This should be by the middle of the Easter Term. The department cannot guarantee to obtain or pay for maps ordered later than this.
- It may be necessary to order foreign maps ahead of this schedule, or they may only be available for purchase by you in the country concerned. These cases will negotiated individually. In the second case, the Library would normally reimburse you for the cost of the maps when you return from your field work, as long as the maps are handed over in a condition suitable for re-use.
- The librarians will inform you when your maps have arrived, and loan them to you for copying in the Earth Sciences Library or, exceptionally, elsewhere. The Department has a licence allowing copying of British Ordnance Survey maps. You pay the costs.
- Although the Department will pay reasonable costs of the maps that you need for your project, we reserve the right not to do so if the maps are very expensive or of an area that is unlikely to be revisited in future years. Each case will be considered individually in consultation with the librarians. In exceptional cases the prohibitive cost of maps may require you to switch to another project.

For some countries, digital map data may be available at low or no cost. The main challenge then will be to import it into a GIS or graphics package in a usable form. You will sessions on the Quantum GIS program at the end of the Lent Term in IB and on ArcGIS early in the Michaelmas Term in Part II.

For a U.K. project most library stock is of old-style 1:10,000 map sheets, for which you need a sheet number. You will need to refer to a 1:50,000 map covering the relevant area. The Earth Sciences map library has a full set of these.

- Each old-style 1:10,000 sheet covers an area of 5km x 5km. Its number has a three part format such as **TA 24 SW**.
- The first part (e.g. **TA**) is the code for the relevant 100km square of the National Grid. This is given in the marginal key to a 1:50,000 sheet, and also printed in

large blue letters at each corner of recent map editions.

- The second part (e.g. **24**) is the grid reference of the bottom left hand corner of the relevant 10km grid square. So, square 24 has its bottom left corner 20km east and 40km north of the origin of the containing 100km square.
- Each 10km grid square contains four 5km x 5km sheets. The third part of the sheet number (e.g. **SW**) specifies the quadrant (NW, NE, SW or SE) within this square.
- UK 1;10,000 maps are now available through the EDINA Digimap archive. Log in with a Raven password. There are various ways of using Digimap data, but the simplest is to print out tiled coverage of your area on A4 sheets.

Information on foreign maps might be obtained from:

- The person who suggested the area to you, or other contacts you have made since.
- The Department Librarian, Sarah Humbert.
- The Digital Map Library on Earth Sciences library web page:

The Department will not normally buy aerial photographs. Individual cases might gain approval if the photos are inexpensive and if the area is used regularly.

- The most accessible source of aerial photographs is Google Earth, earth.google.co.uk, though the quality is obviously variable from region to region.
- Information on UK aerial photographs to purchase can be obtained from such sites as UK Aerial Photos or Get Mapping. However the cost of these photos usually prohibits their purchase for your project.
- In some overseas areas you may need to use aerial photographs as a mapping base rather than maps. Such photos may be available through your informant about the area, or through a local contact. Aerial photos are difficult to buy in many countries. They may be classified information, and being found in possession of them may have serious consequences.

3.2 FIELD SLIPS

You need to make copies of the original topographic maps for use as field slips. If the scale of your field slips is close to that of your originals, or if you have digital map data, you can skip to the next section. Enlarging the originals by 1.5 times or more may make the line thicknesses on the map too great to be usable as field slips. The only solution to this is to trace over all relevant linework in a vector drawing package such as Inkscape. This is VERY time-consuming.

Make field slips from the original or rescaled base map.

- Preferably make a tiled array of A4 prints onto high quality thin card rather than paper. Card is more resistant to the wear and tear of field work.
- Add the grid numbers around the edge of each field slip.
- Make at least one spare paper copy of every field slip. Take this with you to your field area in case of loss of the card copies.
- Beware that some copies from inkjet printers are not very waterproof. Laser

printed and photo- copies are usually more satisfactory. Art shops sell various waterproofing and sealing sprays, but experiment with these before use.

3.3 EQUIPMENT

Get all your geological and personal kit together in good time before departure. Forgetting something vital may waste precious mapping time if you are working abroad or in a remote area. The lists below only include geological and safety equipment, and even this will vary from project to project. Note that metal-tip drawing pens, whilst more expensive than fibre-tip pens, produce a better result, and that you will probably prefer them if you are hand-drafting your final map.

Mapping equipment will include some or all of:

- mapping board with weatherproof cover
- field slips and/or aerial photos
- 0.3mm propelling pencil (and spare HB leads)
- spare pencils and sharpener
- coloured pencils
- pencil rubber and spare
- writing pens with waterproof ink
- weatherproof field notebooks
- hammer
- compass/clinometer
- hand lens
- protractor and set square
- fine drawing pens (0.1mm fibre tip or 0.2mm metal tip or finer) – black, green and blue, waterproof ink
- thick drawing pens (black waterproof ink, 0.3mm, 0.5 mm)
- acid bottle
- grain size comparator
- camera
- binoculars
- tape and blank logging forms
- sample bags and waterproof marker pen
- GPS or smartphone app

Note: Acid bottles (and acid for UK projects) are available from The Classroom Assistants.

