Day Trip to
Cononish Gold Mine

Sat 24/8/13
Participants: 16
Leader Chris Sangster
Reporter: *M.Donnelly*

On a pleasant sunny morning we drove up the A82 in private cars to the Dal Righ car park (NN 285292) south of Tyndrum where we met Chris Sangster, CEO of Scotgold, at 9.30 am. A couple of trips in two range rovers, driven by Chris and an 'obliging friend', Rob Barbour of OUGS EoS, transported the company two and a half miles up to the mine. We were divided into groups of eight, and once we were kitted out with safety gear, Chris gave us an introduction.

Geologists from Irish gold mines first identified these rocks as possibly 'gold-bearing' – there are prospects in Northern Ireland, and now one opencast gold mine called 'Omagh Mine' in Co.Tyrone but its productivity is very much higher than the potential of Cononish. BGS mapped the area in the 1960's, reported alluvial gold in streams and identified likely places to search for the ore. The Cononish gold and silver deposit was delineated by diamond drilling carried out between 1985 and 1988 and an underground development programme was started in 1990. A total of 1280 m of underground adits were also completed, of which 590 m was driven on the vein. This is the most important precious metal deposit discovered so far in Scotland this century. The mineralisation (450,000 tonnes at a cut and diluted grade of 11.3 g/t Au and 60.1 g/t Ag) is hosted by a steeply dipping breccia zone, the Eas Anie vein, silicified and haematised by the hydrothermal solutions which carried the minerals, and penetrated the rocks of psammite, pelite, amphibolite and impure limestone of the Grampian and Appin Groups. These same Dalradian rocks extend from Canada through Ireland and Scotland to Scandinavia where gold is also found. The vein extends for more than 1 km along strike and 500 m down dip. It is up to 8.3m wide, has an average width of about 2 m and fills a structure considered to have formed during left-lateral movement of the early Tyndrum Fault (Treagus *et al.* 1999) during the Caledonian orogeny.

The adit went into the side of the hill and the quartz breccia vein outcropped on top, marked with posts, about 800 m above. There were also lamprophyre dykes. Wearing wellingtons, hard hats and carrying 3 or 4 safety torches, we were led inside – it was cold and I couldn't see where I was going!! The diameter of the adit was about that of a Glasgow subway tunnel; it was very wet, and rough underfoot as the ground, though essentially flattish, was strewn with coarse pebbles and cobbles from blasting operations. About 200 m inside, we stopped at a big indent in the wall. It had been bored for samples, and now ground water had found a line of least resistance through the rock, bringing out iron and creating a brownish colour – this was a 'leaking borehole'. In the dim light, I asked what were the shiny things on the wet wall – they were in fact drops of water and ***not*** flakes of gold, as I had hoped! The quartz breccia here was not a good enough quality for extraction. We continued to a large vertical feature in the adit, extending from ceiling to floor and about 9 inches wide. It looked like an area of shearing and was in fact the Eas Anie Fault, which had had left lateral movement similar to the Tyndrum Fault. This fault (and related others) had provided the conduit for the thermal silica fluids to emplace the gold. From here on, the Eas Anie Vein, now named the 'Cononish Main Vein' was very obvious, running along the roof of the tunnel, and as wide – a sheet cutting through the hill at an angle of approximately 45^0.

About 200 m further on, we came to a second large indent on the other side of the adit – another 'leaking borehole', and beyond this, a quartz vein cut off by a fault

Photo B.Balfour

We came to a large black lamprophyre dyke which had displaced the vein, and so the adit took a left turn, continuing for about 400 m until it was back into the vein. Finally, here, there was good quality ore with abundant pyrite and minerals………and another indent in the wall – this time discoloured to a deep brownish, reddish pink by iron, an indication of thermal fluids bringing in the gold. This particularly deep colouration suggested good quality gold-bearing rock, as the discolouration is usually merely a pale pink. The gold occurs as flecks in the quartz, around the margins of the pyrite, in cracks within the pyrite and within the crystal structure of the pyrite itself. By now there was ***lots*** of pyrite in the quartz breccia vein on the roof.

In the process of mining, pipes about 20 or 30 cm diameter are drilled and explosive inserted. After blasting, the broken rock is removed in trucks, crushed to a small size on site and then treated by 'gravity separation' (mixed with water and stirred), during which the 'pyrite with gold' will sink to the bottom. There is then a frothing process – all the now tiny particles are stirred into a frothy slurry; the foam or scum at the top contains unwanted material, and again the 'pyrite with gold' sinks to the bottom. In this way 25% of the gold is recovered. This is then sent off to a 'plant' for a 'cyanide process' –apart from 'aqua regia', cyanide is the only chemical which will dissolve gold – and so all the 'nasty processes' are carried out offsite. One tonne of rock is required for 10 gm gold………..i.e. 2 gold rings!!

After all the 'gold rock' has been extracted from this tunnel, another will be dug into the hill immediately above, with stoping to prevent collapse. The mining will continue here, the broken rock dropped down through a hole into a truck in the first tunnel and then removed. When all the commercially viable ore is taken from here, a third tunnel will be dug below, and the broken rock brought up. Repetition of this on 3 or 4 levels will create a gallery of tunnels throughout the vein, until finally all the 'gold rock' has been extracted. On our way back out of the adit Chris pointed out the large amount of minerals, especially of galena (lead sulphide), present in the quartz in the roof, however there was not enough for commercial viability.

