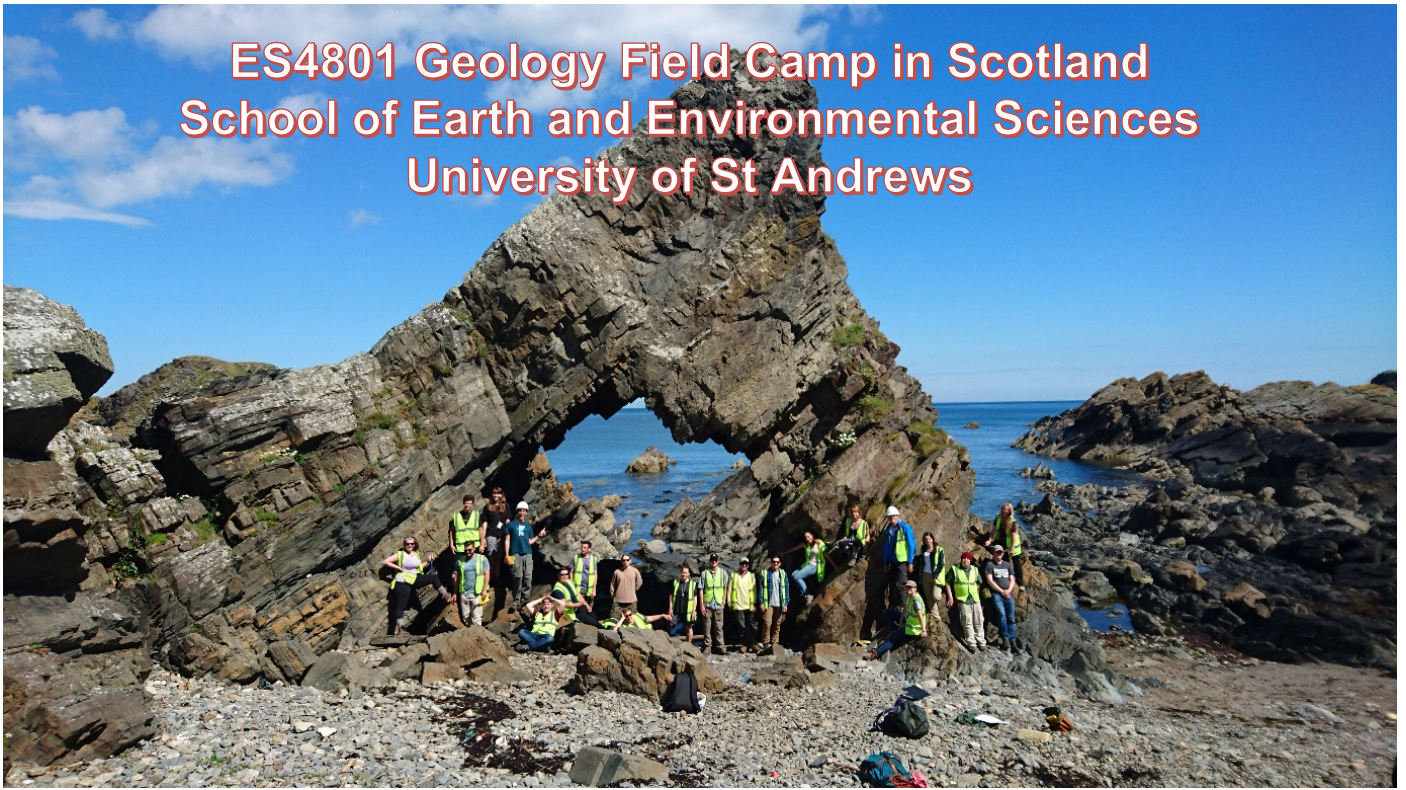


# ES4801 Geology Field Camp in Scotland School of Earth and Environmental Sciences University of St Andrews



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Find us on Facebook <https://www.facebook.com/GeologyFieldCampScotland/>

# Welcome

Scotland is the birthplace of Geology. In the mid 18<sup>th</sup> Century, James Hutton deduced the existence of Deep Time at Siccar Point and the intrusive nature of granite in Glen Tilt, Charles Lapworth documented mylonites and a mechanism for thrust faulting around Loch Eriboll, and George Barrow's observations through the Angus glens paved the way for the concept of metamorphic facies. During this course you will literally walk in the footsteps of those workers whose insights laid the foundations upon which Earth Science is built.