Safety equipment will include some or all of the following (starred items are compulsory):

- waterproofs
- appropriate field boots
- high-visibility clothing
- hard hat*
- goggles
- mask
- sunscreen
- sunhat and sunglasses
- survival bag*
- emergency rations*
- whistle*
- watch
- torch and batteries*
- tide tables
- first-aid kit (including pressure bandage)*

*A **compulsory** safety preparation* is to photocopy sufficient copies of a Route Card to use daily in the field. You *must* use this device or an equally reliable method for ensuring that help is called if you do not return to base each evening.

3.4 LITERATURE

Before you leave Cambridge you may want to copy some of the relevant maps or literature on your area. However, do not let this literature be a hindrance rather than a help to you. The examiners will expect you to be familiar with previous work in the area but they will grade you on the quality of *your* work. Don't regard previous maps as 'correct': In most cases you are just as likely to be right as previous mappers. In particular, the examiners will not view favourably boundaries on your map that are identical to those on existing maps but for which you provide no field evidence.

You should take with you the departmental guide on *Geological Mapping Techniques.* For further guidance you may want relevant volumes from the Geological Society's series of field handbooks: Lisle et al. (2011) on general mapping techniques, Tucker (2011) for sedimentary rocks, Jerram & Petford (2011) for igneous rocks, Fry (1991) for metamorphic rocks and McClay (1987) for structural mapping. Goldring (1991) offers a good guide to fossils in the field.

4 FIELD WORK

4.1 TECHNIQUE

Detailed instructions on how to map are given in the departmental guide on *Geological Mapping Techniques.* This is issued on the Sedbergh and Skye mapping courses and on the IB course to SW England, and is available on Moodle.

Be prepared to modify the techniques that you use to suit the local geology and terrain.

Important things to note:

- Remember that there is no single correct way of mapping.
- However, it is important that an examiner can see from your field slips exactly where you have made observations and therefore the degree of constraint on the bedrock and superficial boundaries on the map. They are looking for evidence of **Observation-Based Mapping**.
- The best way to show where observations apply is to use 'green line' (exposure) mapping. In very well exposed areas detailed exposure mapping may be inappropriate, but the main areas of superficial deposits should still be delimited, perhaps by the use of darker shading.
- Don't forget to map geologically relevant topographic features, usually in blue ink. Examiners will give extra marks for good feature mapping.
- Keep your field notebooks to a high quality. Don't forget to put in some sketch cross-sections and sketch interpretations.
- Define your 'mappable units' as best you can in your notebook fairly early on. You should refine these as you continue mapping.
- All diagrams should be accompanied by orientation and scale. These form a key part of your **Evidence Base**.

4.2 STRATEGY

The mapping guide includes a section on strategy, but a few points are worth emphasizing:

- Make an initial reconnaissance of the area, both for safety reasons (below) and to get an overview of the range of rock types and relationships.
- This reconnaissance might take several days. It can usefully be carried out in part with colleagues mapping adjacent areas.
- Tackle an informative area first. A well-exposed area showing a coherent sequence through a number of key rock units is ideal. Be sure to measure lithological logs of important, well-exposed sections.
- Think ahead and form hypotheses about expected relationships in unmapped areas. Use these ideas to set specific work targets each day.
- Follow up some aspects of the geology in more detail than needed for the basic mapping, if these will add to your geological understanding. You will get credit for good observations and analysis on, for instance, sedimentary facies analysis, faunas, igneous relationships, or structural textural work on metamorphic rocks.
- Plan your last few days with particular care, to ensure that you do not leave gaps

in your mapping or data collection.

- Do not feel that you must spend more than 28 days in the field. A very long field season is tiring, and you are likely to get better marks by working efficiently in the allotted four weeks.
- Collect suitable hand specimens if you intend to get thin sections cut. You are allowed up to *seven* samples per pair. These should be larger than a matchbox but smaller than fist-size. They must be delivered to the Earth Sciences reception no later than the first week of the Michaelmas Term.

4.3 SAFETY

You must use your initial reconnaissance of the area to update the risk assessment that you agreed with your project advisor. Record separately in the back of your field notebook:

- any amendments to the nature or severity of hazards,
- how you plan to address these hazards to minimise the risks to yourself and others,
- a safety plan on what to do in an emergency, including relevant phone numbers.

