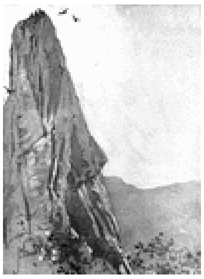
Field geology

Unit II

SYLLABUS

Unit II : Rock outcrops and their surficial expressions. Basic concepts: strike, dip, apparent dip and rock trends. Introduction to the outcrop features used in mapping: foliations, lineations, bedding, and lithological contacts. Geological mapping: Techniques of mapping:Traverse methods: Compass and Contact traverse, Exposure mapping, Variable lithologymapping, Line maps. Preparation of field note based data sheet.

Rockoutcrop and their surficial expression



. **rock outcrop** - the part of a rock formation that appears above the surface of the surrounding land
outcrop, **outcropping**
belay - something to which a mountain climber's rope can be secured
outthrust - an outcropping of rock that extends outward
rock, **stone** - a lump or mass of hard consolidated mineral matter; "he threw a rock at me"

Outcrops do not cover the majority of the Earth's land surface because in most places the bedrock or superficial deposits are covered by a mantle of soil and vegetation and cannot be seen or examined closely. However, in places where the overlying cover is removed through erosion or tectonic uplift, the rock may be exposed, or *crop out*. Such exposure will happen most frequently in areas where erosion is rapid and exceeds the weathering rate such as on steep hillsides, mountain ridges and tops, river banks, and tectonically active areas. In Finland, glacial erosion during the last glacial maximum (ca. 11000 BC), followed by scouring by sea waves, followed by isostatic uplift has produced many smooth coastal and littoral outcrops.

Bedrock and superficial deposits may also be exposed at the Earth's surface due to human excavations such as quarrying and building of transport routes.

Basic concepts

Strike

The *strike line* of a bed, fault, or other planar feature, is a line representing the intersection of that feature with a horizontal plane. On a geologic map, this is represented with a short straight line segment oriented parallel to the strike line. *Strike* (or strike angle) can be given as either a quadrant compass bearing of the strike line (N25°E for example) or in terms of east or west of true north or south, a single three digit number representing the azimuth, where the lower number is usually given (where the example of N25°E would simply be 025), or the azimuth number followed by the degree sign (example of N25°E would be 025°).

Dip

The *dip* gives the steepest angle of descent of a tilted bed or feature relative to a horizontal plane, and is given by the number (0°-90°) as well as a letter (N,S,E,W) with rough direction in which the bed is dipping downwards. One technique is to always take the strike so the dip is 90° to the right of the strike, in which case the redundant letter following the dip angle is omitted (right hand rule, or RHR). The map symbol is a short line attached and at right angles to the strike symbol pointing in the direction which the planar surface is dipping down. The angle of dip is generally included on a geologic map without the degree sign. Beds that are dipping vertically are shown with the dip symbol on both sides of the strike, and beds that are level are shown like the vertical beds, but with a circle around them. Both vertical and level beds do not have a number written with them.

Apparent dip

Apparent dip is the inclination of geologic beds as seen from any vertical cross section **not** perpendicular to the strike of the geologic beds.

Note: When a vertical cross-section **is** perpendicular to the strike of the beds, the inclination seen in the cross section is called the **true dip**.

Rock trend

Trend is the direction of the line formed by the intersection of the planar feature with the ground surface; trend is the same as strike only if the ground surface is parallel to the horizontal plane.

Outcrop features using in mapping

Outcrops do not cover the majority of the Earth's land surface because in most places the bedrock or superficial deposits are covered by a mantle of soil and vegetation and cannot be seen or examined closely. However, in places where the overlying cover is removed through erosion or tectonic uplift, the rock may be exposed, or *crop out*. Such exposure will happen most frequently in areas where erosion is rapid and exceeds the weathering rate such as on steep hillsides, mountain ridges and tops, river banks, and tectonically active areas. In Finland, glacial erosion during the last glacial maximum (ca. 11000 BC), followed by scouring by sea waves, followed by isostatic uplift has produced many smooth coastal and littoral outcrops.

