

LECTURE 2

SUSTAINED GEOLOGICAL MAPPING IN THE FIELD

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2.0 INTRODUCTION

Welcome to lecture 2. From the previous lecture, you have learned the importance of the planning stage for a field geological project. We have seen that it is important to determine if other geologists are working in the proposed area of study in order to avoid duplicating their work. We have seen the necessity to accumulate and study reports and maps of the region in order to have an understanding of the broader features and problems of the area.

Once the initial field preparations have been done, the geologist is now ready to undertake a sustained geological mapping exercise in the field. Lecture 2 will briefly review the basic equipment needed in the field, introduce you to the procedures of taking geological field notes, abbreviations used for field notes, lithological descriptions, and collecting, numbering and marking of rock samples and fossils.

2.1 OBJECTIVES



Objectives

At the end of this lecture you should be able to:

- List the primary field equipment required for a geological mapping exercise.
- Give examples of common abbreviations used in geological field mapping
- Outline the characteristic lithologic and structural features to be noted in the field.
- State characteristic textural features of rocks and fossils to be described in the field.
- Describe the procedure to be used in collecting, numbering and marking of samples in the field.

2.2 PRELIMINARY PREPARATION

Before the geologist goes to the field, he should make some preliminary preparations. He should contact a reconnaissance survey of the area mapped and assess the cost of the fieldwork. He should also obtain the necessary permission to carry out the work as well as field equipment, which should include:

- (i) Base maps
- (ii) Sample bags
- (iii) Barometer
- (iv) Adhesive tape for labeling rock samples
- (v) Camera and film accessories
- (vi) Compass (Brunton type); a clinometer; sample bags.
- (vii) Chisels and geological hammers
- (viii) Drawing board; erasers; pencils; notebooks; colored pencils; permanent marker pens; protractors etc.
- (ix) Hydrochloric acid (dilute)
- (x) Magnet and pocket knife

- (xi) Binocular microscope
- (xii) Mineral hardness set
- (xiii) First aid kit including snakebite kit.
- (xiv) Stereoscopes

2.3 TAKING GEOLOGICAL NOTES IN THE FIELD

The geologist takes notes as he studies the outcrops in the field. The geologist moves to places where he expects rock outcrops. The most likely areas to find these rock outcrops are:

- Along river valleys (or stream valleys). Follow a stream, which cuts or traverses across the strata. This is likely to expose more of the contrasting and underlying geology in a given area.
- Following road cuts and taking note of any rock exposures.
- Hills and mountains – The barometers can help to indicate your relative position



Which are the likely places to find rock outcrops in the field?

The geological notes and descriptions taken in the field depend on the project. Most of the items recorded in the notebook are factual. Geological notes taken are brief. However drawings or diagrams should be used wherever they save time and space or add clarity. For many cases small accessory maps and cross-sections serve to record large amounts of data briefly and clearly. For example, a lithological body with a striking 30° to the northwest with a dip of 25° to the northeast can be represented by the symbol:

Strike, north thirty degrees west ($N30^\circ W$)

Dip, twenty-five degrees northeast ($25^\circ N$)



Usually the strike is given as a compass direction relative to north. For example, “North sixty-three degrees west” is a strike that is 63° west of geographic north (see Fig. 2.1). For any given strike, two directions of dip at the same angle are possible, so the compass

direction of the downward slope must be specified. “Thirty-three degrees southwest” is the dip of the rock layer in Fig. 2.1. Strike and dip measurements for the example are written as follows: $N63^{\circ}W, 33^{\circ}SW$

