2 Barmouth

There are many excellent rock outcrops in and around Barmouth. The bedding dips steeply east, and a traverse in this direction crosses the full succession between the Rhinog and Maentwrog formations. This particular excursion, which follows a popular footpath from St John's Church to Panorama Hill and back into Barmouth along the coast road, is confined to the Harlech Grits Group. However, it may be extended to include the Panorama Walk (p. 53) along which there are good exposures of the lower part of the Mawddach Group. Both this and the Panorama Walk can be accomplished in half a day. The route, in all about 3.5 km long and rising from sea level to over 90 m OD, starts at St John's Church [SH 6128 1590], which overlooks the centre of the town (Figure 8). There is only limited parking space near the church and it is advisable to use one of the car parks in the town.

Locality 1 The church stands on a platform cut into the Hafotty Formation. Lithologies typical of the lowest part of this formation are exposed in the rock-face behind the church.

The lowest beds, exposed just above a bend in the road, are pale grey parallel- and cross-laminated siltstone alternating with non-laminated darker grey siltstone. Several thin resistant beds of pale grey pyritic fine-grained sandstone or coarse siltstone stand out on the weathered surfaces. Some of these show grading and load casts at the base. The siltstone contains scattered lenses and nodules of manganese garnet (spessartine), and the weathered surfaces show a characteristic purplish brown patina with small pits where the manganiferous nodules have weathered out. Higher up the slope an overgrown adit has been cut into a quartz vein which strikes at about 30° and is exposed in the hillside at 'Dripping Well'. Beyond the adit a number of thick greywacke beds are exposed. They form the hanging wall of the manganese ore-bed, and persist for a considerable distance to the north. At St John's Church about four beds are exposed and they illustrate clearly the bedding features of coarse turbidites. The 'ideal' turbidite consists of five intervals (shown in (Figure 9)), and is collectively referred to as the 'Bouma-cycle'. The beds here show most of the intervals.

They are up to about 60 cm thick (Figure 10), have sharp erosional bases, and show well-defined graded bedding from a coarse pebbly base to a finer-grained sandy top. Most of the beds have large fragments of siltstone incorporated near the top.

The greywacke beds are overlain by interbedded grey to greenish grey siltstone and mudstone and fine-grained sandstone with rare, fine- to medium-grained greywacke beds. The siltstone and mudstone are alternately evenly laminated, cross-laminated and massive. One 26 cm-thick greywacke bed shows all the turbidite intervals except the upper laminated one. The base of the bed, though sharp, displays large bulbous lobes and flames of the underlying sediment, caused by differential loading when the sediments were water saturated.

From here, return downhill to the bend in the road, and take a tarmac path which climbs steeply northwards up the hill. At the top of the hill the route follows the path leading off to the right. The next locality is at the junction of two paths. This is a good vantage point to view the Mawddach estuary, Fairbourne, built on a sand bar which reaches almost across the mouth of the river, and Pen y Garn, the westernmost peak of the Cader Idris range. Slate tips near Arthog across the estuary to the east mark the site of old quarries in the upper Cambrian slates.

Locality 2 [SH 61187 16054] Here, coarse-grained greywacke of the Rhinog Formation, in beds up to 2.3 m thick, contains pebbles of quartz up to 8 mm long. Some beds show the full range of turbidite features described above (Figure 9). In addition, some of the thicker beds show multiple and reverse grading. The most common combination of bedding units here is ae.

Locality 3 [SH 6125 1605] A few metres to the north-east, the footpath passes back on to the Hafotty Formation, and a small trial pit marks the position of the ore-bed underlying the greywacke. Typically, the ore-bed is thinly laminated and superficially stained with a purplish brown residue from the weathering of the manganese minerals. It consists mainly of spessartine with some rhodochrosite, quartz, albite and chlorite (Woodland, 1939). Glasby (1974) suggested that it formed as a gel at the water/sediment interface in a shallow marine basin, initially as rhodochrosite, but was regionally metamorphosed to spessartine.