We are delighted to welcome you to the University of St Andrews where Geology and its earlier counterparts have been taught for several centuries. We aim to teach and expose you to the maximum amount of geological diversity possible (Fig. 1). The University is ideally located for direct access to world-class geology that literally starts at our doorstep. As a taster, you will work on the classic metamorphic Buchan and Barrovian sequences in the Grampian Highlands, unravel the complex structure of the Moine Thrust and geological framework of the Caledonian Foreland, and document sedimentary-igneous relationships in the Devonian-Carboniferous strata of Fife and Angus, concluding with an independent synthesis, *based on your observations and data*, of the 3-billion-year geodynamic evolution of Scotland.

This document provides background information about the course and associated logistics. It complements the information in your Fieldwork Handbook, as well as field guides that will be provided for the localities you will study. If you have questions, please contact us at: [gfps@st-andrews.ac.uk](mailto:gfps@st-andrews.ac.uk)

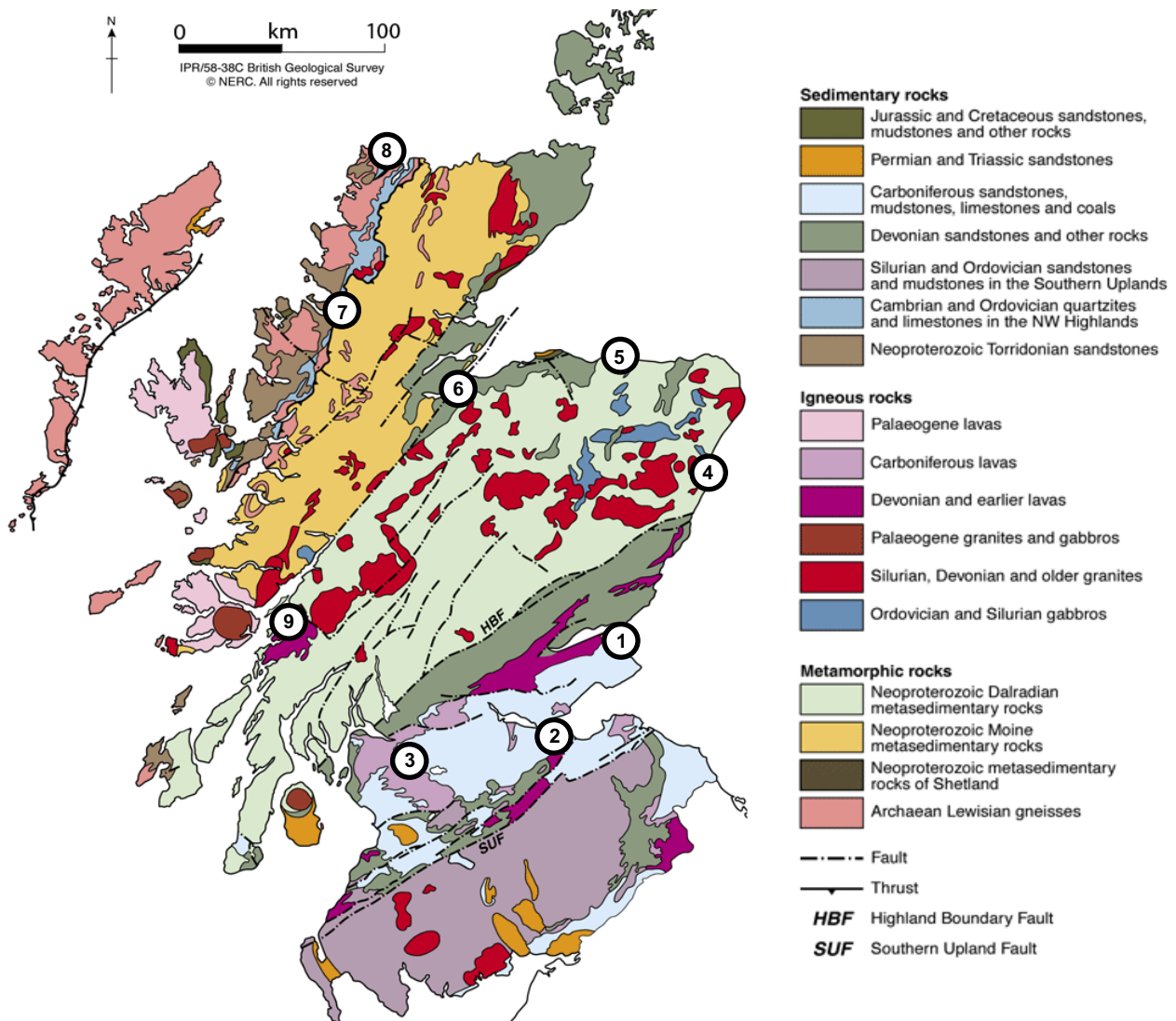


Figure 1. Generalised geology of Scotland. Main towns: 1-St Andrews, 2-Edinburgh, 3-Glasgow, 4-Aberdeen, 5-Cullen, 6-Inverness, 7-Ullapool, 8-Durness, 9-Oban.

