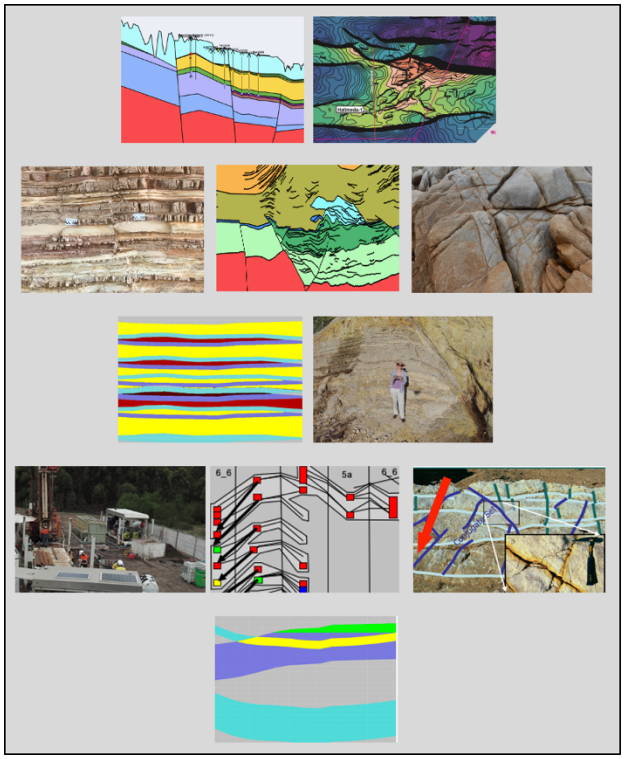
SOUTHERN HIGHLANDS
STRUCTURAL GEOLOGY

2020-21 FaultRisk Distance Learning



Select and combine the modules you need
when you need them
with on demand distance learning.

Rev 1.0 18 June 2020

Modular Distance Learning

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Our distinct modular teaching system provides a framework to dip in and out of the courses depending on individual needs and knowledge base. There are a wide range of tools useful for considering flow in groundwater, radioactive waste, mineral systems, oil and gas. While there are differences in use, base data and technology, there are significant similarities. We can help you make sense of the best tools and the best approach to ensure success.

Travel and location restrictions shouldn't limit you or your team's skill development in these key areas, which remain vital to achieving project deliverables.

Training will occur over three distinct time zones;

- Late afternoon Central US time
- Lunchtime Australia (Morning SE-Asia)
- Lunchtime the Middle East (Morning Europe)

If you have unique time zone needs, please contact us directly as here is scope to modify times and sequences for most modules dependent on demand. Similarly, there will be options to combine modules for customers.

