Quadrant II – Notes

Programme: **Bachelor of Science (Third Year)**

Subject: **Geology**

Paper Code: **(DSC) GEC-106**

Paper Title: **Structural Geology**

Unit: **Structural Geology I**

Module Name: **Folds Part 6**

Module No: **11**

Name of the Presenter: Raghav R Gadgil

Notes:

Determination of top of the beds by primary features:

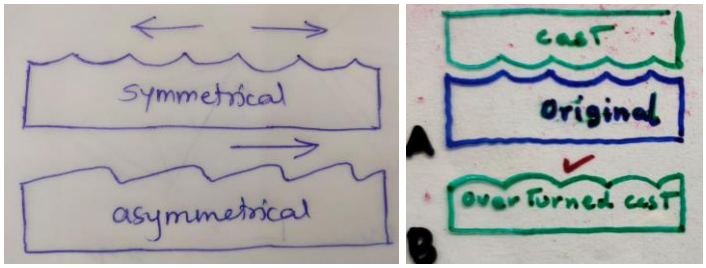
1. *Paleontological methods*:

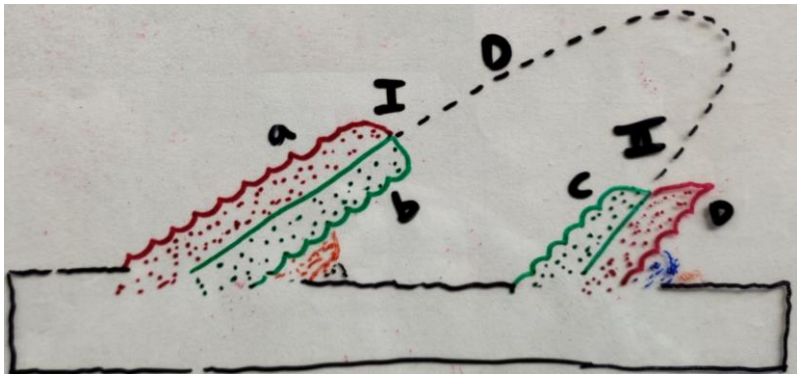
- These methods may be of great help in indicating whether beds are right-side-up or not.

2. *Ripple marks*:

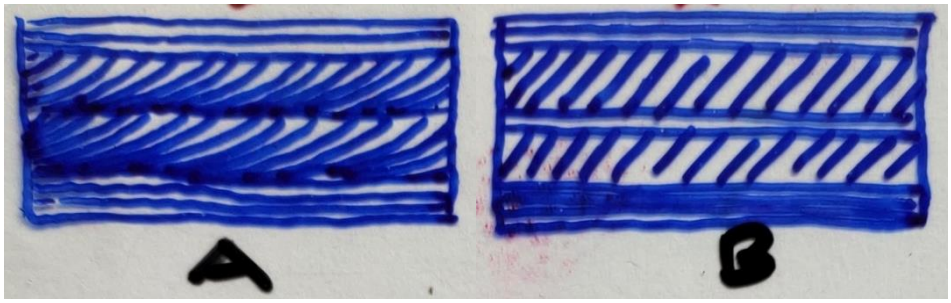
- Ripple marks may be aqueous or Aeolian in origin; i.e. ripple marks may form on the bottom of a body of water or, by wind action, at the surface of the earth.
- Ideally oscillation ripples in A are symmetrical and form in bodies of standing water.
- Either original ripple marks or its cast may be preserved.
- Current ripples (C) are asymmetrical and both the crest and trough are rounded. Here, the current moved from left to right.
- Either original ripple marks or its cast may be preserved.

- Current ripples cannot be used to determine top from bottom because an overturned current ripple has the same form as one that is right-side-up.
- Oscillation ripple marks can be readily used to tell whether a bed is right-side-up or overturned.
- The sharp crests point towards younger beds, whereas the rounded trough is convex toward the older beds. This is true whether a specimen is original or cast.



