

Tyndrum & Glen Orchy: 10 June 2017

Leader: Iain Allison

9 participants

Report by: *Bill Gray*

In today's excursion we visited rocks in the Central Highlands Terrane belonging to the Dalradian Supergroup. The sediments forming these rocks were deposited as mainly marine sands, silts, muds and calcareous sediments during the Neoproterozoic and early Palaeozoic eras and the rocks were deformed and metamorphosed during the Mid-Ordovician Grampian Orogeny. The Dalradian Supergroup is divided into the *Grampian, Appin, Argyll and Southern Highland groups*. The excursion was split into two parts: in the morning we looked at the workings of the old Tyndrum lead mine and in the afternoon we visited several localities in the classic Glen Orchy/Beinn Udlaidh area.

The coach carrying our small but enthusiastic group arrived at the Green Wellie car park in Tyndrum at 11:00 and we disembarked into an unseasonal drizzle. We followed a marked path SSW from the road and went through the underpass under the railway, turned right to follow the path beside the railway and then left to follow a stream and climb the hill towards the workings of the lead mine (grid reference NN 321 305). Before we started the climb, Iain gave a short talk to set the scene. He explained that the mineral veins occur in fractures associated with the NE-SW Tyndrum-Glen Fyne fault, a late Caledonian sinistral strike-slip fault which has placed middle Dalradian Argyll Group rocks east of the fault against lower Dalradian Grampian Group rocks to the west. The Argyll Group comprises various types of sedimentary rocks – sandstones, shales and limestones – now metamorphosed, while the Grampian Group consists of meta-sandstones (psammites). The Grampian Group rocks behave in a very competent manner compared to the Argyll Group rocks when subjected to fault movements and so have been intensively fractured to produce extensive open cavities into which the mineralising fluids flowed and precipitated the vein systems.

The mineralisation consists mainly of vein quartz (but also a little chert) with sphalerite (zinc sulphide) and galena (lead sulphide). Other minerals that may be found are chalcopyrite, pyrite, barite and calcite. The mineralisation is thought to have occurred less than 1 km below the surface during the Lower Carboniferous (~360 Ma), just before the Campsie lavas were extruded and around the same time as the big Irish Pb-Zn deposits were formed. The mine produced 20,000 tonnes of ore at >30% Pb+Zn and was worked from 1741 to 1929.

We climbed to one of the lower shafts, which was fenced off for safety reasons. The first part of the climb was alongside the stream, with spoil on either side, and the last part was over a more concentrated spoil heap. Most of the spoil was quartz and calcite (the calcite was precipitated from the mineralising fluids just like the quartz), but we found one or two specimens of galena and several specimens of sphalerite and barite. On the way back we stopped to look at tailings pond and waste dumps at the site of the former processing plant.



The party at the spoil heap near one of the shafts of the Tyndrum lead mine. *Bill Gray*

We returned to the coach at the Green Wellie for our picnic lunch before setting off for the afternoon session in Glen Orchy.

The Glen Orchy-Beinn Udlaidh area has been extensively studied by Tanner and Thomas (2010) and shows large flat-lying fold nappes refolded into an open dome, the Orchy Dome. The rocks involved in the section that we studied are the Meall Garbh Psammite of the (lower) Grampian Group and the overlying Beinn Udlaidh Quartzite and Coire Daimh Pelite of the Appin Group. Although these rocks have been deformed and metamorphosed, in places original sedimentary structures may be observed and are important in interpreting the regional structure.

Treagus (2009) describes a geological excursion from south to north through the southern part of Glen Orchy. We travelled through the entire length of the glen in the coach along the B8074 but went from north to south, along the east bank of

the River Orchy. We stopped at four localities, of which the first two were not described by Treagus, but the second two were. This itinerary provided a traverse across the Beinn Udlaidh Syncline from the lower, right-way-up, limb to the upper, inverted, limb. (Although the Beinn Udlaidh fold has younger rocks at the centre and is therefore a *syncline*, it is actually slightly inverted, and so is an *antiform*). The weather steadily improved throughout the day and the sun broke through at the last locality.

Locality 1 (NN 278 367). This stop was beside a bridge across a stream entering the River Orchy at Invergaunan. This locality was in the Meall Garbh Psammitic Formation of the Grampian Group, and the rocks on the banks of the Orchy could be seen to have a dipping fabric, which was a tectonic rather than a sedimentary feature. We didn't linger long here as the local midges had discovered our presence!

Locality 2 (NN 266 356). Easan Dhuba waterfall.

At this locality we had the chance to examine the Meall Garbh Psammitic Formation more closely. The dip was to the NW and the rock showed compositional variation, with a fining-up structure, indicating that it was the right way up. (We were still on the lower limb of the Beinn Udlaidh Syncline.) An outcrop on the opposite bank of the Orchy displayed no layering. This was a volcanic vent filled with a quartz breccia.



