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### 3 Clogau goldmine

The mine is privately owned, but there are public footpaths around the mine area from which it is possible to examine the upper part of the Gamlan Formation, the Clogau and lower Maentwrog formations, some of the concordant intrusive rocks which characterise the southern side of the Harlech dome, some dykes, and part of the old workings. The route, about 2.6 km of easy walking, takes about 4 hours.

Access is by a minor road north from Bontddu Hall Hotel. Park near the telephone box at Pont Hirgwm [SH 6677 1977]. The footpath, which is wide and well marked, starts by a cottage 240 m S of the parking place (Figure 12).

Near the start of this path is an excellent viewpoint: Diffwys, to the north, is capped by the Gamlan Formation with the Hafotty Formation on the east containing disused manganese workings. Cadar Idris lies to the south, and to the south-west the old Vigra gold mine is visible just above the boundary between the oak and coniferous forest.

Locality 1 [SH 66877 19535] The grey, altered intrusive rock is characteristic of the sills of microdiorite to microtonalite compositional range, which are common within the Cambrian rocks in this area. Such rocks, together with dolerite, are plentiful on the south and eastern parts of the Harlech dome.

Locality 2 [SH 66888 19583] The markedly discordant contact of an offshoot from the sill, seen at the previous locality, against baked grey silty mudstone of the Clogau Formation is well exposed. Despite the strong cleavage, which is nearly at right angles to it, the bedding is clearly visible in this outcrop. The strike is parallel to the NE-trending rocky features caused by the main intrusion on the hill above.

Locality 3 [SH 66957 19648] Another contact is seen to be concordant with the sedimentary bedding; the discordance of the previous locality is, therefore, probably only a local feature.

Locality 4 [SH 66971 19671] The Clogau Formation, about 95 m thick, consists of very dark grey or nearly black carbonaceous silty mudstone, commonly with lenses and laminae of pyrite or pyrrhotite with minor amounts of other sulphides. Sandstone laminae or beds, rarely more than 15 cm thick, are generally uncommon. In places the formation has yielded many middle Cambrian fossils, including the large trilobite *Paradoxides davidis* (Figure 13) which has been found near the Clogau mine.

Locality 5 [SH 67211 19929] An exposure in weathered, altered dolerite, probably forming a thin sill, shows an irregular upper contact against mudstone of the Clogau Formation.

Locality 6 [SH 67255 20103] The distinctive feature extending obliquely down the hill marks the top of the Gamlan Formation. Typically, this formation consists predominantly of green, grey or purple siltstone, but beds of coarse-grained greywacke-type sandstone occur throughout. In this area the first appearance of laminae and thin beds of quartzose fine sandstone of the type characteristic of the overlying Mawddach Group takes place within the upper part of the Gamlan Formation.

Below this locality is Ty'n-y-cornel cottage, and near it is the main adit of the Clogau gold mine driven in 1880–1884. Birch trees near the cottage are growing on the waste tips. More spoil heaps from other adits are present behind the wall to the south-east of this locality. About 45 m to the north-east the path crosses one of the old tramways.

Locality 7 [SH 67324 20151] Beds of laminated, quartzose fine sandstone, up to 3 cm thick, and similar to those in the lowest Maentwrog Formation, are present near the top part of the Gamlan Formation. Some show irregular bases, infilled eroded troughs and flat tops; other are lens-shaped.

Locality 8 [SH 67354 20174] A thin sill of altered dolerite, too small to be shown on the map, is seen here. Such intrusions diminish in abundance below the Clogau Formation. Beyond this locality, towards the north-east, the path passes progressively downwards through the Gamlan Formation.

In the crags along the path are beds up to 20 cm thick mostly of greenish grey greywacke. This rock is more abundant here than in the overlying strata. This locality is the lowest at which beds of fine quartzose sandstone have been found.

