GeoSchool

Geoscience training for the 21st century
The British Geological Survey (BGS) founded in 1835, is the world’s oldest national geological survey and the United Kingdom’s premier centre for earth science information and expertise. Our position as a leading global geological survey organisation, with a strong research focus and extensive overseas experience, allows us to provide a unique range of high quality and cost-effective geoscience training solutions. This training is available to external organisations including government agencies, industry and academia through the BGS GeoSchool programme. This brochure outlines the range of training available.

All of our training presenters are experts in their respective fields. They are actively involved in leading edge research and consultancy, and frequently have an international scientific reputation. Our trainers are well skilled in the art of presenting and communicating complex science effectively and have considerable experience in delivering professional training.

Training is delivered through a variety of methods including classroom-based and field-based courses. Classroom-based courses (including those for IT subjects) are generally provided at our headquarters at Nottingham (Keyworth) or Edinburgh; however, most of these courses can be delivered at customer’s preferred locations. Prescribed courses are run to an annual schedule provided there is sufficient demand. In addition, the BGS seeks to provide courses which meet the client needs and timing. These bespoke courses may combine parts of existing courses as required or be totally new; they are specifically configured to the capability and experience of the participants.

With field-based courses, attendees are encouraged to gain hands-on knowledge at classic exposures and successions under our expert guidance.

The GeoSchool initiative strives to provide the students with intellectually stimulating, achievable challenges, which should prove to be an enjoyable learning experience. Crucially, GeoSchool is focused on delivering a real benefit to the customer’s business.
Hydrocarbons and energy
- Glacial sediments and glaciogenic reservoirs
- An introduction to carbon capture and storage
- Extensional tectonics in the field: Utah and Nevada
- An introduction to sequence stratigraphy in the field: Utah
- Tectono-sedimentary architecture and modelling applied to exploration, carbon sequestration and fluid flow
- Biostratigraphy for non-biostratigraphers
- Specialist training for biostratigraphers
- Training in non-acid palynological preparation techniques
- An introduction to petroleum data management
- Core description workshops
- Seismic reflection interpretation

Geological mapping and digital field data collection
- Geological field surveying
- Geological mapping in deformed terrains: foundation skills
- Quaternary field mapping: Lowland Britain
- Quaternary field mapping: Upland Britain

Geoscience modelling
- Introduction to ArcGIS for geoscientists
- Introduction to GeoVisionary
- Introduction to GoCAD
- Introduction to groundwater modelling
- Modelling with ZOOM

Remote sensing and photogeology
- Introduction to photogeology and remote sensing
- Photogeology and SOCET
- Satellite image interpretation

Environment and processes
- Introduction to hydrogeology
- Introduction to groundwater
- Introduction to physical hydrogeology
- Description and classification of rocks and soils for engineering purposes

Statistics for geoscientists
- Statistics for geoscientists: basic
- Geostatistics
- Sampling design and interpretation of sampled data

Costs quoted are per course participant subject to a minimum number of participants and do not include VAT. Fully inclusive costs for courses described in the brochure or for bespoke courses customised to meet client needs can be provided on request.
Glacial sediments and glaciogenic reservoirs

Intended audience
Recommended for all petroleum geoscientists working with glaciogenic reservoirs and sediments anywhere in the world.

Course objectives
To enable participants to:
- Observe, describe, interpret and classify processes and products in a modern terrestrial glacial environment.
- Analyse contemporary glacial sediment sequences, as analogues for glaciogenic reservoirs in the rock record.
- Examine dynamic and diagenetic post-sedimentation processes in a range of subaerial and subaquatic proglacial settings.
- Understand the interaction between ice-caps, climate, sea level and sediment supply.

Course description
- 9-day fully residential course based in south-east Iceland within walking distance of Vatnajökull, Europe’s largest glacier!
- Focused, discussion-led, evidence-based teaching in a small group, with one-to-one sessions, practical field exercises, and evening seminars.
- Led by BGS Quaternary geologists with over 10 years’ experience working in south-east Iceland; full logistical support including 4-wheel drive vehicles.
- 50-page bespoke teaching pack and course notes included.

Course duration
9 days

Delivery mode
Field-based course

Course fee
Dependent upon seasonal price fluctuations and exchange rates

It is expected that course attendees make their own travel arrangements to and from Reykjavik, Iceland

Date(s)
Early Autumn
An introduction to carbon capture and storage (CCS)

Intended audience
The course is particularly recommended for consultancies, regulators, power and energy companies with an interest in carbon capture and storage (CCS). This course will also benefit anyone with a geological background interested in learning how their skills can be applied to the expanding research field of CCS. The course can be adapted to suit the background and level of geological knowledge of the attendees.

Course objectives
▪ To introduce the concept of carbon capture and storage (CCS) and its potential contribution reducing carbon dioxide (CO₂) emissions.
▪ To provide participants with an understanding of what makes a good site for storage and the mechanisms for trapping CO₂ underground.
▪ To provide participants with an awareness of the tools and methodologies used for assessing the suitability of sites for underground storage of CO₂.
▪ To outline the potential risks of CO₂ storage and potential mitigation strategies.

Course description
The course will be delivered as a series of lectures, exercises and case studies. The emphasis of the course is to give an overview of CCS with the focus on geological storage of CO₂, using real case studies and cutting edge research results. The lectures will introduce real geological examples of potential and existing CO₂ storage sites. The exercises will guide the trainees through essential aspects of assessing CO₂ storage potential of geological sites.