A short detour along the footpath to Locality 3a [SH 6125 1609] shows one of the adits where the ore-bed was worked.

Locality 4 'Dripping Well' [SH 61297 16006] This is an old adit into the quartz vein, first encountered at the church, which was exploited for copper and lead minerals. The adit is flooded and has been partially fronted with a low wall. The thick quartz vein is exposed near the adit, but the adjacent siltstones are permeated with thinner veins.

Following the path to the SSE, there are numerous exposures in the Hafotty Formation. The path leads along the back of Barmouth. The siltstone is well cleaved near a bench [SH 6154 1574] provided by the National Trust.

Locality 5 [SH 6155 1577] Where the path passes through the wall, a number of thick, coarser-grained, quartz-veined greywacke beds near the top of the Hafotty Formation are exposed. Both *abe* and *ae* intervals are apparent. Through the gate the greywacke beds pass to the east into siltstone.

Locality 6 [SH 6156 1569] At this exposure the argillaceous rocks of the Hafotty Formation are overlain by a thick unit of very coarse-grained, pebbly quartzose greywacke beds at the base of the Barmouth Formation. Several beds contain large clasts of siltstone, up to 15 cm long, near the top of the graded division. The lowest bed, 40 cm thick, shows the ideal 'Bouma cycle' (Figure 11). There is a well developed intersection lineation between cleavage and bedding on some bedding surfaces. The turbidites in this formation are similar to those in the Rhinog Formation and looking to the southeast, across a wall, they can be seen forming craggy knolls that contrast with the even surface of the softer weathering shales of the underlying Hafotty Formation on the hillside to the north-west. There is little intercalated mudstone or siltstone in this formation but, moving ENE to a hollow [SH 6162 1598], there are some outcrops of banded siltstone and fine-grained sandstone similar to those of the Hafotty Formation. The turbidites in this general area show minor channelling at the base of some beds and multiple grading. In addition, a number of intercalated conglomeratic horizons occur with cobbles of quartzite up to 26 mm long. In places the conglomerate occurs as discrete beds about 5 cm thick; in others it is contained within the graded division.

Locality 7 about [SH 6174 1572] The Barmouth Formation is overlain by thinly bedded siltstone, mudstone and fine-grained sandstone of the Gamlan Formation. The beds, 2 to 3 cm thick, are accentuated by parallel- and cross-lamination as well as colour banding. In this exposure the cross-lamination indicates derivation from the east. Also a 20 cm-thick bed shows asymmetric convolute-laminations.

Passing eastwards up the succession, some sparsely distributed beds of graded greywackes (1 to 9 cm thick, but rarely up to 1.10 m), interbedded with the siltstone, are exposed.

Locality 8 [SH 6195 1595] Opposite a five-barred gate leading downhill to Cae-Fadog, the upper part of the Gamlan Formation is exposed consisting of much finer-grained grey siltstones and purple-weathered mudstone. Careful inspection of this and adjacent exposures shows sparse, pale grey tuffaceous beds up to about 2 cm thick.

The path continues past Gorllwyn-Fach and joins the public road which leads back to Barmouth or to Panorama Hill.

