

# Earth 390: Methods in Geological Mapping

## Introduction

Earth 390 is a required credit course for students in the Earth Sciences and Geological Engineering programmes.

The field trip involves eight days of field exercises and mapping. There will be instructors and TA's to assist throughout the field school. Your background should include Stratigraphy (Earth 235), Petrography (Earth 232), and Structural Geology (Earth 238). You will also find that your Sedimentology course (Earth 333) will come in very useful, as we will be mapping in a metamorphosed sedimentary terrain.

In addition to mapping in the Whitefish Falls area, we will also be visiting the Sudbury area, the Parry Sound area, and Manitoulin Island, in order to introduce you to some of the geology of these terranes.

## Course Objectives

The goals of this geological mapping field school are to teach you the following:

- ✓ to observe and record a variety of different types of geological information in the field;
- ✓ to make decisions based on these observations;
- ✓ to construct a geological map using your own field observations and measurements;
- ✓ to interpret geological maps.

## Transportation

The Department of Earth Sciences will provide transportation to and from the university and all necessary transportation during the trip. You may bring your own private vehicle if necessary, with prior permission from the instructor, but you will not be reimbursed for any costs and you will not be allowed to use it while in the field camp.

## Accommodations and meals

We will stay at Forbes Resort ([www.forbesholidayresort.ca](http://www.forbesholidayresort.ca)) at Whitefish Falls most of the days. There will be five to six students per cabin and each will have a bed. You may arrange into groups beforehand. Otherwise, we will organize sharing once we arrive at Whitefish Falls. For one or two of the nights, we will stay at a hotel with four students in each room and you will need to share a bed. Sleeping bags are not required, but you can bring one if you wish.

You are responsible for all of your meals. Forbes Resort provides excellent cooking facilities, including a microwave, an oven, a coffee maker and a large fridge. There will be a major food-shopping stop on the way to Whitefish Falls on the first day. There is a small convenience store

in Whitefish Falls. In addition to groceries, you need to buy your own coffee filter and dish detergent.

## **What to bring**

**PLEASE PREPARE FOR EXTREMES IN WEATHER CONDITIONS!**

A rain coat (and pants), a warm hat and gloves were absolutely necessary in some previous field camps. Some years it rained almost every day! You will be outdoors for approximately 8-9 hours each day and a relatively short field camp could seem like eternity if you are cold and wet! In other years, temperatures soared and overheating and sunburns were a problem. Don't forget sunblock and a (sun) hat.

Poison ivy is sometimes a nuisance – so you will need to watch where you step and sit. Bring a suitable lotion/cream if you are particularly sensitive to poison ivy. Biting insects are usually not a problem at this time of year.

### **Things to bring:**

- **GEOLOGICAL HAMMER**
  - **HAND LENS**
  - **SAFETY GLASSES**
  - Clipboard
  - Coloured pencils (**ALSO FOR USE IN THE FIELD**)
  - Field notebook (sturdy, ideally hard cover)
  - Drafting pen (black), ruler, protractor
  - Knapsack
  - Field clothes, including **WATERPROOF RAIN WEAR** (especially coat and pants), gloves, etc.
  - **Sturdy waterproof boots** with non-slip soles
  - Sunglasses / sunblock / hat
  - Personal First Aid supplies
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## **Safety Rules - Please Read!**

Listed below are some of the safety requirements for this trip. In signing the release form that will be presented at the beginning of the trip, participants agree to abide by these rules and to conduct themselves at all times in a manner that does not compromise the safety of anyone.

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- **Safety glasses must be worn whenever hammers are being used.** Failure to do so could place your health at risk. It is the responsibility of participants to police themselves in this matter.
  - Never cause rocks and material to fall on those below. Never work close to an unstable quarry or pit wall or climb up the walls of working quarries.
  - Be careful not to lose hammers and chisels in working quarries or pits; these objects can cause damage to equipment and result in the owners not allowing collecting on their property.
  - Fill in any excavations that you make that may cause injuries to animals or humans. You are responsible, too, for restoring sites when you have disturbed them, particularly near habitation or in public places.
  - Take home all cans and other garbage, leaving the area as tidy as you find it.
  - Cause no wilful damage by collecting material, and take home only what can reasonably be used.
  - Do not discard burning material that may cause a fire.
  - Take particular care, when working or assembling near the edge of a road, not to step into the path of traffic.
  - The Whitefish Falls area has numerous lakes and streams and if the weather is hot, they can be tempting but very dangerous diversions. As well, if spring is late in arriving, these could be covered by ice. Please take care anytime you are near open or ice-covered water.
  - The mapping area is close to a number of private cottages. Their porches and outhouses are equally private. Please do not trespass or disturb the property in any way.
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The Department of Earth and Environmental Sciences recognizes its responsibility to plan field programmes so as to minimize the risk of personal harm to the participants, but the Department cannot take responsibility for actions of individual students on these trips.