While mapping in a pair you should:

- Keep within sight and, or, sound of your colleague such that they can be alerted effectively in an emergency. The interpretation of this rule will depend on terrain and weather conditions.
- Make regular contact with your colleague, at least mid-morning, lunchtime, mid afternoon and evening.
- You should **NOT** be working side by side outcrop by outcrop.
- Keep independent field maps and notebooks.
- Collect data independently as far as possible. Safety considerations might exceptionally make it advisable to collect shared data. Such data must be clearly identified in notebooks and in the report.
- Leave a completed route card with a colleague or other contact, in the same way as if you were working alone.

You must always put your own safety above the need to collect geological data:

- Follow the advice outlined in the Department's *Fieldwork Code of Safe Practice and Good Conduct*, with respect to specific hazards.
- Ensure that you are properly equipped for the terrain and weather that you will encounter. In particular, you should carry a first aid kit, emergency rations, waterproof clothing, survival bag, whistle and torch.
- Leave a completed route card with a colleague, hostel or campsite warden, shopkeeper etc., so that help will be called if you do not check in by a given time each evening.
- Stick to your planned route except in emergencies, and be sure to report your safe return.
- Be aware that examiners will not criticise you for labelling particular areas as inaccessible on safety grounds.
- Rather than trying to visit poorly accessible coastal or inland cliffs, attempt to

take photos and make field sketches of the exposures from several viewpoints in order to reconstruct the geology.

In the event of serious accident or illness:

- Make the provision of medical advice and treatment a priority.
- Inform your contacts in the host country and the Department of the nature and circumstances of the accident by phone (01223 333400) or get in touch with Helen Averill, Teaching Support Manager (hpd20@cam.ac.uk / 01223 768330).
- Make a written report of the incident as soon as possible. An Accident Report Form, which should be returned eventually to the Department. The form can be found on the department website.

5 REPORT PRODUCTION

5.1 INTRODUCTION

This section outlines the steps needed to turn your field material into a report for submission. However, *there is no one recommended procedure to follow*. The details will vary from project to project. It is for *you* to decide what is appropriate for your own field area, and to schedule the work so that it is finished on time. Your ability to do this is a component of what is being examined.

A major decision is whether to hand draft or computer draft your map. Either method is acceptable to the examiners. Hand drafting will prove quicker for most people, but you cannot make corrections as easily. Computer drafting will need you to become skilled with a drafting package such as Inkscape or CorelDraw or with a GIS package such as Quantum or Arc.

Material (e.g. tracing paper, plastic permatrace) for hand-drafting maps is getting increasing difficult to source. Try Tyndalls Graphics Shop in King Street.

You will have at least one session with your project advisor during the Michaelmas Term. To make best use of this you should have already done much of the data analysis, and be facing the problems of final interpretation and presentation.

You should feel free to ask for advice from members of the Department other than your project advisor. This advice might be about geological interpretation or technical presentation. However, you remain responsible for all drafting and editing of text, diagrams and maps. In particular, teaching staff will not be prepared to act as proof readers or editors of your report.

Those of you computer-drafting your map may be using the Galson Lab as a project room in the Michaelmas Term. You are also welcome to use this room for hand-drafting. However, because of the number of people using this lab, please do not leave your maps and belongings on the benches when you are not actively working, and please clear your belongings away each evening.

It is for you to schedule your work to meet the submission deadline. However, we suggest that you will have difficulty doing this is you do not meet the following advisory targets:

- *By Christmas*: Final map and section drafted and proofed. Draft report text completed.
- *By end of Friday before submission date*: Report text and figures assembled and proofed.
- *By end of Monday before submission date:* Map and section printed.
- *By end of Tuesday before submission date:* Report printed.

Bear in mind that even these targets may prove impossible to meet if the majority of the class leaves printing until the target day.

5.2 ROCK SAMPLES

Have thin sections cut as early in the Michaelmas Term as possible, and the deadline for this year is **Tuesday 15 October**. You are allowed up to **seven sections per pair** but do not feel obliged to use up your quota. Marks are given primarily for observations made in the **field** rather than in the lab.

Hand in *small* (matchbox to fist size) numbered hand specimens for sectioning to Reception, with the cut-lines marked in pen. You will need to fill out a form detailing samples and requirements.

Please avoid getting essentially identical samples cut by each pair who has mapped the same or adjacent areas. Two mappers can describe the same thin section, as long as you clarify in the report that you have done this.

Describe and photograph or draw relevant hand specimens and thin sections, particularly to emphasize mineralogy and texture. Drawings can be as effective as photographs, which themselves need to be annotated to be useful. Instruction in photographing thin sections is available early in the Michaelmas Term.

Detailed descriptions could be given in an appendix to the report but are better integrated with the main body of the text.