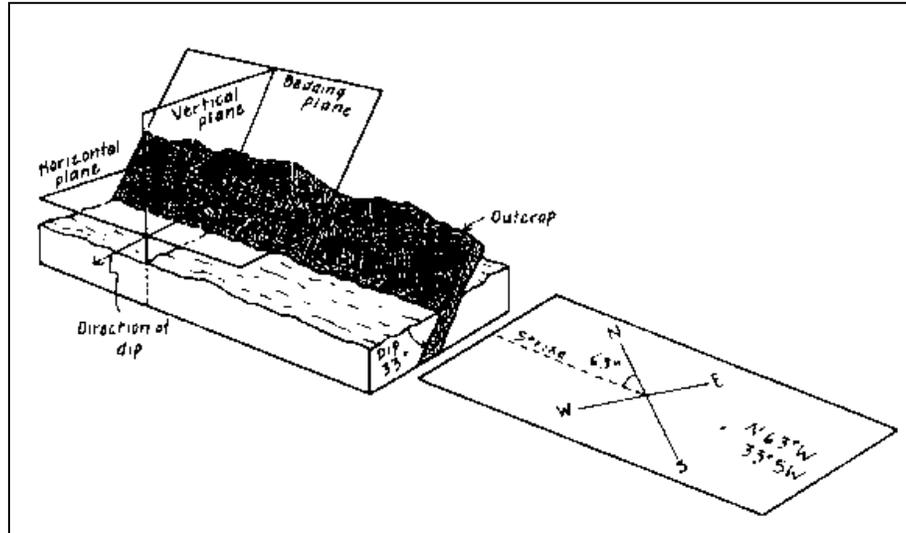


Fig 2.1 Measurement of strike and dip on a rock layer.

Because it is necessary to record the orientation of rock layers in a simple way on a map, geologists measure the strikes and dips of all rock layers they encounter while mapping an area in the field. The data are written directly onto a map at the point where the measurement is made. The symbols used are explained in Fig. 2.2 and in more detail in Lecture 3 of this course unit.

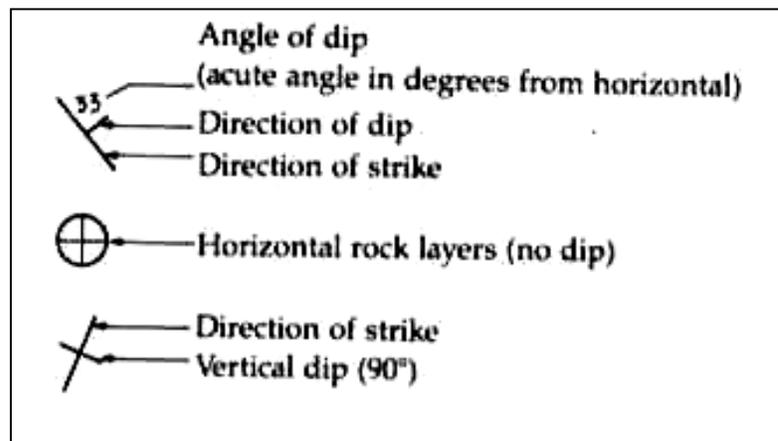
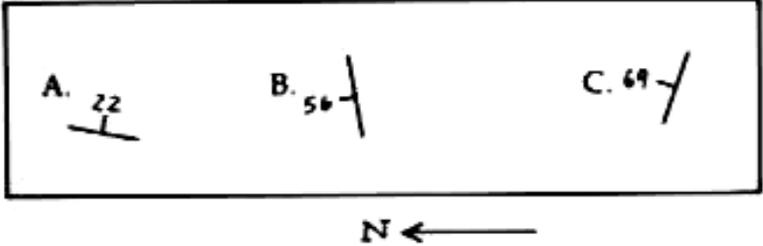


Fig. 2.2. Symbols for strike and dip.



ACTIVITY

Assuming that north is to the west of the page, determine the orientation of the strike and dip symbols shown here below using your protractor.



The discontinuous measure of rock exposures makes it necessary to base some geological relations on inferences rather than on observable facts. However, it is important to write down that these are inferences. Although each person develops a somewhat different way of note taking, all notes must be:

- (i) Legible
- (ii) Accurate
- (iii) Brief and concise

2.4 ABBREVIATIONS FOR FIELD NOTES

Common abbreviations should be used. A few of the many possibilities are listed here below in Table 2.1. A more complete list of abbreviations is given by Compton (1978).

