

TRUE AND APPARENT DIP

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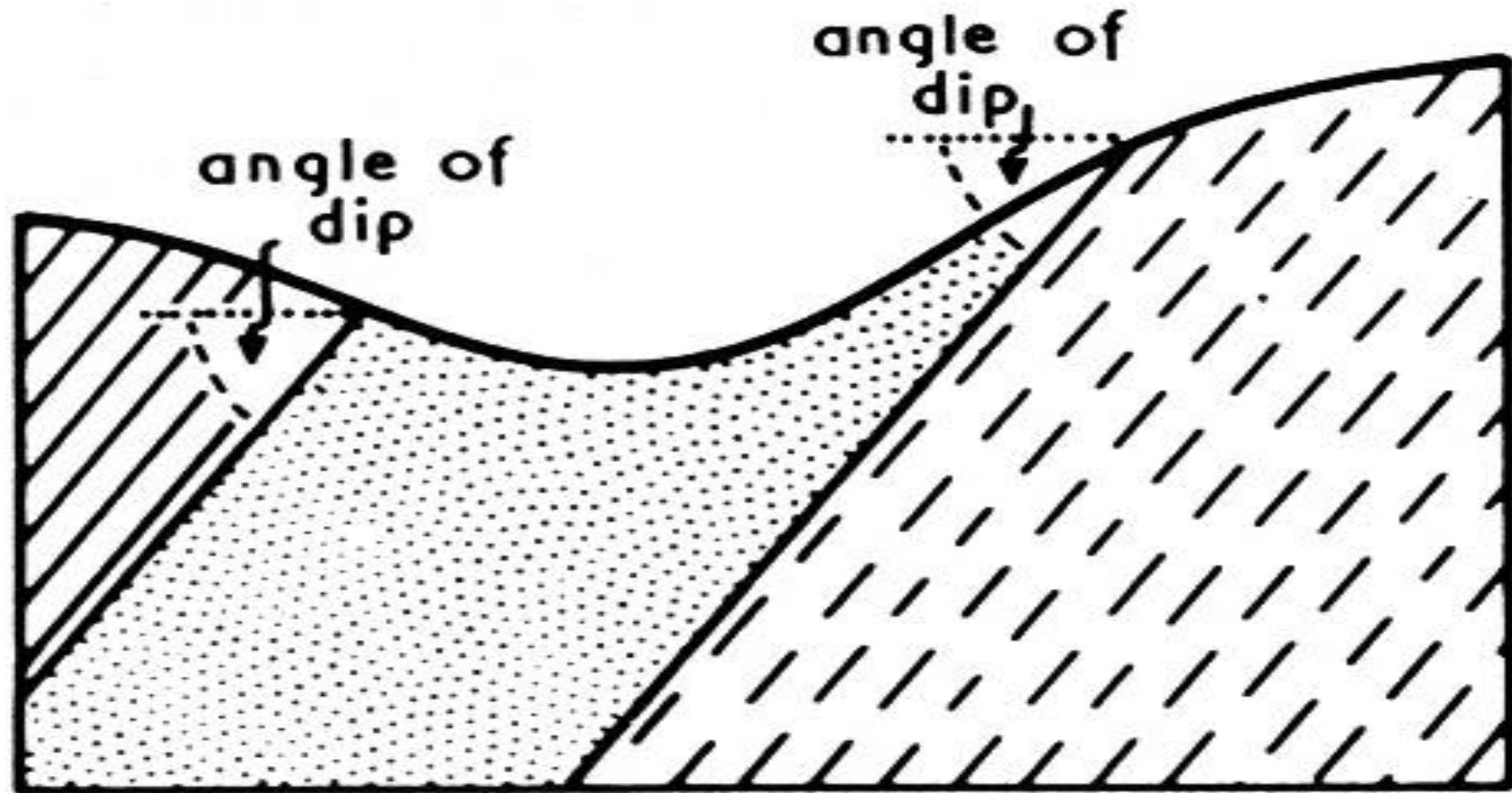
3. Calculation of Vertical & True Thickness

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DIPPING STRATA

Inclined strata are said to be dipping.

Angle of dip = maximum angle measured between strata and the horizontal (regardless of slope of the ground).



Section showing dipping strata. Angle of dip is measured from horizontal

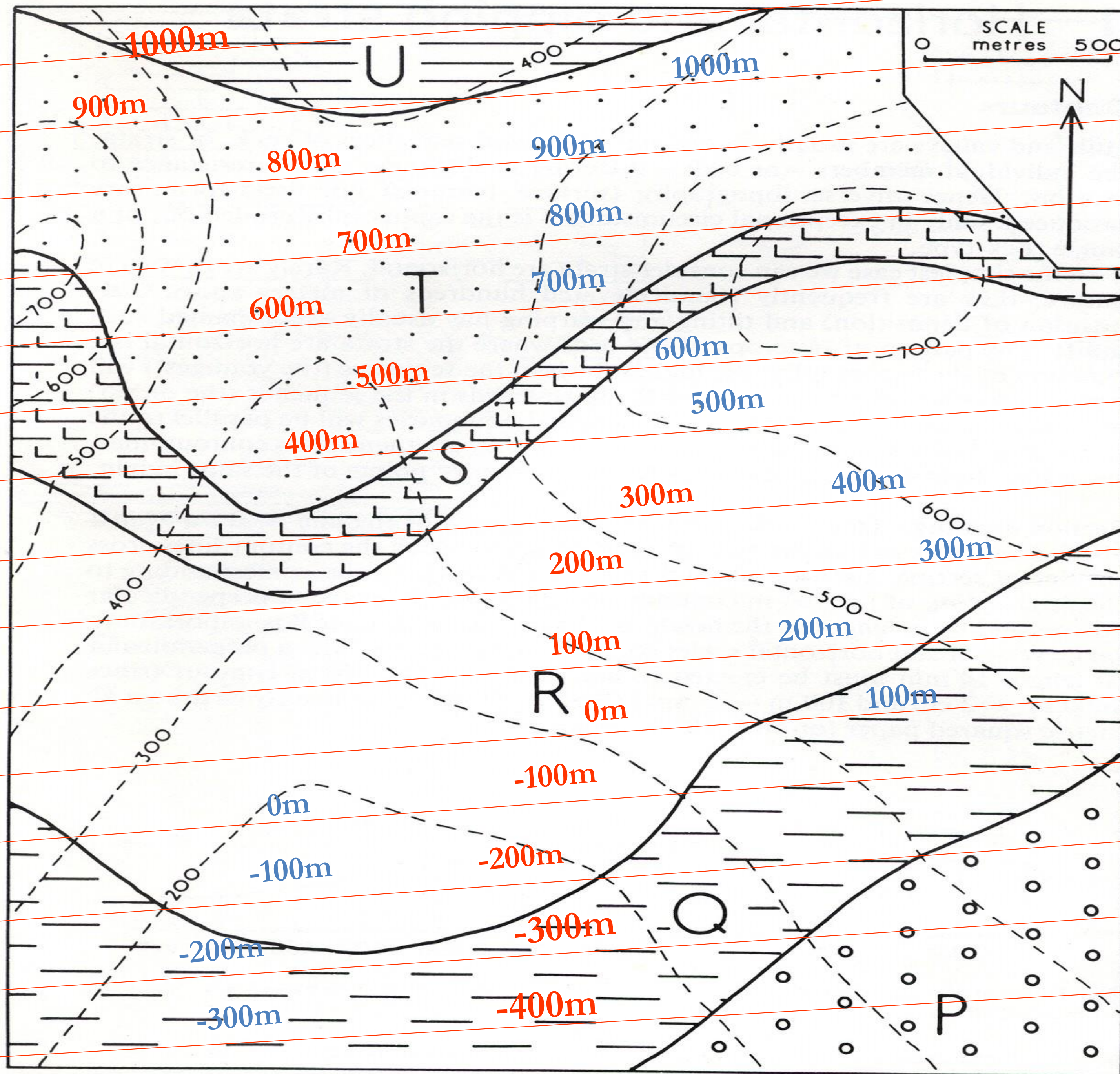
DIPPING STRATA.....contd.