Hand in your thin sections with your report, packed in boxes available from Reception.

5.3 FIELD SLIPS

- Much of this work should already have been done in the field.
- Ink in all information that you wish to preserve.
- Make sure that the examiners can tell observation from interpretation, preferably by having outlined exposures in the field or coloured them in a deeper tone.
- Leave in pencil interpretations of contacts in places where they are very uncertain. Don't necessarily erase all speculative pencil lines or notes. Examiners like to see evidence that multiple hypotheses have been considered.
- If at all possible, hinge your individual field slips together into a composite map. If not, then include a diagram on the back or an unused front corner of each field slip showing how it fits into the mosaic as a whole.
- Check that the edge of the map shows grid ticks or latitude/longitude ticks along with their numerical values.
- Put a key either on the back or a blank corner of the composite of field slips, and on any separate slips. The key should show colours, symbols and abbreviations used.

5.4 DRAFT CROSS-SECTIONS

Make a mosaic of your field slips and mark on them the planned section lines, or at least their ends. Choose lines that will best display the structural variety of the area:

usually such sections are perpendicular to bedding strike, to fold hinges, or to major faults.

Construct draft cross sections using familiar techniques. *This is best done by hand*, not on-screen. You need the fluidity of hand-drawing to get realistic results. In particular:

- Use the same horizontal scale as you plan for the fair-copy map (usually identical to the field slips).
- Use the same vertical scale as horizontal scale, unless the geological relationships make this very impractical.
- DO NOT use a ruler for drawing any contacts: stratigraphic and structural contacts are very rarely straight.

Check that the sections are consistent with each other and with the map:

- map contacts in the right place?
- dips of contacts and faults?
- up/down and away/toward relations on faults?
- all stratigraphic units shown?
- unit thicknesses same on different sections or is there known lateral variation?
- do sections agree at their intersections?

5.5 DRAFT FAIR-COPY MAP

If you are going to hand-draft your fair-copy map, you must first compile a first draft on tracing paper. If you plan to computer draft your map then this tracing-paper stage can be omitted, and successive drafts developed on-screen. However, you may still need to sketch layout ideas on paper rather than screen, and *the guidelines below on content and layout apply equally to both methods*. Technical tips for computer- and hand-drafting follow separately in sections 5.6 and 5.7.

The first-draft map sheet should include, as well as the central map, a geological key (perhaps partly in the form of a stratigraphic column), scale, north arrow, grids, and section locations. Put structural cross sections on the same sheet if possible. Use the first hand-draft of the map to design the layout of the components above. For ease of printing it is best to fit the design to a standard metric paper size if possible (e.g. A0 or A1);

The first-draft map should include at least the main mapped contacts and topography traced off the field slips. Detailed structural data and notes can be copied later, directly onto the final map.

The scale of the map and sections is usually the same as the field slips. But consider -

- Would reduction or enlargement be appropriate considering the density of information that you want to portray?
- Would detailed inset maps of complicated areas be helpful?

The fair-copy map is not merely a redrawn version of the field slips. It is more

interpretive, for instance in showing continuity of contacts and units wherever possible. It may more **selective**, omitting some of the notes and data which might clutter the field slips, although a full map usually looks more impressive than a half-empty one.

Do include on your fair-copy map:

- **locational information**:
  - grid ticks or lat/long ticks with their values
  - north arrow, scale bar and numerical scale
- **topographic information**:
  - sufficient contours to make the geological pattern intelligible
  - summit points (and heights?) or from lines to indicate topography not adequately defined by the contours
  - main drainage, main roads and settlements if useful for location
  - names of at least those features mentioned in the text
- **geological features**:
  - stratigraphic contacts, faults, fold axial traces, all shown solid or variously dashed to indicate reliability
  - solid geological units, each one **both** distinctively coded (numbers or letters) **and** either coloured or ornamented: never omit the code
  - drift units, each coded but usually only coloured or ornamented in special cases
  - as much structural information as possible; planar structures as bar-and-tick type symbols, linear structures as arrow-type symbols: show numerical values at least of dip or trend.
  - lines or the line ends of the sections accompanying the final map
  - key to all symbols, codes, colours, ornaments on the map and sections; stratigraphic units are shown in correct age order, as a scaled stratigraphic column where appropriate.
  - detailed inset maps if appropriate

Do not include on your fair-copy map

- the limits of individual exposures (i.e. the 'green line' information): the extent of exposure should be generally conveyed by showing the boundaries of the drift, the pecked or continuous nature of the linework, the distribution of structural data, or by specific notes on areas of poor exposure.
- the full notes that you may have used on the field slips. Edit these down to information which justifies the position or nature of rock units but which cannot be gleaned from the colour, lithology codes, reliability of contacts etc.
- too much 'white space'. Unmapped corners can be used for sections, the map title, or the key. Think carefully about the layout with this in mind.