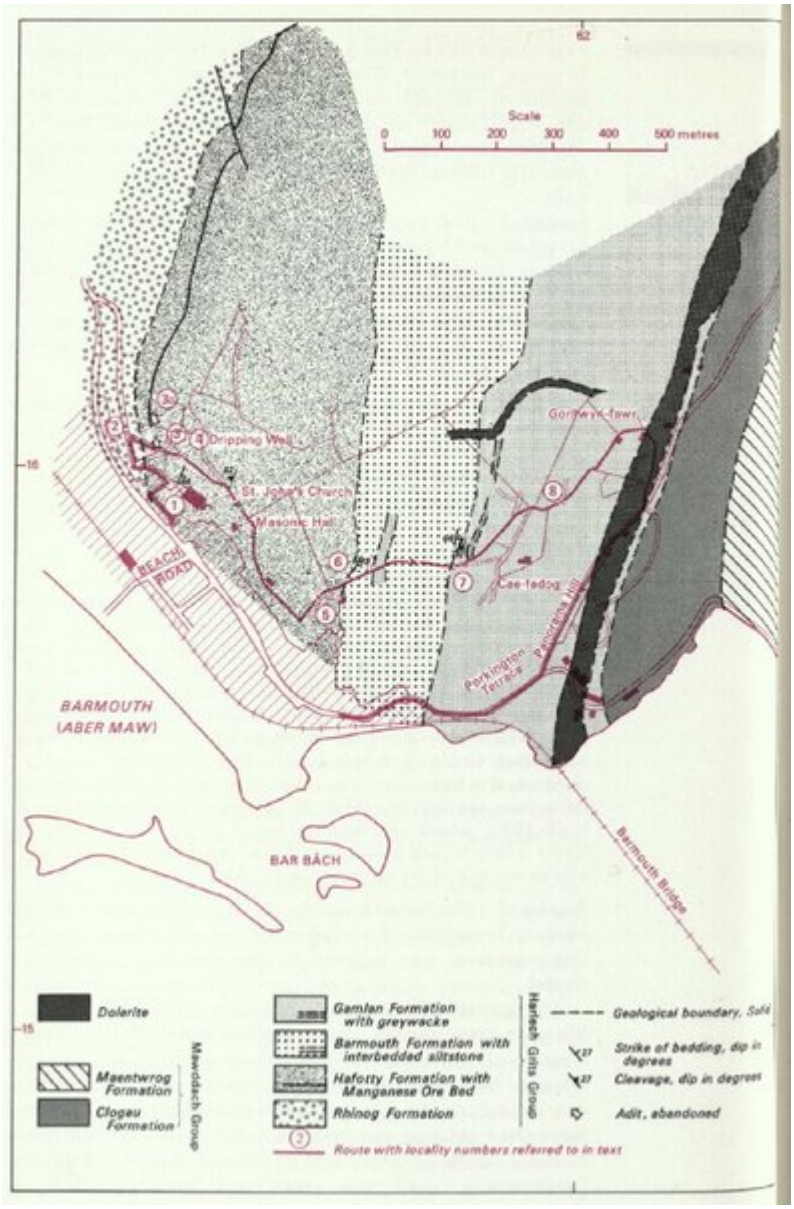
(Figure 46) Simple grading with large clasts on top.

(Figure 47) Multiple grading.