Structure contours (= Strike Lines)

Just as it is possible to define the topography of ground by means of contour lines, so can we also draw contour lines on a bedding plane. These we call **structure contours or strike lines**:

- The former since they join points of equal height
- The latter since they are parallel to the direction of strike

Construction of Structure contours (Strike Lines)

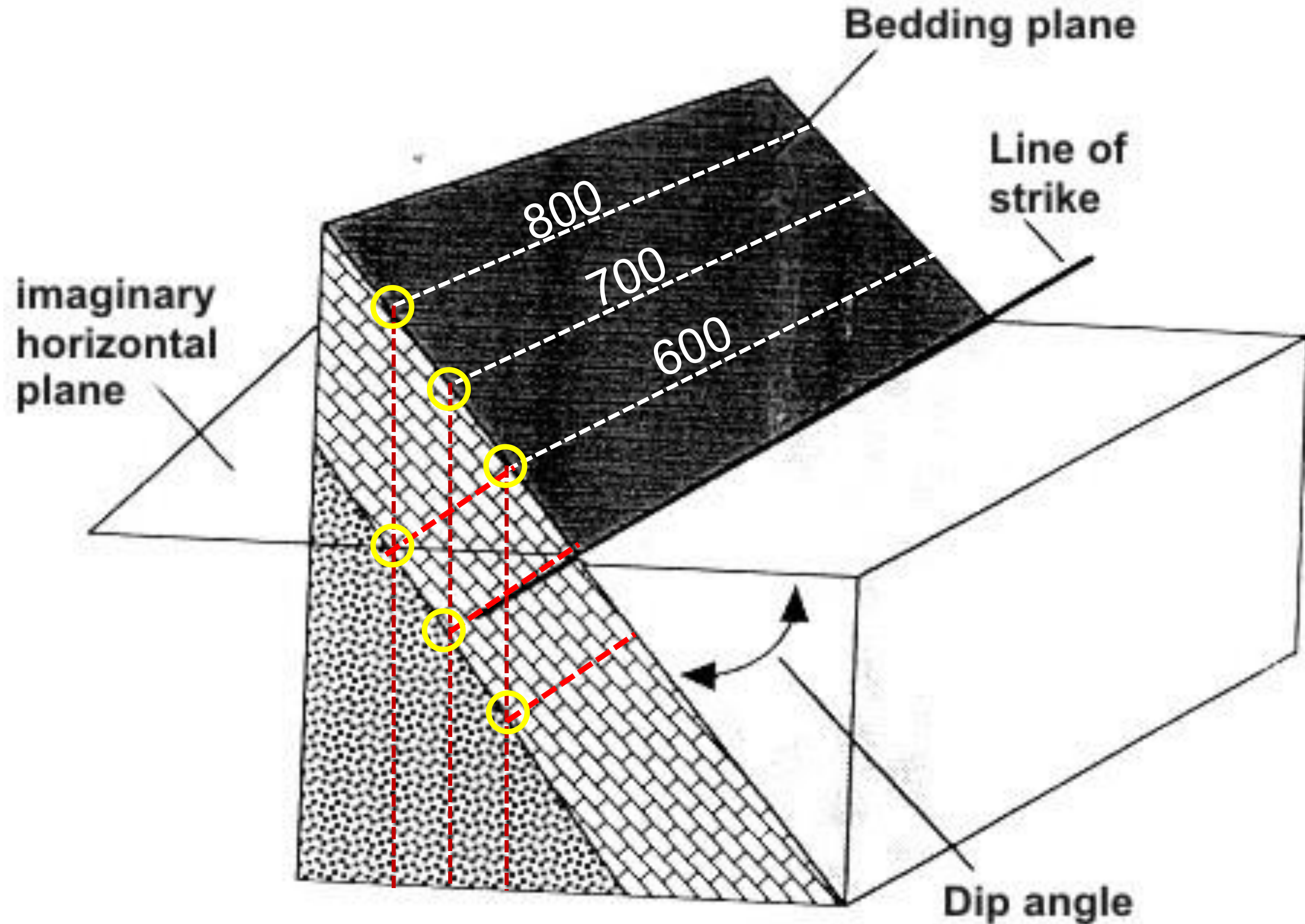


Height of geologic boundary is known where it crosses a topo contour line.

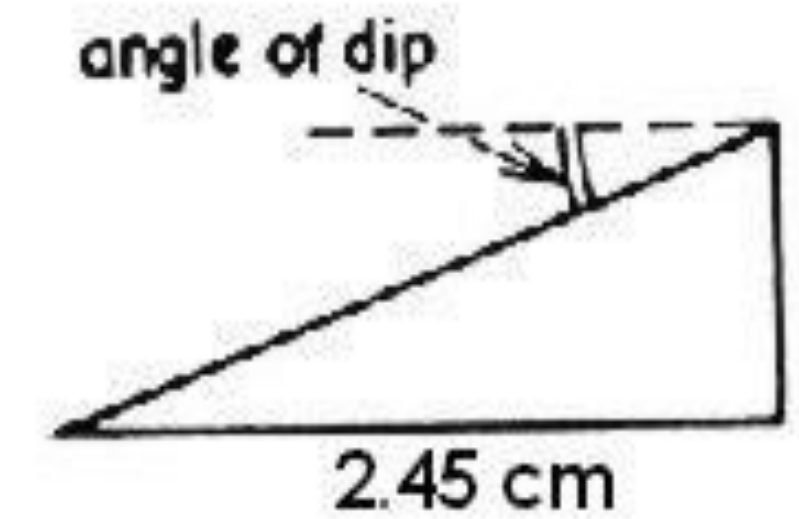
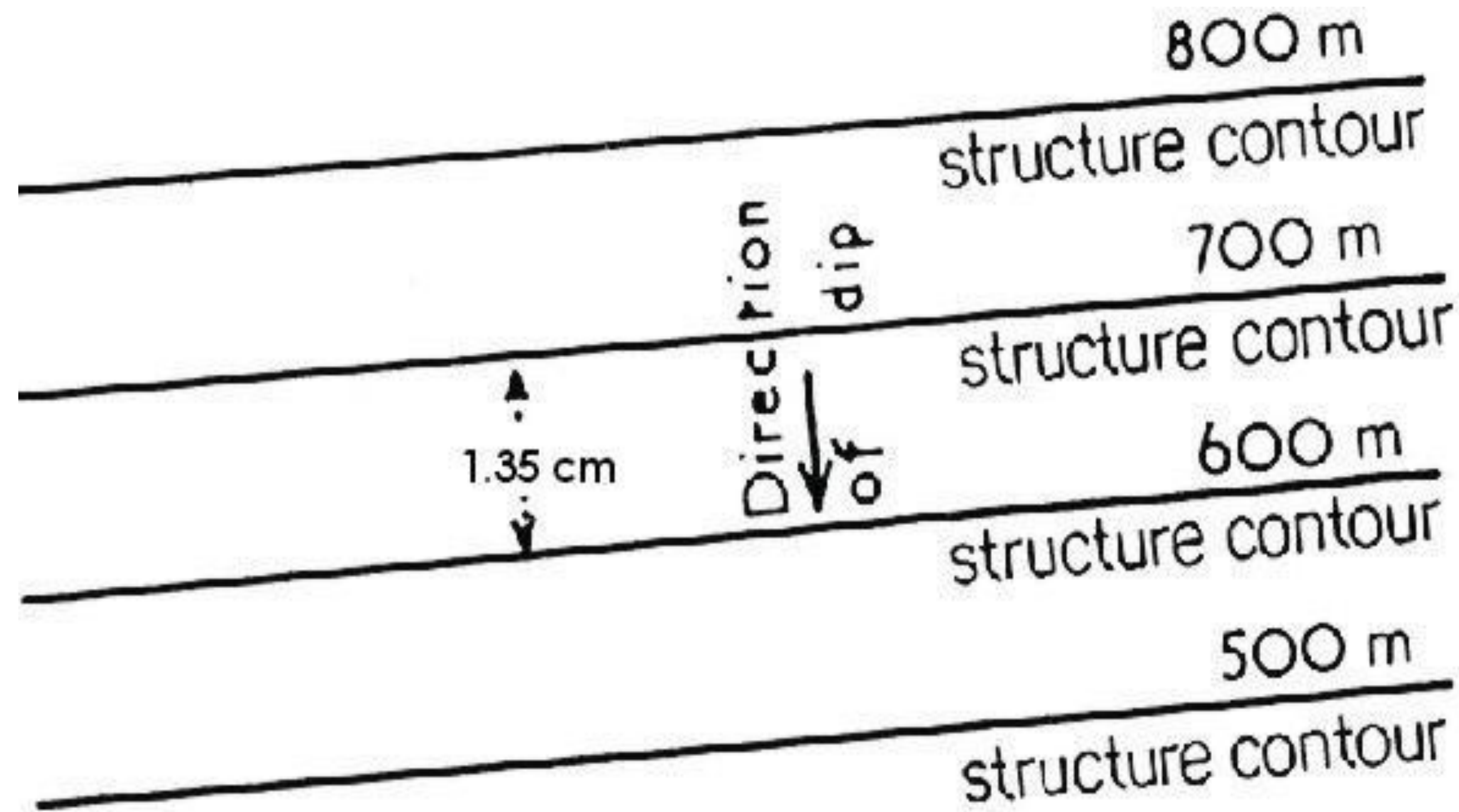
E.g., boundary between beds S and T in map cuts the 700 m contour @ 3 points. These points lie on the 700 m structure contour.