5.6 FINAL FAIR-COPY MAP/SECTIONS (HAND-DRAWN)

The recommended hand-drafting technique is to use black ink on plastic tracing film (Permatrace):

- easy to copy from field slips and first draft map
- easy to erase mistakes with ink rubber and/or blade
- easy to make photocopies onto paper for submission

- more resistant to distortion and damp than tracing paper

Things to note:

- Use metal-tip rather than fibre-tip pens if you have access to some: they give a sharper and denser ink line.
- Generally do the linework before the lettering. Avoid lettering crossing linework if at all possible, but then erase short gap in the line.
- Neat hand lettering is usually adequate for small items such as dip and trend values, formation codes, notes etc. For legibility, hand lettering should not be less than about 2mm high (for a letter 'H').
- Machine lettering looks better for large material. Use a stencil, or computer-generated lettering. Machine lettering can safely go down to about 8 point (about 1.5 to 2mm).
- Computer-generated lettering should be output on to paper in the first instance. Then have your paper output copied on to transparent adhesive polyester film (e.g. Folex), which is then cut up and stuck down. *Under no circumstances should you use Folex film in the Department photocopiers or laser printers without explicit permission* – the wrong combination of film and machine can damage the printer. Please use an external print shop.
- Letratone ornament can be added if necessary and available. Best applied to the back of the drafting film and scalpelled to shape on the map.
- Trim the submitted copy of the map to remove unnecessarily wide margins.

Final maps should be coloured. There are various means of doing this:

- best to photocopy the finished but uncoloured original onto paper, then hand colour using coloured pencils. Make a copy to submit and one for use yourself at interviews?
- a more time-consuming and expensive alternative is to colour the original using Letratone, and make multiple copies by colour photocopier. Only feasible for small maps (check maximum size).

5.7 FAIR-COPY MAP/SECTIONS (COMPUTER-DRAWN)

The Part II Skills course at the beginning of the Michaelmas Term will have sessions on basic use of Inkscape and its application to map drawing and also to map compilation in a GIS such as ArcGIS or QGIS. What follows here is only a brief guide to computer-drafting of maps using a graphics package such as Inkscape or CorelDraw. The logic of drafting in a GIS is essentially similar, though you are forced to be more explicit about the map attributes on each graphic layer.

First scan in your field slips, draft cross-sections and any other material that will appear on your final map sheet. Use a scan resolution (dpi = dots per inch) no higher than necessary for on-screen tracing, otherwise file sizes may become unmanageably large. Experiment with 200 dpi, and increase or decrease this as appropriate.

Set up a new graphics file, with a paper size and orientation to match your planned final product. On one layer of your Inkscape file, draw a topographic grid at the correct scale of your final map (e.g. at 1 km = 10 cm spacing on a 1:10,000 map).

Lock this layer.

- Import your field slip scans onto a second, underlying, layer of the file. Rotate and, or, stretch the scans so that they key exactly to the overlying grid. This may only be possible for one grid square at a time, but if you can, tile the scans so that they form a complete mosaic over your mapped area. Lock this layer.
- Create new named layers above both the scan and grid layers, one for each attribute of the map: e.g. contours, drainage, place names, contacts, faults, structural data etc. As you trace off information from the scans, it is best to lock layers that you are not using.
- Trace off successive attributes from the scanned field slips. *This is very time consuming:* there are few short cuts. Some tips are:
    - Use straight line segments joining nodes close-spaced enough so that, with the map zoomed out to reproduction scale, they appear to define acceptable smooth curves.
    - Do not convert lines to curves and do not smooth lines, or you will encounter later problems of fitting together polygons of colour or ornamental fills.
    - Draw continuous lines for e.g. contours, ignoring any gaps for lettering on the line. Lettering will be overlain later.
    - Roads can be drawn as a thick black line, the full width of the road, overlain by a duplicate but thinner white line.
    - Draw contacts as open lines at first. You will create the areas of fill between them later.
    - Carefully superimpose appropriate nodes on different layers, where the two attributes, typically faults and contacts, will eventually bound areas of colour or ornamented fill.
    - On your first draft, ignore details such as line thickness and colour. The point of grouping each map attribute on a separate layer is that the component objects can easily be selected and their design parameters changed as a group.
    - Prioritise linework: leave lettering till a later stage.

At this stage, have a first attempt at assigning appropriate line thicknesses and colours for you map elements. Work on the principle that the geology should stand out (faults more boldly than contacts) and that the topography should be more muted by using thinner lines or more faded line colours. Never use ‘hairline’ thicknesses, or those less than 0.1 mm: they risk not printing at all.