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Foliation

Foliation in geology refers to repetitive layering in metamorphic rocks.[1] Each layer can be as thin as a sheet of paper, or over a meter in thickness.[1] The word comes from the Latin *folium*, meaning "leaf", and refers to the sheet-like planar structure.[1] It is caused by shearing forces (pressures pushing different sections of the rock in different directions), or differential pressure (higher pressure from one direction than in others). The layers form parallel to the direction of the shear, or perpendicular to the direction of higher pressure. Nonfoliated metamorphic rocks are typically formed in the absence of significant differential pressure or shear.[1] Foliation is common in rocks affected by the regional metamorphic compression typical of areas of mountain belt formation (orogenic belts).

Lineation

A lineation is any linear feature or element in a **rock** , and can occur as the product of tectonic, mineralogical, sedimentary, or geomorphic processes. Lineations are the one-dimensional counterparts of foliations, and both are part of the fabric (geometric organization of features) of a rock. Lineations and foliations are said to possess preferred orientations, meaning that the spatial orientation of the features comprising the lineation or foliation is similar throughout the rock mass.

Bedding

Bedding (also called **stratification**) is one of the most prominent features of sedimentary rocks, which are usually made up of 'piles' of layers (called '**strata**') of sediments deposited one on top of another.
Every stratum is characterized by its own **lithology** (composition), **sedimentary structures**, **grain size** and **fossil content** that make it unique and different from the strata that lie above and below it. Every layer represents an event, a moment in the geological time when chemical, biological, and physical conditions led to the deposition of a specific rock layer. An **event** in the sedimentary record could have lasted thousands of years (e.g., the slow settling of a clay layer on the seabed) to a few minutes (e.g., the fast deposition of a **turbidite**). In any case, when looking at a sequence of strata, we are looking through the sequence of events that occurred in a sedimentary basin over the geologic time.

Lithological contact

The surface that separates rock bodies of different lithologies, or rock types. A contact can be conformable or unconformable depending upon the types of rock, their relative ages and their attitudes. A fault surface can also serve as a contact.

Geological mapping

Geological interpretation is one of the critical works in the geological field. To get a geological interpretation that's closer to the truth, we need adequate data and important geological data packaging. Geological mapping is one geological data presentation that's most competent and is used for various purposes either for science or exploration of natural resources. A geological map is a map that consists of geological information of the outer layer of earth crust; they are a variation of lithology, distribution of geologic structure, stratigraphy and geomorphology. All of that information read by symbols and colors. Details of geological map depend on the its scale, and the density and accuracy of observations in the field. The final result from all geological methods is a geological map.

Techinues of mapping

Geological maps portray the distribution of different **rock** types, the location of faults, **shear zones** and **folds** , and the orientation of primary and structural features. Mines, quarries, mineral occurrences, fossil localities, geochronological sampling sites, oil and **water** wells may also be shown. Geological maps illustrate rock relationships that enable the depositional, intrusive, and structural history of an **area** to be established, and the three-dimensional geometry to be visualized. They provide fundamental information for mineral and **petroleum** exploration and for hydrological and environmental investigations.

In small areas such as exploration tenements where detailed maps are required, it is common practice to undertake grid mapping. After a grid is surveyed and pegged, the geologist carries out detailed traverses along grid lines. Rock types, lithological contacts, and alteration are noted and structural measurements made using a compass-clinometer. Information may be recorded by hand on traverse maps or collected digitally. A complete map is compiled by interpolating between gridlines, collecting additional data where necessary. Aerial photographs, **satellite** or other remotely sensed images (as discussed below) serve as the base for recording regional map data. Digital data recorders integrated with **GPS** (global positioning system) location measurements enable lithological and structural data to also be digitally recorded in the field. Data can be directly input into a **GIS** (geographic information system) or custom computer package that enables different attributes to be displayed on a map and spatially analyzed.

