Lochaber 1st trip Fri 21 April – Mon 24 April 2017

16 participants

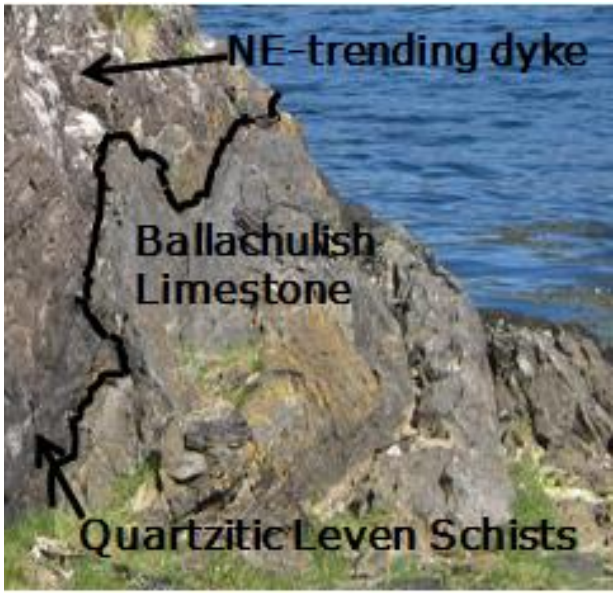
Fri 21 April, am

Report by Maggie Donnelly

We met in the car park beside the Ballachulish tourist information centre, around noon on a fine morning, and drove 2 km west to St John's church, NN 065 587, on the shores of Loch Leven, where we planned to locate the Ballachulish Slide, one of a number of 'slides' found in the west central Grampian Highlands. A 'slide' is now interpreted as a syn–sedimentary low angled fault which occurred in a basin prior to the opening of the Iapetus Ocean. Later, as the ocean closed and the land masses collided, this fault was reversed – the rocks came back up, but not as far as they had gone down, with the result that the stratigraphy indicates a normal fault but the sense of shear indicates a reverse fault. This Slide occurs within the Appin Group; the rocks exposed consist of the lower Leven Schists, the Appin Transition Formation and the base of the Appin Quartzite. All have been folded into a major recumbent nappe – the Ballachulish Syncline.

We walked about 200 m NW, crossing the road and making our way down to a small inlet beside a peninsula, and an exposure of phyllitic graphitic pelites with thin semipelite beds, NN 0669 5869, – the upper Ballachulish Slate Formation. This youngs to the southeast into the Appin Transition Formation and then into the basal Appin Quartzite, all of which lie on what was originally the upper limb of the Ballachulish Syncline. At the northwestern end of this peninsula there are thin beds of gritty quartzite, of the Appin Transition Formation. The bedding in the Slate and its penetrative schistosity strike northeast and dip steeply northwest, with the two planar surfaces having axial planar to tight folds which plunge steeply to the southwest. There is a marked stretching lineation (pyrite blebs and mica) pitching down the dip of the schistosity; the latter is folded by minor tight folds which plunge subvertically, with a mainly 'Z' geometry and an axial-planar crenulation cleavage.

The group then scrambled up and over the steep grassy bank (fighting through bushes and trees!) to the next inlet where, about 50 m to the southeast, NN 0665 5875, the rocks are black phyllitic pelites, with a more variable strike than previously, and more beds of gritty quartzite, up to 70 cm thick, towards the northwest. These are Appin Transition beds and again the penetrative schistosity is almost parallel to the bedding. They end at a NE-trending, 4 m-thick microdiorite dyke. Between this dyke and a second 5 m-thick dyke, there is a 10 m-thick unit of yellow-weathered, grey metacarbonate rock interbanded with millimetre- to centimetre-thick beds of dark semipelite – typical of the Ballachulish Limestone Formation. These NE-striking beds are locally strongly folded by steeply plunging minor folds displaying both 'S' and 'Z' geometries. The Ballachulish Slide occurs at the junction of the metalimestone with this western dyke, NN 0663 5882, and a few centimetres of platy quartzose schist outcrop over a distance of about 1 m to the west of it. The latter is interpreted as a slither of the basal facies of the Leven Schists, which occur over the remainder of the peninsula to the west of the dyke. The Leven Schists consist of quartz-rich psammite interbedded on a centimetre scale with ribs of semipelite; no way-up criteria have been established. One well-exposed minor fold has a plunge of 40° to the north-east and an 'S' geometry, but otherwise there are no well-developed minor structures.