Be sure that you have double-checked the accuracy and plausibility of your linework before you start creating area fills for the map. Printing a black/white A4 hard copy can be revealing. You can turn off any combination of layers (e.g. the scanned bitmaps) to help you in this proofing process.

Create area fills as follows:

- First check (for CorelDraw) that the ‘nudge’ and ‘duplicate placement’ parameters are set to the same distance: 1mm is convenient.
- Focus on one closed area of fill at a time. Make a duplicate (using Ctrl-D) of each line (usually a contact or a fault) bounding the area. Where the line extends

beyond the area concerned, break it at the appropriate node (via shape tool) and break apart the two resulting segments. The spare segment will probably be needed for another area.

- Combine the lines bounding the area and, if necessary, nudge the combined object back to its proper position on the map, precisely overlying the parent contacts.
- Draw in any missing line segments to make a closed object, and fill it with a colour or pattern fill, perhaps temporary at this stage.
- Remove the object's outline and move the object onto a separate 'fills' layer created *below* the linework layers. Check that the fill and its contacts register correctly before moving on to the next fill area.
- Use lighter rather than darker colour tones where possible. They are more elegant, and allow overlying linework and lettering to show more clearly. Avoid all but small areas of pattern fill.
- Add the lettering at this stage
    - Put lettering on a layer above all linework and fill.
    - Use only one or two fonts, in a limited number of sizes. Simple, sans-serif fonts (e.g. Arial rather than Times) are most effective on maps and diagrams. Choose sizes that are easily legible (generally 8pt or more).
    - Align lettering horizontally, except where it parallels contours, drainage or faults.
    - Avoid overlapping lettering with linework if possible. Where unavoidable, either:
        - put a white or appropriately coloured box behind the text object or, more elegantly,
        - (in CorelDraw only), use a thick white or coloured outline pen for the lettering, with the outline put *behind* its fill (use the outline pen dialog box), or
        - (in Inkscape) make a duplicate of the lettering, give it a thick white outline, and move it behind the primary lettering.

Create other elements of your map sheet (key, scale, north arrow, grids, and sections) using similar techniques to above.

Do the final print run during working hours when the computer officers' area available to trouble shoot. DO NOT LEAVE THIS PRINTING TILL THE LAST FEW DAYS before the submission date.

5.8 MAP PRINTING

Printing to the A0 plotter (in room N316) is expensive (at least £3 per map). Follow the guidelines here or risk making costly and time-consuming errors, or not getting your work to print at all.

Inkscape files produce more reliable print files than CorelDraw: use CorelDraw at your own risk.

When you print, the system expands the file significantly. Keep the size of your print file to a minimum by:

1. Reducing the resolution of any bitmap files to a maximum of 300dpi.
2. Importing images/graphics from .jpeg files rather than from .tiff files.
3. Using fonts from the standard font sets.

- Create a PDF file first. Then print the PDF file from a PDF reader, such as Adobe Acrobat. If this is problematic, print directly from the programme of your choice.
- Proof your map/poster on an A4 printer, before any attempt to print it to the A0 plotter.
- You will block the print queue if you don't prepare well. The computer officers reserve the right to cancel your job any time if it is found to be problematic.
- DO NOT leave your map/poster printing until the last moment. A print job can take up to a couple of hours and there is always a long queue before a submission deadline.
- Printing is supported between 08:00 and 17:00, Monday to Friday.
- You can cancel your printing by pressing the CANCEL button on the plotter, if your print job is going wrong.
- Contact the Computer Office (at helpdesk@esc.cam.ac.uk) if you have any technical questions.
- Sarah Humbert in the Library is always happy to help!

5.9 FIELD DATA

Appropriate analysis of field data depends on its nature and intended use. Examples of report items that might be generated from specific data are:

- logged sections *give* stratigraphic logs, fence diagrams, bed thickness histograms, isopach maps
- palaeocurrent measurements *give* rose diagrams, circular statistics
- structural orientation data *give* stereoplots, spherical statistics
- fossils *give* faunal lists, range charts

Most areas should generate at least some stratigraphic logs and some stereoplots. Don't include any of these items merely as ornament to the report – you must discuss their geological interpretation in the text.

5.10 LITERATURE

Read or reread the previous literature on your area. Some routes into this are:

- The on-line *University Library catalogues* cover a lot of the material in the Earth Sciences Library and allow searches by geographical keywords.
- *Web of Science*, *GeoScience World, Scopus* or *Zetoc* (searchable online).
- The index to the major geological journals of the country concerned.
- If in doubt, get advice from the Department Librarian, your project advisor, or a relevant member of the teaching staff.

Read relevant literature to aid the interpretation of geological processes in your area. Refer back to relevant course notes and their cited references.

