INTERPRETATION OF GEOLOGICAL MAPS

Drawing of Geological section

Interpretation of geological maps should follow a few objective studies on the basis of the given geological maps.

After the line of geological section is chosen, a strip of paper with one straight edge should be placed along the line of section. Along the straight edge of the paper the points of contour intersection and rock contacts will be taken at first. Then drawing of the necessary strike lines will be made complete and the intersections of the strike-lines on the section line should be taken as necessary points for drawing of the angle of dip.

Then the strip of paper should be placed along a straight base line having the same length with that of the section line. The points of contour intersection and rock contacts should be plotted on the base line and the point of altitudes at respective vertical distances on the given scale above the base line should be determined. A line joining these points will give the topographic profile along the section line.

Then the the rock contacts will be taken along vertical direction from the base line to the topographic profile. The dip angle of rock-beds either calculated graphically or by trigonometric ratio, will be placed at strike intersections on the section line or at respective points of rock contact. From the topographic profile downward the rock contacts will follow the dip angles and will terminate at the base of the section. If the structure is folded, the bedding planes drawn from the rock contacts may meet each other in the case of a syncline.

For the two series maps the structure of the upper series will be drawn at first. Then the lower series should be constructed, but a portion of the lower series may remain hidden under the upper series and if that part is not taken into consideration, the structure may remain incomplete.

However, for the construction of such hidden beds the extended strike line intersections of the beds of the lower series on the section underlying the upper series will be used for drawing of dip angles of the beds of the lower series. In that case the points from which the hidden beds will be drawn will be taken at the base of unconformity, i.e. at the lower contact plane of the lowermost bed of the upper series. Then the hidden beds will be drawn below the unconformity. For the three series map the same principle will be followed.

For transferring the contact planes of the partly hidden lower series the strike lines as well as the notional contact planes which are supposed to be present below the upper series can be used. For drawing of notional contact planes care must be taken so that they follow the trend of their exposed counter parts and they should match the fellow-beds of the same series.

After drawing of the geological section the student should notice which beds in particular have formed the surface topography. The vertical scale should be properly shown along the ordinate with the respective units mentioned. The direction of the section line should be given at the top or below the section line. The sequence of beds of all the series present in the geological section should be given along with the unconformity, if there is any, on the right hand side or below the section. The respective symbols should be used and dip and strike be given. The sequence should follow the stratigraphic order of succession. The bed which is not present in the geological section but whose order of occurrence has been understood, should also be incorporated in the sequence.

For a folded structure in particular, the projection of the possibly eroded portion or the portion underlying the base line may be done, so that the completion of the folded structure appears before the viewer.

Interpretation of the Geological Section

The geological section should be interpreted on the basis of the following topics :

a) Topography
b) Sequence of beds
c) Attitude of beds
d) Structure of beds
e) Correlation between structure and topography
f) Geological history

a) Topography

The topographic expression often gives a hint about the underlying structure as it is the product of the sum total effect of the interaction between the structure and process. Moreover, the nature of surface may depict the advancement of planation in terms of maturity. The relief is also

determined by such interactions, the highest altitude is formed by a relatively more resistant rock bed and wide valley floors are carved out on less resistant rocks. Other parameters, besides this interaction, cannot be indicated by these geological maps. However, wider exposures are formed in relatively less resistant beds and vice versa.

b) Sequence of beds

The stratigraphic succession should be mentioned with complete sequence, according to the directions mentioned earlier. In this connection a better presentation will be to add the approximate thickness of beds.

For the calculation of approximate thickness of rock beds three procedures may be followed :

(i) If any strike line of the upper or lower contact plane of a bed coincides with another of different value at the lower or upper contact plane of the same bed, the vertical distance between the two strike lines in feet or metre will give the thickness of the bed.

(ii) In the second method notional strike lines are drawn at fixed horizontal and vertical intervals as obtained from the two consecutive strike lines on the lower/upper contact plane of a bed and thus any one of the successive notional strike lines of lower or higher value may ultimately coincide with any other strike line at the upper/lower contact plane of the same bed. Then the difference of two strikeline values at that plane, i.e. between the notional strikeline and actual strikeline will be considered as the thickness of the bed. If perfect coincidence does not occur between the notional strikeline and the actual strikeline, the intermediate distance between the nearest notional strikeline and the actual strikeline can be added with the difference between the nearest strikeline and the actual strikeline.