## Course philosophy

Fieldwork and mapping are fundamental to the geosciences. They are foundational for the spatial and temporal frameworks of geological reconstructions, hence an essential component of your training. During the course you will develop skills in the techniques of fieldwork, including systematic observation and data collection, accurate recording of that information, critical thinking and independent testing of hypotheses.

Emphasis is placed on building self-confidence. You will learn to trust your interpretations as based on *your* observations and ideas. Brief, daily lectures will introduce you to the day's geology and discussions are held every evening (termed 'surgeries') to ensure your techniques are correct, observations are sound and that you are progressing in your understanding.

All questions are worth asking. All uncertainties are worth addressing. Our learning environment encourages dialogue and constructive criticism. This is key in ensuring that you have a fulfilling experience, gain new and deeper knowledge and, importantly, have fun doing so.

## Learning outcomes

On completion of the course, you will have the ability to:

- identify geological relationships and interpret them in the context of complex structural settings
- visualise and interpret the 3-D and 4-D relationships that define the geology of a given region
- create and test hypotheses and undertake problem solving using field-based data
- systematically describe and identify minerals, rocks and geological structures
- systematically collect, record, assess and compile data in a field notebook
- develop map reading, spatial awareness and compass/GPS skills
- work in groups to refine communication and cooperation skills
- hone time management and organisational skills
- construct geological maps and cross sections
- gain self-confidence to work independently

## Assessment and grading

Your mark will be determined on work you complete for each assignment; each will be weighted equally unless noted otherwise. Formative feedback will be given for the first exercises and you will receive guidance on what is expected prior your work that will be assessed formally. In general, the main criteria for assessing your work include but are not limited to:

- maintaining a neat, organised and systematically kept field notebook that contains detailed observations and clear sketches, accurate descriptions of rocks and geological features, and high-quality end-of-day summaries that include evidence of critical thinking;
- the systematic collection and representation of data on Field Maps and the correct transferral of this information onto Office Maps and, if required, Final Maps; all data must be plotted accurately on all maps with legends and, when completed, your map must make geological sense;
- cross-sections that capture the key geological features and structures within a given area and show understanding of their 3-D relationships into the subsurface, they must also have a legend;
- there must be evidence of an overall understanding and coherent interpretation of the geology and the processes by which that geology was produced, and of the geological evolution of Scotland.

St Andrews uses a grade-point-scale system that differs from what you are likely used to. Below is a conversion guide as to how your marks might translate into those of your home institution, although the actual conversion will depend on the specific policies and practices of your institution.

Grade Point converted to letter grade		
19-20 = A+	17-18 = A	16 = A-
15 = B+	14 = B	13 = B-
12-11 = C	10 = C	9 = C-
8-7 = D		
≤6 = F (fail)		

## Standards of behaviour

Once accepted on the course you will be a registered student at the University of St Andrews, thus bound by the regulations of the University and expected to conduct yourself accordingly. Any deviation from this expected conduct will result in swift disciplinary action, which could lead to your expulsion from the course. See: <https://www.st-andrews.ac.uk/students/rules/conductdiscipline/conduct/>

Numerous areas in Scotland are protected SSSI's (Sites of Special Scientific Interest). Scientific study is allowed but restricts certain behaviour is restricted; we will inform you about these at the appropriate time. Scotland also has a *Right-to-Roam*, which permits unhindered walking and hiking almost anywhere in the country. This is possible by everyone being polite, respectful of landowner's property, not leaving rubbish (always carry it with you and dispose of properly), closing gates, not damaging or climbing over fences or harassing livestock or other animals. For more information, see the *Field Geology Code*:

<https://www.scottishgeology.com/where-to-go/geological-fieldwork-code/>

## Itinerary

The concise itinerary below summarises the course. Note that it is subject to change dependent on contingencies such as weather, accommodation availability, etc. *All work will be based on the observations you make whilst independently mapping and studying the geological features noted below.*