Locality 9 [SH 67627 20376] The well-made track ends at a tip outside one of the many adits associated with the St David's mine. The workings in the St David's mine are on the east of the Bryntirion Fault in the same vein system as that worked in the Clogau mine, west of the fault. The mines yielded over 80 000 oz of gold between about 1860 and 1911, with peak production in the years 1899–1907 (Hall, 1975). This work resulted in the excavation of over 15 miles of tunnels under the mountain. The open workings and stopes can be examined along the top of the hill, and there are many adits, shafts, and tramways. The old miners believed that gold-bearing parts of quartz vein occurred where the vein crossed the junction between a sill and the Clogau Formation – a coincidence which occurs at this mine. Little gold has been won from veins cutting formations below the Clogau. In the veins of the Dolgellau gold-belt, gold occurs in association with two main suites of sulphides. One suite is dominated by sphalerite, galena, and pyrite with rare chalcopyrite. The other, which includes the vein in this mine, contains pyrite, pyrrhotite and chalcopyrite with minor or rare galena and sphalerite. All these minerals can be found on the tip at this locality. The main gangue mineral is quartz, but an examination of the tip will yield much calcite, some chlorite, sericite and large included fragments of wallrock. The Clogau mine re-opened in 1980.

Locality 10 [SH 67516 20692] On the north side of the wall at Locality 9, two dolerite dykes 2 to 3 m thick can be traced north-west, cutting rocks of the Gamlan Formation. The northern dyke can be followed for about 150 m to a craggy outcrop, Locality 10, under two rowan trees. Here, at the contact, the bedding in the adjacent sedimentary rocks is sharply upturned (Figure 14). Also here, the dyke crosses a thin dolerite sill. In this well-exposed area, the graded beds of coarse-grained greywacke which characterise the Harlech Grits Group are common.

Immediately east of Locality 9 the footpath, which is a few metres north of the wall, crosses the Bryntirion Fault. Along the footpath there are some excellent exposures of the Gamlan Formation, including a purplish grey siltstone which locally characterises the top of the formation.

Locality 11 [SH 67976 20379] The top of the Gamlan Formation is not exposed, but it coincides with a hollow or topographic slack. On the south of the slack, 3 m of dark grey mudstone of the Clogau Formation underlie a grey microtonalite sill. The view north from this locality is informative: the bedding on Diffwys can be seen clearly dipping westwards, whereas on Y Garn, to the east of Cwm-mynach, and across the axis of the Dolwen pericline, the bedding dips eastwards.

Locality 12 [SH 68071 20278] There are several thin microdiorite and dolerite sills here, and a short trial has been excavated in a quartz vein along the upper contact of one of them.

Locality 13 [SH 68133 20189] The Maentwrog Formation overlies the Clogau Formation with apparent conformity, but the absence of an important fossil zone at this level suggests that there may be a depositional break between them. The Maentwrog Formation consists of medium and dark grey mudstone and silty mudstone interbedded in places with laminae and beds (usually less than 40 cm thick) of fine quartzose sandstone or coarse siltstone. In this area the arenaceous beds occur only in the lower half of the formation, which led Matley and Wilson (1946) to divide it into a lower, Vigra, member and an upper, Penrhos, member. This distinction, however, is not apparent everywhere around the Harlech dome, and it has not been made on the Harlech (135) Geological Sheet. The basal part of the Maentwrog Formation is exposed here, folded about a roughly N-trending axis in a craggy outcrop with an oak tree on it.

The sandstones in this formation show two sets of sedimentary structures indicative respectively of deposition by turbidity currents and of reworking. The turbidites are locally graded, but are more commonly massive in the lower part of the bed reflecting the uniform grain size of the source material. Rarely, a layer of coarse grains can be seen at the base. Above the massive or graded interval is a parallel-laminated interval (ab – see (Figure 9)) or simply the uppermost pelitic interval (ae). Commonly the beds show complex convolute-lamination, possibly formed by plastic movement of sediment while still saturated. Many beds have flat, eroded tops and complex bottom structures, the latter resulting from loading of flute casts. The reworked sandstone beds display current-ripple or parallel-lamination, and are often composite. Grading can be determined in the foresets and in the laminated beds. The beds are invariably discontinuous or lens like, and show

marked thickness variations. Strings of lenses are interpreted as disconnected ripples; in places the ripples are inverted. These beds are believed to be turbidites that have been reworked by persistent sea-bottom currents analogous to contourites in deep ocean basins.