Course fee based on delivery at BGS’s training centres
£500

Date(s)
As required

Location
The course is available at BGS’s Nottingham (Keyworth) or Edinburgh training centres, or at customer premises, worldwide, by arrangement.
Extensional tectonics in the field: Utah and Nevada

Intended audience
Geoscientists requiring an understanding of how three-dimensional extensional fault relationships, that are often inferred in subsurface models, maps and sections are recognised in the field. The course would be of particular relevance to geologists and geophysicists working in the field of petroleum exploration.

Course objectives
- To give participants the opportunity to ‘see’ three-dimensional extensional fault relationships in the field that are often inferred in maps, sections and three-dimensional models.
- To examine the three-dimensional form of extensional geometries, faulted geology, and the dynamics of faulting on a full range of scales from that of the fault zone to that of the basin.
- To examine and analyse three-dimensional structural modelling techniques commonly applied to the analysis of both two-dimensional and three-dimensional remotely-sensed subsurface data.
- To develop concepts and models of extension that are applicable on a variety of scales and to many geological terrains of the UK, particularly the Devono-Carboniferous basins of central and northern England and southern Scotland.
- To examine the effects of faulting and three-dimensional fault relationships on the syn-rift sedimentary fill of basins and the migration of economic fluids (hydrocarbons, mineralising fluids, water), and to develop three-dimensional models of the ways in which structure can aid or inhibit migration.

Course description
The course places a heavy emphasis on the three-dimensional aspects of faulting and fault interpretation. It will equip participants with a three-dimensional understanding of the principles and geometries involved, allowing them to make rigorous, three-dimensionally sound, geological interpretations in areas of limited data and from spatially limited, remotely sensed datasets such as seismic sections, satellite imagery and air photographs.

To this end, the course integrates examples of extensional structures visible in remotely sensed data, from the field area and elsewhere, and compares them with structures visible in the field. The course also makes extensive use of computer modelling to demonstrate and explain the three-dimensional application of structural modelling techniques examined in the field. Analysis of three-dimensional structural geometries and modelling techniques will be performed using three-dimensional computer models of both the field area and other extensional terrains, in order to demonstrate the applicability and limitations of the techniques and compare the results with field analysis.

This course is run jointly between the BGS and Dr Stu Clarke of Keele University. The course leaders are active researchers in the area and share supervision of a number of PhD and M.Geoscience research projects that are developing new structural insights and models into the region, putting this course at the leading edge of research here.
An introduction to sequence stratigraphy in the field: Utah

Intended audience
Geoscientists needing to become acquainted with modern techniques for basin analysis and sequence stratigraphic analysis. The course would be of particular relevance to geologists and geophysicists working in the field of petroleum exploration.

Course objectives
To enable participants to:
- Gain an overview of sequence stratigraphy and facies architecture on a ‘ramp type’ basin margin in the field.
- Compare lithostratigraphic and sequence stratigraphic approaches to the division of rock successions.
- Gain experience of the sedimentology of the well-exposed, Cretaceous alluvial to marine siliciclastic rocks.
- Gain experience of the sedimentology of alluvial, red bed successions, including palaeosols and of aeolian/lacustrine successions of Permian to Cretaceous rocks of the Paradox Basin (an analogue to the southern and central North Sea).
- Gain experience of extensional and salt tectonics, at an outcrop scale, as analogues to North Sea hydrocarbon traps and pathways.

Course description
The course will enable participants to develop an understanding and appreciation of the role of sedimentology studies in building genetic models and defining parasequences; this is essential to understanding the complexities of the sequence stratigraphic concept. The course is, therefore, designed to allow participants to work through the process of depositional model building and parasequence/sequence boundary recognition, in order that they may critically evaluate the sequence stratigraphic concept.

Particular attention will be paid to the difficulties of applying the sequence stratigraphic concept even in the classic, type locality, and emphasis will be placed on the inherent difficulties of applying the techniques in the sub-surface.

The red bed successions of the Paradox Basin provide the opportunity to extend the sequence stratigraphic concept to fully non-marine strata.

Although all of the sedimentological studies made on the course can be placed into a sequence stratigraphic context, there are also valuable lessons to be learnt in the field concerning many other aspects of petroleum basin studies. Consequently, the course covers a broader spectrum of interest than sequence stratigraphy alone.
Tectono-sedimentary architecture and modelling applied to exploration, carbon sequestration and fluid flow

Intended audience
Any geoscientist with a working interest in or requirement to understand the relationship between facies development, tectonic control, fluid flow, fluid flow barriers, fault development and linkage. The course will be particularly relevant to geoscientists in the fields of petroleum exploration, carbon sequestration and radioactive waste disposal. It is suitable for specialist sedimentologists, structural geologists, geophysicists and general geologists.