Table 2.1 Abbreviations for field geological notes.

Name	Abbreviations
Abundant	- abnt.
Acicular	- acic.
Aggregates	- aggr.
Amount	- amt.
Argillaceous	- arg.
Arenaceous	- aren.
Conglomerate	- cgl.
Contact	- ctc.
Crystal	- Xl
Crystalline	- Xln

2.5 TAKING A PHOTOGRAPH IN THE FIELD

Where a photograph is taken in the field, a simple diagram noting the direction of the view and labeling its important features is likely to prove valuable for cross-reference after the fieldwork session. Efforts should be done to include in the photo a standard item whose dimensions are known (e.g. geological hammer) that can act as a scale. In circumstances where notes are taken on loose-leaf sheets, then each of the sheets must have the following at its top:

- Must bear the date on the sheet
- The geologist's name
- A brief geographic title or description of the area covered by the page.
- The name or number of the base map used or aerial photograph used.

2.6 DESCRIPTIONS TO BE ENTERED IN FIELD NOTES

The data to be recorded in field notes will always depend to the project undertaken. In most geologic surveys the notes concentrate on:

- (i) Descriptions of rock units/ contacts.
- (ii) Description of structures

In both descriptions, emphasis is made on those features that indicate the mode of origin of the rocks and/or their relative ages. Descriptions are entered as the outcrops are found and determined. As the fieldwork progresses the geologist enters down more critical descriptions of features that have been traced through a series of outcrops. Before the geologist leaves the field for the season, he should make sure that his field notes include full descriptions of rock units and structures in all parts of the area surveyed.

Lithologic descriptions are more useful if recorded in a fairly systematic way as follows:

- 1) The name of the unit or brief rock name – e.g. biotite gneiss
- 2) Specific locality or the area to which the description applies
- 3) Thickness and overall structure or shape of unit in the area.
- 4) Gross characteristics of the area underlain by unit, for example:
 - (i) Topographic expression
 - (ii) Colour and type of soil
 - (iii) Vegetation
 - (iv) Nature of outcrops
- 5) Characteristic structures of unit, for example:
 - i) Range of thicknesses and average thickness of beds or other layered structures
 - ii) Shapes of beds or other structures (e.g. tabular, lenticular, lineate etc.)
 - iii) Primary features within beds or bedding, inclusions, flow bending etc.
 - iv) Linear structures e.g., faults, joints etc.
 - v) Characteristic secondary structures especially cleavage and prominent weathering effects.
- 6) Fossils
 - i) Description of fossils (see Fig 2.3)
 - ii) Special characteristic of fossiliferous rocks
 - iii) Position and condition of fossils (this includes growth position; fragmental; winded; rounded; pitted or fluted by solution; external or internal molds, etc.).