The turbidites and reworked sandstones and coarse siltstones are commonly interbedded, and all may be examined in the craggy outcrop at Localities 13, 14 and 15. Generally the silty mudstone is well cleaved and at Locality 15 [SH 68065 20085] a strong tectonic lineation is visible on the bases of the sandstone beds.

Locality 16 [SH 67828 19869] At the Old Clogau mine a quartz vein, parallel to that in the Clogau and St David's mines, was worked intermittently mostly for copper from the early 19th century to about 1867. The vein cuts the Maentwrog Formation and parts of the complex, anastomosing system are exposed. In addition to the old shafts, adits and tips, the remains of a horse-whim that is probably unique in Wales is of particular interest.

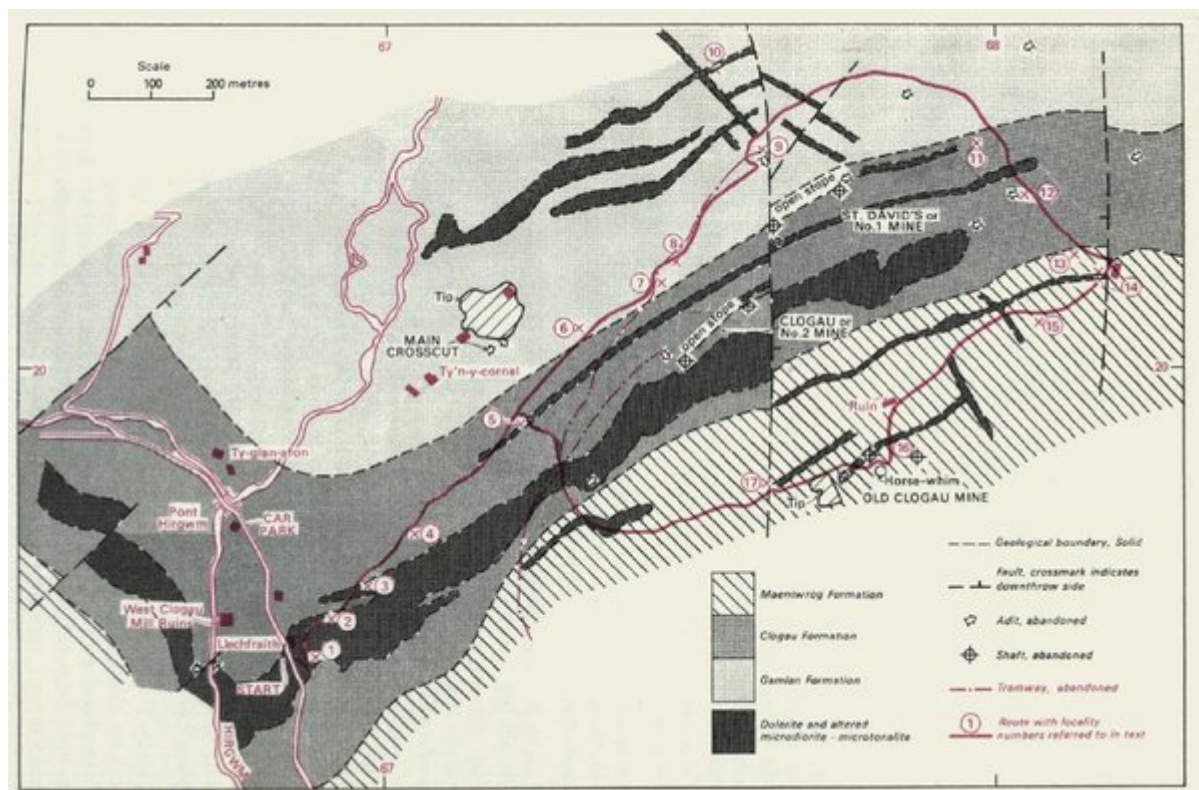
The route leads from the mine over a stile in a high wall on the north side of a tip along a well-made miners' track.