Course objectives
To enable participants to:
▪ Observe and interpret basin-scale sedimentary architecture and facies relationships of a fluvial to near offshore system in superbly exposed localities.
▪ Relate facies development to relative sea level changes and tectonic control in the hinterland.
▪ Observe the development of salt walls and diapirs, and understand their effect on sedimentation, halokinetic unconformity development and the structural fragmentation of surrounding strata.
▪ Observe, measure and model extensional fault relationships in the field, at a range of scales from outcrop to basin.
▪ Examine and analyse three-dimensional structural modelling techniques commonly applied to the analysis of both two-dimensional and three-dimensional remotely-sensed subsurface data.
▪ Develop concepts and models of extension and associated sedimentation that are applicable on a variety of scales and to many geological terrains of the UK and elsewhere.
▪ Examine the effects of faulting and three-dimensional fault relationships on the syn-rift sedimentary fill of basins and the migration of economic fluids (hydrocarbons, mineralising fluids, water) and injected CO₂, and to develop three-dimensional models of the ways in which structure can aid or inhibit migration.
Course description

Day 1  Attendees meet up at Salt Lake City airfield, Utah.
Day 2  3D sedimentary facies model building in the littoral to near offshore zone.
Day 3  3D facies modelling, fluid flow interactions and tectonic controls on sedimentation in shallow marine to fluvial facies.
Day 4  Modelling of: a) extensional fault development and the evaluation of faults as conduits for and barriers to fluid flow; and b) the development of bleaching of sediments through hydrocarbon emplacement and/or CO$_2$ migration.
Day 5  Halokinesis, sedimentation and fluid flow: a) the development of halokinetic unconformities, salt walls and diapirs; b) their collapse/withdrawal and the associated development of listric fault blocks, relay ramps and cataclastic shear band development as pathways and inhibitors to fluid flow.
Day 6  Cataclastic shear band development associated with tectonism and its influence on fluid flow, followed by analysis of natural CO$_2$ leakage and mineralisation along a fault system.
Day 7  Development of graben systems, relay ramps, sediment input and fluid flow pathways.
Day 8  Travel back to Salt Lake City, via Kennecott Copper Mine to view large-scale industrial development of hydrothermal mineralisation.
Day 9  Fly home.
Day 10  Arrive home.
Biostratigraphy for non-biostratigraphers

Intended audience
Geoscientists, postgraduate students, managers and others who use biostratigraphical data and who need to know more about the subject.

Course objectives
Attending the course will provide an understanding of:
- The principles of biostratigraphy.
- The use of biostratigraphical data to solve geological problems.
- What biostratigraphical tools are available for different geological periods.
- How biostratigraphy can be integrated with other geoscience disciplines.
- The use of quantitative techniques to improve timescale resolution.

Course description
The aim of the course is to introduce biostratigraphy to a non-specialist audience. Topics covered will include:
- Introduction to biostratigraphy — what it is?
- Biostratigraphical zones — how they are defined and recognised in stratigraphic sections.
- What fossils are used in biostratigraphy and what makes a good zonal fossil.
- The strengths and weaknesses of biostratigraphy.
- Integration of biostratigraphy with other stratigraphic methods (e.g. sequence stratigraphy, stable isotope stratigraphy) to add value to projects.
- Quantitative methods and the prospects for improving biostratigraphical resolution
- Information other than dating and correlation of rock successions that can be gleaned from biostratigraphy.

Course reference literature
Specialist training for biostratigraphers

Intended audience
Biostratigraphers who need focused training in unfamiliar fossil groups in order to undertake new projects and assignments. Training on a variety of fossil groups within the expertise of BGS biostratigraphy is available.

Course objectives
Attending the course will enable:
- An understanding of the taxonomy of fossil groups of interest.
- Identification to species level.
- Understanding of applicable zonal schemes.
- Recognition of zonal markers.

Course description
The course will cover the following for the group of interest:
- Classification.
- Taxonomy.
- Identification and keys.
- Stratigraphic ranges.
- Key marker taxa.
- Palaeoenvironmental signals.

Course duration
5 days or as determined by the customer requirements

Delivery mode
Tutorial-style teaching, one-to-one or in small groups; directed reading; practical exercises aimed at developing identification skills, including microscope work where appropriate

Course fee
Fee variable dependent on required tuition.
2 day course £2500

Date(s)
As required

Location
The course is available at BGS’s Nottingham (Keyworth) or Edinburgh training centres, or at customer premises worldwide, by arrangement
Training in non-acid palynological preparation techniques

Intended audience
Technicians and palynologists who wish to learn sample preparation techniques that avoid the use of acids.

Course objectives
The objective of the course is to disseminate information on palynology samples and preparation techniques that avoid the use of acids.

Course description
The course teaches the practical procedures used and will be taught through instruction within a laboratory environment.

Course duration
2 days or as determined by the customer requirements

Delivery mode
Tutorial-style teaching, one-to-one or in small groups. Classroom/laboratory-based tuition

Course fee
Fee variable dependant on required tuition.
2 day course £1000

Date(s)
As required

Location
The course is available at BGS's Nottingham (Keyworth) training centre, where we have comprehensive biostratigraphic laboratory facilities. The course can also be provided at customer premises worldwide, subject to suitable laboratory facilities being available.
An introduction to petroleum data management

Intended audience
The course is aimed at geoscientists, data managers and support staff needing to gain an understanding of the principles and practices relevant to the management of petroleum geoscience data.

Course objectives
- To provide participants with an understanding of management issues pertinent to the main types of data utilised in petroleum geoscience.
- To provide an awareness of current practices for the storage and management of such data, including relevant ISO standards.
- To provide an insight into the systems and strategies used by the BGS.

Course description
This course will outline the key data management issues associated with the main types of geoscience data utilised in petroleum exploration, including (for example) records management policies, the capture of appropriate metadata, and digital preservation issues.