The Ballachulish Limestone Formation lies in the core of the syncline and the Leven Schists on the upper limb – hence the 'S' geometry; both have been brought in by tectonic movement.

Looking north-east along the Ballachulish Slide (black line). *Maggie Donnelly*

Satisfied that we had achieved our aim, we returned to the cars and, with time against us, eating our lunch on the way!! We crossed the Ballachulish Bridge and stopped for a short time to take in the view across Lochs Linnhe and Leven to the Ballachulish Igneous Complex and the Pap of Glencoe. We then went into the old slate quarry on the north side for a good look round, before continuing to the Corran ferry. Although a brief sail it was beautiful and the scenery was magnificent. Once across we drove rapidly but carefully to the Silica Mine at Lochaline – our appointment there was for 4.30 pm.

Friday 21st April, pm

Report by Margaret Greene

Visit to Lochaline Silica Mine

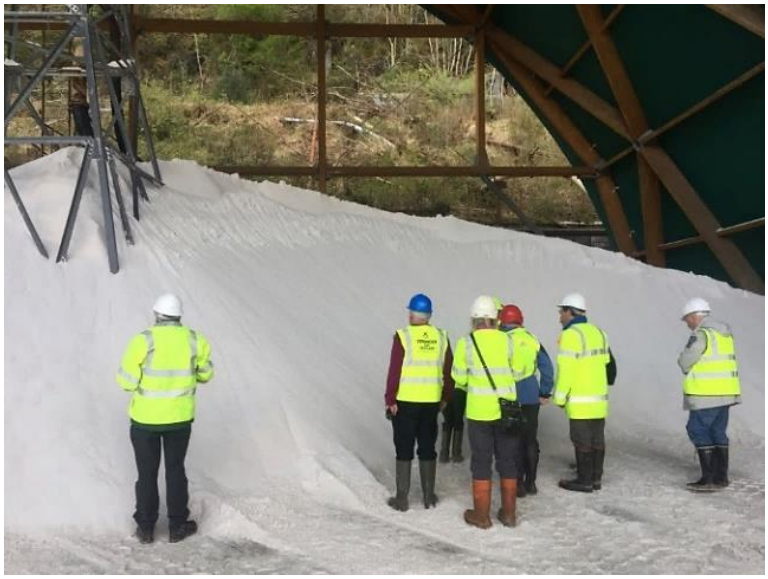
The white sandstone at the mouth of Lochaline has been quarried for building since the 19th century but it was only at the outbreak of the Second World War when the supply of imported sand was cut off that the mine was opened. In 1940 Charles Tennants & Co of London leased the mineral rights from Ardtornish Estate and production was managed by Charles Tennants & Co of Glasgow. The original manager and mine workers were recruited from the Ballachulish slate quarry. Tilcon took over the lease for the mine in 1972, then in 2001 Tarmac took over management and subsequently closed it in 2008. However it was reopened in 2012 by the present owner Lochaline Quartz Sand Ltd which is a joint enterprise between an Italian mining company, Minerali Industriali, and NSG/Pilkington, the glass manufacturers.

We gathered at the mine office to be given a short introduction to the mine by Veronique, the office manager, who also checked we all had the requisite high viz jackets, hard hats, and most importantly, torches. The mine produces very high quality silica sand with very little impurities. The sand is from the early Cretaceous, Greensand group, which is so named due to the greenish tinge due to the presence of glauconite. Above the level of the sandstone is a thick layer of Palaeogene lavas from the Mull igneous complex. There are two grades of sand produced by the quarry; LQS85 and LQS500. The numbers indicate the amount in ppm of iron. The higher level of iron content produces a slightly greenish tinge in the glass

The sand mine is the only underground mine in Britain and is mined in the room and pillar system. It is estimated that there is approx. 14 years of extractible sand left in the mine.

Once the introductions and safety information were issued we were led to the quarry by Diego, the mine manager, with Veronique taking up the rear. The entrance to the quarry is a large opening in the hillside – big enough for the enormous trucks which transport the sand out of the tunnel. We were led in with explanations on the height and width as well as the size of the pillars which are left to hold up the roof. The sand is drilled and blasted, then transported to the surface by trucks. There is a daily check on the air quality; there are a number of entrances as there are at least 14 miles of tunnels. Water also gathers in the mine and this is used in the washing process. The mine is crossed by faults and one of the reasons that the previous mining company closed was the presence of a large fault which meant a change in direction and depth of the sandstone.