Locality 17 [SH 67392 19739] Cleaved sedimentary and intrusive rocks alongside the stream mark the site of the Bryntirion Fault which downthrows to the east. From here the route follows the well-made path westwards and then takes a minor path that branches to the north-west nearly parallel to the wall. It crosses two old tramways and continues downhill to a gate near Locality 5.

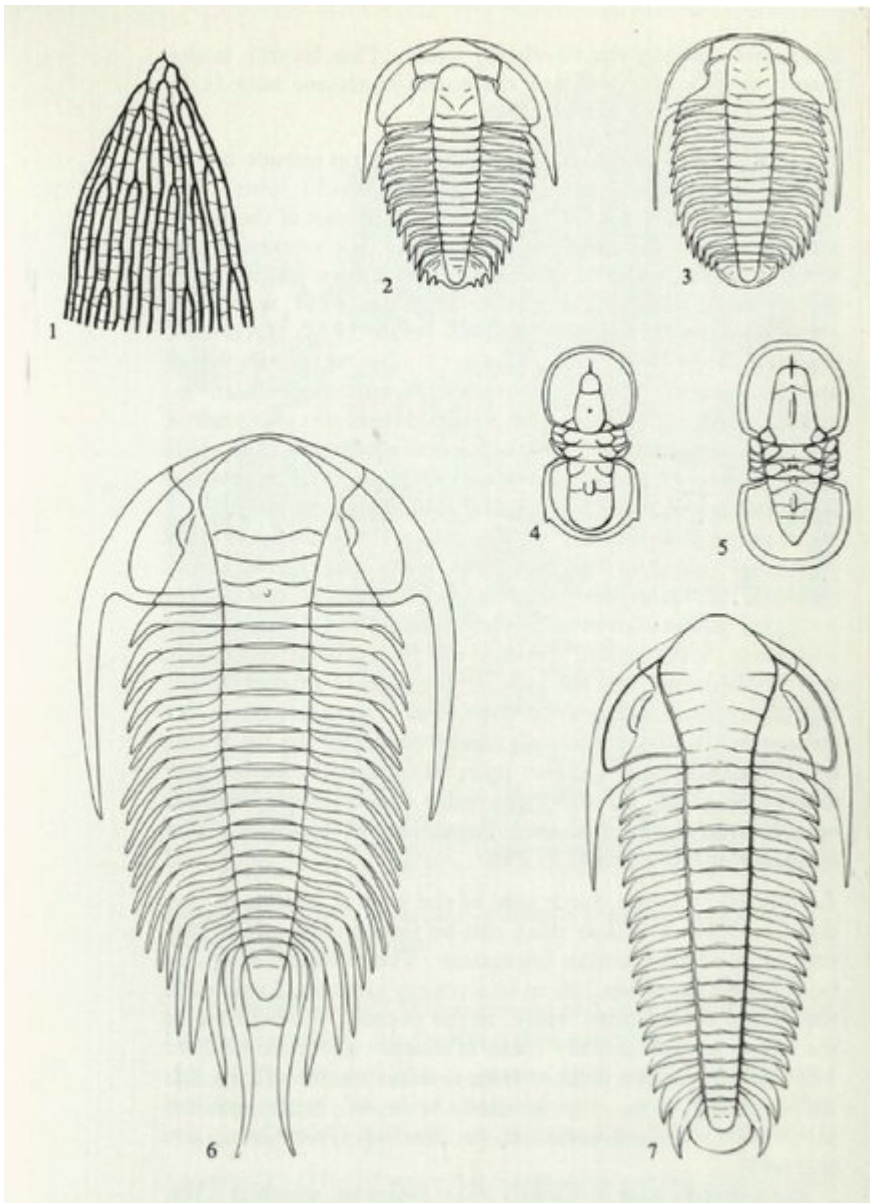
(Figure 50) High grain concentration at base of graded bed due to shear resistance with substrate.