Since these maps portray simply inclined plane surfaces, *structure contours will be straight, parallel* and - if dips are constant - *equally spaced.*

Construction of Structure contours (Strike Lines).....contd.



Determination of Angle of Dip



Gradient = 700 m - 600 m in 'X' cm

i.e. = 100 m in 'X' cm.

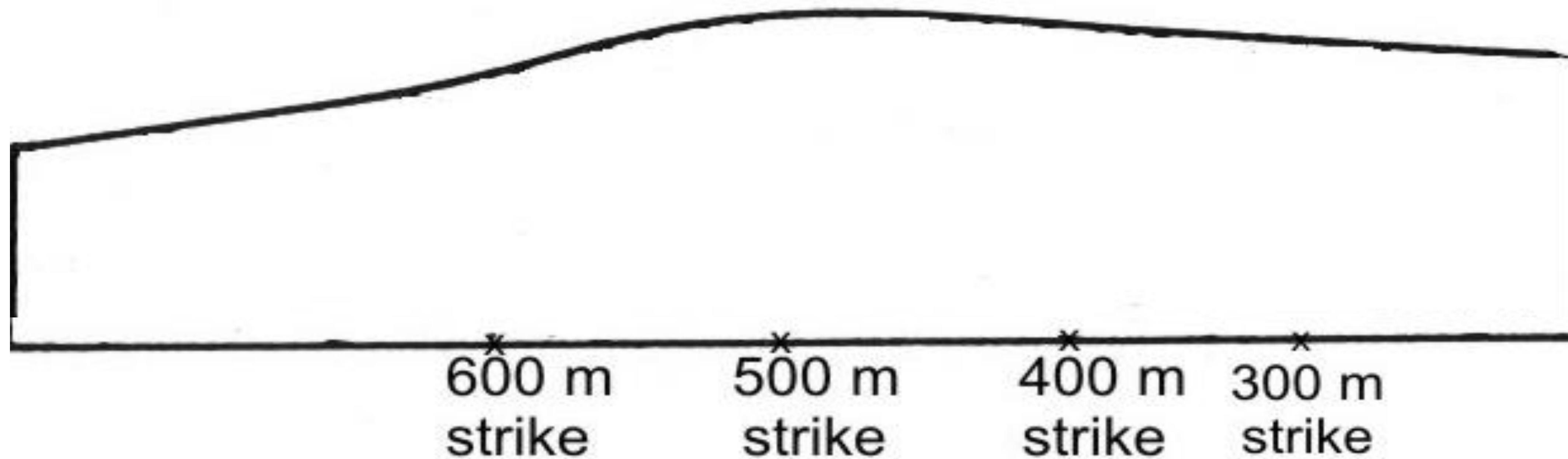
As the scale of the map is given as 'Y' cm = 500m, 'X' cm = 'Z' m

Hence, **the gradient is 100 in 'Z'.**

Section Drawing.....contd.

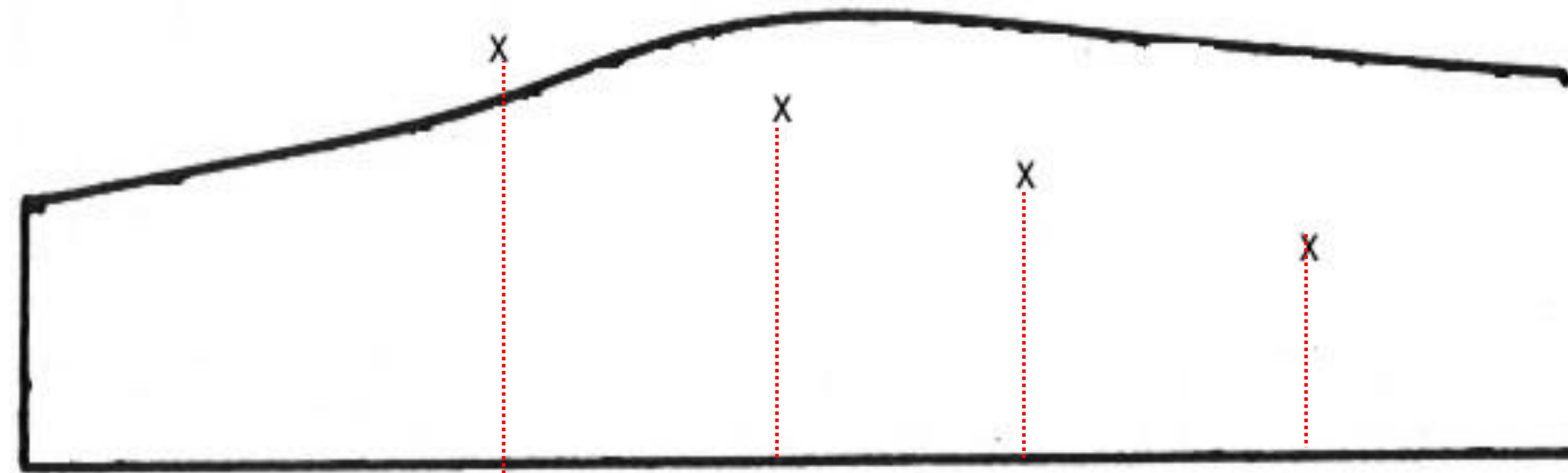
With topographic profile drawn.....

- Mark geological boundaries (interfaces) at points where they are crossed by section line:

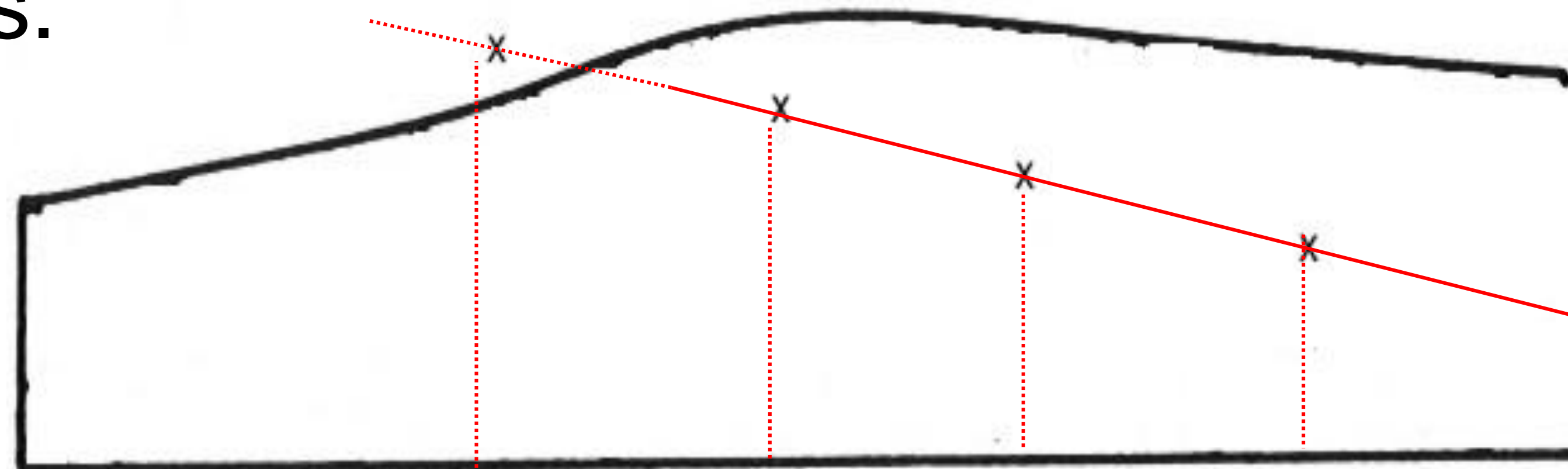


Section Drawing.....contd.