**ALL FIELD TRIP LEADERS ARE AUTHORIZED TO DISMISS IMMEDIATELY ANY STUDENTS WHOSE BEHAVIOUR, AT ANY HOUR OF THE DAY, COMPROMISES THE SAFETY OF THE GROUP, THE ACADEMIC OBJECTIVES OF THE COURSE, OR THE REPUTATION OF THE DEPARTMENT. FEES WILL NOT BE RETURNED AND FORMAL DISCIPLINARY PROCEDURES MAY FOLLOW.**

As you can readily imagine, alcohol has been the common denominator in most problems that we have encountered over the years. **ALCOHOL IN THE FIELD IS GROUNDS FOR IMMEDIATE DISMISSAL; EXCESSIVE DRINKING AFTER HOURS LIKEWISE.** Fortunately, there have been very few unpleasant incidences over the years, a fact that can be attributed to the collegiality and common sense of our students. Let's keep it that way and enjoy the trip!

## Earth 390 Course Requirements

*Each student is expected to participate fully in the course activities.* Students will be divided into groups of two. Each pair will produce a geological map with a legend and a brief report summarizing the geology of their map area, and put it in the context of regional geology. There will be other short exercises to complete as part of the course requirements.

*Satisfactory completion of ALL ASPECTS of the course is required.* Toward the end of the course, each student will be interviewed by the instructors, and he/she will answer questions about the map he/she has co-produced, identify rock samples collected in the map area, thereby illustrating his/her understanding of what he/she has mapped. At the end of the field trip in Parry Sound, each student is required to hand in his or her field notebook.

**Grading.** The grade for this course will given based on a combination of evaluating your fieldwork and the work you hand in. The following grading scheme will be used:

Geological Map (40%): The mark for your completed geological map will be based on accuracy of geology, quality of presentation, clarity of data, and accurate inclusion of all essential elements (scale, legend, etc.). A checklist is provided in this handout to ensure that your final map is complete. Make sure you consult this list.

Geological Report Part I (20%): Including regional cross section, stereonet plot and description of the regional geology; see *Requirement for Report* below.

Geological Report Part II, description of the local geology of your map area (10%): see *Requirement for Report* below.

Individual assessment (20%): This mark will assess your understanding of the map area based on the individual interview, as well as your contribution to the group exercises, your participation on field trips, etc.

Field notebook (10%): Each student is expected to keep his/her own field notes in a notebook, and make notes on every outcrop visited during the field excursions, as well as do assignments related to some of the outcrops.

Your understanding of the geology concerned as demonstrated by the map and the report you hand in and through interview will be an important factor in assigning the marks. You are required to work either individually or in groups of two as instructed. Discussions among groups are encouraged. **HOWEVER, COPYING OR SHARING OF NOTES, DATA, MAPS/SECTIONS ETC. IS A FORM OF PLAGIARISM AND WILL BE REGARDED AS AN ACADEMIC OFFENCE.** Each student is expected to understand the contents of, and conduct himself or herself in accordance with, University of Waterloo's Policy 71, the "Student Academic Discipline Policy".

# Geological Report – Part I

## Cross Section, Stereonet plot and regional geology

The purpose of these exercises is to help you better understand the regional geological setting and structure of our map area, and to demonstrate how data collected from mapping can help understand regional structures. By using maps produced by experienced geologists, one can also get a better understanding of what types of data to collect in the field and how to present them on the map.

### ***1 - Stereonet plot of the Bass Lake syncline***

Plot, on a stereonet, bedding, foliation and lineation data from the Bass Lake syncline (see handout). Use the resulting plot to constrain the geometry and orientation of this fold and other similar folds in the area. To save time, you are only required to plot data shown in black. Include your own measurements at Bass Lake in the plot, using a different symbol.

### ***2 - Cross-Section construction***

Carefully study Map 2311 (northern sheet) and Map 2312 (southern sheet; map scale 1:31,680 or 1 inch to ½ mile). Pay attention to legend and symbols. Construct a cross section along the western edge of the two maps. The line of section should be approximately perpendicular to the general strike of the lithological contacts, and starts at the northern contact of the northern-most exposure of Unit 6 (shown in blue) in the northern map sheet and ends at the southern edge of the southern sheet. No correction for apparent dip is required. Topographic relief is minimal and can be ignored for the purpose of this exercise. The cross section must show the following:

- (1) Major lithological (stratigraphic) units and their contacts. The contacts should be shown with correct dips near the surface.
- (2) Representative younging directions of the units where available (show above the section)
- (3) Major faults; interpret the shear sense of the faults where possible.
- (4) Interpret subsurface structure and schematically show the main folds
- (5) Show horizontal scale and orientation of section. Horizontal scale can be the same as the map scale.
- (6) Mark the main structures (e.g. the Bass Lake syncline) on the cross section.