The two day course will also describe the petroleum data management strategies employed by the BGS, and will include practical demonstrations within the National Geoscience Data Centre (covering for example the use of digital databases and conservation of core material). The course could also be provided in a shortened form on-site at customer premises, if required.

Course duration
2 days

Delivery mode
Classroom based course, with opportunities to view the data management activities of the national geoscience data centre first hand

Course fee
£850

Course fee based on delivery at BGS’s training centres

Date(s)
As required

Location
The course is based at our Keyworth (Nottingham) training centre, and makes use of the facilities of the National Geoscience Data Centre (NGDC)
Core description workshops

Intended audience
Geoscientists and engineers needing to describe and interpret core material obtained from boreholes and hydrocarbon wells. The course can be run either using an established format, or on a bespoke basis using material and content relevant to the hydrocarbons, mining and other industry sectors.

Course objectives
▪ To gain an understanding of the principles of sedimentological core logging.
▪ To gain practical experience of core logging techniques under guidance of BGS experts.
▪ To understand how core logging data are integrated with other relevant data.

Course description
The course can be provided using pre-prepared examples from the Carboniferous and Jurassic of the UK and with a bias towards understanding relevant hydrocarbon reservoir analogues in the North Sea Basin.

Alternatively the course can be delivered on a bespoke basis, where the content is tailored to a stratigraphic interval or locality specified by the customer, and for which BGS holds suitable core material.

The course covers the principles of sedimentological core logging and description, and can also be customised to include other relevant information, for example sequence stratigraphic concepts, or biostratigraphic data from the intervals being analysed.

The course makes extensive use of the core material plus state of the art examination and description facilities of the National Geoscience Data Centre core store at BGS Keyworth.

Course duration
Nominally 2 days or longer as determined by the customer requirements

Delivery mode
The course emphasis is on practical exercises providing the attendee with experience of describing and logging core, supported by relevant presentations on the geological background and methods used

Course fee
£1000 (2 day course)

Course fee based on delivery at BGS’s training centres

Date(s)
As required

Location
BGS Keyworth — including using facilities of the National Geoscience Data Centre (NGDC). The course could also be delivered at customer sites at which appropriate core material is available, by arrangement
Seismic reflection interpretation

Intended audience
Geologists who wish or need to become acquainted with the seismic reflection method.

Course objectives
To enable participants to:
▪ Have a working knowledge of the principles behind the method, and of the associated terminology.
▪ Know how to transfer geology from borehole logs to seismic sections.
▪ Be able to recognise and interpret a variety of structural and stratigraphic features and to distinguish between geological features and geophysical artefacts.
▪ Be able to interpret a grid of seismic data, incorporating other surface and subsurface data, to produce a structural map of a given stratigraphic level.

Course description
The emphasis is on giving participants ‘hands on’ experience via a series of practical exercises that increase in complexity as the course progresses. This is combined with formal instruction.

Course duration
5 days

Delivery mode
Classroom-based course

Course fee
£1500
Course fee based on delivery at BGS’s training centres

Date(s)
As required

Location
The course is available at BGS’s Nottingham (Keyworth) or Edinburgh training centres, or at customer premises worldwide by arrangement
Geological field surveying

Intended audience
Geoscientists needing to gain a practical understanding of the principles of geological feature mapping in the field.

Course objectives
The course develops skills in highly detailed and accurate mapping of sedimentary bedrock successions based on recording and interpreting landform features. The course also includes elements of landslide recognition and mapping, and mapping of man-made deposits in urban areas. On completion of the course, trainees will be able to:

▪ Understand subtle relationships between surface landforms and the three-dimensional stratigraphy and structure of mildly deformed sedimentary bedrock formations.
▪ Reconcile accurately logged surface exposures with adjacent feature-mapped geology.
▪ Use the widely accepted BGS symbols and standards for data recording and field map preparation.
▪ Understand the strengths and limitations of geological feature mapping and how these impact on the reliability and accuracy of BGS geological maps, especially in urban areas.
▪ Appreciate how modern, digital methods of data recording, interpretation and map production can enhance and broaden the application and value of geological maps.

Course description
Feature mapping is a geological surveying technique that uses topographical and geomorphological landforms to construct a geological map in areas where there is no exposure—be they grassy fields or urban areas. The technique is fundamental to geological mapping in most sedimentary geological terrains where the rocks are not highly deformed, and can also be used, with limitations, to map superficial (Quaternary) deposits.

Feature mapping is the primary technique used by the BGS to survey its large-scale (1:10 000) geological maps of Great Britain. The course gives a thorough introduction to feature mapping and associated data recording methods. Practical fieldwork exercises make up the majority of the training, and each participant will be expected to produce a completed geological field map and associated notebook records at the end of the course. The course is suitable for both students and professionals in the applied geological sciences that need to make, use or understand geological maps.

The first day of the course is based at BGS Keyworth, involving a health and safety review with trainees, an equipment check and an introduction to feature mapping concepts. Day 2 at Baslow and days 3–6 at Graves Park, Sheffield, involve demonstration of feature mapping techniques in the field, including mapping exercises. The final day will return to BGS Keyworth for a review of the latest developments in the use of information technology for preparing, managing and delivering geological map data.
Geological mapping in deformed terrains: foundation skills

Intended audience
The course is aimed at student and professional geologists who are expected to work, or anticipate working in regions where polyphase deformation and metamorphism have affected mainly meta-sedimentary sequences.

