

## LLANBEDROG

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### Introduction

Llanbedrog Head preserves one of the best- exposed and topographically most prominent of a series of late Ordovician (Woolstonian) subvolcanic intrusions that crop out on Llŷn. The GCR site (Figure 6.64) occupies much of the area of Mynydd Tir-y-cwmwd (Llanbedrog Head), on the southern coast of Llŷn, to the west of Pwllheli. The microgranite has been quarried in the past from a series of quarries along the southern margin of the headland.

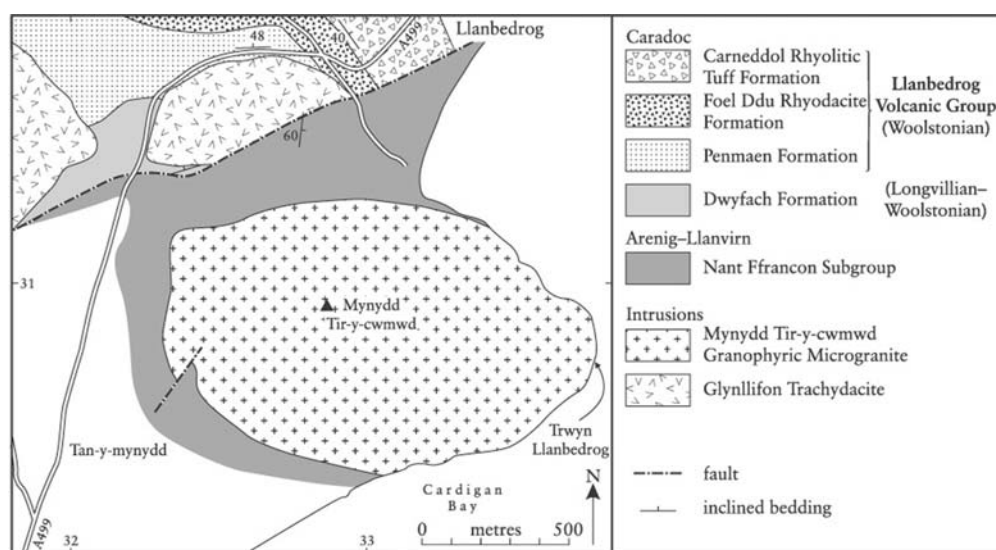


Figure 6.64: Map of the Llanbedrog area, south Llŷn.

The Mynydd Tir-y-cwmwd Porphyritic Granophyric Microgranite (Young *et al.*, in press) is important for its close geochemical affinity with the Carneddol Rhyolitic Tuff Formation of the Llanbedrog Volcanic Group of central Llŷn. It is the only large subvolcanic intrusion on the southern limb of the Llŷn Syncline. For a long time, this intrusion has been believed to be associated with the local extrusive rocks; Matley (1938) described the Mynydd Tir-y-cwmwd intrusion as a subvolcanic plug of 'granite porphyry' and Fitch (1967) identified an unconformity within the local volcanic succession, which he attributed to the effects of the intrusion of the Mynydd Tir-y-cwmwd intrusion (his 'Llanbedrog Granophyre').

The intrusion is one of the few on Llŷn for which an Ordovician age has been accepted by almost all previous authors. Tremlett (1969) interpreted the Mynydd Tir-y-cwmwd Porphyritic Granophyric Microgranite as contemporary with the Caradoc volcanic succession, despite interpreting many other intrusions, such as the Garnfor Multiple Intrusion (see the Trwyn-y-Gorlech to Yr Eifl quarries GCR site report) as having a younger, end-Silurian to Early Devonian age. Croudace (1982) re-investigated the granitoid intrusions of Llŷn and interpreted them all as being of Ordovician age.

### Description

The Mynydd Tir-y-cwmwd Porphyritic Granophyric Microgranite intrusion forms Llanbedrog Head, and is elliptical in plan (1500 m E–W and 900 m N–S). The intrusion has major radial and concentric joint sets which are well exposed in the quarries around the southern margin. The joint pattern suggests that the present level of erosion is close to the exhumed top of the intrusion. At one point in the SW of the intrusion a small fault downthrows part of the roof, so that baked mudrocks are exposed in contact with the microgranite. The country rocks (the

'Tal-y-fan argillites' of Fitch, 1967) are undivided mudstones of the Nant Ffrancon Subgroup (Young *et al.*, in press), which are probably of early Llanvirn age. Abundant, pendent didymograptid graptolites can be found in these cleaved mudstones close to the intrusion.

The microgranite is dominated by perthite phenocrysts (up to 4 mm) with lesser plagioclase (0.7 mm) and minor green biotite. Quartz is abundant in the equigranular, unfoliated groundmass, and abundant granophyric intergrowths commonly nucleate around feldspar phenocrysts.

## Interpretation

Fitch (1967) elaborated on the earlier interpretation of the Llanbedrog area by Matley (1938), identifying an unconformity between his 'Mynytho Volcanic Group' and 'Llanbedrog Ignimbrite Group', which he attributed to the topographical effects of the intrusion of the Mynydd Tir-y-cwmwd intrusion (his 'Llanbedrog Granophyre'). The stratigraphical position of Fitch's unconformity is equivalent to the base of the Carneddol Rhyolitic Tuff Formation in the stratigraphical scheme of Young *et al.* (in press), although the remapping of the area did not prove the existence of an unconformity but instead emphasized the importance of folding and faulting to explain the present-day out-crops.

In addition to the geographical proximity there is a strong petrographical and geochemical case for linking the intrusion with the Carneddol Rhyolitic Tuff Formation. The perthite phenocrysts and granophyric intergrowths of the microgranite can be matched with similar components in the Carneddol Rhyolitic Tuff Formation, particularly in its lower part (the Nant y Gledrydd Member). Both the intrusion and the rhyolitic tuff are Zr-poor and show a closely similar trace element signature that is especially evident on plots of Y vs Zr, and Nb vs Th.

The Mynydd Tir-y-cwmwd intrusion lies close to the southern corner of a triangular region identified by Young *et al.* (in press) as the site of a late Ordovician 'Llanbedrog' volcanic centre. This centre is characterized by dramatic thickness variations in the Carneddol Rhyolitic Tuff Formation, the youngest component of the Llanbedrog Volcanic Group and the one which is genetically associated with the Mynydd Tir-y-cwmwd intrusion.

## Conclusions

The Llanbedrog GCR site provides excellent exposures of the Mynydd Tir-y-cwmwd Porphyritic Granophyric Microgranite, interpreted as a subvolcanic intrusion associated with the volcanic centre from which the Carneddol Rhyolitic Tuff Formation of the Llanbedrog Volcanic Group was erupted in Caradoc (Woolstonian) time. Both petrographical and geochemical evidence strongly support a common source of magma for the intrusion and for the major ash-flow tuff eruptions from the Llanbedrog volcanic centre. Extensive exposures of the intrusion, particularly around the southern side of the headland, show good evidence for the chilling of the magma against the country rocks and for the joints produced by contraction of the solidifying magma. The intrusion presents excellent opportunities for the study of the emplacement of a high-level granitic intrusion paired with an adjacent, overlying, silicic ash-flow tuff.

## Reference list

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