All data required for the section are on the map given. Also take into consideration the observations made during the field trip on the field day.

### ***3 - Regional Geology (text not to exceed 700 words)***

Very briefly describe the stratigraphy and structure of the area from Espanola to the map area, based on the regional geological map and the field trip. Use the following section titles:

1. **Stratigraphy**: List and very briefly describe the lithologies of the main stratigraphic units (formations) in the area. This can be achieved by drawing a stratigraphic column.
2. **Structure**: Briefly describe the main structures (regional scale folds and faults), their orientation, geometry, and sense of shear (of faults).
3. **Regional geological setting** of the map area: In which formation are we mapping? On which limb of which regional scale fold?

## **Geological Report – Part II**

### **Geological map, and local geology**

#### ***1 - Geology of your map area (text not to exceed 700 words)***

Briefly describe the lithological units and structure of your map area based on the data you collected in the field. Use the following section titles and refer to the map you produced:

1. **Stratigraphy**: Very briefly describe the lithologies of the main sedimentary mapping units in the area, in stratigraphic order. Name younging indicators where available. Include a stratigraphic column showing the approximate thickness of each unit.
2. **Intrusive rocks**: Very briefly describe the lithologies of the main intrusive mapping units in the area. Indicate which is younger, which is older, and why.
3. **Structure**: Very briefly describe the structure of the map area, including folds, faults, their geometry, sense of shear, orientation of bedding, orientation of tectonic foliation, etc. Are all the planar structures in the map area beddings, or are some of them tectonic foliations?
4. **Geological history**: Give a short geological interpretation and synopsis of your map area.

#### ***2 - Geologic Map***

Mapping (4 or 5 days) will be carried out using air photos, and pace and compass. The scale of the air photos will allow you to accurately locate any feature within a few meters of its true position. This handout contains information on a variety of map symbols that may be useful for this exercise (see Appendices). You are required to hand in both your field map and the final geological map.

#### **Checklist for final geological map:**

- Is the map clearly drawn in ink?
- Are all map units, symbols, abbreviations, etc. included in the legend?
- Are map units presented in the legend from oldest (bottom) to youngest (top)?
- Are all significant cultural and natural features (e.g., water bodies, highways, railroads) clearly indicated?
- Is the scale indicated?
- Is there an appropriate map title?
- Are the authors indicated?
- Is the date indicated?
- Is there a North arrow and indication of magnetic declination?
- Is there latitude and longitude information indicated?

# Earth 390 2013 Tentative Itinerary

**April 24 (Wednesday) 8:00 am: loading area between EIT and Chemistry building**

- Departure to Whitefish Falls. Expected arrival 4-5 pm
- **Forbes Resort - 705-285-4251 – [www.forbesholidayresort.ca](http://www.forbesholidayresort.ca)**
- Grocery shopping in Espanola or Sudbury (shop for ≈3 days).

N.B. Participants are expected to bring lunches into the field each day- we will not be returning to camp until 4-5 pm.

**8:30 pm**

- Introduction to the geological setting of the mapping area.
- Introduction to mapping techniques. Distribution of supplies.

**April 25 (Thursday) 8:00 am**

- Structural exercise near Espanola.
- Regional overview of Precambrian geology between Espanola and Whitefish Falls.

**8:00 pm**

- Stereonet plotting exercise & geological cross-section.
- Mapping pairs are assigned field areas.

**April 26-27 (Friday-Saturday) 8:00 am**

- MON. AM: Introduction to field mapping areas
- *MON PM AND TUE: GEOLOGICAL MAPPING AND REPORT WRITING*
- **Part I of report due in TA's cabin at 10:00 pm, Friday, April 26.**

**April 28 (Sunday) 8:00 am**

- *FIELD TRIP IN SUDBURY – ONAPING FALLS TOUR AND SUDBURY BASIN*

**April 29-30 (Monday-Tuesday) 8:00 am**

- *GEOLOGICAL MAPPING AND REPORT WRITING*

**May 1 (Wednesday) 8:00 am**

- AM: Completion of Part II of report (due by 11:00 am)
- **PM and Evening: Final drafted map due; Personal interviews on map and field geology**
- **Tidy up cottages in preparation for departure next day**

**May 2 (Thursday) 8:00 am**

- AM: Load vehicles and Manitoulin Island field trip
- PM: drive to Parry Sound



- Overnight in Parry Sound

**MAY 3 (FRIDAY)**

**8:00 AM**

- AM: Parry Sound area geology – Killbear Provincial Park
- PM: departure for University of Waterloo. ETA 4-5 pm
- Hand in **FIELD NOTEBOOK**

**(THE ITINERARY MAY BE ADJUSTED DEPENDING ON WEATHER CONDITIONS.)**