

Cononish Gold Mine and Glen Orchy

Sat 12/4/14

Report by *Maggie Donnelly*

Participants: 13

On a somewhat damp and overcast day we met Chris Sangster, CEO of Scotgold, at 10 am at the Dal Righ car park (NN 285292) south of Tyndrum, and, as last year, were transported the two and a half miles up to the mine in two 'off road' vehicles, driven by Chris and an 'obliging friend', Rob Barbour of OUGS EoS. We were divided into groups of eight, kitted out with safety gear and given an introduction by Chris.

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 several safety torches, we were led inside. The diameter of the adit was about that of a Glasgow subway tunnel; it was dark, very wet, and rough underfoot as the ground, though essentially flattish, was strewn with coarse pebbles and cobbles from blasting operations.

We came to the 'leaking borehole', drilled for samples which demonstrated that the quartz breccia here was not a good enough quality for extraction, and then the Eas Anie Fault, a large vertical area of shearing which had shown 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°.

About 200 m further on was another 'leaking borehole', and beyond this, a quartzite marker bed cut off by a fault. We passed the large black lamprophyre dyke which had displaced the vein, so that the adit took a left turn, and continued for about 400 m until it was back into the vein. Finally, here, was good quality ore with abundant pyrite and minerals in the quartz breccia vein on the roof. Another indent in the wall was discoloured to a deep brownish, reddish pink by iron, an indication of thermal fluids bringing in the gold, and its particularly deep colour here suggested good quality gold-

bearing rock. 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.

In the process of mining, pipes about 20 or 30 cm diameter are drilled and explosively blasted. The broken rock is removed, crushed to a small size on site, treated by 'gravity separation' and then a frothing process, during which the 'pyrite with gold', as tiny particles, will sink to the bottom. In this way 25% of the gold is recovered. The remaining ore is sent off to a processing plant in Holland for the final extraction, and the resulting gold returned to Scotgold. One tonne of rock is required for 10 gm gold.....i.e. 2 gold rings!! Over time, a gallery of tunnels, with stoping, will be created throughout the vein, until all the 'gold rock' has been extracted. On our return journey out of the adit Chris pointed out the abundant 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 attempted to provide us with more information about the background geology, and the methods and history of mining precious metals in the British Isles. Unfortunately the rain came on and our 'briefing' was cut short!! One little gem gleaned last year was that Dr Geoff Tanner had produced a map of 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 settled down for lunch.

After a short introduction to the geology of Glen Orchy we drove north, and turned west into the Glen Orchy road, B8074, about 1 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; the rocks show 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 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 unconformity 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.

As we drove along, abundant glacial features of drumlins, breached moraines, kames and kettle holes were obvious on either side, while directly ahead of us loomed the Orchy Dome, and Beinn Udlaidh. After about 2 miles, locality 1, ~ NN 286373, we squeezed into a parking place for a closer view – the fold axis of the dome ran approximately northeast – southwest, the pelite beds were on the northwest side of the crag while the semi-pelite-psammite was dipping off the northeast side. There is a prominent quartz breccia dyke running through the Beinn in a northeast – southwest direction, an area of quartz-breccia, and a small knob at the end formed by an explosion breccia pipe. Unfortunately these features were difficult to discern through the mist high on the Beinn!! At about 1.7 miles further, locality 2, ~ NN 286373, below the Easan Dubha waterfall, there was a sizeable parking space beside the river...which, as a result of snow melt and recent heavy rain, was a raging torrent!! However, the Grampian psammite rocks on the banks could be clearly seen dipping to the northwest, and on the opposite bank, the upper half of a circular area of broken up material – one of the numerous explosive breccia pipes. We were fortunate to have Dr John Mendum of BGS in the party; he helped us in our attempts to find convincing evidence of the 'way up' of the rocks.

At locality 3, a further two miles on, there was another large parking area beside a sizeable expanse of water in the river below a set of rapids, NN 246326. We walked upstream along the bank through overgrown vegetation. It was *very* wet underfoot and the going was not easy, but the rocks were amazing!



We stopped numerous times to examine them on the bank, in the river and on the far side – they were composed of large, isoclinally folded beds of Beinn Udlaidh Quartzite.

We were 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. After about 400 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!! Thankfully the mullions were not submerged, as I had feared, and the company was suitably impressed. We spent a considerable time examining the rocks from every angle and taking photos. Our final bonus was cross-bedding in the quartzite which indicated that the beds were younging downstream, and that we were on the lower, right-way-up limb of the Beinn Udlaidh Syncline..

We made our way back to the cars, and drove further southwest to Locality 4, Iron Bridge and the Falls of Orchy, NN 243321, where there were amazing structures, and potholes, in the bed of the river.



We continued about another 200m downstream to a weir or dam where we hoped to find ‘z vergence’ in the bed of the river. However the water level was too high and the river broad; nevertheless some of the company were satisfied that the elusive ‘z vergence’ could be seen on the opposite bank. Altogether we had had a marvellous day of fascinating geology, and it was time to head for home. Many thanks are due to Dr John Mendum who was *not intended* to be a ‘leader’ but whose expertise and enormous assistance enabled us to interpret lots of the ‘little details’ hidden in the rocks.

References.

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4. Trewin, Nigel (Ed.). (2002). *The Geology of Scotland*, 4th edition, pp 443-5. The Geological Society.
5. Field Trip Report ‘Cononish Gold Mine’ Sat 24/8/13; *Proceedings of the Geological Society of Glasgow*, 155.