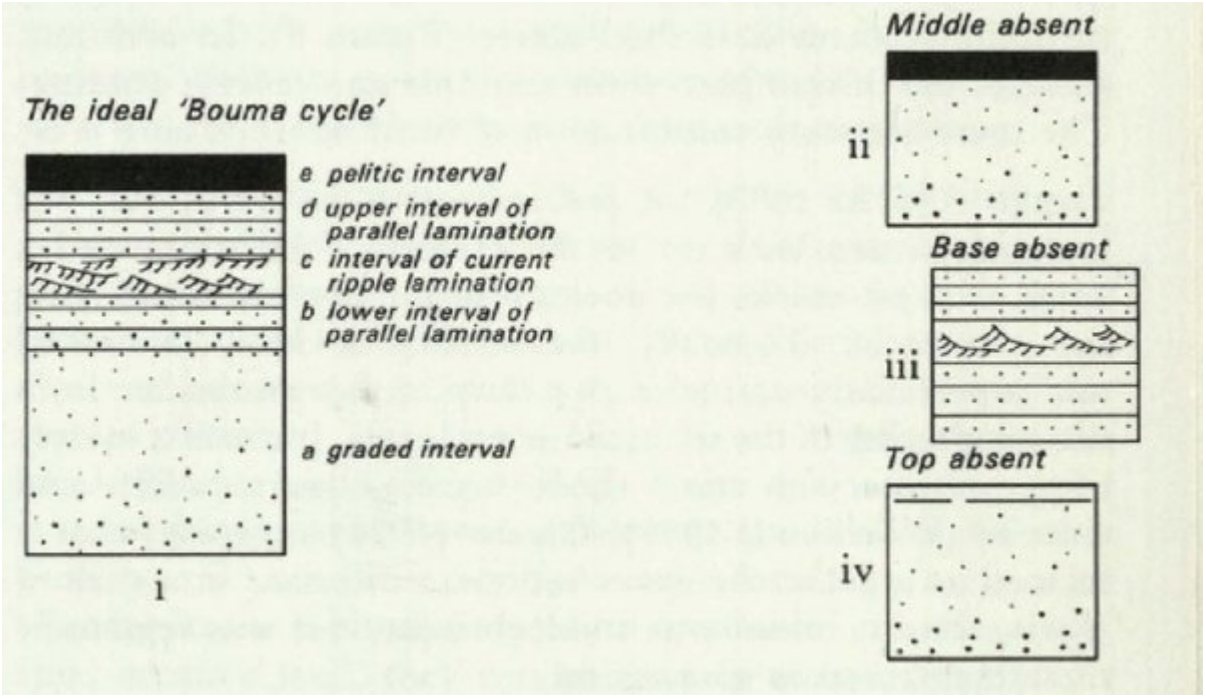
(Figure 48) Inverted grading at tops of bed (grains have migrated to area of minimum shear).

(Figure 49) Channel formed base of turbidite bed by current erosion.