Course objectives
Practical fieldwork mapping forms the core of the 10 day course. Evening presentations consider lithologies, metamorphism, the development of structure during ductile deformation, superficial deposit lithologies and landforms and their interpretation. The emphasis is on the development of good practical skills in observation, recording and interpretation at the outcrop, together with the production of good field maps. Students will be introduced to field mapping techniques consistent with BGS methods.

Participants will develop skills in the techniques required to:
- Make systematic observations and descriptions.
- Apply appropriate lithological names.
- Assess the nature and degree of metamorphism.
- Build a local lithostratigraphy.
- Elucidate the relationships between rocks units.
- Delineate the major folds and other structures.
- Delineate and classify geomorphological landforms and associated superficial deposits.
- Determine the broad deformation history of a region of polyphase folding, based on field evidence.

Course description
The course aims to provide a grounding in mapping skills necessary for work in such terrains, including basic vocabularies that can be used to describe the rocks and superficial deposits, and the development of objective observational skills.

The course is based in a large house in Kingussie at present, where the course team self-caters. The mapping area includes relatively low-lying land and some open upland. The bedrock comprises metamorphosed and variably deformed meta-sedimentary rocks, with some meta-igneous and igneous lithologies. The superficial deposits include glacial deposits of various sorts and their associated landforms.
Quaternary field mapping: Lowland Britain

Intended audience
Student and professional geologists, environmental scientists and geoengineers who need to gain an understanding of Quaternary mapping techniques.

Course objectives
The aims of this course are to:
- Provide a hands-on opportunity to gain confidence in field mapping Quaternary deposits (including landslips).
- Familiarise individuals with some basic techniques to use when mapping the range of Quaternary and man-made deposits commonly encountered in parts of lowland southern Britain.
- Enable participants to acquire an understanding of Quaternary depositional processes and landforms—essentially to develop ‘landscape literacy’ skills.
- Demonstrate how to undertake mapping to BGS corporate standards
- Emphasise relevant health and safety issues, particularly in the use of augers

Course description
The course is set up as four discrete modules which can be run separately if required:
- Module 1 Great Yarmouth (5 days): Pre-Anglian, Anglian and Holocene sequences.
- Module 2 Vale of York (2 days): Devensian and Holocene sequences.
- Module 3 Southern Pennines (1 day): Periglacially affected ground, landslipped ground.
- Module 4 Midlands, Vale of Belvoir (2 days): Anglian and Holocene sequences, floodplain alluvium and river terrace deposits, landslipped ground, artificial ground.

A manual is provided which includes detailed information relating to the four modules comprising the course as well as essential fieldwork information not specific to the mapping of Quaternary superficial deposits such as office-based methods including ‘pre-fieldwork’ assessment of literature, assessment of borehole data; aerial photo interpretation etc. The various techniques and practices that may be implemented for Quaternary field-mapping are additionally tagged with a ‘priority ranking’, giving a proportionate estimate of their usefulness to the mapper and their appropriateness.
Quaternary field mapping: Upland Britain

Intended audience
This field course is suitable for students and professional geologists, environmental scientists, and geoengineers wishing to gain a greater understanding of upland Quaternary deposits and the techniques used to map them. It is recommended that participants wishing to attend this course should have previously attended the Geological Field Surveying course.

Course objectives
To provide participants with an introduction to:
- The recognition, description, interpretation and mapping of glacigenic and glacially conditioned sediment-landform assemblages using air photos and ‘rapid’ walk-over surveying methods.
- The establishment of stratigraphical successions in order to decipher sequences of events.

Course description
The course provides:
- Experience in applying air photo interpretation to mapping superficial landforms and deposits
- Field demonstration and sedimentological analysis of a wide range of glacigenic deposits and associated landforms.
- Application of the BGS litho-morpho-genetic symbol scheme to map sediment/landform assemblages.
- Exercises in the description, interpretation and classification of glacigenic sediments.
- Techniques for establishing lithostratigraphies and interpreting histories of glacial, deglacial and post-glacial events from the geological record.
- Experience of mapping glaciated terrains (in pairs). Each participant will be expected to produce a geological field map and associated notebook records by the end of the course.

Course duration
Variable depending on requirements

Delivery mode
Field-based course

Course fee
£2300 for the whole course but subject to variation depending on requirements

Date(s)
Spring and Autumn

Location
The course is based in the Spey Valley and Inverness districts
Background

Few districts in the British Isles can rival the Inverness area for the range of Quaternary landforms and deposits that occur within easy travelling distance of one another. The area is particularly well suited for teaching purposes because it abounds with fine examples of a wide range of glacial features and glacigenic deposits. It also contains good evidence of Late-glacial and Postglacial sea level change, two internationally important interglacial sites and is within easy reach of the famous Parallel Roads of Glen Roy and other noteworthy Quaternary localities in Northern Scotland. Upland periglacial phenomena can be studied in the Cairngorms or the Nevis range. The course will cover:

- Application of air photo interpretation to drift mapping.
- Field demonstration of a wide range of glacigenic deposits and landforms.
- Application of the BGS litho-morpho-genetic symbol scheme to map sediment/landform assemblages.
- Application of the 'Miall' sedimentary facies scheme in describing glacigenic sediments.
- Establishing glacigenic stratigraphies and interpreting histories of glaciation and deglaciation from the geological record.
- Individual mapping exercise.
Introduction to ArcGIS* for geoscientists

Intended audience
Geoscientists who have not used or are not confident in using GIS. A basic knowledge of Windows is assumed.