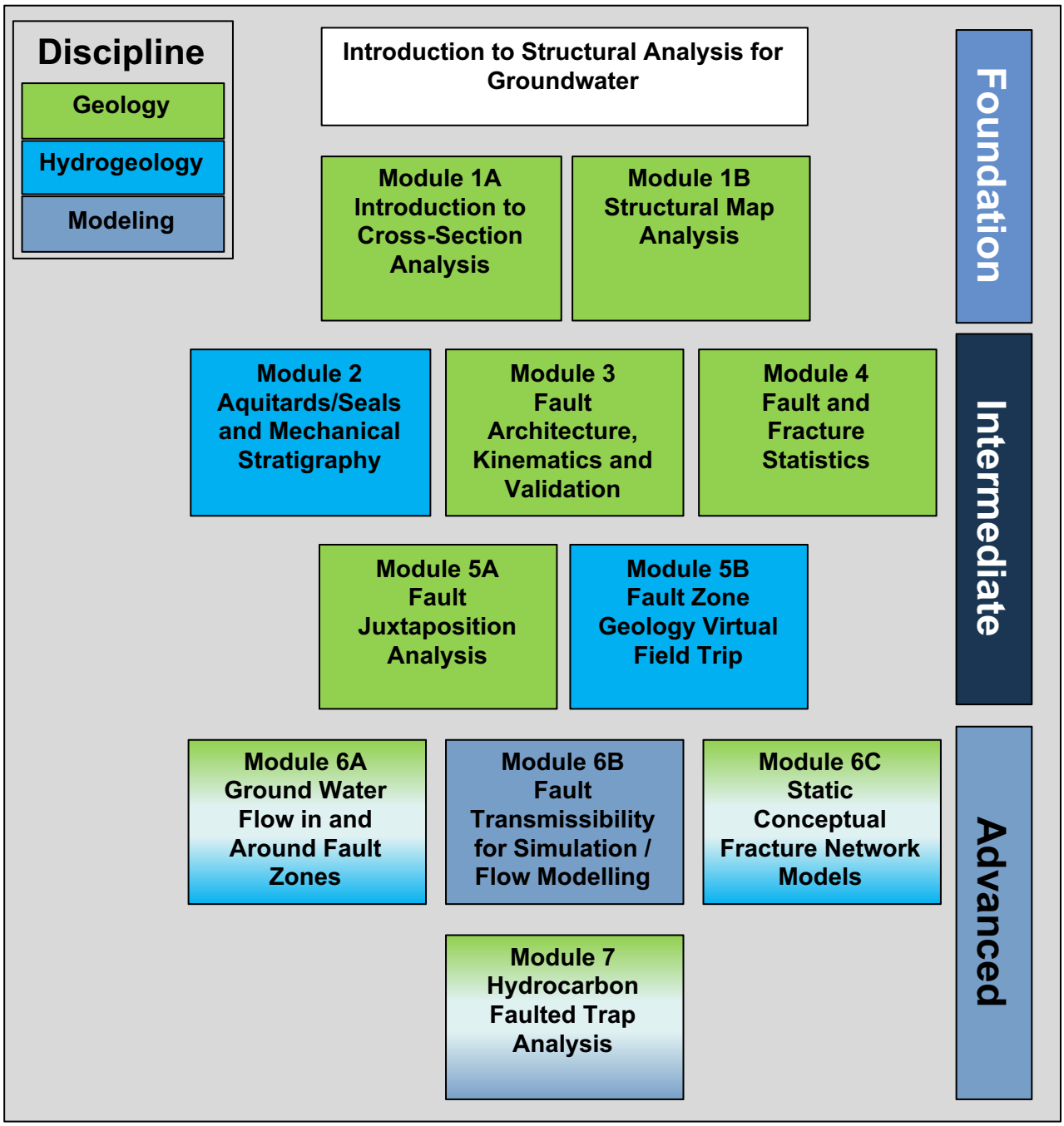
For customers in Eastern Australia, opportunities exist to combine online modules with field training on the outcrop south of Sydney and or as boarders open other locations in Australia.

Training is coming to you via go-to-training with a timetable as we initiate courses on our website. www.shsgeo.com

Get in contact with us titus@shsgeo.com to schedule a call to help us tailor training and or check our website for timing of training courses.

Module	Title	Level
0	Introduction to Structural Analysis for Groundwater	Background
1A	Introduction to Cross-Section Analysis	Foundation
1B	Structural Map Analysis	Foundation
2	Aquitards/Seals and Mechanical Stratigraphy	Intermediate
3	Fault Architecture, Kinematics and Structural Validation	Intermediate
4	Fault and Fracture Statistics	Intermediate
5A	Fault Juxtaposition Analysis	Intermediate
5B	Fault Zone Geology Virtual Field Trip	Intermediate
6A	Groundwater Flow in and Around Fault Zones	Advanced
6B	Fault Transmissibility for Simulation/Flow Modelling	Advanced
6C	Static Conceptual Fracture Network Models	Advanced
7	Hydrocarbon Faulted Trap Analysis	Advanced

Each module will consist of a series of lectures, optional reading based a range of textbooks and papers will be provided. Tutorial / practicals classes will allow participants to learn concepts and techniques. Many of the exercises will involve the use of printouts pencils and paper, with extension exercises using common office software and or open source applications.



Wherever possible will also utilise our significant set of outcrop analogue models to support each module. The training is conducted in the Southern Highlands – Illawarra. In the region there is good outcrop over a range of gas and underground coal projects.