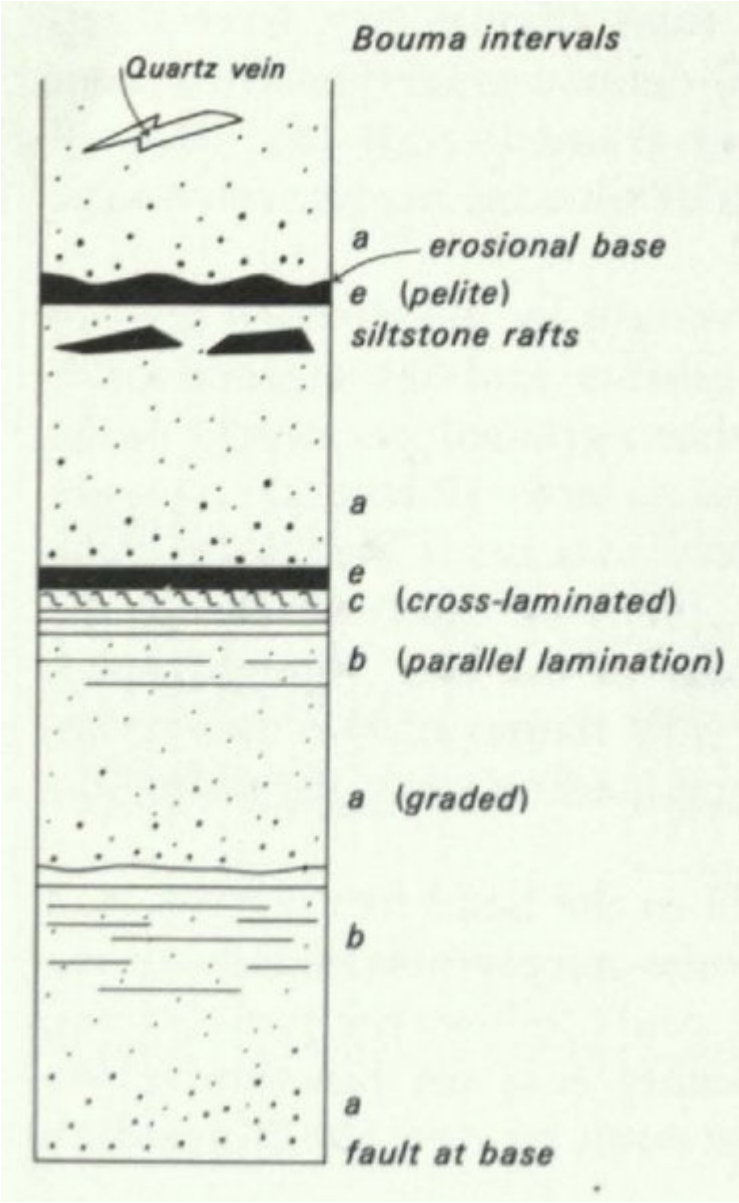
References



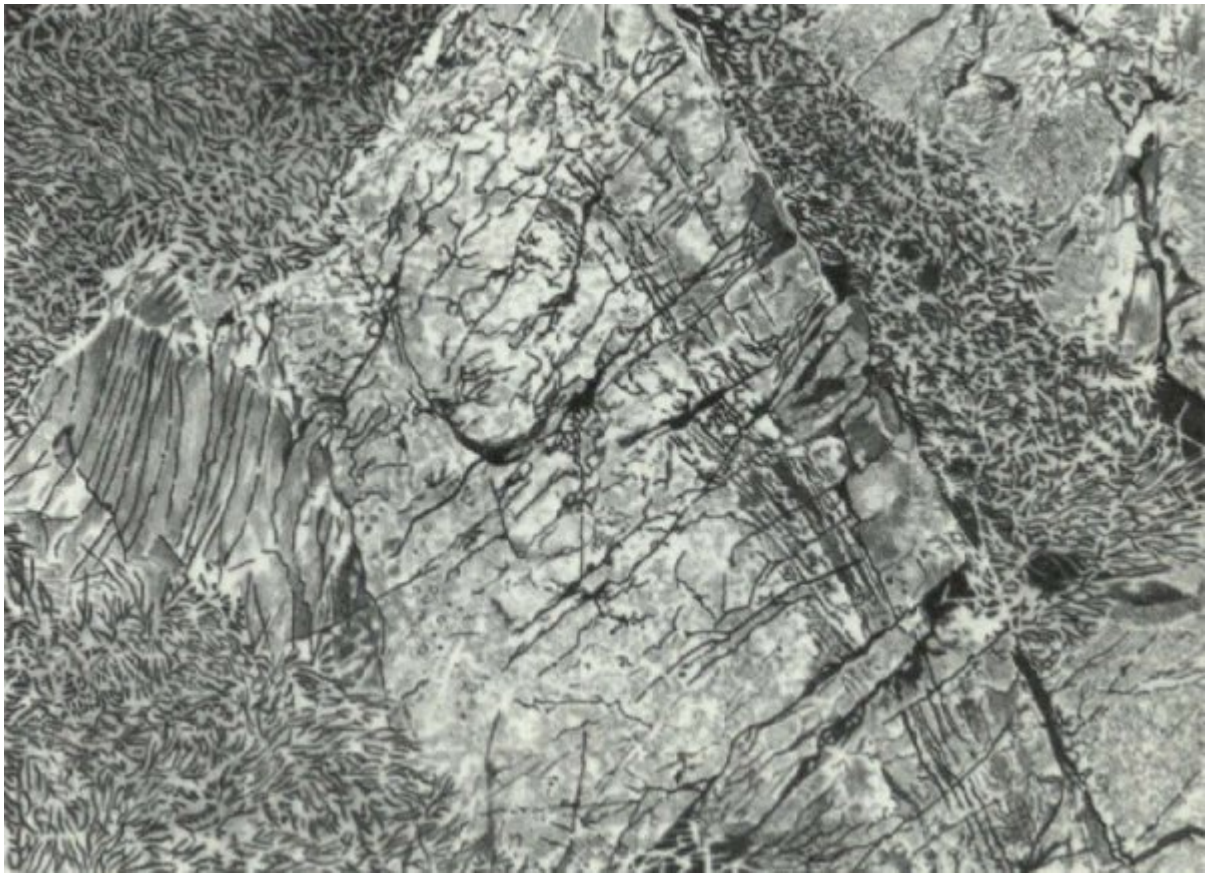
(Figure 8) Geology of the Barmouth area and excursion route No. 2.