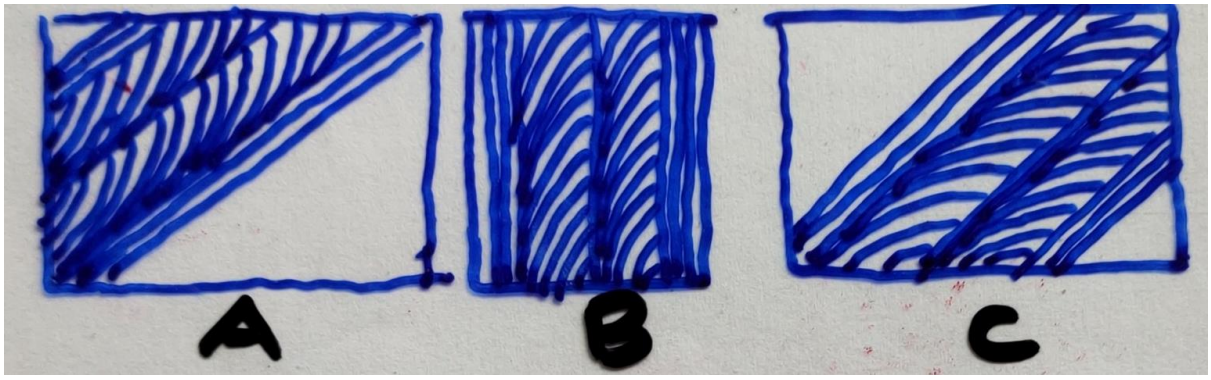


In the figure, the beds at outcrop I dip to the west. At *a* the original ripple marks are preserved; the crest point upward to the left, indicating that the beds are right-side-up. At *b* there is an overhanging cliff on which the casts of ripple marks are preserved; here, also, the crests point upward to the left, confirming the conclusion that the beds are right-side-up. At outcrop II, the beds dip to the west. On the sloping surface of the outcrop at *c* , the cast of ripple marks are preserved; the crests point downward to the right, indicating that the beds are overturned. On the face of the overhanging cliff at *d*, the originals are preserved, and again the crests point downward to the right. The inferred structure is indicated by a broken like.



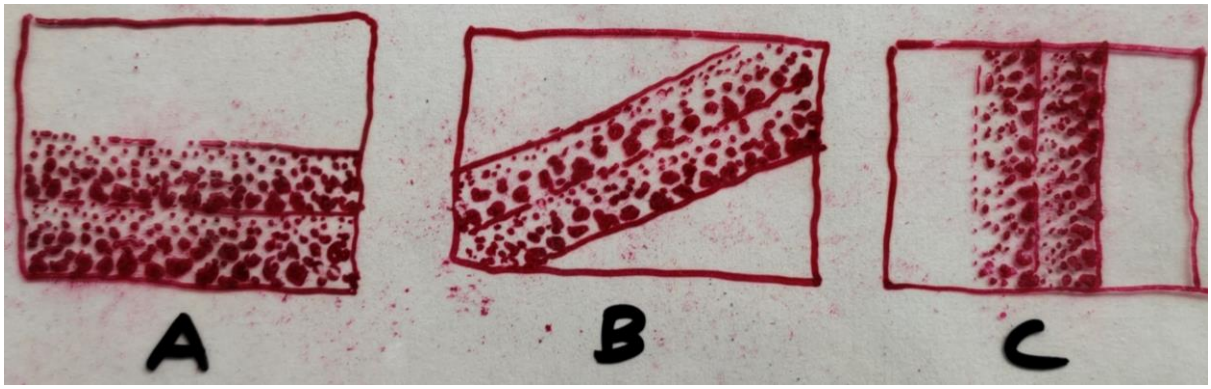
3. *Cross bedding:*

- Whereas the true bedding is horizontal, the cross-bedding is inclined at various angles.
- The upper extremity of each cross-bed is commonly inclined at a considerable angle to the true bedding, whereas the lower extremity is essentially parallel to the true bedding.
- The cross-beds are thus sharply truncated above and tangential to the true bedding below.
- The cross-beds in B are inclined to the true bedding at a considerable angle at both their upper and lower extremities.



3. Cross bedding:

- Thus in A the beds are right-side-up
- In B the top is to the right
- In C the beds are overturned