- Then draw perpendiculars from the base line, of length corresponding to the height of the structure contours.

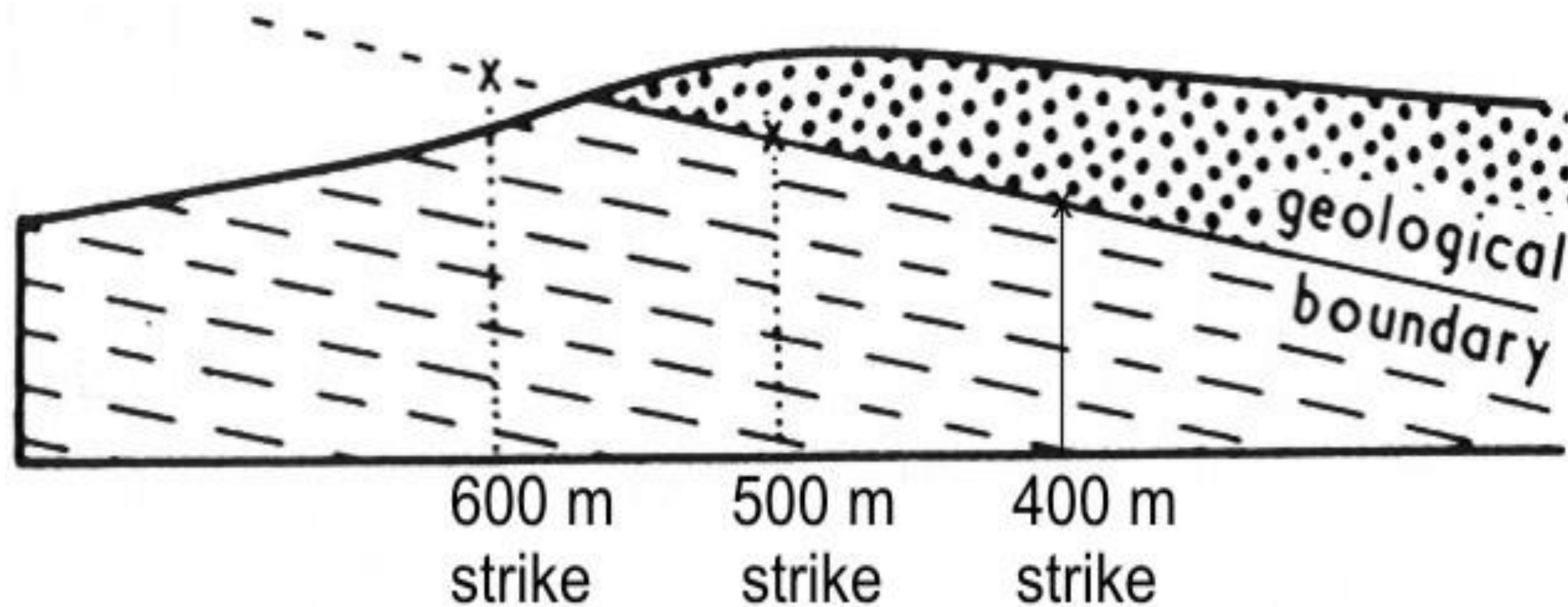


- Join the points above. This forms a geologic boundary at the angle of dip of the lithologies.



Section Drawing.....contd.

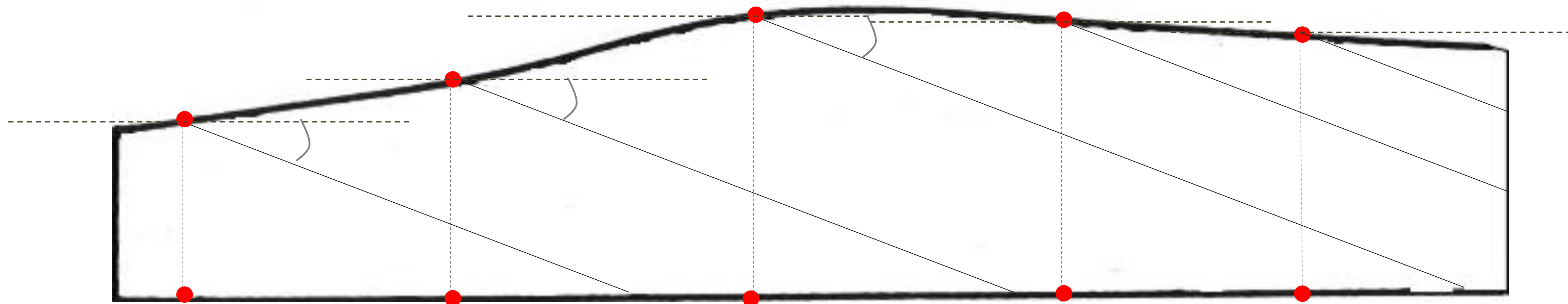
- Shading-in of the geology.....



Section Drawing.....contd.

Alternative method, and which might turn out to be simpler, is:

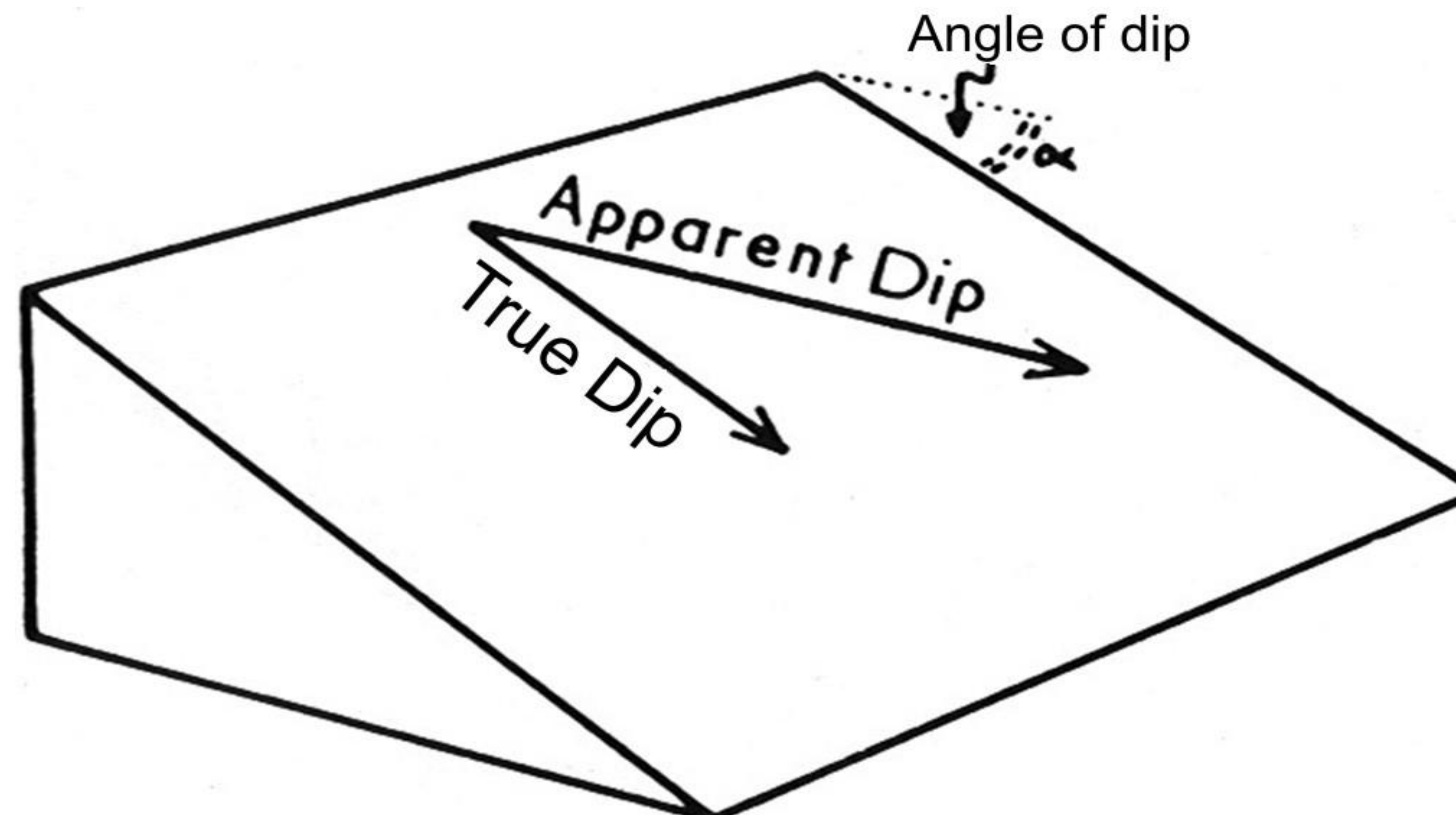
- Mark geological boundaries (interfaces) at points where they cross section line.
- Place these along section line and project them up to where they intersect topography.
- Using angle of dip calculated, slant geological boundaries accordingly.