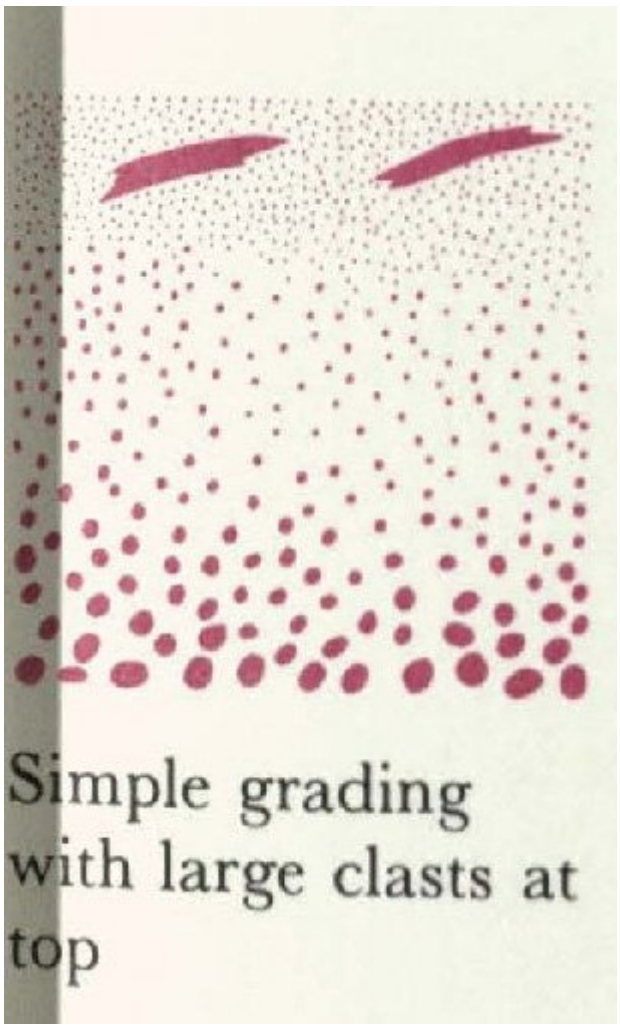
(Figure 9) Internal features of turbidites Superficially, turbidite may appear as a monotonous sequence of greenish grey greywackes bed but in detail there is much variation within individual bed . This has been described by a number of author but is now often referred to as the 'Bouma-cycle'. The 'ideal' sequence (i) consists of five intervals labelled a, b c, d , e. Numerous combination of these are possible and some of the most common seen in the Harlech area are shown in (ii to iv).



(Figure 10) Diagrammatic section of turbidite beds above the manganese ore-bed at St John's Church, Barmouth.