5.11 DRAFT TEXT

Decide on the layout of your report. This will vary from project to project depending on the type of geology, but will contain some or all of the following components:

- **Title page** - with your name and the submission date
- **Abstract** – no more than 250 words.
- **List of contents** - main sections only with page numbers. A list of figures is unnecessary if the figures are numbered sequentially.
- **Introduction** - briefly explain the general purpose and any special aims of the project, summarize the regional geographical and geological setting of the area and previous literature. Include a brief section on logistics. If colleagues have mapped overlapping or adjacent areas, include an index map showing the relative positions of the areas.
- **Stratigraphy** or **Rock Sequence** - describe main lithologies, oldest to youngest then intrusives; use existing formal lithostratigraphic names or erect new ones (with type sections) as appropriate; systematically describe each unit, its base, top, lithology, thickness and age. Best to delay detailed process interpretation until a later specialist section.
- **Structure** - at least in enough detail to explain the geometries on your map and sections.
- **Sedimentology**, **Palaeontology**, **Metamorphism**, **Igneous Geology**, **Economic Geology** or any other specialist topic which justifies a chapter in your particular area. Cover interpretation of processes here.
- **Geomorphology and Superficial deposits** if these features warrant separate discussion.
- **Synthesis** or perhaps explicitly **Geological History**; a chapter which draws together all aspects of the geology of your area into a coherent story. Wherever possible, refer to your own observations rather than previous work.
- **References** - a list of the literature that you have quoted in the text or figure captions (excluded from word count).
- **Figure Captions** - are best word processed, leaving gaps for pasting in the relevant figure. Figures should be interspersed at the correct place in the text, rather than grouped at the end. Captions are not totalled in the word count, as long as they are short and appropriate.
- **Appendices** - best avoided, but might be justified to present tabulated data, or dense description that would break the flow of the text. However, any text here must be included within your 6000 word count.

Your first draft should concentrate on describing the geology accurately and clearly; the English-style can be tidied up later.

Be sure that any localities described in the text are locatable on your final map and field slips; use grid references and optionally the direction and distance from a named feature.

5.12 PHOTOGRAPHS

Field photographs are useful as reminders when describing lithologies and

structures, but be very selective about those to include in the report; only use photos that show rock types or geological relationships clearly.
Consider drawing over a photo to highlight important features. If these lines will obscure the original evidence, reproduce both an original and an interpreted photo side-by-side.

Some photos might be better traced and shown in the report as labelled line-drawings.

Draft an informative caption for each report photo, understandable without reference to the text, and including a grid reference that will locate it on your map.

Digital photos can be pasted electronically into Word documents, but Word is fussy about locating them correctly. Right click on pasted-in figures and select 'Format Picture' to get the full range of positioning options. Select 'Square' from the 'Layout' tab to get the text to wrap around the photo.

5.13 LINE FIGURES

- Hand-drawn or computer drawn figures are equally acceptable.
- Either format can be imported into Word as a digital file (after scanning hand-drawn figures). From CorelDraw, choose File > Export for Office to get the best result. However, scanned copies of field-notebook sketches should be avoided. They are rarely of high enough quality for the report without modification.
- Position the figures in Word as described above.

5.14 FINAL TEXT

Your final text must be word processed and printed and include an Abstract of not more than 250 words.

The final text must not exceed 6000 words in length; only figure captions, the contents list, and references are not included in this total but citations within the report are included in the word count as they are an integral part of the running text. To keep within length you will need to use an economical writing style and make full use of figures.

Revise your draft text to improve the English-language style. Be ruthless in pruning out anything that does not add to the meaning.

Decide on a format for layout and typographic style before you start, and follow this consistently throughout. Some guidelines are:

- The text is required with 1½ line spacing
- Use a hierarchical structure of subdivisions and their headings e.g. (Note: more than three levels of subdivision within a chapter becomes very fussy)

1. STRATIGRAPHY *(chapter heading)*
1.1. Lower Palaeozoic *(major subheading)*

The Cefn Formation (minor subheading)

Things to note:

- It is safer to cross reference sections (also figures) by their number rather than their page number, which may change with reformatting.
- Leave a space **after** each item of punctuation, like this, rather than around it , like this , or before it ,like this .
- Avoid Unnecessary Capitals; for instance it is correct to describe the Cefn Formation, but not to say that the Formation was poorly exposed
- Recommended geographical spellings are east, easterly, eastward, northeast, north-northeast. Use NNE only if usage is very frequent.
- Cite references in a consistent form such as Smith (1984), Smith & Jones (1984), Smith *et al.* (1985) and as (Smith 1984, Smith & Jones 1984, Smith *et al.* 1984)
- Use a consistent bibliographic style; for instance:
  Smith, A.B. 1989. *Introduction to reports*. London: XYZ Press.
  Smith, A.B. & Jones, C. 1990. Writing good reports. *Journal of Report Writing*, 5, 69-77.
  Wright, L.M. 1987. Avoiding loud reports. In Jones, C. (ed.) *Reports through history*, 344-378. London: XYZ Press.
  (A reference handling program such as Endnote is on useful way of achieving a consistent style.)
- Label figures and photos sequentially through the whole report (Figure 1 to Figure n) or within each chapter (Figure 1.1 to Figure 1.n)
- Include *brief* acknowledgements to those who have helped you and provided financial assistance