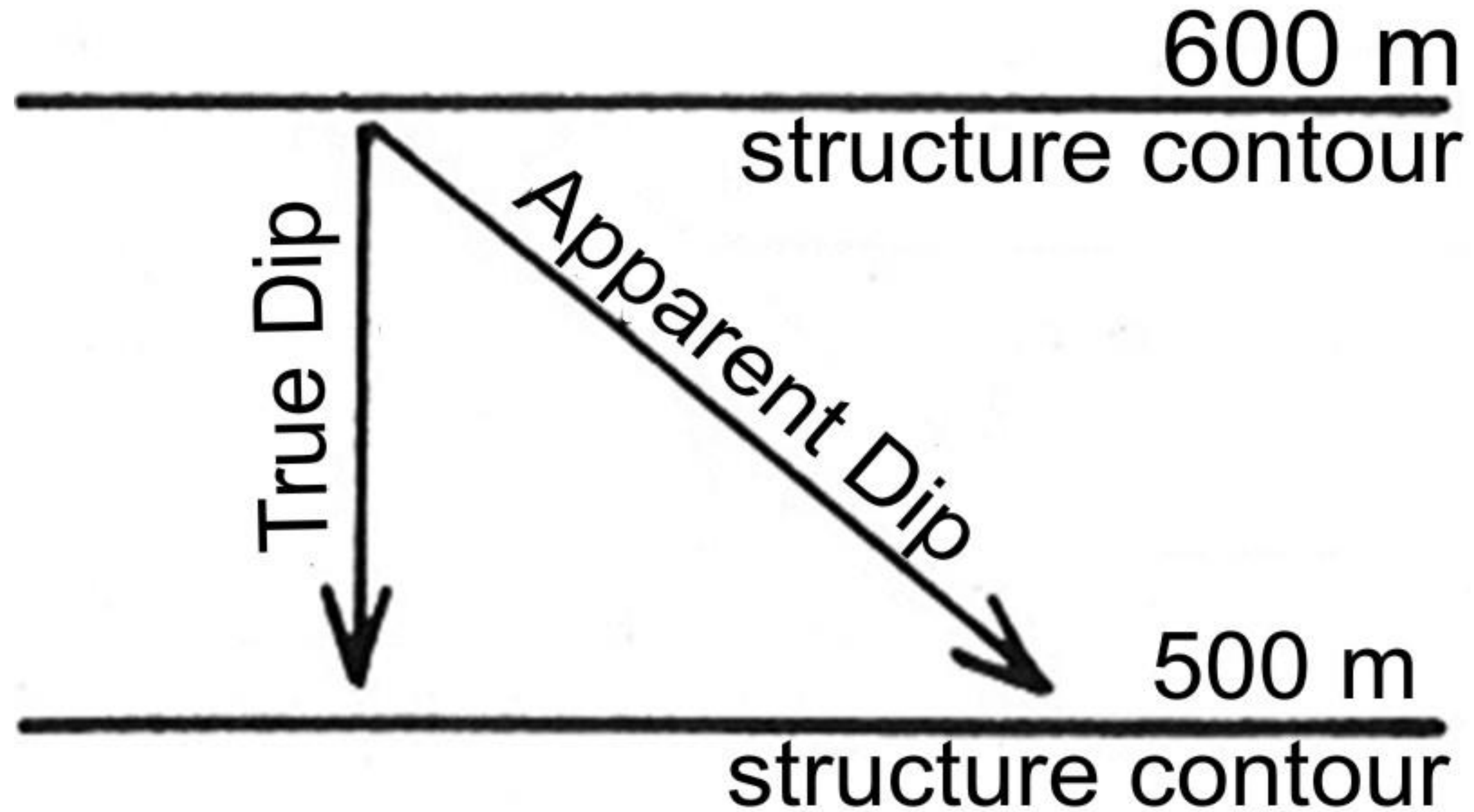
Determination of Apparent Dip

True and Apparent Dip

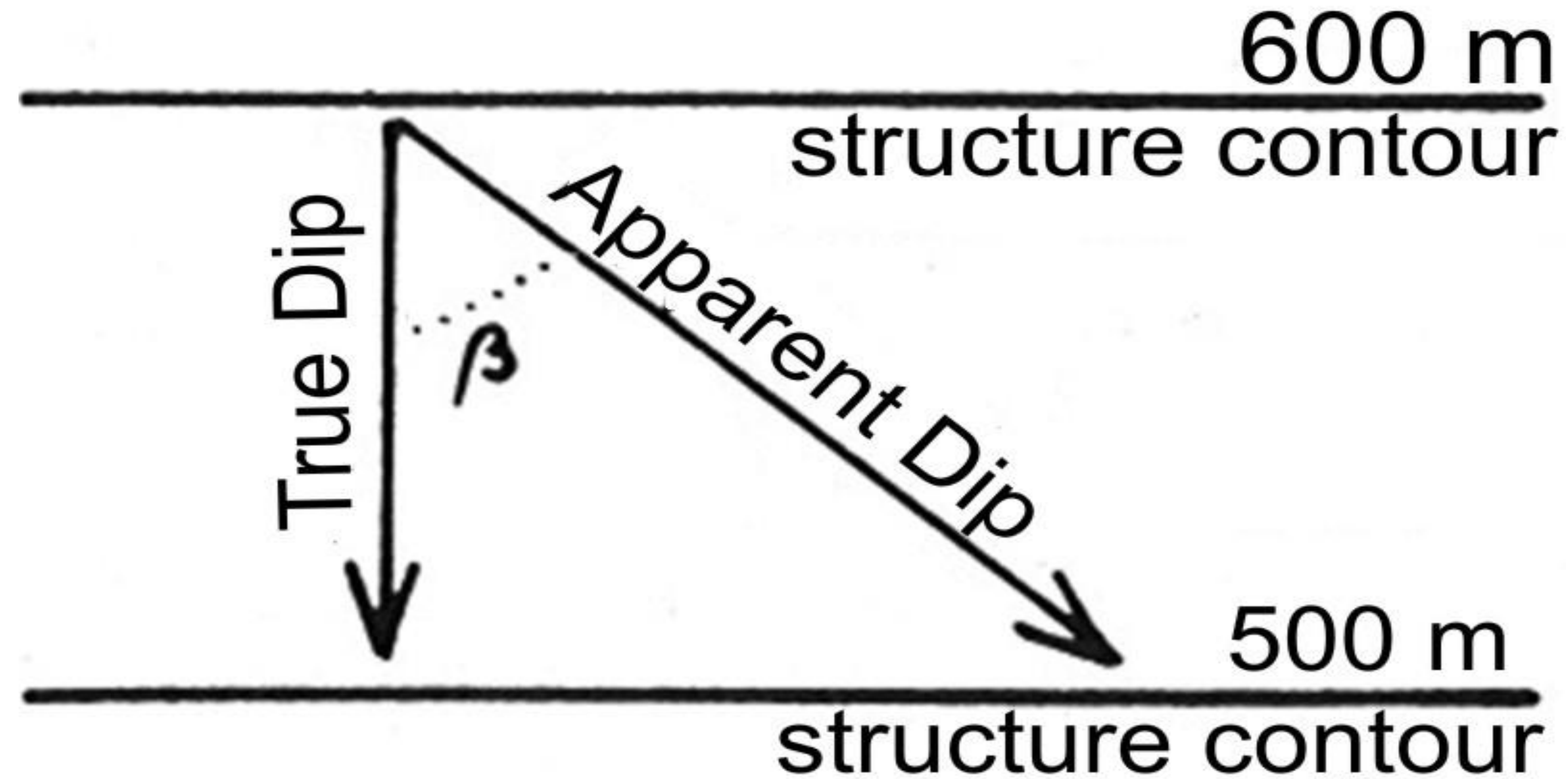
- If the slope of geological boundary is measured in any direction between strike direction and direction of maximum dip, angle of dip in that direction is known as an apparent dip.
- Its value will lie between 0° and value of maximum or true dip.