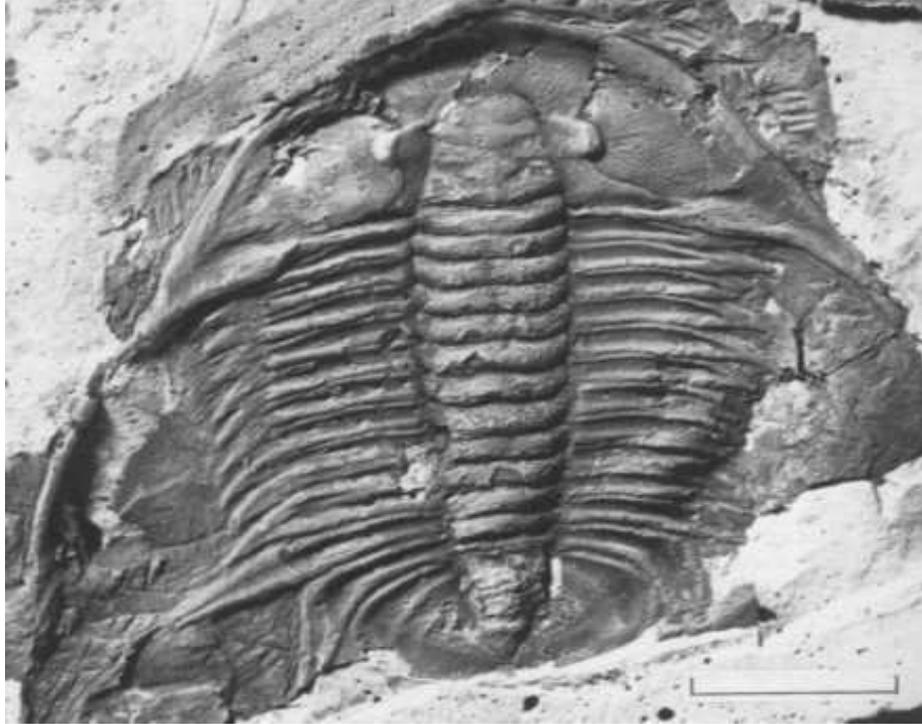


Fig. 2.3. A trilobite fossil preserved in shale.

- 7) Description of rocks with most abundant variety described first.
- i) Colour: both fresh and weathered surfaces
 - ii) Induration (of weathered or completely fresh rock)
 - iii) Grain sizes (range of sizes and the average median sizes)
 - iv) Degree of sorting or equigranularity
 - v) Shapes of grains (anhedral, subhedral, euhedral)
 - vi) Orientations or textural fabric of shaped grains (e.g., schistosity and mineral banding in Fig 2.4)), especially in relation to rock structures e.g. in rocks such as schists and gneisses.