Course objectives
- To introduce new users to the principles of GIS and ArcGIS Desktop software.
- To ensure users fully appreciate the capabilities of ArcGIS Desktop and how the software may help them carry out their own work.
- To ensure that users become familiar with the software and feel confident to pursue it further.

Course description
The course will introduce the general concepts of GIS followed by training in the three components of ArcGIS: ArcCatalog, ArcMap and ArcToolbox. The course aims to allow beginners to use ArcGIS with confidence to view, manipulate, analyse and produce maps from a range of spatial data.

*ArcGIS is a geographic information system software suite produced by Esri. ArcGIS applications can include:
- **ArcReader** which allows the user to view and query maps created with Arc products.
- **ArcView** which allows the user to view spatial data, create layered maps, and perform basic spatial analysis.
- **ArcEditor** which in addition to the functionality of ArcView, includes more advanced tools for manipulation of shapefiles and geodatabases.
- **ArcInfo** which includes capabilities for data manipulation, editing, and analysis.
Introduction to GeoVisionary*

Intended audience
Geoscientists, environmental scientists and engineers who need to learn how to use the GeoVisionary 3D visualisation package for virtual field reconnaissance.

Course objectives and benefit
- To familiarise participants with the GeoVisionary software and data conversion tools.
- To introduce participants to the GeoVisionary — ArcGIS dynamic link tools.
- To ensure that participants appreciate the capabilities of GeoVisionary and how the system may help them carry out their work.

Course description
The course introduces the new user to all aspects of GeoVisionary and the VSI Converter, and is taught via a combination of tutor presentations and hands-on exercises.

*GeoVisionary is the result of a collaboration between Virtalis and the British Geological Survey. Combining a powerful data engine with a virtual geological toolkit enables geoscientists to visualise, interpret and share large datasets seamlessly in an immersive, real-time environment. GeoVisionary software works on office-based workstations as well as on laptops used by geologists in the field. Virtually any spatially related data can be visualised within the system, including digital elevation data and remote-sensed images such as Landsat or aerial photography.
Introduction to GoCAD*

Intended audience
Geoscientists needing to use the GoCAD 3D geological modelling software. The course does not assume any prior knowledge of the software and so begins from an introductory level, though some familiarity with 3D modelling concepts prior to the course would be useful.

Course objectives
▪ To provide an introduction to the GoCAD 3D geological modelling package.
▪ To familiarise participants with the different GoCAD objects.
▪ To enable participants to use GoCAD to model surfaces and faults.

Course description
The course is delivered by means of tutor presentations and on-screen demonstrations supported by practical exercises and a course manual.

*GoCAD stands for ‘Geologic Computer Aided Design’. It is a program specifically written by a consortium for the oil and gas industry. The software marketed by Paradigm Geophysical enables interactive 3D geologic modelling of the geometry and properties of complex subsurface objects; it may be used for surface extending to subsurface geological mapping, geophysics and reservoir engineering. GOCAD utilises standardised data formats to facilitate the easy exchange of digital data from a variety of sources.

Course duration
2 days

Delivery mode
Classroom-based course

Course fee
£750

Course fee based on delivery at BGS’s training centres

Date(s)
As required

Location
This course is normally delivered on-site at customer premises, both in the UK and worldwide, by arrangement.

An example of a GoCAD modelling exercise.
Introduction to groundwater modelling

Intended audience
Hydrogeologists and groundwater professionals wishing to gain an understanding of the principles of groundwater flow modelling.

Course objectives
▪ To introduce attendees to the use of groundwater flow modelling and its application to aid the understanding of groundwater systems.
▪ To help attendees become competent in routinely using recharge, water balance and groundwater flow models to aid the understanding of groundwater systems.

Course description
An introduction to all aspects of groundwater flow modelling from recharge modelling, the creation of a water balance through to setting up and running a groundwater flow model. The course includes:
▪ Conceptual models.
▪ Recharge.
▪ Urban processes.
▪ Agriculture losses.
▪ Run-off.
▪ Water balances.
▪ Model development.
▪ Numerical techniques.

Course duration
2 days

Delivery mode
Classroom-based course

Course fee
£750

Course fee based on delivery at BGS’s training centres

Date(s)
As required

Location
The course is available at BGS’s Nottingham (Keyworth) or Edinburgh training centres, or at customer premises worldwide by arrangement (and subject to the availability of appropriately licenced software)
Modelling with ZOOM

Intended audience
Hydrogeologists and modellers wishing to gain an understanding of groundwater systems through the application of the ZOOM suite of object-oriented modelling software.

Course objectives
▪ To provide an introduction to the benefits of adopting an object-oriented approach to the modelling of groundwater systems.
▪ To provide a practical hands-on introduction to the use of the ZOOM suite of numerical groundwater models.

Course description
An introduction to object-oriented groundwater modelling and the ZOOM suite of models: ZETUP – set up code, ZOOMQ3D – groundwater flow model, ZOOPT – particle tracking code and ZOODRM – recharge model. The course enables the user to become familiar with the software and set up and run recharge, groundwater flow and particle tracking models.

Background to ZOOM software
The BGS is developing groundwater models that more closely represent the structure of hydrogeological systems, producing flexible models which can both conform to aquifer geometry and simulate processes at different scales.