Travse method

Traverse is a method in the field of surveying to establish control networks.[1] It is also used in geodesy. Traverse networks involve placing survey stations along a line or path of travel, and then using the previously surveyed points as a base for observing the next point. Traverse networks have many advantages, including:

- Less reconnaissance and organization needed;
- While in other systems, which may require the survey to be performed along a rigid polygon shape, the traverse can change to any shape and thus can accommodate a great deal of different terrains;
- Only a few observations need to be taken at each station, whereas in other survey networks a great deal of angular and linear observations need to be made and considered;

- Traverse networks are free of the strength of figure considerations that happen in triangular systems;
- Scale error does not add up as the traverse is performed. Azimuth swing errors can also be reduced by increasing the distance between stations.

The traverse is more accurate than triangulateration[2] (a combined function of the triangulation and trilateration practice).

Compass

A **compass** is a magnetometer used for navigation and orientation that shows direction relative to the geographic cardinal directions (or points). Usually, a diagram called a compass rose shows the directions north, south, east, and west on the compass face as abbreviated initials. When the compass is used, the rose can be aligned with the corresponding geographic directions; for example, the "N" mark on the rose points northward. Compasses often display markings for angles in degrees in addition to (or sometimes instead of) the rose. North corresponds to 0°, and the angles increase clockwise, so east is 90° degrees, south is 180°, and west is 270°. These numbers allow the compass to show magnetic North azimuths or true North azimuths or bearings, which are commonly stated in this notation. If magnetic declination between the magnetic North and true North at latitude angle and longitude angle is known, then direction of magnetic North also gives direction of true North.

Exposure mapping

A geological map is one of the most important tools of geologist's trade. It shows how geological features (rock units, faults, etc.) are distributed across a region. It is a two dimensional representation of part of the Earth ’ s surface, scaled down to a size that is convenient for displaying on a sheet of paper or a computer screen. Information on the third dimension is incorporated by means of strike and dip symbols and other structural labels. Different rock units are usually shown as different colours (and/or ornaments) and are overlain on a topographic base map for easy location. Additional information on features such as structure, lithology and stratigraphy is also included, allowing interpretation of the subsurface. Increasingly, geological mapping data are stored with subsurface information in computer models that allow more sophisticated visualization and manipulation in three dimensions than is possible with traditional paper maps.

Variable lithology

Lithologic identification and classification can provide important basic information for regional geological survey and mineral resource exploration. Topographic variables constitute the quantitative parameters of digital expression for topography, and are very important in improving the accuracy. Based on the classification validity and correlation of 10 topographic variables such as elevation, slope, profile curvature, surface roughness, and surface cutting depth in the known lithologic area, the authors screened the topographic variables and used the variables under the best scale for the classification of lithology. The result shows that the combination of elevation, profile curvature, surface cutting depth, surface roughness and plane curvature is very useful and, in terms of the capability of identification, each variable has the corresponding lithology. The adding of the best terrain variables combination to fully express terrain characteristics in identifying each type of lithology is helpful to improving the recognition and classification of lithology.

Line mapping

a contour line (often just called a "contour") joins points of equal elevation (height) above a given level, such as mean sea level.[3] A **contour map** is a map illustrated with contour lines, for example a topographic map, which thus shows valleys and hills, and the steepness or gentleness of slopes.[4] The **contour interval** of a contour map is the difference in elevation between successive contour lines.

Preparation of field note book based on datasheet

Fieldnotes refer to qualitative notes recorded by scientists or researchers in the course of field research, during or after their observation of a specific organism or phenomenon they are studying. The notes are intended to be read as evidence that gives meaning and aids in the understanding of the phenomenon. Fieldnotes allow the researcher to access the subject and record what they observe in an unobtrusive manner.