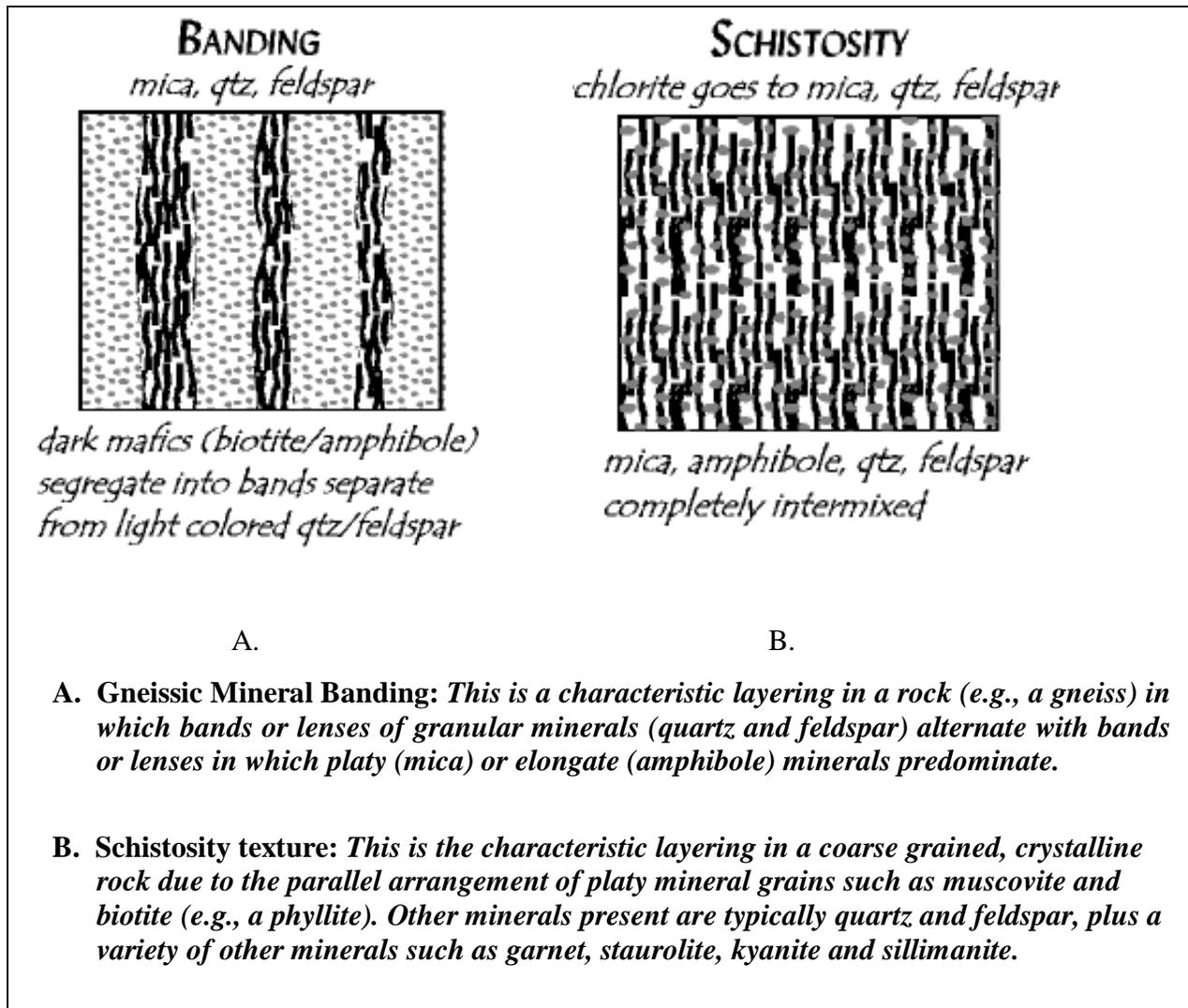


Fig. 2.4 Typical textural fabrics in rocks: mineral banding and schistosity.

- (vii) Nature and amount of cement, matrix or groundmass if any.
- (viii) Nature and amount of holes (porosity) and indications of permeability.
- (ix) Constitution of grains (mineral; lithic; fossil; glass) and then percent (%) by volume. The mineralogy of any identifiable crystals will fix the composition more precisely. Pay particular attention to the percentage of quartz and the type of feldspar present. Most people tend to over-estimate the percentages of dark minerals in rocks. Figure 2.5 depicts various percentages of dark areas in a white background and may be helpful as a guide.