Level	Title	Description
Foundation	Module 0 Introduction to Structural Analysis for Groundwater	Faults and fracture are ubiquitous and with tectonics control erosion and sediments. In most cases, they bring deeply buried ore closer to the surface. In groundwater regimes, faults/fractures guide flow and recharge. A systematic analysis of geologic structures will better define critical aquitard/aquifer geometry and allow for adequate parameterisation of models. This course provides an overview of examples and learning outcomes. Participants will better understand when structural support is needed.
	Module 1A Introduction to Cross-Section Analysis	Cross-sections provide an invaluable view of the subsurface. They help all subsurface practitioners: understand stratigraphic thickness, erosion, and fault movement. They form a valuable part of any report. We will learn how to project well, seismic and outcrop data to sections. Understand the effects of a vertical exaggeration and orientation. Begin to interpret, faults and folds consistently. Practice sketching structural evolution through time and review available structural modelling tools.
	Module 1B Structural Map Analysis	In the time of 3D modelling, there is still a place for well-produced depth structure contour maps in reporting reserves and environmental assessments. We can use maps to assess fault geometries, relationships and regional statistics. During the training, you will learn how to use a set of easy to use quantitative tools to review and improve maps. Using high-quality maps and a set of geometric techniques, an understanding of how fluids may move around and through the subsurface geology is possible.
Intermediate	Module 2 Aquitards/Seals and Mechanical Stratigraphy	A stratigraphic analysis is vital to evaluating flow in fractures and around faults. Similarly, some rocks define seals/aquitards. Participants will learn to identify ductile layers that are unlikely to fracture and rocks that will have well-connected fractures. Key learning will be the ability to use depositional models to identify broad regions of fracture-resistant, low permeability facies. Students will use the concept of mechanical stratigraphy to estimate fracture connectivity and storage.
	Module 3 Fault Architecture, Kinematics and Structural Validation	Faults and folds form due to tectonic and regional stresses. This training is an intermediate course for geoscientists and environmental scientist who have attended previous training. Students will learn how faults move and interrelate and link. Commonly faults in outcrop and subsurface are seen as static features; it is crucial to think of them as boundaries of moving bodies. Students will build on previous courses to validate the kinematics and architecture of folds and faults in 3D and 4D.
	Module 4 Fault and Fracture Statistics	Faults/fractures are the strain responses to stress in the earth's crust. They form systematically, yet it is often hard to characterise rock material properties and strain history. We will use a range of concepts and tools to describe structural discontinuities systematically. Students will learn how to test interpretations and estimate the extent of undescribed discontinuities. A set of exercises will demonstrate how to calculate the probability of flowing features being unrecognised.
	Module 5A Fault Juxtaposition Analysis	Faults may change the connection between aquifers/reservoirs and seals/aquitards. During training, students will hone their skills in fault QC and learn how to make displacement profiles and consider uncertainty. Building on module ?? flow stratigraphy will be defined. The fault and stratigraphy will be combined to build fault plane profiles (Allan Maps). Students will learn to confidently read, label and assess the validity of Allan Maps. Tips and tricks on presenting results will be shared.

	Module 5B Fault Zone Geology Virtual Field Trip	As faults move, on the sliding surfaces, rock is crushed to form a fault core. Around the core, strain generates fractures, deformation bands and subsidiary slip surfaces. Using virtual outcrops, we will explore the types of features commonly observed. During the "field trip", we will address issues of preservation and observational bias as well as measurement error. These observations will be drawn together into a conceptual model of structural features to allow us to infer potential hydraulic attributes.
Advanced	Module 6A Groundwater Flow in and Around Fault Zones	Building on module 5A and 5B students will work through a conceptual model for flow across, up and along faults. We will work on a series of scenarios based on the geometry of the fault and flow within permeable versus fractured rocks. A summary of the commonly used fault seal algorithms will be provided along with case studies. A series of exercises will help participants to explore flow rates related to the models. Using case studies, we will explore the practical impact of fault-related flow.
	Module 6B Estimation of Fault Transmissibility for Simulation / Flow Modelling	Many flow modelling exercises involve geologic faults. This primmer course will help students to understand how commonly used flow modelling codes explicitly represent faults. Students will better understand how reductions in permeability and fault rock thickness combine with geometry influence flow. Key learning will be an appreciation of geometric uncertainty and the influence this has on across layer flow. We will also review the relative impact of multiple-phase fluids and fracture flow.
	Module 6C Introduction to Static Conceptual Fracture Network Models	Fracture networks are inherently complex. With the addition of a permeable matrix, and or different fluid types, even more, complexity is added. During the course, we will work hard to use simple observations to constrain uncertainty. Using virtual outcrops, students will build up cartoon and statistical models of fractures in a range of host rocks. We will explore a variety of analytical approximations to assess fracture storativity and transmissivity.
	Module 7 Hydrocarbon Faulted Trap Analysis	A large proportion of hydrocarbon discoveries have a lateral seal against fault. Students will learn how to assess, define and catalogue trap elements. Students will work through a range of case studies of successful and unsuccessful wells. We will examine a variety of pitfalls related to facies changes and excess aquifer pressure. The module brings together a wide range of skills from previous modules providing a sound foundation for prospect assessment in oil/gas exploration.