<b>Weeks 1 and 2: St Andrews (Fife – Angus area)</b>
Registration and orientation; introduction to the geology of Scotland
Mapping the Carboniferous: Hercynian structures and sedimentary-igneous rock relationships
Sedimentary facies: identifying, logging and interpreting the Carboniferous fluvial-marine systems of Fife
Reconstructing the anatomy of an orogenic molasse: the Caledonian Orogen and Old Red Sandstone
Maar volcanoes and their plumbing system, volcanic necks and volcanoclastic sedimentation
<b>Week 3: Aberdeen – Cullen – Inverness</b>
Mapping a plate boundary: the Highland Boundary Fault and Iapetean oceanic crust
Regional metamorphism: the classic Barrovian metamorphic zones
High-temperature metamorphism: the classic Buchan zone transect
Migmatites and migmatisation, and felsic and mafic granitoids
<b>Weeks 4 and 5: Northwest Highlands</b>
Fold and thrust belts: mapping the iconic Moine Thrust system
The Sauk sequence: characterising the Cambrian-Ordovician transgression of Laurentia
Palaeotopography and unconformities: identifying, mapping and reconstructing the Torridonian
The Archaean Earth: mapping Lewisian granulite-amphibolite gneissic 'basement' terranes
Putting-it-all-together: 3 billion years of Earth history

## Logistics, accommodation and subsistence

All transport, accommodation and subsistence expenses are included in your fee. To ensure that all goes to plan as smoothly as possible, please take note of the following:

- *Accommodation.* In St Andrews you will have a room in one of the University's halls of residence. Away from St Andrews, we will use Youth Hostels and share rooms with 4 to 8 people (the typical number of beds per room). We will arrange as best we can for single-sex rooms. Bedding is provided (you do not need a sleeping bag) and laundry facilities are available at most Hostels.
- *Transport.* Transport is via 15-seater minibus; **seat belts must be fastened at all times.** Your baggage will be transported in a separate vehicle to ensure comfortable seating for everyone.
- *Subsistence.* All accommodations have cooking facilities to prepare breakfast, lunch and dinner. For efficiency, we will organise cooking groups and be considerate of dietary needs (vegetarian, vegan, etc.). Food shopping will be done by either click-n-collect or delivery, and food ordering must be organised at least 24-hours in advance. *If you have food allergies (celiac, peanuts, etc.) you must inform us as soon as possible.*

## Safety in the field

Safety is always our priority. Staff will explain verbally and provide risk assessment forms that outline potential risks of fieldwork and safety measures to avoid or guard against those. You must pay attention and sign and return the forms before you can undertake any fieldwork.

*Staff must be informed about any existing or potential medical issues prior to the start of the course (all such information will be held in strictest confidence).* Please be aware that Staff are not permitted to provide medication hence you need to carry whatever medication you might require (e.g. inhalers, epi pens, antihistamine, diabetic drugs, etc.).

You will be assigned safety equipment consisting of a hard hat, high visibility vest and goggles (to be used when hammering) and these must be worn at all times. For safety, you will also need to carry extra clothing and always have your waterproofs (see the checklist on the last page to help plan your field gear). As a reminder, general risks/hazards to be aware of include:

- failure to pack adequate equipment (maps, compass, clothing, etc.)
- isolation (always stay within sight of your partner/group)
- steep/unstable slopes, rock overhangs and fast-flowing rivers (use common sense)
- hammering without goggles (*n.b.*: using chisels is not allowed)
- wild or domesticated animals (do not disturb them)
- severe changeable weather (have appropriate clothing and footwear)

Site-specific risks/hazards to be aware of include:

- Do not expose yourself to risks inherent in caving, rock climbing or along steep, exposed slopes.
- Do not work in active quarries and ask owners for permission to enter disused properties.
- Road sections require lookouts wearing high-visibility clothing to warn approaching traffic.
- Cross streams only at appropriate fords or bridges.
- Watch out for boggy areas, including along the margins of lochs (lakes).
- Coastal areas have all the hazards of upland areas compounded by changing and variable tides and waves; be aware that headlands and coves can become cut off at high tide and coastlines can have slippery rocks and boulders; do not go swimming.

***Safety wisdom and the Golden Rule: if you feel frightened, then don't do it!***

**In case of an emergency dial or text: 999 or 112.** Ask for Mountain Rescue if you are in an isolated area away from roads and be ready to give a **CHALET** report:

- **Casualties.** Number of casualties and, if possible, their age and the type of injury (e.g. broken leg, head injury, seizures, etc.)
- **Hazards.** What hazards could there be to rescuers (e.g. cliff face, rock fall, dangerous animals)
- **Access.** Describe the terrain, especially any distinguishing features. Also, describe weather conditions at the incident site, particularly if you are in fog or mist.
- **Location.** Use your field map or GPS to provide your position and description of your location.
- **Equipment.** What equipment is at the scene (e.g. torches [flashlight], group shelter, survival bags)
- **Type of incident.** Explain what caused the accident (falling off a cliff, car crash, etc.)