In collaboration with the University of Birmingham and the Environment Agency, the BGS has developed the ZOOM group of numerical groundwater models. This group consists of the saturated groundwater flow model ZOOMQ3D, the advective transport particle-tracking code ZOOPT and the distributed recharge model, ZOODRM. Each of these models has been developed using object-oriented techniques, a programming approach commonly applied in commercial software development but only relatively recently adopted in numerical modelling for scientific analysis.

Course duration
Determined by level of tuition required

Delivery mode
Classroom-based course

Course fee
Fee variable determined by level of tuition required

Date(s)
As required

Location
The course is available at BGS’s Nottingham (Keyworth) or Edinburgh training centres, or at customer premises worldwide by arrangement (and subject to the availability of appropriately licenced software)
Introduction to photogeology and remote sensing

Intended audience
All geologists and geoscientists involved in geological mapping and site investigations.

Course objectives
- To introduce participants to concepts and geological applications in remote sensing with an emphasis on aerial photography although other airborne and satellite imagery are also included.
- To familiarise participants with the fundamentals of both the photogeological interpretation of air-photo stereo pairs and satellite imagery through laboratory practice.
- To encourage the use of large-scale air-photo stereo pairs and satellite imagery in field surveying and site investigations.

Course description
This course provides a practical introduction to photogeology and geomorphological interpretation using UK and overseas examples. Practical experience will be gained in the interpretation of aerial photography as related to geological field surveying. The course covers:
- Geometry of aerial photographs, stereo pairs and orthophotos.
- Photogeological interpretation and landform recognition.
- Sedimentary-structural landforms.
- Volcanic/intrusive landforms.
- Landslipped ground.
- Glacial landforms.
- Modern fluvial landforms.
- Annotation of interpreted aerial photographs and satellite imagery.
- Transfer of data to base maps.

Examining aerial photograph stereo-pairs using a stereoscope.
Photogeology and SOCET

Intended audience
All geologists and geoscientists involved in geological mapping and site investigations.

Course objectives
▪ To introduce participants to concepts and geological applications of stereo aerial photography.
▪ To familiarise participants with the fundamentals of photogeological interpretation in SOCET for ArcGIS.
▪ To encourage the use of digital aerial photography in field surveying.

Course description
The course provides a practical introduction to geomorphological interpretation primarily using UK examples. Practical experience will be gained using SOCET and ArcGIS in the interpretation of aerial photography for geological field surveying. The course covers:
▪ Starting a SOCET project and loading stereo aerial photography.
▪ Navigating around the aerial photos in the SOCET and Arc environments.
▪ Annotation of interpreted aerial photograph pairs.

Examining digital stereo-pairs using SOCET SET.
Satellite image interpretation

Intended audience
Geologists and geoscientists involved in geological or geomorphological mapping. The course is suited to professional geoscientists in industry and academia, as well as post-graduate students.

Course objectives
- To introduce participants to concepts and geological applications in remote sensing with an emphasis on satellite imagery.
- To familiarise participants with the fundamentals of interpretation of satellite imagery through laboratory practice.
- To encourage the use of satellite imagery in field mapping.

Course description
This course provides a practical introduction to satellite imagery and geomorphological interpretation using UK and overseas examples. Practical experience will be gained in the interpretation of satellite imagery as related to geological field surveying. The course covers:
- Fundamentals of satellite imagery (optical and microwave).
- Introduction to advanced basic and sensors.
- Image interpretation and landform recognition.
- Annotation of interpreted satellite imagery.
- Using imagery in ArcGIS.

Landsat 7 ETM false-colour image of the Richat structure in northern Mauritania. Once thought to be a meteorite impact structure, it is now interpreted as a periclinal dome uplifted probably by magmatic intrusion and subsequently laid bare by erosion. The ages of the rock exposed in this concentric structure range from Pre-Cambrian to Lower Palaeozoic. The features is approximately 45km diameter. Processed imagery © BGS, NERC.
Introduction to hydrogeology

Intended audience
Geologists, environmental scientists and others needing to gain an understanding of the key principles of hydrogeology. The course assumes little or no previous experience of groundwater, and would be suitable for professionals working in industry and academia, as well as post-graduate students.

Course objectives
To give participants:
- A grounding in the principles of hydrogeology.
- An ability to make sound hydrogeological decisions including when to call in a specialist hydrogeologist.

Course description
This course provides an introduction to the theory and practice of hydrogeology covering both the water resource and quality aspects of the subject. The following topics are covered:
- Water — an introduction to the resource.
- The hydrological cycle.
- Fundamental aquifer concepts.
- Aquifer flow.
- Aquifer protection.
- Groundwater occurrence.
- Groundwater exploration.
- Pumping tests.
- Groundwater contamination.
- Groundwater quality.
- Groundwater modelling.

Classroom demonstration of subsurface fluid flow paths.
Introduction to groundwater

Intended audience
The course is suitable for any geoscientist with no or minimal knowledge of hydrogeology who wishes to gain an overview of groundwater occurrence and flow. The course is a shortened version of the 'Introduction to Hydrogeology' training course.

Course objectives
▪ To provide a basic introduction to hydrogeology.
▪ To provide an overview of the occurrence of groundwater and how groundwater systems work.
▪ To introduce methods used in hydrogeology.