One major disadvantage of taking fieldnotes is that they are recorded by an observer and are thus subject to (a) memory and (b) possibly, the conscious or unconscious bias of the observer.[1] It is best to record fieldnotes while making observations in the field or immediately after leaving the site to avoid forgetting important details. Some suggest immediately transcribing one's notes from a smaller pocket-sized notebook to something more legible in the evening or as soon as possible. Errors which occur from transcription often outweigh the errors which stem from illegible writing in the actual “field” notebook

The ways in which you take notes during an observational study is very much a personal decision developed over time as you become more experienced in fieldwork. However, all field notes generally consist of two parts:

1. **Descriptive information**, in which you attempt to accurately document factual data [e.g., date and time] along with the settings, actions, behaviors, and conversations that you observe; and,
2. **Reflective information**, in which you record your thoughts, ideas, questions, and concerns during the observation.

Note that field notes should be fleshed out as soon as possible after an observation is completed. Your initial notes may be recorded in cryptic form and, unless additional detail is added as soon as possible after the observation, important facts and opportunities for fully interpreting the data may be lost.

Characteristics of Field Notes

- **Be accurate**. You only get one chance to observe a particular moment in time so, before you conduct your observations, practice taking notes in a setting that is similar to your observation site in regards to number of people, the environment, and social dynamics. This will help you develop your own style of transcribing observations quickly and accurately.
- **Be organized**. Taking accurate notes while you are actively observing can be difficult. Therefore, it is important that you plan ahead how you will document your observation study [e.g., strictly chronologically or according to specific prompts]. Notes that are disorganized will make it more difficult for you to interpret the data.
- **Be descriptive**. Use descriptive words to document what you observe. For example, instead of noting that a classroom appears "comfortable," state that the classroom includes soft lighting and cushioned chairs that can be moved around by the students. Being descriptive means supplying yourself with enough factual evidence that you don't end up making assumptions about what you meant when you write the final report.
- **Focus on the research problem**. Since it's impossible to document everything you observe, focus on collecting the greatest detail that

relates to the research problem and the theoretical constructs underpinning your research; avoid cluttering your notes with irrelevant information. For example, if the purpose of your study is to observe the discursive interactions between nursing home staff and the family members of residents, then it would only be necessary to document the setting in detail if it in some way directly influenced those interactions [e.g., there is a private room available for discussions between staff and family members].

- **Record insights and thoughts**. As you take notes, be thinking about the underlying meaning of what you observe and record your thoughts and ideas accordingly. If needed, this will help you to ask questions or seek clarification from participants after the observation. To avoid any confusion, subsequent comments from participants should be included in a separate, reflective part of your field notes and not merged with the descriptive notes.

General Guidelines for the Descriptive Content

The descriptive content of your notes can vary in detail depending upon what needs to be emphasized in order to address the research problem. However, in most observations, your notes should include at least some of the following elements:

- Describe the physical setting.
- Describe the social environment and the way in which participants interacted within the setting. This may include patterns of interactions, frequency of interactions, direction of communication patterns [including non-verbal communication], and patterns of specific behavioral events, such as, conflicts, decision-making, or collaboration.
- Describe the participants and their roles in the setting.
- Describe, as best you can, the meaning of what was observed from the perspectives of the participants.
- Record exact quotes or close approximations of comments that relate directly to the purpose of the study.
- Describe any impact you might have had on the situation you observed [important!].

General Guidelines for the Reflective Content

You are the instrument of data gathering and interpretation. Therefore, reflective content can include any of the following elements intended to contextualize what you have observed based on your perspective and your own personal, cultural, and situational experiences.

- Note ideas, impressions, thoughts, and/or any criticisms you have about what you observed.
- Include any unanswered questions or concerns that have arisen from analyzing the observation data.
- Clarify points and/or correct mistakes and misunderstandings in other parts of field notes.
- Include insights about what you have observed and speculate as to why you believe specific phenomenon occurred.
- Record any thoughts that you may have regarding any future observations.

BY

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