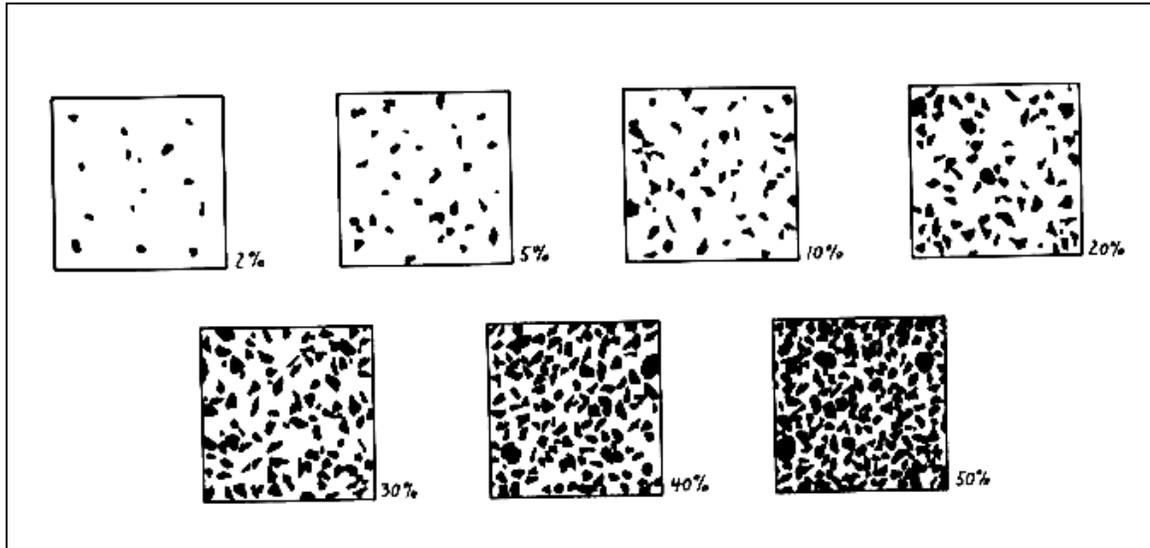


Fig. 2.5 Chart for estimating percentages of dark minerals in rocks.

(x). Nature of contacts of rock units as illustrated in Figure 2.6 includes:

- Sharp or gradational – state dimensions
- Evidences of unconformity
- Criteria in tracing contact in the field.

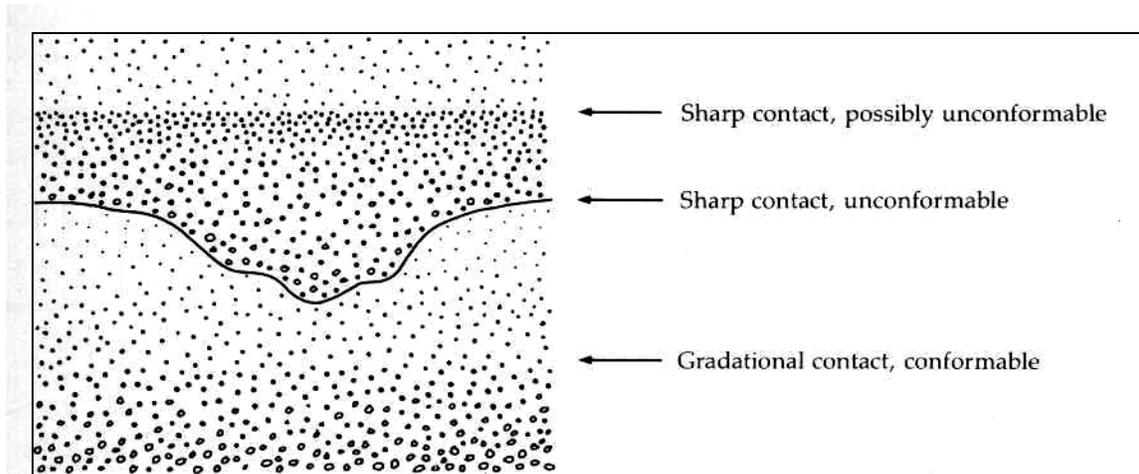


Fig.2.6 Nature of rock contacts.



Faults, unconformities, intrusive contacts etc are examples of structures that require systematic and thorough descriptions in the field.

2.7 COLLECTION AND IDENTIFICATION OF SPECIMENS

2.7.1 COLLECTION OF ROCK SAMPLES AND FOSSILS

Despite lithological descriptions made in the field, rock samples are collected because of:

- Better identification in the office or camp by a more experienced geologist or under microscopic observations.
- For accurate determination of porosity and permeability, mineral ratios and other laboratory analytical work.

The specimen collected must be a truly representative of the unit being studied. Specimens should be broken directly from the outcrop. Unweathered specimens are preferred to weathered ones but an ideal specimen has both weathered and un-weathered part. For rocks with grains smaller than 2mm samples should be of the size 3 x 4 x 1 inch. It is advisable to trim the specimens so as to fit in drawers.



What is the purpose of collecting rock specimens and fossils from the field?

Fossils are collected for three basic reasons:

- (i) To determine geologic age and sequence of rock
- (ii) To correlate fossiliferous rock units
- (iii) To help in determining the environment of deposition of sediments.