Course description
This introductory course provides an overview of the main concepts of groundwater occurrence and flow and includes the following topics:
▪ The hydrological cycle.
▪ Aquifers, groundwater occurrence and flow.
▪ Hydrogeological techniques.
▪ Groundwater problems; resources and quality.
Introduction to physical hydrogeology

Intended audience
Geologists, environmental scientists and others needing to gain an understanding of the key principles of physical hydrogeology. The course assumes little or no previous experience of groundwater and consists of the first two days of the ‘Introduction to Hydrogeology’ training course.

Course objectives
- To provide an overview of physical hydrogeology, introducing its principles, methods, scope and limits.
- To develop an understanding of how physical hydrogeology relates to associated disciplines, e.g. geology.

Course description
This course provides an introduction to the theory and practice of physical hydrogeology. The course is aimed principally at those involved in the geosciences and related disciplines with little or no previous experience of groundwater. The following main topics are covered:
- Occurrence and flow of groundwater.
- Physical groundwater evaluation techniques.
Description and classification of rocks and soils for engineering purposes

Intended audience
All geoscientists who deal with or are likely to be involved with the geological aspects of civil engineering and engineering geology; in particular field geologists and those who describe earth materials.

Course objectives
▪ To introduce the subject of engineering geology.
▪ To explain how earth materials are described and classified for engineering purposes and outline how this information is used.
▪ To enable geologists and others to include information focussed to the needs of the engineering geologist/civil engineer industry in geological reports.

Course description
This introductory course provides an understanding of how earth materials are described and classified for engineering purposes. It is based on the recently revised BS5930:1999 + A2:2010 — Code of Practice for Site Investigation.

The course covers the following main topics:
▪ What is an engineering soil?
▪ What is an engineering rock?
▪ Soil description and classification.
▪ Rock description and classification.
▪ Description of discontinuities.
▪ Rock mass classification.
▪ Weathering.

UK engineering geological maps
(1:1000 000 scale). Western portion — superficails deposits. Eastern portion — bedrock.
Statistics for geoscientists: basic

Intended audience
Geoscientists who routinely work on the interpretation of data sets and wish to gain a basic knowledge of statistics or who would like to refresh their knowledge in this area. Participants should be familiar with Excel and ideally, have some knowledge of S-plus.

Course objectives
To enable participants to;
▪ Explain, calculate and interpret descriptive statistics including: basic terminology, frequency distributions, measures of central tendency, measures of dispersion, and the normal distribution.
▪ Read and analyse basic charts and graphs and other basic data summaries.
▪ Explain, calculate, and interpret basic inferential statistics including probability, and basic hypothesis tests.
▪ Identify and apply the correct statistical technique to the research question.
▪ Use a combination of Microsoft Excel and S-Plus software to compute descriptive and inferential statistics and produce appropriate summary plots.

Course description
▪ Why do we need statistics?
▪ Types of data.
▪ Populations and samples.
▪ Describing univariate data — central tendency, spread, shape of univariate distributions, displaying univariate information, data distributions and probability density functions.
▪ Describing bivariate data — correlation and regression.
▪ Significance testing — steps involved in a hypothesis test, t-tests, analysis of variance, significance test.
▪ Non-parametric tests — bootstrap resampling.
Geostatistics

Intended audience
Geoscientists who need to know how geostatistics can help with the analysis and interpretation of spatially distributed scientific data.

Course objective
▪ To provide an understanding of regionalised variable theory as the basis for geostatistics.

Course description
▪ The course provides practical experience of using the statistical environment and packages in R* for exploratory analysis variogram estimation and modelling and optimal estimation of sample values at unsampled sites using kriging.
▪ Geostatistical theory sufficient for the course content.
▪ Exploratory data analysis — descriptive statistics, transformations, presence of trend, removal of trend.
▪ Variogram estimation.
▪ Variogram modelling.
▪ Kriging — punctual and block.
▪ Cross-variograms and co-kriging, universal kriging.
▪ Pointers for more advanced work.
▪ The course will include examples based on real data using packages from the open source R environment (sp, gstat) for spatial prediction and mapping.

*R is a programming language and software environment for statistical computing and graphics.

The R language has become a de facto standard among statisticians for the development of statistical software, and is widely used for statistical software development and data analysis.
Sampling design and interpretation of sampled data

Intended audience
Geoscientists who need to understand the principles and pitfalls of designing sampling programmes and/or interpreting sampled data.

Course objectives
After completing the course, the participants should:

▪ understand the key theoretical and practical principles of design-based sampling, exemplified by simple random sampling and stratified random sampling, and analysis of the resulting data to construct estimated means and their confidence intervals;
▪ be aware of some of the refinements available to improve the precision of design-based estimates, specifically the use of regression estimators and ranked set sampling;
▪ be aware of design-based methods such as multistage, clustered and nested sampling;
▪ understand the distinction between model-based and design-based sampling, and the circumstances in which one might be chosen rather than another;
▪ be aware of how to analyse data by model-based methods to estimate regional means;
▪ be aware of how design- and model-based sampling can be combined for monitoring spatial processes over time;
▪ understand how decisions on sample size requirements are made in design- and model-based sampling.

Course description
The aim of this course is to familiarize the participants with the basic issues that arise when sampling spatial variables, and analysing the data that are obtained. After the course participants should be able to implement some standard design-based sampling methods and to undertake model-based analysis of systematically sampled data. Most importantly they should be aware of some of the pitfalls in sampling design and the analysis of legacy data collected in different ways, and know when to ask for statistical input.