When he considered we were deep enough into the tunnel Diego suggested we all turned off our torches to experience the total darkness which exists in the mine – quite an eerie experience.



Examining the silica sand drying under cover. *Jim Martin*

Once we returned to daylight Diego introduced us to all the processes which crushed and washed the sand. It was screened through mesh to ensure only the finest grains got though. The crushing machinery has recently been replaced and this has improved the production and profitability considerably. The sand is finally directed through spirals where the last of the impurities are removed.

The sand is constantly tested to ensure it is of the right quality, either LQS85 or LQS500. Diego has had constructed large covered sites, where the sand is stored before it is loaded into the boats which pull up at the adjacent pier. These covers have ensured that the sand is dry for transfer into the boats. Diego has improved the quality and production of the sand tremendously by his innovations and as such has kept his rivals at bay.

Saturday 21st April, am
Report by Muriel Alexander

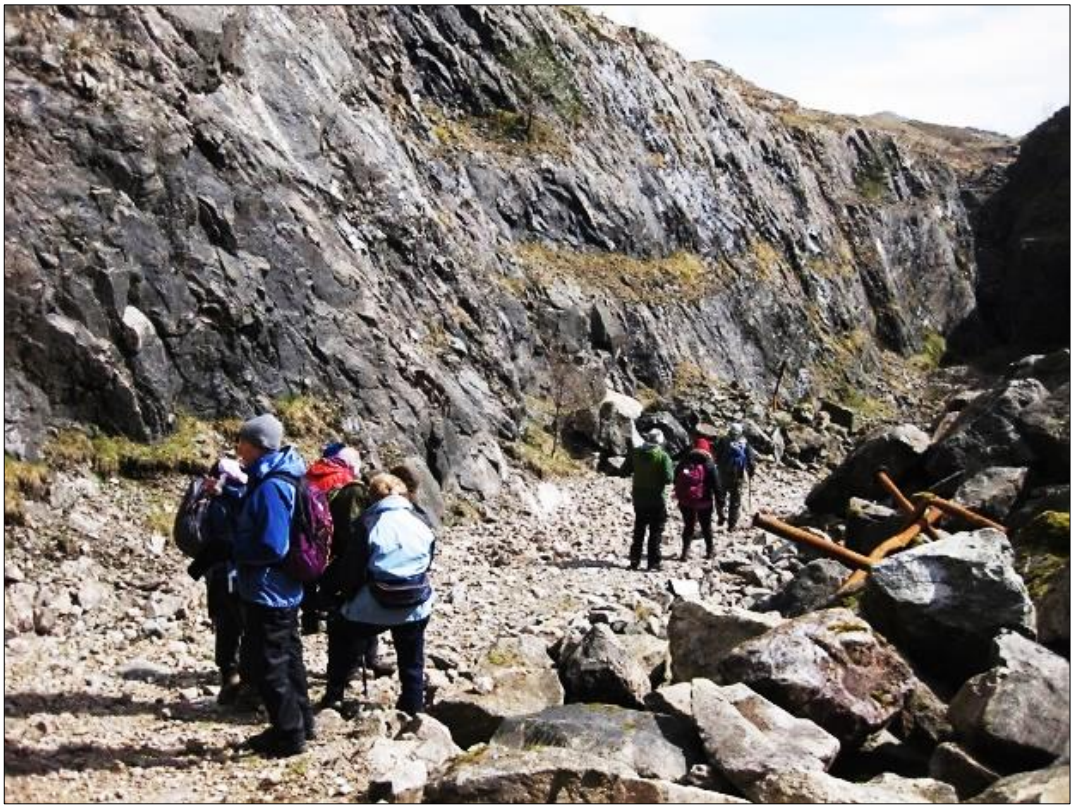
After an enjoyable breakfast we gathered at the Strontian Hotel, sorted out transport and set off northwards towards the hills, following the road through the Ariundle Oak Woods behind Strontian. Our objective was to explore the Strontian mines. Our first stop was at an area where we could inspect outcrops of granitic country rock, identifying the pink and white feldspars and hornblende along with darker xenoliths, perhaps of a basaltic origin.