True and Apparent Dip.....contd.



True and Apparent Dip.....contd.



The trigonometrical relationship is given by:

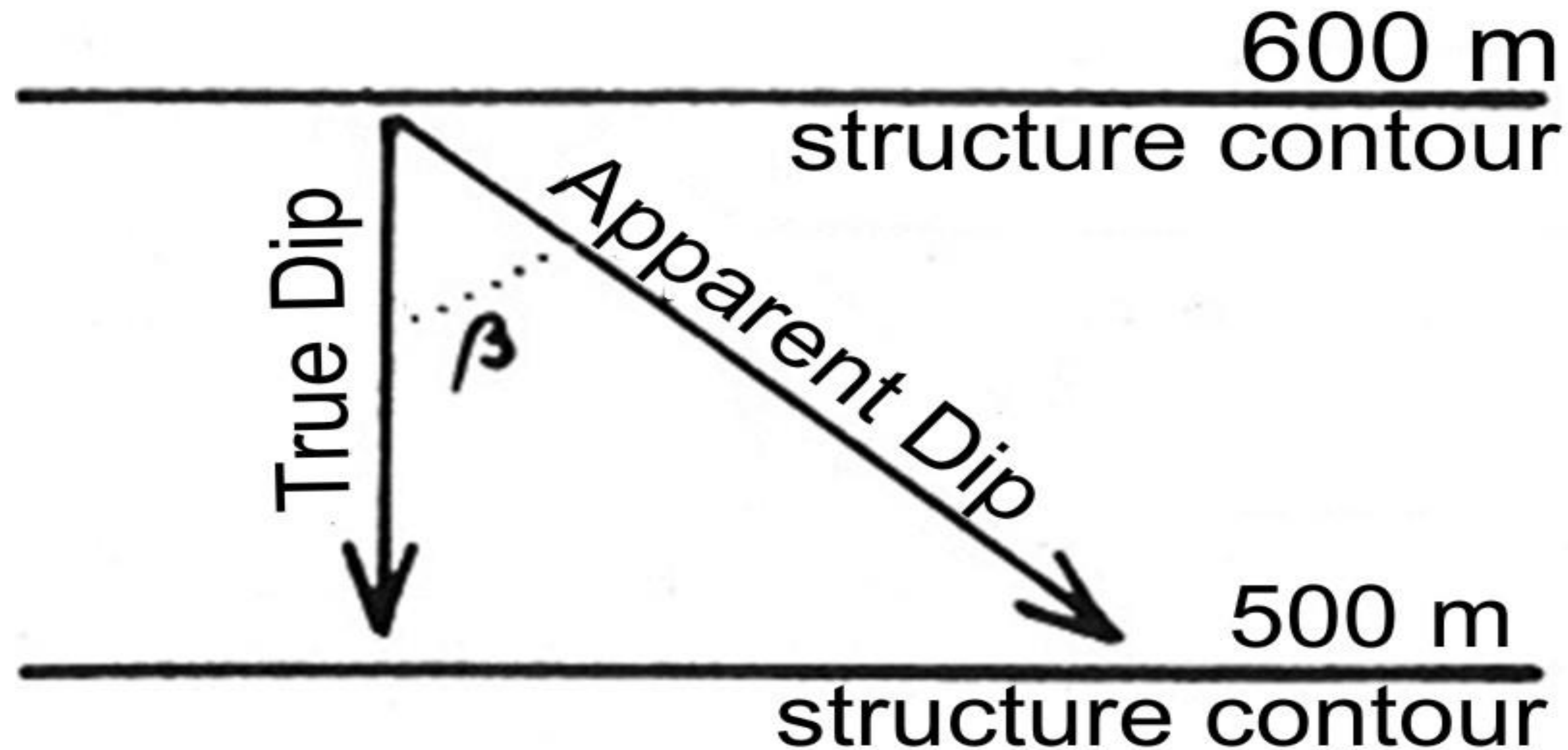
$$\text{Tangent AD} = \text{Tangent TD} \times \text{Cosine } \beta$$

$$\mathbf{\tan \alpha = \tan \theta \times \cos \beta}$$

where α = Apparent Dip, θ = True Dip and β = angular divergence between the two angles.

True and Apparent Dip....contd.

- Put differently, the gradient in the direction in which we wish to obtain the apparent dip is given by the structure contour spacing measured in that direction.