## Responsibilities

The course leader will be appointed by the School and will be in charge of all participants to ensure that:

- safety briefings are given with adequate time for you to prepare, including checking your field gear
- all staff have a list of the names, addresses and phone numbers of your next-of-kin
- you acknowledge receiving safety advice (by signature or a witness)

As a participant of the field course, your responsibilities include:

- taking safety advice seriously
- not endangering yourself or others by indiscipline or abuse of drugs/alcohol
- following instructions of the staff including the rigorous keeping of appointments
- informing the leader, prior to the trip, of existing injuries, illnesses or disabilities
- reporting any injury, illness or harassment immediately
- obtaining and wearing appropriate field clothing and footwear as advised
- signing and returning all requested documents
- providing up-to-date details about next-of-kin in case of accidents

## Personal baggage/luggage and daily field gear

The Scots have a saying: “*four seasons in a day*” because weather conditions can vary dramatically over short periods of time, including dropping below freezing with wind chill. This requires you to pack extra layers, always have rain gear, wear appropriate sturdy footwear and carry extra food and water. Use the list below as a guide:

What we will provide	personal items	field gear
hard hat*	ruck sack/day pack	A5 hard-back notebook
high visibility vest*	sturdy footwear (ankle support)	map board, plastic bag
goggles*	waterproof jacket and trousers	hand lens
compass-clinometer*	warm hat, sun hat, gloves, scarf	acid bottle
Group 1 <sup>st</sup> -aid kit*	extra layers (fleece, etc.)	pocket knife
hand lens	headlamp or torch (flashlight)	rock hammer
A5 field notebook	water bottle/camel pack	pencils, coloured pencils
acid bottle	matches or a lighter	map pens (0.1, 0.3mm)
grain size card	insect repellent (midges!!!)	permanent marker
plastic bag for map board	sunglasses, sunblock, lip balm	survival bag
Field Handbook Guide	toilet paper	food, snacks, water (2-3 litres)
*return at end of course	swim suit (sometimes it is warm!)	emergency contact info

*Please limit your luggage to 1 daypack and 1 suitcase/backpack because space is limited.* Almost all our accommodations have stores and pharmacies nearby, as well as laundry facilities, so you can always buy something you forget, lose or damage.

## Suggested readings

The brief reading list below provides useful background information that will help prepare you for the course and complement your learning experience.

### General background information

N.L. Trewin, ed. (2002) *The Geology of Scotland 4<sup>th</sup> Edition*. Geological Society of London. <https://doi.org/10.1144/GOS4P>

N.H. Woodcock and R.A. Strachan, eds. (2012) *Geological History of Britain and Ireland*. Backwell Publishing. <https://onlinelibrary.wiley.com/doi/book/10.1002/9781118274064>

### Fieldwork-focussed texts

A.L. Coe, ed. (2010) *Geological Field Techniques*. Wiley Blackwell. <https://www.wiley.com/en-gb/Geological+Field+Techniques-p-9781444330625>

D. Jerram & M. Caddick (2022). *The field description of metamorphic rocks*. Wiley Blackwell. <https://www.wiley.com/en-us/The+Field+Description+of+Metamorphic+Rocks,+2nd+Edition-p-9781118618752>

D. Jerram and N. Petford (2011) *The Field Description of Igneous Rocks*, 2<sup>nd</sup> Edition. Wiley Blackwell. <https://www.wiley.com/en-us/The+Field+Description+of+Igneous+Rocks%2C+2nd+Edition-p-9780470022368>

M.E. Tucker (2003) *Sedimentary rocks in the field*, 4<sup>th</sup> Ed. Wiley Blackwell. <https://www.wiley.com/en-us/Sedimentary+Rocks+in+the+Field%3A+A+Practical+Guide%2C+4th+Edition-p-9780470689165>

## Contact Information

For general questions, feel free to call or email the School of Earth and Environmental Sciences. If no one answers, leave a message and we will get back to you as soon as possible.

- Geology Field Camp Scotland email: [gfps@st-andrews.ac.uk](mailto:gfps@st-andrews.ac.uk)
- School of Earth and Environmental Sciences:  
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