On driving further up through the forest we next made a stop near the demolished Bellsgrove Lodge where we noted a water adit draining the mines, and a settling pond in use when the barite was mined for a few years in the 1980's. The road now opened out onto bare hillside and from our exposed parking place we could look across and slightly up the valley

to see much evidence of mining on the hillside and, in the distance, the abandoned buildings of several of the mine workings. Close to our parking place we found a very old mineshaft through the granite and could trace the evidence of the mining from there across the hillside to the buildings and beyond.

Mining in the area started in the 18th Century and was initially based totally based on galena (lead ore) with other minerals such as sphalerite (zinc ore) being identified later. However, profitability was poor and many companies opened their mining activities only to collapse after a short period of time. The mineral strontianite, from which the element was isolated, was also found in the veins and named after the local village. Barite also in the veins was originally put onto the spoil heaps but was more recently found to be useful in North Sea Oil drilling and thus was mined from 1983 for a limited period of time.

We then set off to walk up to the mines identifying the deep, now collapsed shafts and adits of the 18th Century mines. We moved on to the more recent strontian/barite mine which was opencast, but since 1986 was no longer in use. It was wide and sloped quite steeply downwards to an old adit at the end. Here we identified many examples of galena, sphalerite and barite of the vein, cutting through the granitic rock and were able to pick up some good samples. After a short beak we crossed over to the yard where the remains of the processing plant stood and which was now littered with discarded rusted equipment. At the back of the yard an adit with railway lines running into it led straight into the hill, but it was now totally collapsed.



The more recent opencast strontian/barite mine.
Maggie Donnelly

Having enjoyed exploring the mines it was now time to return to the cars and head to the seaside for the afternoon.

Saturday 21st April, pm
Report by Maggie Donnelly

In early afternoon we drove east along the A861 and turned southwest along the B8943 coastal road, parking at a farm near Kilmalieu, NM 897 558. We were now standing on a raised beach, one of several in the area, created during and since the end of the last ice age. We were close to the centre line of the Great Glen Fault, active since 450 Ma with initial sinistral movement of about 200 – 300 km between 430 and 400 Ma, followed by later dextral movement of 25 – 30 km, post-Devonian. Note, however, that different sources provide different displacement distances.

Prevented from crossing the intervening field by a large herd of cattle, we took the long way round on the coastal path to the southern end of the bay and onto the flat rocks below a high cliff face. Beneath our feet were metamorphic rocks of the Loch Eil Group, the youngest group of the Moine Supergroup – psammite (metamorphosed sandstone) and semipelite (metamorphosed mudstone). There was a sizeable intrusion of granite pegmatite, emplaced via a fault. Continuing across the rocks to the cliff, Rubha na h'Earba, NM 908 555, we could see a distinct change – on top of part of the Moine was a large lithified deposit of angular pebbles and cobbles. This was the Basal Devonian Conglomerate, deposited during flash floods in a desert environment.

The unconformity between Moine rocks and Lower Basal Devonian Conglomerate.
Maggie Donnelly

At its base was a significant unconformity, lying at a steep angle up the slope – quite spectacular! We spent time examining this and the fallen rocks while taking photos. Further along the grassy and rocky shore to the south, up dip towards younger rocks, it could be seen that the depositional environment had become less energetic with time as the clasts in the conglomerate became progressively smaller and finer.

