Academic Year	2019/2020	**Semester**	2
Course Coordinator	Sylvain Rigaud (Dr)		
Course Code	ES2101		
Course Title	Introduction to Geological Field Mapping		
Pre-requisites	ES1003 Solid Earth		
No of AUs	3		
Contact Hours	Laboratories: 78, Lectures: 13		
Proposal Date	11 June 2019		

Course Aims

This intensive field-based course introduces you to map interpretation and geological field mapping. In class, you will learn how to extract geological data from a geological map and how to make a cross-section. You will also be introduced to way-up and fault kinematic indicators. In the field, in small groups, you will map, at a scale of 1:10,000, an area showing lithologic and structural similitudes with Singapore. You will learn how to identify, describe and name lithostratigraphic units, how to position and extrapolate geological contacts, and how to present and interpret the obtained field information in a formal geologic report. Training in the construction and analysis of geological maps is an elemental activity to any geoscientist.

Intended Learning Outcomes (ILO)

Upon successfully completing this course, you should be able to:

1. Position themselves precisely on a topographic map.
2. Report three dimensional data on a plan.
3. Calculate the dip and true thickness of a geological unit from a map.
4. Characterize field relationships between sedimentary units and deformation structures.

Course Content

- How to analyse topographic and geological maps.
- How to construct geological maps and cross sections.
- How to reconstruct the geological history of an area.

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team/Individual	Assessment Rubrics
Geological maps	1, 2, 3, 4	2. a 3. c 4. b 5. c 6. a 7. a	40	both	See Appendix for rubric

		8. a, b 10. a, b			
Cross section and exercises	3, 4	1. a 2. a 3. c 4. b 6. a 7. a	20	individual	See Appendix for rubric
Field notebook and Participation	1, 2, 3, 4	1. a 2. a 3. c 4. b 5. c 6. a, b 7. a 8. a, b 10. a, b	20	individual	See Appendix for rubric
Final Report	3, 4	1. a 2. a 3. c 4. b 5. a 6. a, b 7. a 9. a	20	individual	See Appendix for rubric
Total			100%		

<u>These are the relevant ASE Graduate Attributes:</u>

1. Apply environmental knowledge, concepts and skills to make sound decisions
    a. Interpret evidence to give sound environmental advice to stakeholders
2. Demonstrate intellectual flexibility and critical thinking
    a. Demonstrate intellectual flexibility to view environmental issues from multiple perspectives
3. Demonstrate passion and use advanced communication skills to share that passion
    c. Effectively communicate environmental concepts in various forms of media such as data visualisation, diagrams, animation, video, or podcasts
4. Formulate key scientific questions and develop hypotheses
    b. Create and evaluate hypotheses to research such questions
5. Conduct research
    a. Search for relevant scientific literature
    c. Make first-hand observations in order to draw conclusions
6. Solve environmental problems
    a. Demonstrate creative approaches to solving environmental problems
    b. Express and explain why the problems are important

7. Synthesize interdisciplinary approaches to solving problems
    a. Apply techniques from diverse disciplines to solve environmental problems
8. Demonstrate the willingness and skills for lifelong learning
    a. Demonstrate aptitude and enthusiasm to learn independently
    b. Demonstrate good observation skills and a curiosity about the world
9. Demonstrate ethical values
    a. Debate the ethical implications of scientific processes and results
10. Demonstrate collaboration and leadership skills
    a. Learn collaboratively and be willing to share expertise with peers
    b. Demonstrate leadership of small teams

Formative feedback

Following lab sessions, you will receive direct written feedback within a week after you present your assignments. In this way the lecturer and you can monitor progress. You will also be given oral feedback on your maps, cross section, and report.

Learning and Teaching approach

Approach	**How does this approach support students in achieving the learning outcomes?**
Field Trip (57 hours)	The field trips will i) Allow you to observe diverse sedimentary rocks, joints, folds, and faults. ii) Develop your spatial ability. iii) Allow you to apply various field techniques and methods. iv) Enable you to understand the importance of field work in solving geoscience-related issues.
Laboratories (21 hours)	Lab sessions will i) develop your map analysis skills. ii) introduce you to the building of cross sections.
Lectures (13 hours)	Lectures will pass on the theoretical knowledge required to reconstruct the geological history of an area.

