

Lesson 3 Starter: Ask the Researcher, questions with answers

- Why is it necessary to map landforms in the field when we have aerial photography and satellite imagery? (see Lesson 2)

Satellite imagery is very useful when mapping very large areas and aerial photos (e.g. from aircraft) can be used to map smaller areas. However, when dealing with very small areas the imagery may not have a high enough resolution to identify smaller landforms. There may also be shading on aerial photographs from topographic features which may obscure landforms. Landforms may also be misidentified from imagery so checking this in the field is vital.

- How do you map landforms in the field?

Depending on the accuracy required, there are different ways of mapping landforms in the field. You can use a blow up of a topographic map to locate and map your landforms directly onto this. You can use a combination of mapping and a handheld GPS (~10 m accuracy) to position each mapped landform in real world coordinates. You could also use a differential GPS (mm accuracy) in order to undertake a high-accuracy survey and then use a Geographic Information System (GIS) to produce a map from this data.

- How much can you tell about a landform in the field before analysing any samples in the lab?

Mapping of landforms requires a certain degree of interpretation which may be subjective. Two different people mapping the same area may come up with different interpretations for the same landform in the field (e.g. moraine ridge (glacial) by one and pronival rampart (periglacial) by the other). (A pronival rampart forms where rock slides down and accumulates at the base of a snowfield.) In the field you can interpret a landform based on its morphology (meaning its shape). However you may need more information, for example from sediment analysis, to determine whether it formed from periglacial or glacial processes.

- Why do you need to bring samples back from the field, and how do you collect samples of landforms?

It's possible to undertake some analyses of samples in the field (e.g. general sediment descriptions, clast shape); however other forms of analyses require laboratory work (e.g. particle size analysis, samples for dating).

If sediment exposures already exist, (such as by fluvial incision or because of a road built through a moraine exposing the sediment) then you could sample directly from these. Unfortunately many times exposures do not exist and large trenches need to be dug to expose the sediment. If there are different layers within the sediment exposure then samples would be collected from each of these. The exposure face to be sampled is cleaned to ensure that there is no contamination by slumped material. Sampling for particle size would involve scraping the sediment sample into a sample bag. Bulk samples collected are given individual numbers or samples codes so that they can be identified later.

- What kinds of field and laboratory analyses are used to determine if a landform has a glacial origin or not?

Clast morphology (shape and roundness of rocks) is a useful indicator of the transport path of a particle. Clasts for example from glacial, periglacial and fluvial environments exhibit different forms of roundness. The orientation of clasts within sediment has also been used to try and distinguish different glacial and non glacial environments, however this method is more useful as an indicator of ice flow direction and strain.

Sediments from different environments often contain distinct particles ranging from large boulders to clay fractions; therefore particle size analysis can help give an indication of the depositional environment of the landform. Glacial sediments often comprise a range of particle sizes. You could also sample the chemical property of the sediment.

- What methods can be used to work out the age of a glacial landform?
Radiocarbon dating can be used if sufficient organic matter is present within the landform; however it is very rare to get enough organic matter to date within moraines. One of the more recent methods of obtaining ages for glacial landforms is using surface exposure dating of boulders on moraines.
- Why are you using the surface exposure dating method and how does it work?
Surface exposure dating is used to estimate the length of time a rock has been exposed at the Earth's surface. We are constantly being bombarded with cosmic rays which produce different isotopes when they are absorbed within rock. We can measure the concentration of these isotopes within rocks to determine how long the rock has been exposed to these cosmic rays. Surface exposure dating of rocks on moraines tells us how long it's been since a glacier was there.
- What do you look for, and how do you sample landforms for surface exposure dating?
You look for the largest boulders on the moraine crest. The larger the boulder, the less likely it is to have moved. If you were to sample on the slopes of the moraine the boulder may have rolled there (the boulder needs to be stable through time to get a realistic age), therefore crest locations are vital. A small amount of rock (~1kg) is broken off the top of the boulder (see photo and video) using a hammer and chisel. This sample is then photographed and placed in a labelled sample bag and is taken back to the lab for chemical and isotopic analyses.