(Figure 51) Convolute lamination.

## References

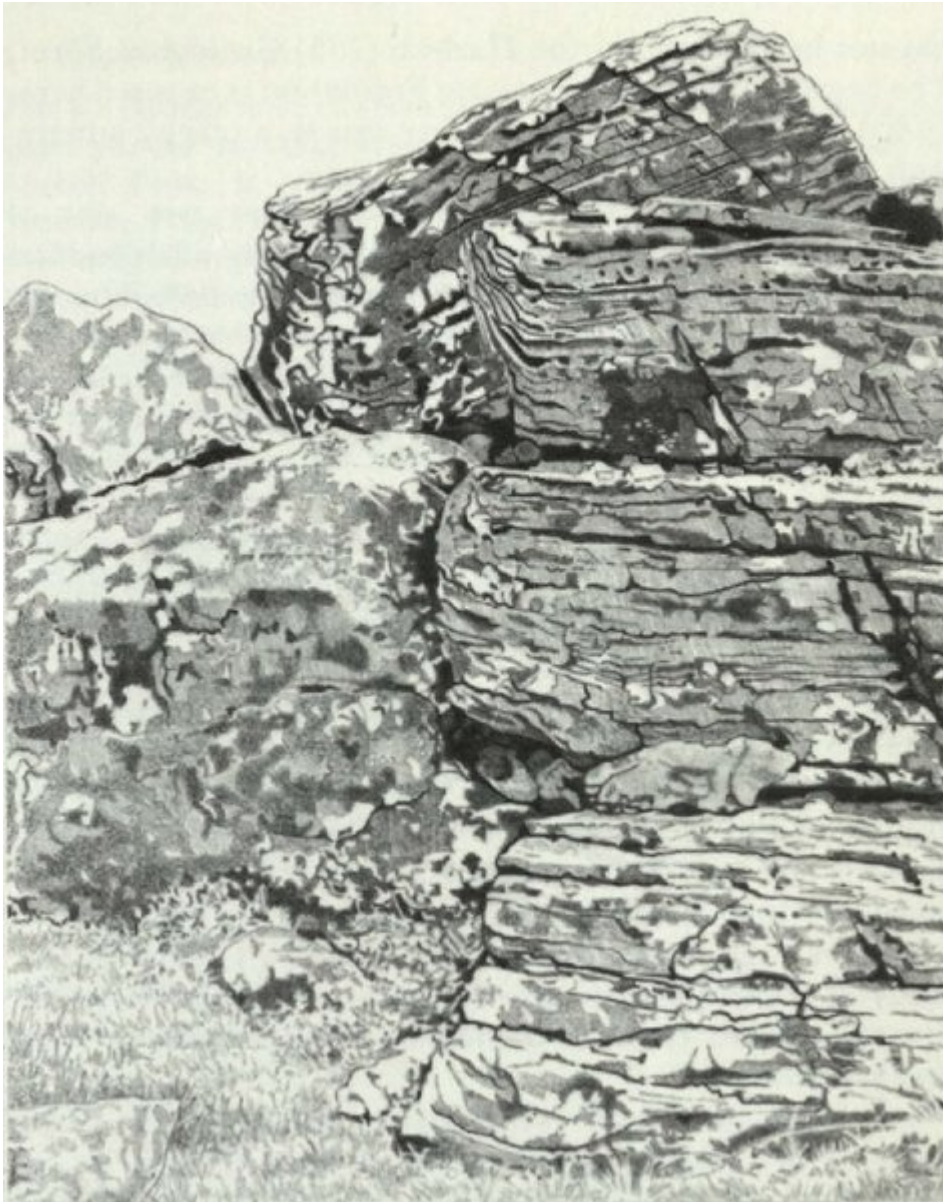


(Figure 12) Solid geology and excursion route No. 3 around Clogau and St David's goldmines.

