7. 野外調查報告撰寫

SOME NOTES ON FIELD MAPPING

THE MAPPING AREA

The nature of the mapping area, to some extent, determines the scale at which to map. For instance, if the mapping area is complex, with lithological and structural changes on the scale of 100's m, then you should map at 1:10,000 (or 1/5,000) and will probably cover 10-15 square kilometres during a four week period. Alternatively, if the structure is simple, then you may cover a much larger area (25-50 square kilometres) in the same period, mapping at a scale of 1:25,000. So, be prepared to adapt your mapping to the local geology, and if necessary map at a number of different scales: i.e. a regional map at 1:25,000, and more detailed maps of areas which are particularly interesting at much smaller scales (1:10,000 to 1:100). This means that you should have base maps (several copies) at different scales (e.g. 1:25,000 and 1:10,000) and be prepared to make more detailed maps in the field.

NOTEBOOKS

The notebook contains the written record of your mapping. Treat it like a diary, noting the date of each mapping day. It is a good idea to clearly label the notebook with your name and address and explanation of what the book is - this way, if you lose it, there is a chance that somebody will find it and return it to you. Each day you should write down all your observations, measurements, and ideas about the geology. All these observations and measurements **must** be tied to the field slips by way of **grid references**. **Do not** rely on station numbers from field slips as there is nothing more frustrating for anyone trying to look at your map and notebook than trying to scan through a field slip looking for a random outcrop number.

By all means use location numbers on your field slip but make sure that localities are cross-referenced to the notebook with grid references. Fill the notebook with sketches - detailed sketches of particular outcrops, panoramic views with geological interpretation, sketch cross-sections or ideas about the structure of the region. Good notebooks contain more sketches and diagrams than words. Experienced mappers spend a lot of time drawing panoramic views which at one glance give an impression of the relationship between the various geological units. It is also good practice to change your notebook every so often, even it is only half full - this way, if you do lose it you won't have lost the entire record of your mapping.

FIELD SLIPS

These are the base maps you carry around with you in the field. The field slip is **the most important document** in your mapping - here you record all the spatial information about the geology of the area. It should be possible to produce the final map using only the field slip, without recourse to the notebook. It is good practice to record as much information on the field slips as possible - shorthand lithological descriptions, **mapped contacts** or putative contacts, orientation data (i.e. strikes and dips of contacts, bedding, cleavages etc.), areas of no exposure, topographic features which may indicate geological contacts or lithologies etc. Use empty parts of the map to put your notes, linking them to particular locations with arrows.

It is essential that all the pertinent detail be on the map: sketch the **actual shapes** of the outcrops rather than plotting on coloured dots with station numbers. It is recommended that you colour in the outcrops in a darker shade or with bolder strokes than the inferred extent of the lithology. When you find a contact between two lithological units mark it directly on the field slip, including the orientation, and **map it out** by following it along strike.

Plot the orientation of contacts (strike & dip) directly on the field slip. If you lose the contact in the field check the adjacent outcrops along the projected strike until you find it again. If you find faults in your area, again, map them out by following them and plotting all orientation data directly on the maps. A good field slip is a record of the process of map making - the geological map is there together with all the supporting information. It should be possible to reconstruct the entire map with recourse only to the field slips, with the notebook as back-up, and nothing should appear in the final map that is not on the field slips.

AERIAL PHOTOGRAPHS

If you have aerial photographs, you can map directly onto them, using a fine Rotring ink pen. If the aerial photographs are at a 1:30,000 scale and you are mapping at 1:10,000 scale, then map on to both your base map and aerial photographs. Be careful about which direction on your photograph is North. If you see a prominent feature on the ground, then look for it on your photographs and sketch it in. Try and get to high points in the study area and spend some time just looking around and comparing what you see with the aerial photographs. A pair of binoculars would be very useful.

LOCALITIES

Give a locality number to every place where you stop and take notes. The first locality number of the field season is 1 (can be preceded by a one letter code i.e. K1 if you're mapping in Kaohsiung etc..), and the last is whatever you get to. You will probably have over a hundred localities. You **must** mark a map **grid reference** for each locality in your notebook this way if you lose your field slip you can still reconstruct the locality. It is suggested that you give any samples you collect the same number as the locality. Try and take at least one orientation measurement at every locality and mark it directly on your field slip. Write all your notes about a locality in pencil or biro (something that does not run if the notebook gets wet), and include plenty of sketches. There should be more sketches than writing in your notebook. Always give a scale, showing dimensions of important features - one forgets very easily. Take photographs, and remember to have a scale in the photograph (hammer, compass, notebook, etc.).

ORIENTATION DATA

Collecting orientation measurements is a very important part of the mapping. Always take as many measurements as you can - measuring bedding and any other fabric you can see (cleavages, lineations, fold axes, joints). If you are not sure what a particular fabric is (i.e. whether it is bedding or cleavage), then say so in your notes. Try and get an even coverage over the study area. Don't try and guess the measurements - it is very easy to be fooled. You will often be surprised how steep or shallow the dip is. Also, bedding measurements may reveal subtle angular discordances, which are not easily revealed by the mapping. These angular discordances may point to more important structural or stratigraphic discontinuities. A large amount of orientation data can be used in structural analyses - e.g. plotting stereograms, which may be an important part of your project. BEWARE OF MAGNETIC VARIATIONS. There is nothing worse than not knowing if a measurement is with reference to True or Magnetic North!