Reading and References

Barnes J.W. and Lisle R.J. (2004) Basic Geological Mapping. 5th Edition. Wiley-Blackwell. ISBN: 978-0-470-68634-8

Course Policies and Student Responsibilities

(1) General

You are expected to complete all assigned readings and activities, attend all classes punctually and take all scheduled assignments, reports and tests by due dates. You are expected to take responsibility to follow up with course notes, assignments and course related announcements. You are expected to participate in all seminar and field discussions and activities.

(2) Absenteeism
Field activities make up a significant portion of your course grade. Absence without a valid reason will affect your overall course grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the Academic Integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Sylvain Rigaud (Dr)	N2-01b-30	6513 8228	srigaud@ntu.edu.sg

Planned Weekly Schedule

Day	Topic	Course ILO	Readings/ Activities
1	Pre-fieldtrip lecture / Safety	1, 2, 4	Guidebook / Safety documents
2	Pre-fieldtrip exercises	2, 3	Map-related exercises
3	Cross section	3, 4	Simple to complex cross sections
4	Field trip, Day 1. Introduction / Team work: area transect	1, 2, 4	Reconnaissance / Textbook
5	Field trip, Day 2. Team work: Position	1, 2, 4	Textbook
6	Field trip, Day 3. Team work: Lithostratigraphy	1, 2, 4	Textbook
7	Field trip, Day 4. Team work: Structure	1, 2, 4	Textbook
8	Field trip, Day 5. Team work: Geological history	1, 2, 4	Textbook
9	Field trip, Day 6. Team work: Maximum coverage	1, 2, 3, 4	Textbook
10	Post fieldtrip practical	3, 4	Map extrapolation
11	Post fieldtrip practical 2	3, 4	Cross section and geological history

Appendix 1: Assessment Rubrics

Rubric for Field Trip: Geological maps (40%)

- Students are marked both individually and as a group in certain components of the Geology Maps. Other components are marked either solely individually or as a team.

SECTION	UNSATISFACTORY (fail mark)	MARGINAL (fail mark)	SATISFACTORY (pass mark)	VERY GOOD (A-/A)	EXCELLENT (A+)	POINTS
Presentation	· No organization	· Poorly organized	· Organized	· Well-thought organization	· Professional organization	3 (1 pt – individual, 2 pts – team)
Individual assessment	. Data are not recorded in the field. Never take or plot measurements	. Data are poorly recorded in the field. Rarely plot measurements	. Most data are recorded in the field, with a ~ 3 mm uncertainty on the map. Partly follow contacts across unexposed ground	. Data are recorded in the field, along the way, with a ~ 2 mm uncertainty on the map. Responsive to advice. Follow contacts across unexposed ground	. Data are accurately (<1mm uncertainty) recorded in the field, along the way . Noticeable progress . Follow and interpret contacts across unexposed ground	8 (8 pts – individual)
Maps/Keys	· No or fictive maps	· Incomplete, non-representative or disproportionate maps	· Representative maps	· Clear, representative maps	· Neat and meaningful scientific maps	8 (2 pts – individual, 6 pts – team)
	· No legend, symbols, scale, orientation, title	· Minimalist legend and symbols, inaccurate scale bars	· Important features labelled, inaccurately scaled	· Most features labelled, few scale mistakes	· Precisely annotated, properly scaled, well-thought key	
Information	· Irrelevant	· Incomplete and poorly positioned	· Almost complete but inaccurately positioned	· Complete and correctly positioned (within 20m)	· Complete, linked, and accurately positioned	6 (3 pts – individual, 3 pts – team)
Measurements	· No measurement	· Incomplete or erroneous measurements	· Some measurements provided	· Most measurements provided	· All measurements provided, accurately recorded	6 (6 pts – individual)

Scientific Implications	· Missing or showing a lack of understanding	· Showing a poor understanding	· Major features interpreted	· Most features interpreted, consistent with topography	· Advanced state of understanding, just and relevant	6 (6 pts – team)
Neatness/Read ability	· Illegible	· Messy, rushed job	· A few typos, poorly scaled symbols	· Well-written, well-scaled symbols	· Well-written, well-scaled and chosen symbols	3 (3 pts – team)