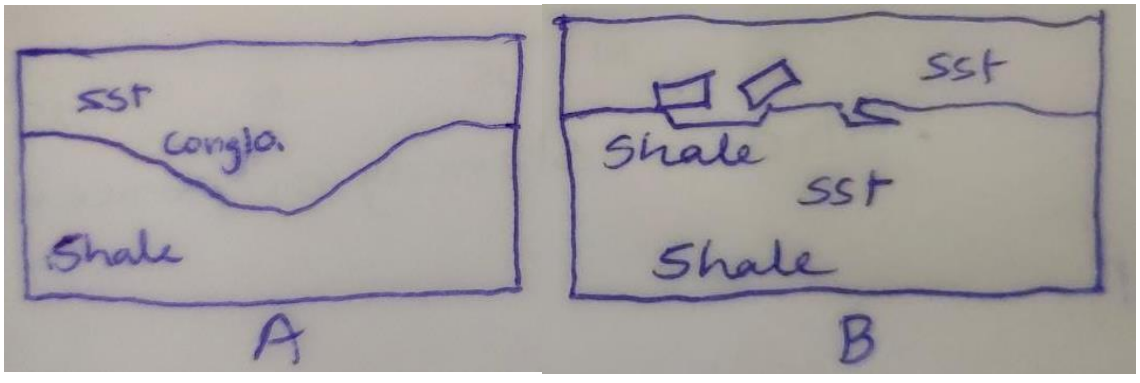


4. *Graded bedding:*

- The grains in a thin beds are progressively finer from bottom to top, a feature known as graded bedding (A).
- The materials comprising a sediment are transported when the currents are swifter than usual. As velocity subsides, the largest particles are dropped first, and then progressively finer particles are deposited.
- The method is more reliable in fine grained sediments but by no means infalliable.

5. *Sole marking:*

- These are casts on the underside of beds.
- The casts, generally composed of sandstone, are more readily preserved than the original, which are usually made in shale.
- The principal sole markings used in determining top and bottom of beds are load casts, groove casts, and flute casts.



6. *Local unconformities, channeling, and related features:*

- During the accumulation of sediments, particularly those laid down by rivers, erosion may alternate with deposition.

- In A, conglomerate occupies a channel in shale. After the original mud had been deposited, swiftly flowing streams in flood carved a channel. When the flood ws subsiding, or at some later time, gravel was deposited in the channel. The base of the conglomerate truncates the bedding of the shale.
- A sst lies on top of shale, the currents that transported the sand ripped up pieces of mud, fragments of which are preserved in shale in the sst.

6. *Local unconformities, channeling, and related features:*

- In the beds dip to the west
- All the evidences at *a, b and c* indicate the beds are overturned.
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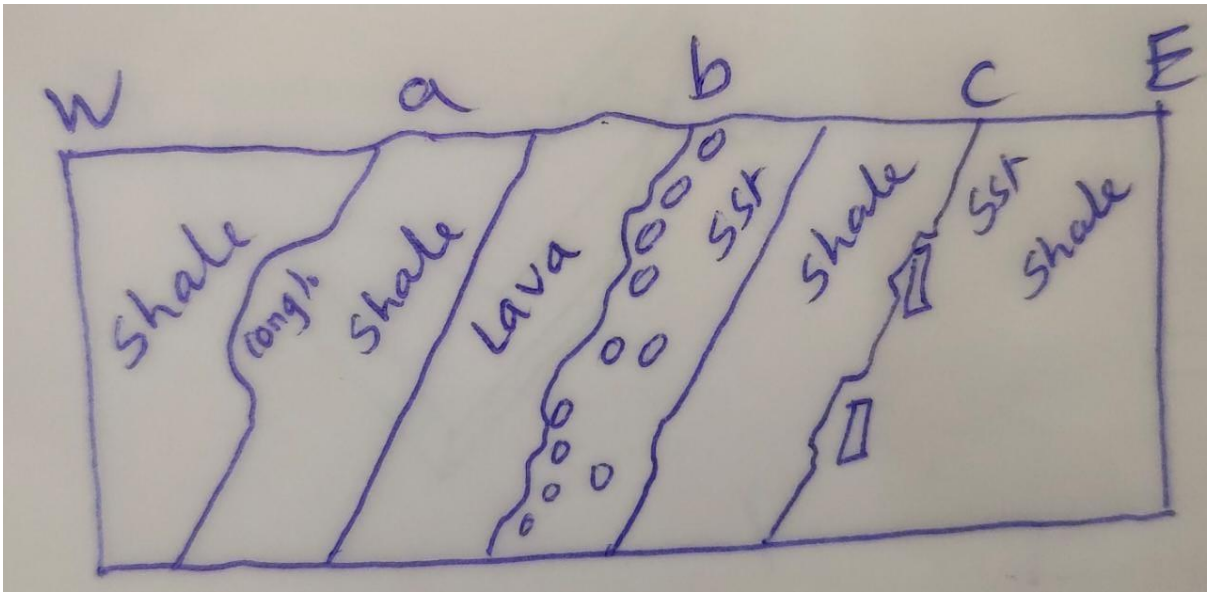
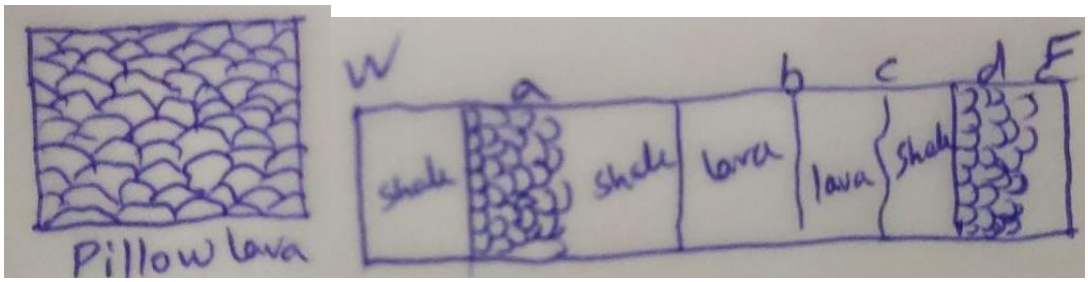