SAMPLES

Collect samples, both of rocks you can't identify and also representative lithologies in the study area. Don't end up with only samples of all the oddities. Each sample should be about fist-size. Make sure you have collected the freshest sample available - this might mean you will have to spend some time chipping away weathered portions of the outcrop. Don't be afraid to collect lots of samples - you can always sort them out at the end of mapping and take back only the important ones. You will probably collect a lot of samples to begin with, as you will have difficulty identifying the rock types. Samples can be useful in the field if you want to compare one outcrop with another. After a while you will get your eye in, and then you can discard many of your samples, many of which will probably turn out to be of the same rock type. Put your samples in plastic bags, and label both sample and bag with an indelible felt pen. Don't let samples bang around lose in your rucksack - they will break up and become useless.

SEDIMENTARY SECTIONS

You should gather information to produce an approximate stratigraphic column for the study area. In parts this may be generalised, based on distances measured off your map. However, you might need to spend a few days measuring up in more detail parts of the stratigraphy that you think are interesting or merit a closer look. In any case, a general description of the lithologies in the study area must go with your map, and this will involve general descriptions of lithology, grain size, sedimentary structures, bed thicknesses and alternations etc.

CROSS-SECTIONS

Representative cross-sections through the study area should accompany your report. Again you may produce them at a number of scales, and be careful about vertical exaggeration. The map plus cross-sections should together give an impression of the three dimensional geometry of the study area. You should always try to think about the 3-D structure when you are mapping, and so at frequent intervals during mapping and when you don't understand a particular geological relationship, try to draw sketch cross-sections. Don't leave the cross sections to the very end when you have left your mapping area! The cross-sections will certainly raise questions which may help your mapping.

PHOTOGRAPHS

Photographs provide a valuable record of your field observations. Take as many as possible. Remember to place a scale in the picture (hammer, notebook, coin, penknife etc.). If you are photographing geological features in a mountain side or cliff, then it is always a good idea to make an accompanying annotated sketch in your field notebook. Don’t use photography as a substitute for field observations - often what appears clear in the field does not show up well on the photograph.

EQUIPMENT

- Camping equipment if necessary (tent, sleeping bag, cooking equipment).
- Rucksack (small day sack, if possible, as well), strong walking boots, spare laces, thick socks, waterproof clothing, sun hat, sunglasses, sun cream.
- Safety pack including survival bag, whistle, watch, torch, first aid-kit, emergency rations (chocolate bars etc.)
- Hard-hat
- Compass-clinometer (possibly a spare one between two people, in case one gets lost)
- Several strong surveying notebooks
- Mapping case large enough to take maps and photographs. The mapping case protects these from damage.
- Geological hammer (possibly a spare one between two people)
- Hand lens
- Barometer (can be useful for relative heights)
- Grain size scale
- Pencils (2H, HB), coloured crayons, pencil sharpener, rubber, tracing paper, graph paper.
- Two Rotring pens (.25 and/or .35)
- Ruler, set square, protractor
- Tape measure (30m and pocket 5m)
- Sample bags and waterproof markers
- Binoculars & Camera

PRODUCING THE REPORT

On the basis of the field project, you should prepare and present the following to the advisor by the end of term.

1) **The original field slips (topographic base maps), original field notebooks, logs and structural sections.**
2) **A neat geological map**, prepared on a topographic base (1/25,000 scale).
3) A **typed report** of between 4000 and 6000 words.
4) Accurate **cross-sections** across the mapped area. You should present as many as are necessary to illustrate the structural and stratigraphic relationships within your area.
5) If you include **photographs** in your report there should be a full explanatory caption and, preferably, a transparent overlay or accompanying sketch illustrating the main geological features in the photograph.

THE REPORT

The following is a general guide as to what you should include in the final report. It is by no means comprehensive, you may add things as necessary, but all reports should contain the following:

Introduction

The study area and its boundaries. Who did the work and when. The base maps used, their scale, source, and year of publication. This section should also contain a brief description of the general geography of the area, topography, level of exposure, and general level of weathering of the outcrops.

A description of the lithologies mapped

This should contain a brief introductory statement of the general rock types encountered (i.e. sedimentary, igneous, and/or metamorphic) and the approximate age. It should contain a description of the hierarchy of units (Formations, members etc.). If stratified units are mapped and overall stratigraphic column, drawn to scale, should be presented illustrating the relationships between the various rock units.

Characteristics common to a number of Formations (e.g. a common grade of metamorphism, or a common structural fabric) should be described, followed by a detailed description of each of the units, in order. These should be accompanied by field-sketches and photographs illustrating various aspects of the units described. Any fossils found should be described and identified as they provide constraints on both the age of the rock unit described and its environment of deposition. This section should all include any petrological and thin-section descriptions you wish to include.

The structure of the Area

This section should deal with the geometrical distribution of the rocks in the field; whether they are folded, faulted or otherwise deformed. The attitudes of the various units should be described and cleavages or schistosities should be noted. This should be illustrated with sketches, photographs, and stereonets. In particular, where more than one phase of deformation is noted the relationships between the various structures should be described and an attempt made to construct a synthesis of the structural history of the region.

A geological history

This section should include the genesis of the rocks described, the nature of the environment in which they were formed (i.e. for sediments whether they are marine or continental etc., for igneous rocks the setting, for metamorphic rocks the P-T conditions), and their subsequent tectonic history, based on your structural observations. This section can also include reference to regional studies, and the work of others in the area. The history will be slanted towards the particular characteristics of your mapping area (e.g. if your mapping area consists of undeformed sediments you should place a lot of emphasis on the depositional environments and subsequent diagenetic history, rather than spend pages comments on the lack of deformational structures in the region).