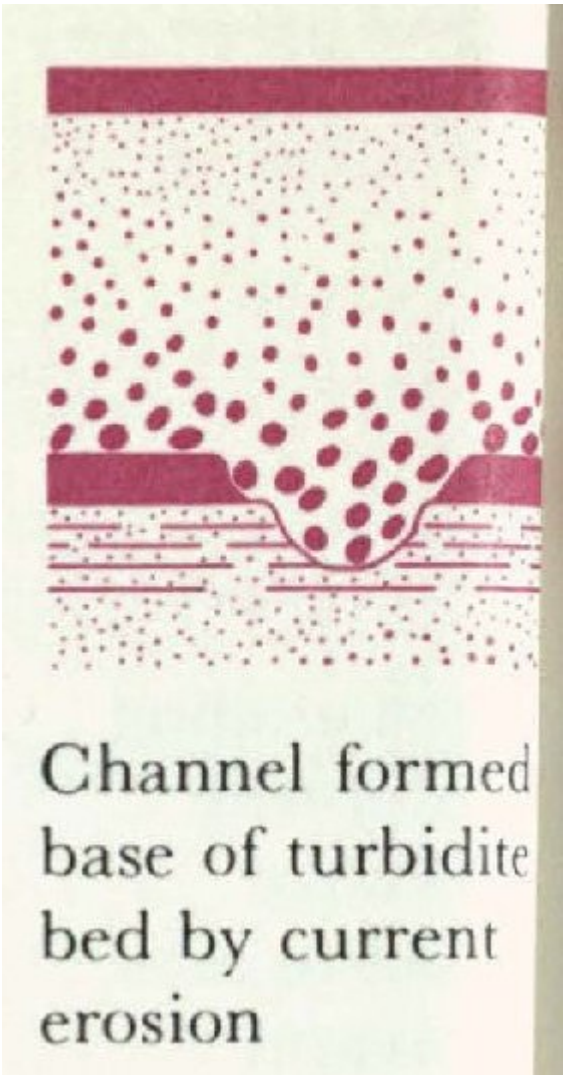


(Figure 11) Sketch of turbidite at the base of the Barmouth Formation showing complete 'Bouma cycle' Channel formed base of turbidite bed by current erosion.

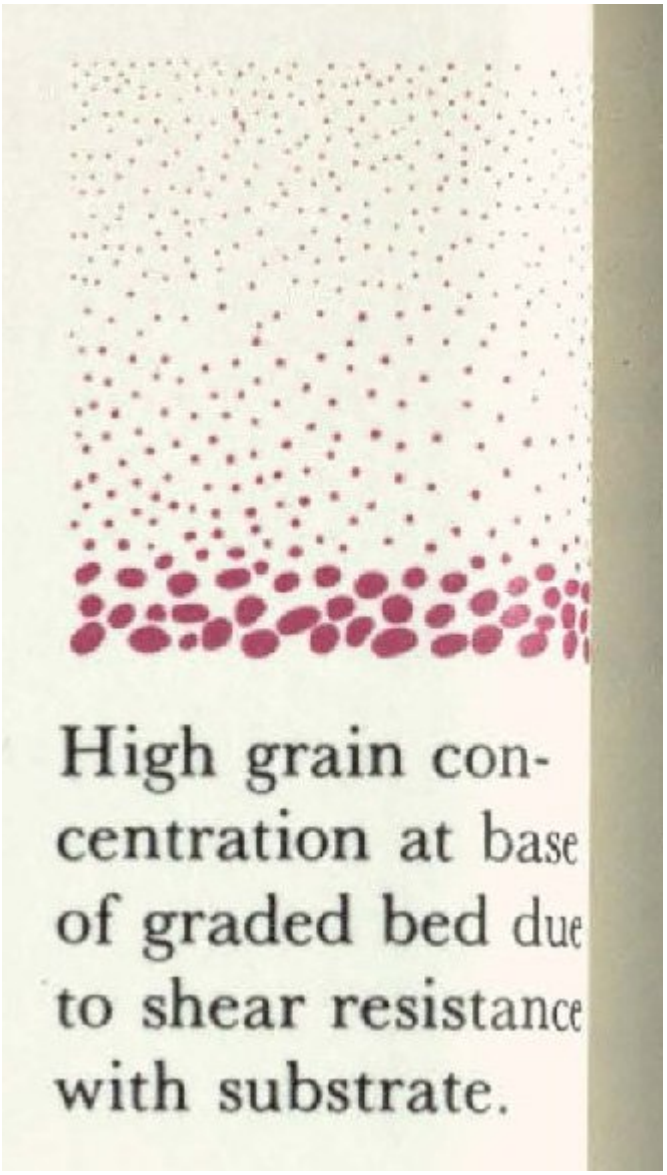


(Figure 46) Simple grading with large clasts on top.

(Figure 47) Multiple grading.



(Figure 48) Inverted grading at tops of bed (grains have migrated to area of minimum shear).



(Figure 49) Channel formed base of turbidite bed by current erosion.