Fossils also occur in pyroclastic rocks and their presence in metamorphic rocks cannot be totally ruled out. Before beginning a fieldwork project a geologist should acquaint himself with the useful index fossils likely to be observed in the rocks of a specific age occurring in the project area.

Fossils are so scarce in some areas that finding them would be a considerable problem. In such circumstances, their initial search should be concentrated on floats – specimens not embedded on the outcrop - and weathered outcrop surfaces. Notes should be entered about fossils where they are observed. Fossil occurrences are also governed by lithologies of rocks, e.g. graptolites occur in fissile shale beds or fissile limestone beds. Fossil bones occur most frequently in non-marine lacustrine, fluvial or deltaic sediments. Fossils may provide useful indications of palaeo-climatic conditions.

2.7.2 NUMBERING AND MARKING OF SPECIMENS

Each rock or fossil specimen must be mapped with a number matching that used in the notes or aerial photographs. Most specimens can be marked directly with a felt tip pen (flow pen). The number may also be written on an adhesive pile of tape fixed firmly to the sample in the field. If the sample is wet, the number can be written on a piece of paper, secured to the sample with string or rubber band. The sample should then be put in a paper or cloth bag on which its number is clearly marked so that it can be identified without being unpacked. A formal style of numbering your specimens is as indicated here below:

JR	-	F3	-	6
The geologist		Map sheet		Specimen number or
Initials		or number		locality number



ACTIVITY

Carry out a library desk study and write a summarized essay about:

- (i) The classification, mineralogy and structures of major sedimentary rock types
- (ii) The classification, mineralogy, textures and structures of metamorphic rocks
- (iii) The classification, textures, mineralogy and structures of igneous rocks

2.8 Summary



SUMMARY

In this lecture we noted that, long before a geologist goes to the field for detailed mapping, he should first make some preliminary preparations. These preparations include a reconnaissance survey of the area to be mapped in order to access the cost of the fieldwork, to obtain the necessary permission from the relevant authorities to carry out the work, as well as accumulating the basic field equipment.

Since a geologist takes notes as he studies the outcrops in the field, we observed that he should move to places where he/she expects the rock outcrops. We noted that the most likely areas to find these rock outcrops is usually along river valleys (or stream valleys), along road cuts that expose any rock exposures, hills, mountains and contacts of rock units. We further observed that most of the items recorded in the notebook should be factual, brief and concise. However, where necessary, drawings or diagrams should be used wherever they save time and space or add clarity. In circumstances where a photograph is taken in the field, efforts

should be done to include in the photo a standard item whose dimensions are known (e.g. geological hammer) that can act as a scale.

We observed in this lecture that the type of data that is usually recorded in field notes usually depend on the project undertaken. In most geologic surveys we noted that the notes usually concentrate on descriptions of rocks and structures. In both descriptions, emphasis is made on those features that indicate the origin of rocks or their relative ages.

This lecture showed that the rock specimens collected in the field must be representative of the units being studied and that they should be broken directly from the outcrop. Un-weathered specimens are usually preferred to weathered ones but an ideal specimen should have both weathered and un-weathered part.

It was clear from this lecture that fossils are collected for three basic reasons, namely to determine geologic age and sequence of rock, to correlate any fossiliferous rock units, and lastly to help in determining the environment of deposition of the sediments. And lastly when it comes to numbering of the specimens, we noted that each rock or fossil specimen must be mapped with a number matching that used in the notes or aerial photographs. A formal style of numbering the specimens is to indicate the initials of the geologist, the map sheet number, and the specimen or locality number.

2.9 References



REFERENCES

Compton, R.R. 1968. *Manual of Field Geology*. John Wiley & Sons, Inc. New York. 378pp.

Lahee F.H. 1980. *Field Geology*. McGraw Book Company, Inc. New York. 926pp.

PettiJohn F.J. 2002. *Sedimentary Petrology*. 3rd Ed. CBS Publishers & Distributors, India. 628pp.