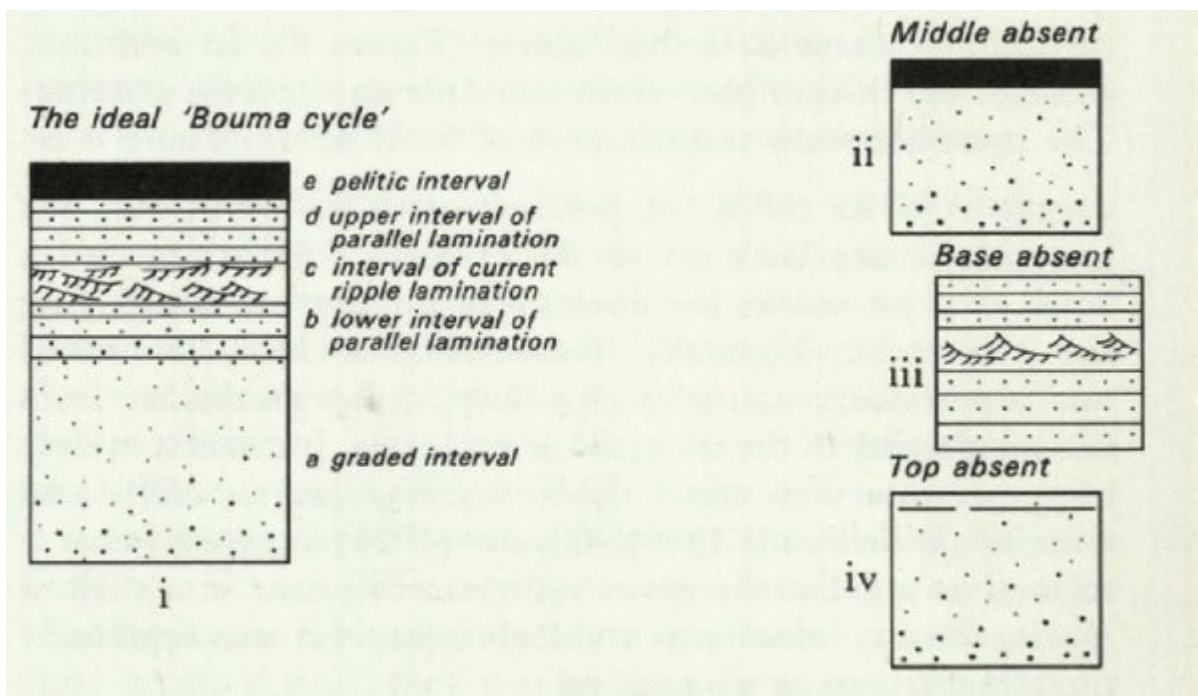


(Figure 13) Cambrian fossils 1 *Diayoreema flabelliforme* (Eichwald), x1, from the base of the Dol-cynafon Member of the Cwmhesgen Formation (Tremadoc Series). 2 *Parabolinoidea bueffbalus* (Belt), x1, from the top of the Ffestiniog Flags Formation (Merioneth Series). 3 *Oknur micrurus* Salter, x1, from the Maentwrog Formation (Merioneth Series). 4 *Hornagnostus obesus* (Belt), x4, from the Maentwrog Formation. 5 *Tomagnostus lessees* (Linnarsson), x4, from the Clogau Formation (St David's Series). 6 *Paradoxides davidis* Salter, x1, from the Clogau Formation. 7 *Paradoxides hieksii* Salter, x1, from the basal Clogau and top of the Gamlan formations.