7. *Pillow structure:*

Individual pillows are ellipsoidal and the tops and bottoms of the pillows are generally convex upward. Gas bubbles, when present, tend to concentrate at the top of flows.



Determination of top of the beds by secondary features
Drag folds and their relation to major folds

These are those folds that develop in an incompetent bed lying between two competent beds that shear past one another.

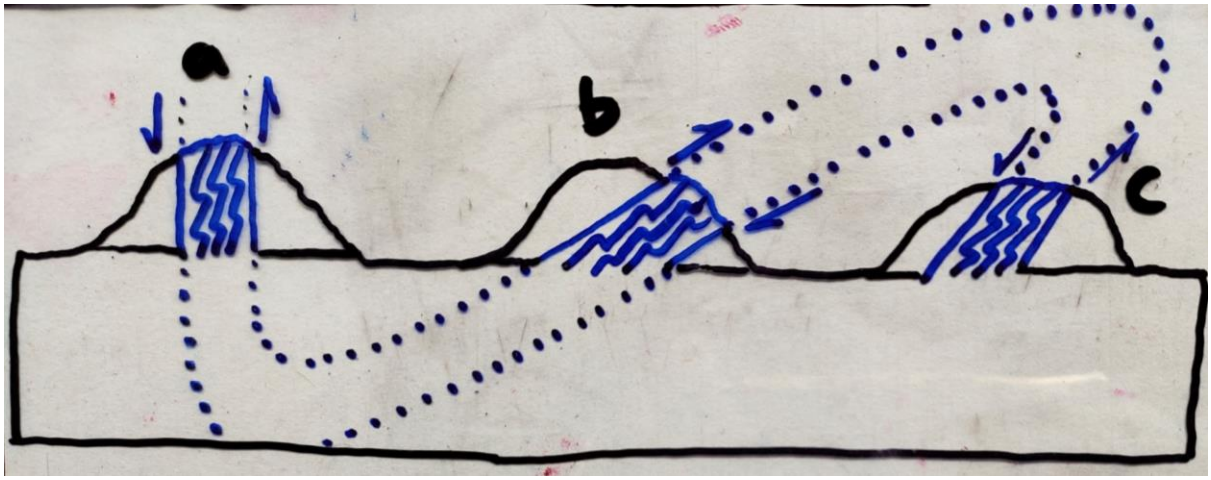
But drag folds may form beneath an overthrust block or in a layer of mud over which other layers of mud slide.

In broader sense, drag folds are minor folds genetically associated with major folds.

Ideally, the drag folds are systematically related to the contemporaneous major folds.

The upper beds slide away from the synclinal axes relative to the lower beds, as shown by arrows.

The acute angles between the axial planes of the drag folds and the more competent bed point in the direction of differential movement.



In this example it is assumed that the major folds plunge at a low angle.

At *a* the strata are vertical and the drag folds show that the beds slipped past each other in the manner indicated by the arrows.

The synclinal axis must lie to the east.

The beds at *b* dip to the west, and the drag folds show that the bed to the left moved upward relative to the bed to the right; the synclinal axis must lie to the west, and the strata are right-side-up.

At *c* the beds also dip to the west, but the drag folds reveal that the beds to the right moved upward relative to the beds to the left.

The synclinal axis must lie to the left.

Assuming that the beds at *a, b and c* are the same, the probable structure is indicated by the broken lines.