(iii) The thickness of a bed can also be measured from the perpendicular distance between the upper and lower contact planes of a bed drawn in the geological section.

c) Attitude of beds

Under this title the strike directions, their respective levels should be mentioned. A geological map should have multiple sets of strike lines, if so required. The dip of the rock beds at right angle to the direction of strike should be depicted.

d) Structure

After calculation of dips from the strikelines the structure will be determined, i.e. if it is folded, homoclinal or horizontal should be mentioned. In a folded structure the anticline, syncline, isoclinal or recumbent etc. should also be mentioned.

e) Correlation between structure and topography

The separation of an outlier from its fellow rock beds may occur in an advanced stage of dissection which is indicated by cap rocks and closely spaced 'V' - shaped contours along the line of dissection.

As such, the forms of topographic units may be depicted from the impression and shape of contours, such as, upland, plateau, valley, spur etc. The relief-form along the section line may be mentioned too. Steeper and gentler sections of topography may also be identified.

The structural control on topography may be indicated by the following clues.

(i) An anticline may form a ridge or upland.

(ii) A syncline may form a valley.

(iii) Under the sequence of an inverted relief the anticline may occupy the valley area and the syncline may occupy a ridge or upland successively.

(iv) A less resistant rock bed may form a gentle slope and a more resistant rock forms a steeper slope.

(v) Relatively less resistant rock beds of the upper series may be eroded earlier and valley inliers may contain the exposures of the lower series beds.

(vi) A folded or homoclinal structure may form a strike valley along the direction of strike of the beds.

(vii) Flanking such valleys dip and anti-dip or obsequent streams may join the strike stream.

(viii) A dip stream may follow the dip slope of the beds.

(ix) A gentler dip slope and a steeper scarp slope may form a cuesta.

(x) If the amount of dip of a homoclinal structure is high, the dip slope and scarp slope being nearly equal may form a hogback.

(xi) Horizontal or near horizontal structures may give rise to mesa or butte when separated by scarp slopes.

(xii) A folded or homoclinal structure may develop a trellised network of drainage with dip and anti-dip streams joining the strike stream at right angle.

(xiii) A dendritic network does not comply much the with underlying structure.

(xiv) A dome may give rise to a radial and an annular drainage network, whereas a basin may give rise to a centripetal pattern.

(xv) A rectangular network is controlled by the presence of joints in beds.

(xvi) A parallel pattern develops due to lithological control and presence of faults, as the case may be.

(xvii) Harder and more resistant beds will occupy the highest elevation of the area, if exposed.

(xviii) A drainage channel may follow a fault.

(xix) A parallel pattern of drainage may evolve, if parallel faults are there.

(xx) The uplifted block may bring forth greater amount of energy and may result in more intense erosion.

(xxi) An uplifted block or elevated foot wall may develop a fault scrap.

(xxii) An obsequent fault scrap may form if the uplifted block is less resistant.

f) Geological history

Rock beds and structures are good story-tellers. What was the environment during the deposition of sediments, did sedimentation occur under a calm or a turbulent condition, was the energy for sedimentation of the geomorphic agent fluctuating—all such questions are answered by the beds and their general characteristics. The structure obviously signifies the tectonic conditions under which the structure was formed. A folded structure obviously indicates the horizontally active compressional forces, whereas, a horizontal structure is least disturbed.

If the beds formed are from coarser to finer upward the environment under which sedimentation took place seems to be quiet, and a reverse order indicates an upside down condition which may be due to tectonic inversion or due to variation in energy.

However, the basic stress will be given on the chronological order of events, i.e. which bed was formed earlier and which later. If the particular geological age is known, care must be taken not to mention anything on the basis of the theoretical knowledge about the fossils of flora and fauna. Nothing should be mentioned about the tectonic events of which no proof is there in the given geological map. Sedimentary beds are formed under a submerged condition, but that does not necessarily mean that a marine condition should prevail at the time of sedimentation. A change in sequence of beds requires an unconformity which is an erosional surface formed due to sub-aerial denudation when the beds of the lower series were exposed before geomorphic agents. This should be mentioned also chronologically. The final surface is again a product of sub-aerial interaction between erosive forces and beds of rocks.

If there is any fault present on the section line, it should be specifically mentioned when and which series has been affected by the fault.