The Meall Garbh Psammitic Formation at Locality
The rocks dip away from the camera, to the NW. *Bill Gray*

Locality 3 (NN 248 330) (Locality 2 in Treagus (2009)). This was our longest stop and we walked along the river bank northwards on a gravel track to examine and discuss the rocks. We were now in the Beinn Udlaidh Quartzite (elsewhere the Glen Coe quartzite; Lochaber subgroup of the Appin Group), still in the lower, right-way-up, limb of the syncline but nearer the axial plane. We saw some blocks of quartzite displaying cross-bedding in the river and eventually reached an exposure of quartzite on the river bank that displayed a beautiful pattern of flat-lying minor *asymmetric* folds. (An asymmetric fold has an S- or a Z- shape.) Although these were minor folds, they were actually fairly large (see the picture). This locality provided an ideal opportunity for a consideration and discussion of *vergence*, a concept which allows the direction of the axial plane of a major fold to be determined from the structure of the minor folds within it. Iain gave us a wonderful explanation of the concept with the aid of a whiteboard and coloured pens.



Iain describing the asymmetric folds and explaining vergence at Locality 3. *Bill Gray*

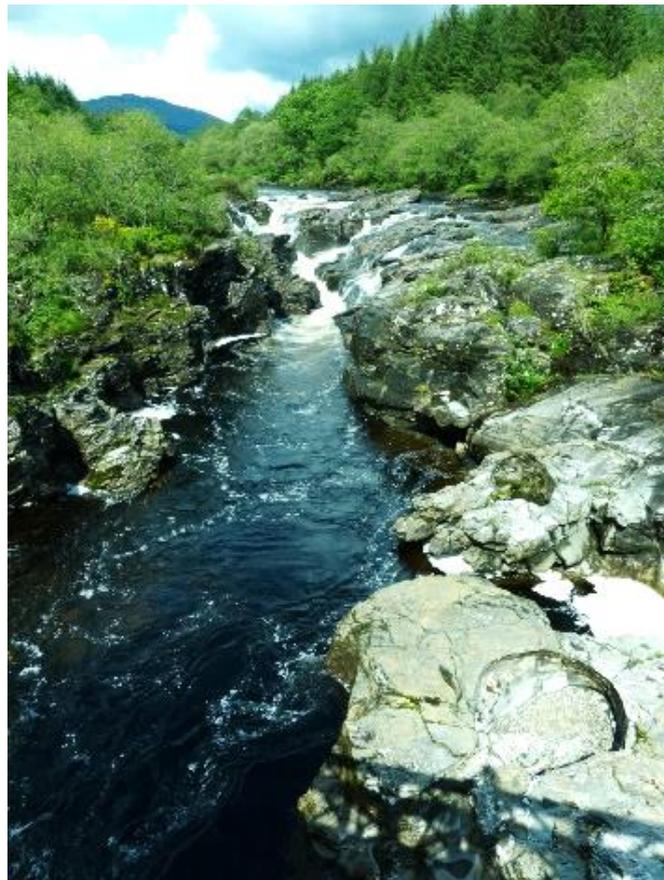
We determined that the vergence of these folds was to the south and so the axial plane of the antiform (syncline) to which the folds belonged was to the south. The structure here is termed “fold mullions” and is an excellent example with trains of folds with rounded parallel hinges.

Locality 4 (NN 243 322). Iron Bridge and Falls of Orchy. (Locality 1 in Treagus (2009)). Our last stop was at the Iron Bridge over the River Orchy, just south of the Falls of Orchy. The sun had now emerged and we enjoyed glorious

weather for the end of the excursion. From the bridge we looked north and could see that the rocks in the river bed were darker than those we had seen previously. These were from the Coire Daimh Pelite Formation (elsewhere the Leven Schist), which lies immediately above the Beinn Udlaidh Quartzite. The beds were dipping to the south-west and were marked by numerous large potholes.

We walked about 200 metres down the road to the south, past an artificial salmon leap to a point where we had access to a prominent exposure in the river bed. This rock was lighter in colour than the pelite and in fact we were back in the Beinn Udlaidh Quartzite.

We had crossed the core of the Beinn Udlaidh Syncline and were now on its upper, inverted, limb. The quartzite displayed flat-lying minor asymmetric folds similar to those we had seen at Locality 3, but this time the vergence was to the north, confirming that we had indeed crossed the axial plane of the syncline. However, persuasive sedimentary structures to determine the way-up were lacking.



Looking north from the Iron Bridge towards the Falls of Orchy at Locality 4. The rocks belong to the Coire Daimh Pelite Formation. A large pothole can be seen in the foreground. *Bill Gray*

We returned to the coach at around 4:15 pm, after a most enjoyable day exploring the geology of the Tyndrum and Glen Orchy area. We were full of admiration for the effort that Thomas and Tanner must have put into the task of mapping the area and for the skill that they had applied in working out its geological structure. Some of us even had a discussion about vergence on the journey back to Glasgow!

References

Tanner P.W.G. & Thomas P.R. 2010. Major nappe-like D2 folds in the Dalradian rocks of the Beinn Udlaigh area, Central Highlands, Scotland. *Earth and Environmental Science Transactions of the Royal Society of Edinburgh*, **100**, 1-19.

Treagus, J. 2009. Excursion D: Glen Orchy. In Treagus. *The Dalradian of Scotland*. The Geologists' Association, London, 47-50.