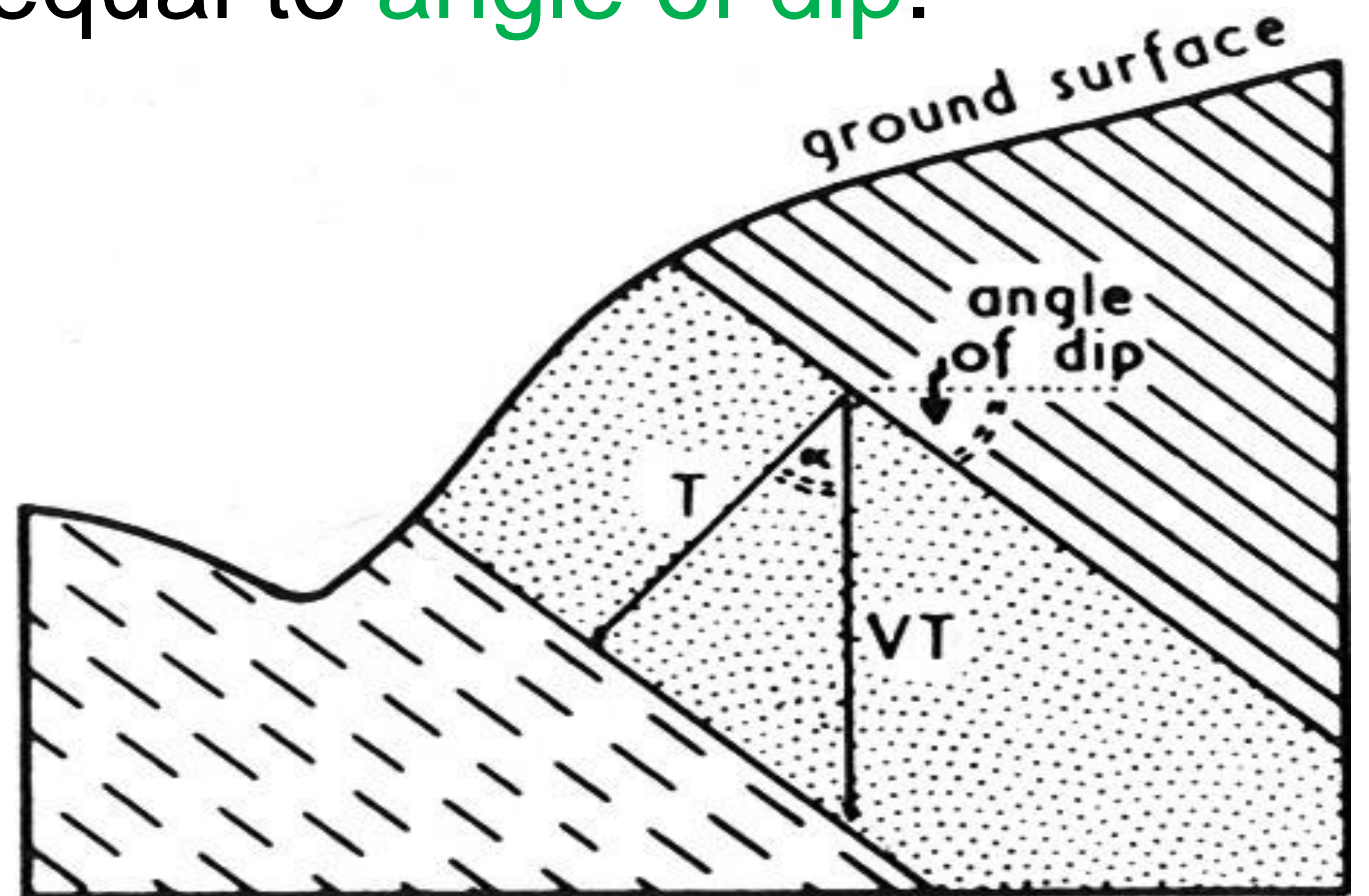
VERTICAL & TRUE THICKNESS

Vertical & True Thickness

- Since beds are inclined, **vertical thickness (VT)** penetrated by a borehole is greater than **true thickness (TT)** measured perpendicular to the geological boundaries.
- angle α between VT & TT is equal to **angle of dip**.

$$\text{Cosine } \alpha = \text{TT}/\text{VT}$$

$$\therefore \text{TT} = \text{VT} \times \text{Cosine } \alpha$$



vertical and True Thickness.....contd.

TT of a bed is equal to:

➤ vertical thickness multiplied by the cosine of the angle of dip.

Where dip is low ($<5^\circ$) cosine is high (over 0.99) and TT &

VT are approximately the same.

THREE-POINT PROBLEMS

Introduction

If the height of a bed is known @ three or more points, it is possible to:

- Find the direction of strike and
- Calculate the dip of the bed, provided dip is uniform.

THIS PRINCIPLE IS CALLED THE **THREE POINT PROBLEM**

This principle has many applications to mining, opencast and borehole problems encountered by applied geologists and engineers.

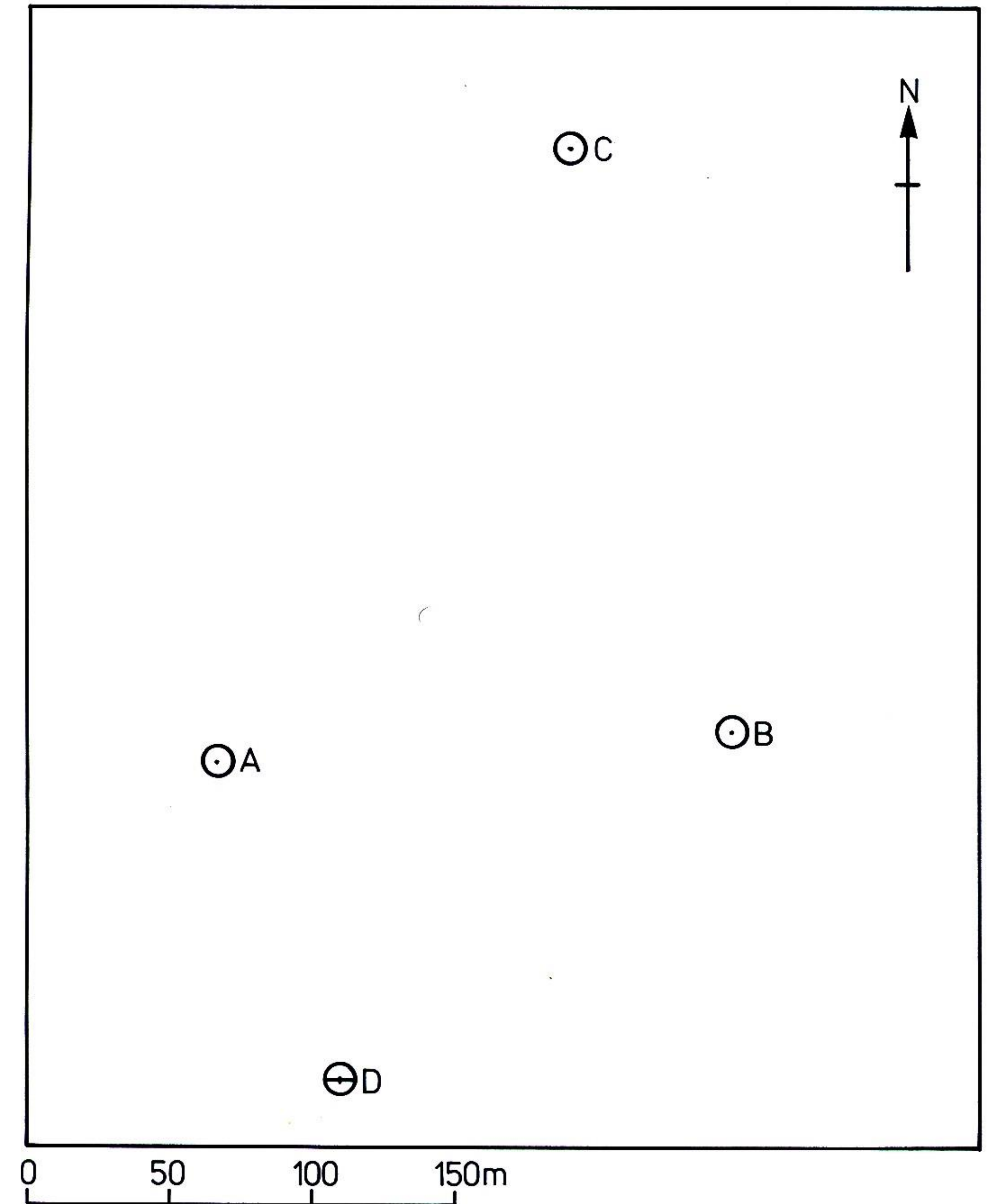
Exercise 3

Information

Map depicts a level land surface lying at an elevation of 30 m above sea level. Below the surface, a granite sill occurs, the top of which has been intersected in three boreholes, A, B and C, at depths of 40 m, 30 m and 15m, respectively.

Answer the following:

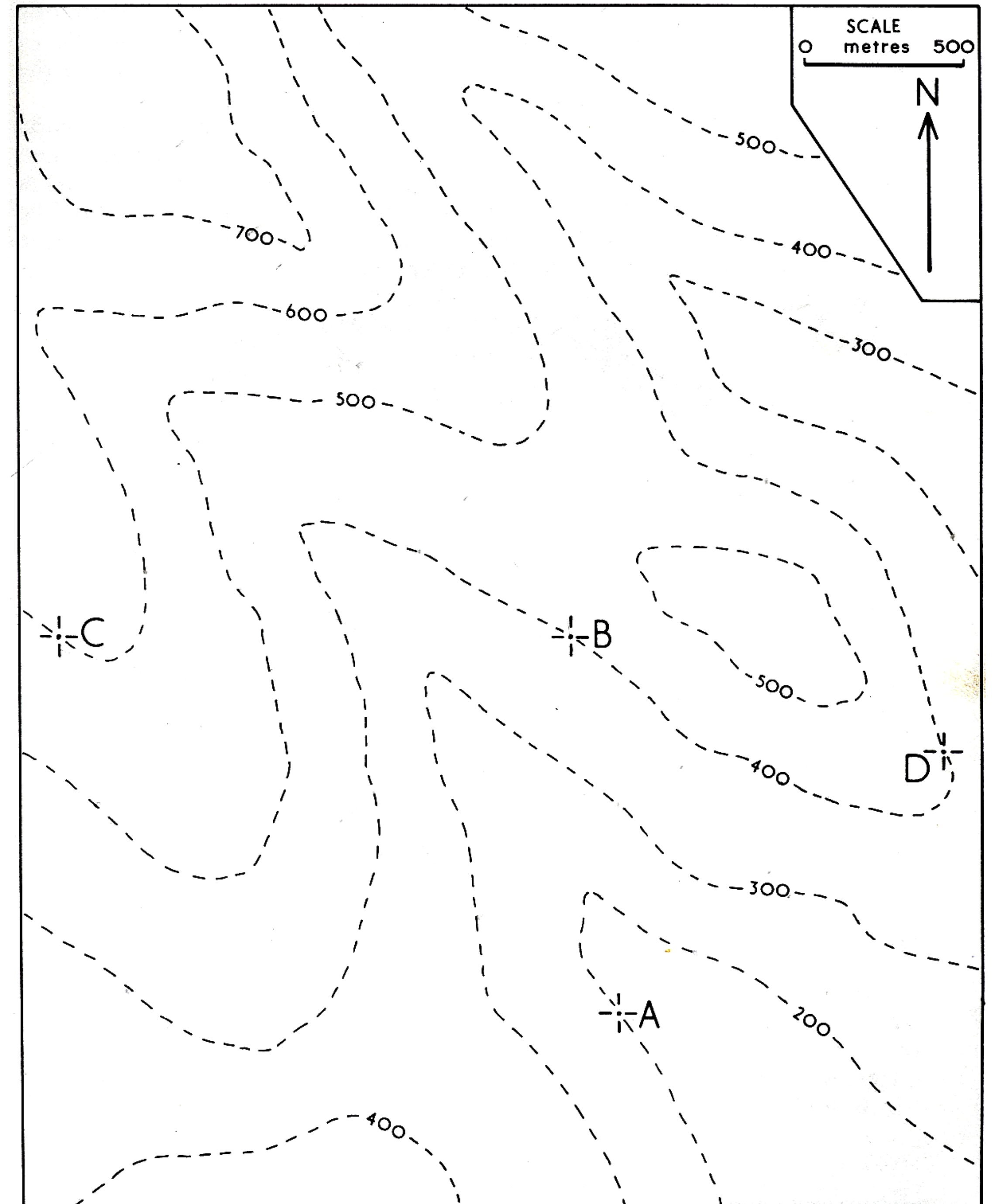
1. Assuming the sill to be planar, project onto the map contours on the sill (strike lines) above and below sea level, at 5m vertical intervals.
2. Determine the **magnitude** and **direction of true dip**.
3. Find the rate of apparent dip in the direction 270° (due west).
4. State at what depth the sill would be encountered in a shaft sunk at D.



Exercise 4

Granite sill is outcropping @ points A, B and C.

1. Deduce the dip and strike of granite sill
2. At what depth would the sill be encountered in a borehole sunk at point D?
3. Complete the outcrop pattern of the sill. (*Contours are in metres*)



Procedure to be followed to complete exercise

Observe heights of granite sill @ points A, B and C where it outcrops.

- a) Join highest point on the sill, C (600 m) to lowest point on the sill, A (200 m).
- b) Divide the line A-C into four equal parts (since $600\text{ m} - 200\text{ m} = 400\text{ m}$).
- c) As the slope of the sill is constant, we can find a point on AC where the sill is at a height of 400 m (the mid-point).
- d) We also know that the sill is at a height of 400 m at point B. A straight line drawn through these two points is the 400 m structure contour.

Procedure to be followed to complete exercise.....(2)

- e) We also know that the sill is at a height of 400 m at point B. A straight line drawn through these two points is the 400 m structure contour.
- f) On a simply dipping stratum, such as this, all structure contours are parallel.
- g) Construct the 200 m structure contour through point A, the 300 m, the 500 m and the 600 m structure contour - the latter through point C.
- h) Having now established both the direction and the spacing of the structure contours, complete the pattern over the whole of the map.

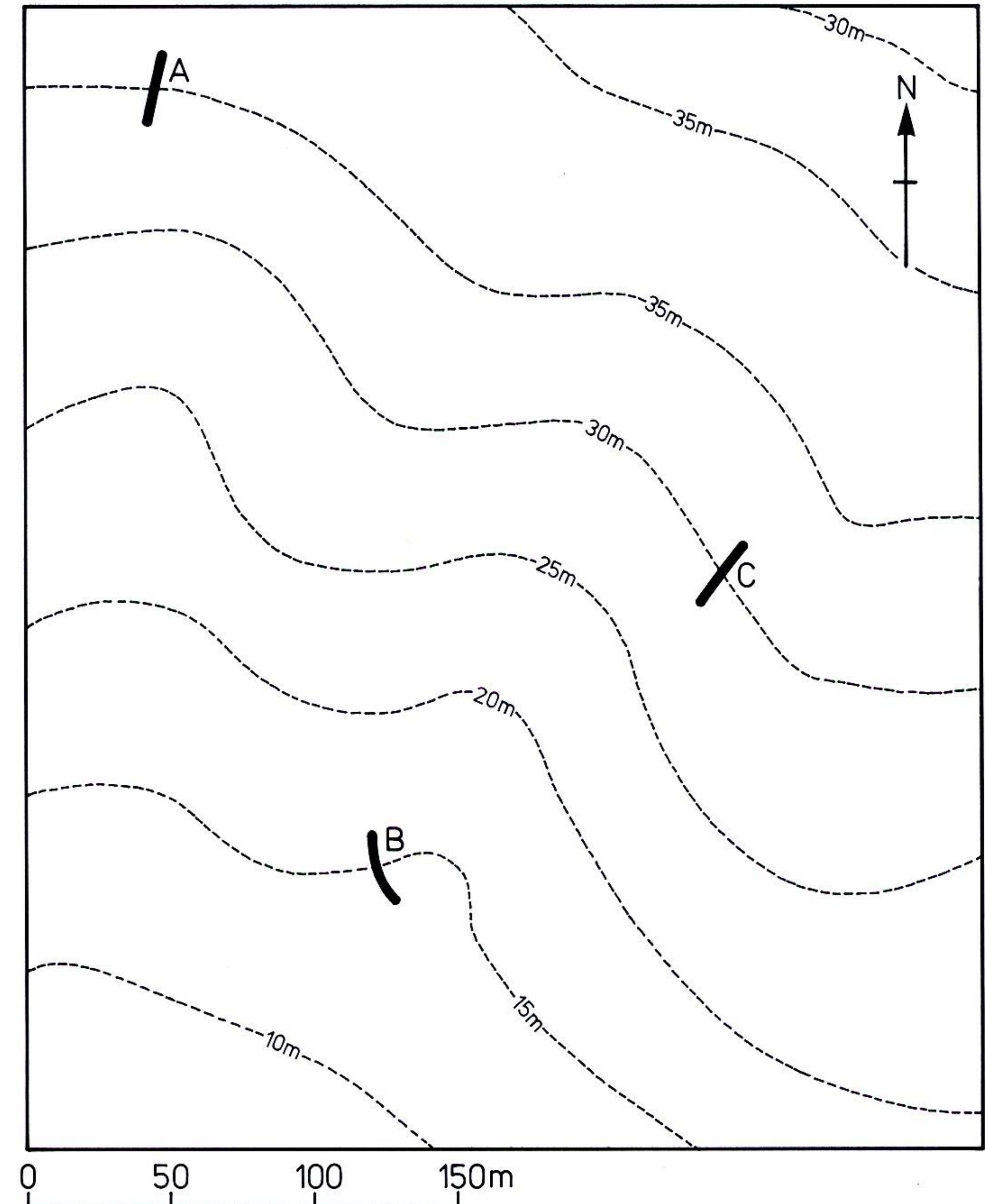
Exercise 5

Information

The Map depicts a land surface contoured at 5m intervals, with a granite body outcropping at A, B & C.

Answer the following:

- Indicate on the map the probable location of the remainder of the granite outcrop.
- Shade the area underlain by granite.



Exercise 6

Information

The Map above depicts a land surface contoured at 5m intervals on which the outcrop locations of three bed boundaries are marked; the base of a sandstone outcrops at A, the base of a limestone outcrops at B, and the base of a mudstone at C. Assume that between B and C only limestone is present and that only mudstone is present in the succession above C.

Answer the following:

Complete the outcrops of the bed boundaries.

Shade the lithologies as appropriate.

Note: The rate of true dip of the beds is 1 in 10 on a bearing of 210°.