5.15 FINAL REPORT PRODUCTION

DO NOT LEAVE PRINTING TILL THE LAST DAYS BEFORE SUBMISSION. Murphy's Law – anything that can go wrong will – invariably applies to material printed in a hurry.

- Ruthlessly reduce the size of electronic files, to reduce printing times and failure risk.
- Print or photocopy as many copies as you will need.
- Bind report: spiral binding is good because the report will open flat.
- Fold the final map, sections and field slips to A4 size maximum. Place them with the field notebooks and the report in the smallest feasible A4 wallet or box file.

APPENDIX 1

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APPENDIX 2

DEPARTMENTAL FIELD EXPERTISE 2019-20

BY SUBJECT AREA

Carbonate Sediments	Neil Davies, Alex Liu
Clastic Sediments	Neil Davies, Morag Hunter, Nick McCave, Nigel Woodcock, Alex Liu
Fossils	Nick Butterfield, Liz Harper, David Norman, Alex Liu, Neil Davies, Daniel Field
Igneous Rocks	Marie Edmonds, Sally Gibson, John Maclennan, Marian Holness, Helen Williams, Oliver Shorttle, Owen Weller
Metamorphic Rocks	Mike Bickle, Marian Holness, Ed Tipper, Owen Weller
Neotectonics	James Jackson, Nicky White, Alex Copley
Quaternary geology	Nigel Woodcock, Luke Skinner, Neil Davies
Structures	Mike Bickle, James Jackson, Nicky White, Nigel Woodcock, Alex Copley, Owen Weller

BY GEOGRAPHIC AREA

Highlands/Islands	Marie Edmonds, Sally Gibson, Marian Holness, John Maclennan, David Norman, Neil Davies
Grampians	Nigel Woodcock
Midland Valley	Nigel Woodcock
Southern Uplands	Nigel Woodcock
Northern England	Sally Gibson, Nigel Woodcock, Neil Davies
Isle of Man	Nigel Woodcock
Central England	Nigel Woodcock, Neil Davies
East Anglia	Nick McCave, David Norman
Hampshire Basin	Nick McCave, David Norman
Wealden District	David Norman
Southwest England	Mike Bickle, Marie Edmonds, Nigel Woodcock
Welsh Borders	Nigel Woodcock, Neil Davies
North Wales	Nigel Woodcock, Neil Davies
South Wales	Sally Gibson, Nigel Woodcock, Neil Davies
Ireland	Mike Bickle, Nigel Woodcock, Neil Davies
Africa	Mike Bickle, Sally Gibson, Morag Hunter, Neil Davies
Alps	Mike Bickle, Ed Tipper
Antilles	Marie Edmonds
Arctic	Owen Weller, Neil Davies
Australia	Mike Bickle, Neil Davies, Alex Liu, Nick Rawlinson
Belgium	Neil Davies
Brazil	Alex Liu
Canada	Mike Bickle, Nick Butterfield, Luke Skinner, Neil Davies, Alex Liu, Owen Weller, Daniel Field
Caucasus	Steve Vincent (CASP)
Central America	Marie Edmonds

China	Steve Vincent (CASP), Owen Weller, Alex Liu, Alex Piotrowski
Cyprus	Mike Bickle, Nigel Woodcock
Egypt	Judith Bunbury
France	Ed Tipper
Greece	Marian Holness, James Jackson, Nicky White, Alex Copley, Owen Weller
Greenland	Marian Holness
Himalaya	Mike Bickle, Ed Tipper, Owen Weller
Iceland	John Maclennan, Oliver Shorttle
Italy	Marie Edmonds
New Zealand	Marie Edmonds, Liz Harper, Morag Hunter
Norway	Neil Davies
Pyrenees	Mike Bickle, Steve Vincent (CASP)
Russia	Neil Davies, Steven Vincent (CASP)
South America	Marie Edmonds, Sally Gibson, Morag Hunter
Southeast Asia	Ed Tipper
Spain	Nigel Woodcock, Mike Bickle, John Maclennan, Owen Weller, Neil Davies
Spitsbergen	Peter Friend, Neil Davies
Turkey	James Jackson
U.S.A.	Marie Edmonds, Sally Gibson, Neil Davies, Daniel Field