Back at the Dal Righ car park Chris provided us with more information concerning the background geology, and the methods and history of mining precious metals in the British Isles. One little gem was that Dr Geoff Tanner had produced a map, with plots predicting where the vein would be found. Scotgold had followed this carefully in their prospecting and proved Geoff to be almost ***exactly*** right every time!! We gave Chris, and our 'obliging friend', a 'great big thanks' for a marvellous experience, and then headed to the 'Green Welly' for lunch.

Afterwards, we drove north, and turned west into the Glen Orchy road, B8074, about I mile south of Bridge of Orchy. The geology of Glen Orchy is complex and has only recently been reinterpreted (Tanner & Thomas, 2010). The Glen Orchy/ Beinn Udlaidh / Glen Lochy area is bound to the northwest by the Ericht-Laidon Fault, to the southeast by the Tyndrum Fault and to the west by the Glen Etive Granite. The rocks belong to the Meall Garbh Psammitic Formation (top of the Grampian Group) underlying the Beinn Udlaidh Quartzite Formation and then the Coire Daimh Pelite Formation (bottom of the Lochaber Subgroup of the Appin Group), and all belong to the Neoproterozoic–Lower Ordovician Dalradian Supergroup. The region is dominated by two major recumbent folds, the Beinn Udlaidh Syncline and the underlying complementary Glen Lochy Anticline, which demonstrate a sedimentary transition from the Grampian Group to the overlying Appin Group. They achieved their maximum deformation during D2, subsequent to the regional metamorphic peak, and are part of a stack of larger SE-facing recumbent folds created during the Grampian Orogeny, ~ 470 Ma. The core of the south-facing Beinn Udlaidh Syncline contains the Appin Group and, together with the underlying Glen Lochy Anticline, it is gently folded by an elongate, east-west regional structure, the Orchy Dome. There is an early fabric (S1), which is mainly destroyed by the D2 imprint, but *does* survive as inclusion trails in regional metamorphic garnets, which are highly oblique to, and wrapped by, S2. Dalradian rocks from below the Iltay Boundary Slide nearby are now believed to be in structural continuity with those of the Tay Nappe above, and the Slide is reinterpreted as a structurally-modified disconformity between the Leven Schist (Appin Group) and the overlying Ben Lui Schist (Argyll Group). There are also a number of later minor intrusions and explosion vents of the lamprophyre suite in the area, whose spatial distribution was probably influenced by the Orchy Dome

Driving along the first 2 or 3 miles of the road, we could see abundant glacial features on either side – drumlins, breached moraines, kames and kettle holes. After about 1.7 miles (~NN 287375), locality 1, our four cars squeezed briefly into a passing place to allow a view of the prominent quartz breccia dyke which runs through Beinn Udlaidh in a northeast – southwest direction. The pelite beds were on the northwest side of the crag, and we were looking directly at the Orchy Dome, whose fold axis runs approximately northeast – southwest. Some 400 m further, at locality 2, (~ NN 286373) we had a closer view of the dyke. The semi-pelite-psammite was dipping off the dome on the northeast side; there was an area of quartz-breccia, and a small knob at the end formed by an explosion breccia pipe. We continued for about 1.7 miles to locality 3, ~ NN 286373, below the Easan Dubha waterfall, and a sizeable parking area on the banks of the river – we got out to explore. The rocks were Grampian psammites and were clearly dipping to the northwest in the river. We endeavoured to find convincing evidence of the 'way up' of the rocks………… with limited success.

However, on the opposite bank of the river, we could clearly see a circular area of broken up material – it was one of the numerous explosive breccia pipes.

Photo M. Donnelly

Grampian psammites dipping northwest and circular explosive breccia pipe, left centre.

Driving a further two miles, we came to another large parking area beside a sizeable expanse of water in the river, below a set of rapids. This would be the highlight of the afternoon. We walked upstream along the bank through long grass and overgrown vegetation.

It was very wet underfoot and the going was not easy, but the rocks were amazing! We stopped a couple of times to examine them on the bank, in the river and on the far side – they were composed of large, intensely and isoclinally folded beds of Beinn Udlaidh Quartzite. We were, in fact, in the core of a major recumbent fold (considered to be the best-exposed example in the British Isles), which has itself been folded by the regional Orchy Dome – we were on the lower, right-way-up limb of the Beinn Udlaidh Syncline. After about 100 m we arrived at our target……… fabulous 'fold mullions', so called because the beds continue around them and are not broken into separate rods …….. ……..…*and* we were in the nose of the fold!!

Sitting on the mullions

Photo Nairn Balfour

We spent considerable time crawling all over the rocks, examining them from every angle and taking photos. As a final bonus, we found cross-bedding in the quartzite which indicated that the beds were younging downstream, and that we were indeed on the lower limb.

At last, we made our way back to the cars, tired but exhilarated after another fascinating day of geology, and headed for home.

References.

1. Excursion Notes from Dr Geoff Tanner, GSG Excursion, 18th August, 2007.

2. Tanner, P. W. G., & Thomas, P. R., 2010. Major nappe-like D2 folds in the Dalradian rocks of the Beinn Udlaidh area, Central Highlands, Scotland. *Earth and Environmental Science Transactions of the Royal Society of Edinburgh,* **100**, 1–19, 2010 (for 2009)

3. Trewin, Nigel (Ed.). (2002). *The Geology of Scotland, 4th edition, pp 443-5.* The Geological Society.