Rubric for Field Trip: Cross section and exercises (20%)

SECTION	UNSATISFACTORY (fail mark)	MARGINAL (fail mark)	SATISFACTORY (pass mark)	VERY GOOD (A-/A)	EXCELLENT (A+)	POINTS
Presentation	· No organization	· Poorly organized	· Organized	· Well-thought organization	· Professional organization	2
Cross-section	· No or fictive cross-sections	· Incomplete, non-representative or disproportionate cross-sections	· Complete cross section	· Representative cross section	· Neat and meaningful cross section	8
	· No legend, symbols, scale, orientation, title	· Minimalistic legend, inaccurate thickness	· Important features labelled, variable thickness	· Most features labelled, few thickness mistakes	· Precisely annotated, accurate thickness, well-thought key	
Scale/Dip	· Not to scale or erroneous measurements	· Poor scale and incomplete or poor measurements	· To scale, some field measurements	· Accurate scale, field measurements missing	· Accurately recorded	4
Scientific Implications	· Missing or showing a lack of understanding	· Showing a poor understanding	· Major features interpreted	· Most features interpreted, consistent with topography	· Advanced state of understanding, just and relevant	4
Neatness/Readability	· Illegible	· Messy, rushed job	· A few typos, poorly scaled legend/symbols	· Well-written, correctly scaled legend/symbols	· Well-written, neat	2

Rubric for Field Trip: Field notebook and Participation (20%)

SECTION	UNSATISFACTORY (fail mark)	MARGINAL (fail mark)	SATISFACTORY (pass mark)	VERY GOOD (A-/A)	EXCELLENT (A+)	POINTS
	· No organization	· Poorly organized	· Organized	· Well-thought organization	· Professional organization	2
Sketches	· No or fictive sketches	· Incomplete, non-representative or disproportionate sketches	· Representative sketches	· Clear, representative sketches	· Neat and meaningful scientific sketches	4
	· No legend, label, scale, orientation, title	· Minimalistic legend and labels, inaccurate scale bars	· Important features labelled, properly scaled	· Most features labelled, properly scaled	· Precisely annotated	
Information	· Irrelevant	· Incomplete	· Description and context provided	· Clear descriptions and context	· Thoughtful, clear and detailed information	4
Measurements	· No measurement	· Incomplete or erroneous measurements	· Some measurements provided	· Most measurements provided	· All measurements provided, accurately recorded	4
Scientific Implications	· Missing or showing a lack of understanding	· Showing a poor understanding	· Important implications provided	· Most scientific implications provided	· Advanced state of understanding, just and relevant	4
Mechanics	· Illegible	· Messy, rushed job	· A few typos, grammar mistakes	· Well-written	· Well-written, no typos or mistakes	2

Rubric for Field Trip: Final Report (20%)

SECTION	UNSATISFACTORY (fail mark)	MARGINAL (fail mark)	SATISFACTORY (pass mark)	VERY GOOD (A-/A)	EXCELLENT (A+)	POINTS
	· No organization	· Poorly organized	· Organized	· Well-thought organization	· Professional organization	3
Sketches/ Pictures	· No or fictive sketches/pictures	· Incomplete, non-representative or disproportionate sketches/pictures	· Representative skectches/pictures	· Clear, representative sketches/pictures	· Neat and meaningful scientific sketches/pictures	4

	· No legend, label, scale, orientation, title	· Minimalistic legend and labels, inaccurate scale bars	· Important features labelled, properly scaled	· Most features labelled, properly scaled	· Precise and detailed annotations	
Information	· Irrelevant	· Incomplete	· Description and context provided	· Clear descriptions and context	· Thoughtful, clear and detailed information	5
Scientific Implications	· Missing or showing a lack of understanding	· Showing a poor understanding	· Important implications provided	· Most scientific implications provided	· Advanced state of understanding, just and relevant	5
Mechanics	· Illegible	· Messy, rushed job	· A few typos, grammar mistakes	· Well-written	· Well-written, no typos or mistakes	3

Appendix 2: Intended Affective Outcomes

As a result of this course, it is expected you will develop the following "big picture" attributes:

- An ability to look at natural environments in a new light.
- A geological notion of space and time.
- Perseverance in solving geological problems.
- Experience in acquiring data in the field as a team