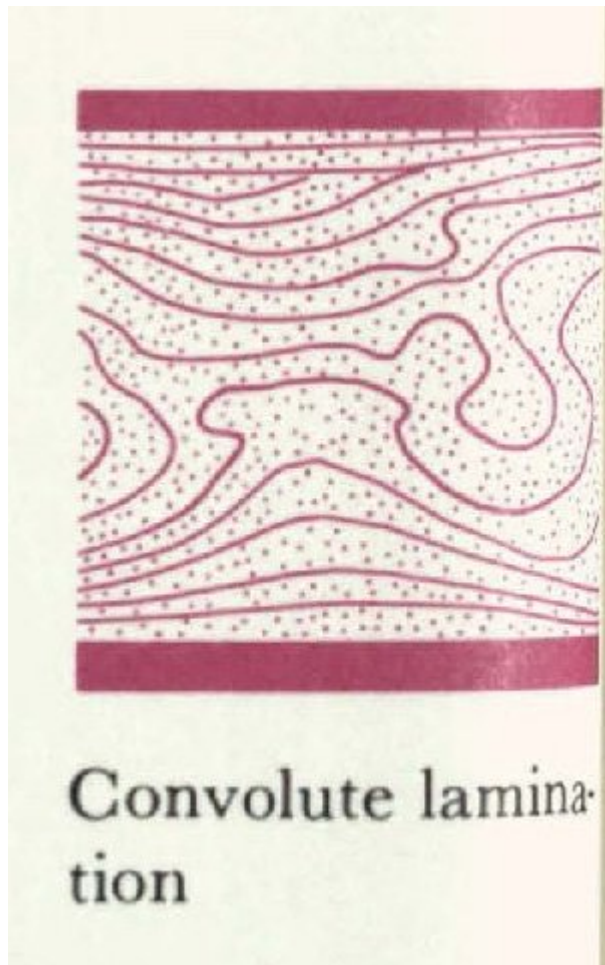




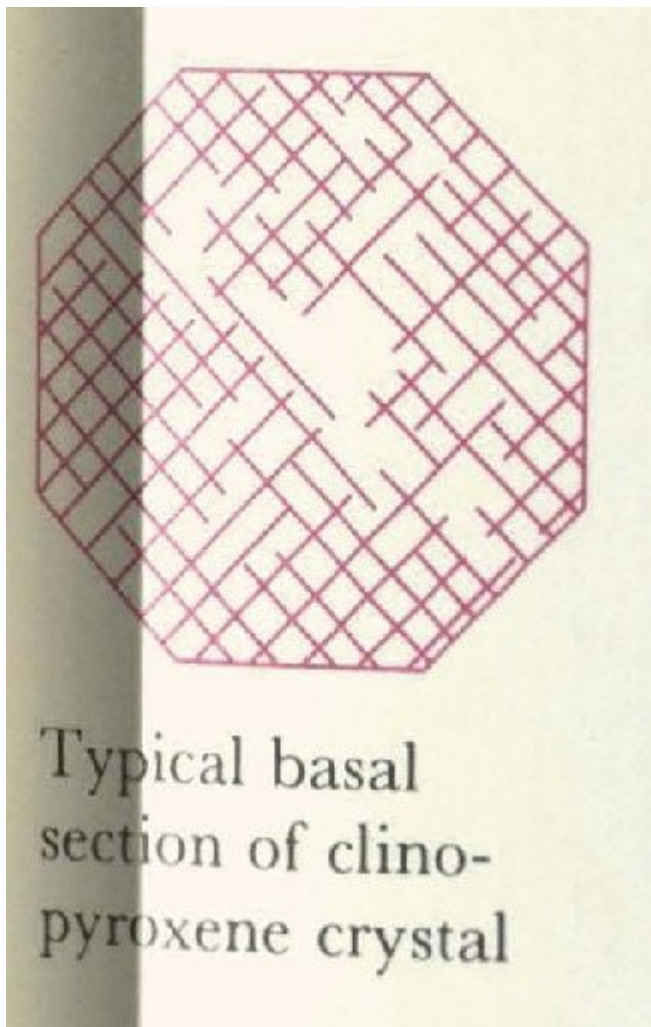
(Figure 14) Sketch of contact of dolerite dyke against siltstone in the Gamlan Formation.



(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 50) High grain concentration at base of graded bed due to shear resistance with substrate.



(Figure 51) Convolute lamination.