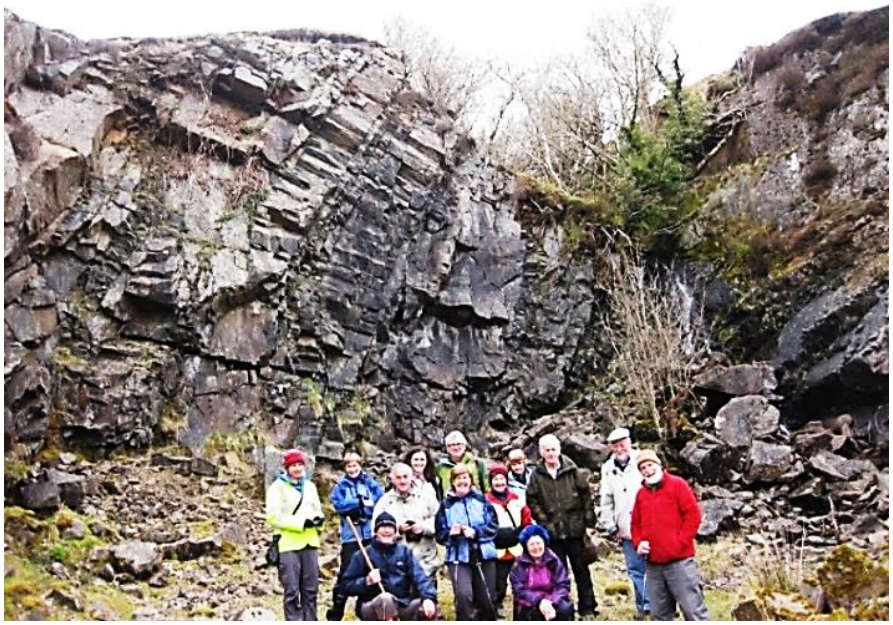
We were informed that the coarse basal sediments were derived from the Moine rocks to the north (the Northern Highland terrane) while the finer sediments at the top came from the Dalradian rocks to the south (the Grampian Terrane).

By now the ground was getting very rough, and at least one member dropped out, to sit on the rocks and take in the view. Soon the weather deteriorated and so a number of others turned back to the sandy beach, leaving a few to continue along the Lower Devonian rocks. Their persistence was rewarded when they successfully found a lamprophyre dyke of the Ardgour swarm, Permo-Carboniferous, 300 to 290 Ma. Back at the cars we continued southwest along the raised beach and up through the valley, (a challenging road!) with abundant glacial features, via Kingairloch. When we reached the A861 some of us turned towards Lochaline and took the road west towards Drimnin for about 5 miles. On the right hand side of the road beyond Funary was an obvious wall of rock about 20 feet high with a large hole through it. We stopped for a closer look. This was a Palaeogene dyke, known as the "Wishing Stone" – its horizontal columns could clearly be seen and some had fallen out creating the hole; we took lots of photos. Returning past Lochaline we parked beside a large road cut through an outcrop of dark olivine dolerite. Several pale green olivine crystals were found both in the rock face and in the loose material lying about. Finally, we made our way back to the hotel.

Sunday 22nd April, am & pm

Report by Maggie Donnelly

On a sunny morning, we drove east from the hotel on the A861 for about a mile and parked beside the beautiful shores of Loch Sunart. Making our way down onto the pebbly beach we came to an outcrop of Strontian granite with a number of 'dark patches' throughout, very similar to the exposure we had seen at our first stop on Saturday. As yet there is no definitive interpretation for these. They may be xenoliths, or perhaps small basic intrusions; their edges are ill-defined suggesting partial melting, and all are aligned in a north-south direction. We continued on for three or four miles, following the road towards Lochaline until, rounding a bend, our leader pulled over in a space at the roadside. We walked back a few paces to a huge quarry previously hidden by the bend and made our way in. As usual, everyone was thinking to themselves 'What **am** I looking at?' We were faced with an immense black outcrop and it took a minute for us to realise that we were staring at a series of huge dykes, all side by side with no intervening country rock, such that some of them looked like composite dykes. The granite, with large red feldspar crystals, into which they had been intruded, could be seen on either side of the quarry. We tried to count them and all came up with a different answer! There must have been about eight or ten. These dykes may be at least in part lamprophyre and, although their exact age is uncertain, are thought to be part of the Ardgour Dyke Swarm, *ca* 290 Ma. They may represent intrusions associated with the movement of the Great Glen Fault. We had great fun looking about for samples of 'dyke/granite contact'.



Our group in the amazing dyke quarry. *Maggie Donnelly*

Driving on, we arrived at the Rahoy junction where we examined an unconformity between Permian red sandstone and the underlying Moine schist, sparkling with abundant Muscovite in the sunshine. We then walked a short distance up a forest track cut into Jurassic limestone pavement containing *Gryphea* fossils. These are the Broadford Beds, deposited with the Pabay Shales, and have been protected from erosion by the overlying Tertiary flood basalts. This is a protected site – no hammering and its location is generally not publicised for its own preservation. A roadside cutting further on contained rocks also protected by the Tertiary lavas – the Stornoway Formation. They are dark red thermal Triassic and Permian sandstones and nodular limestones and are composed of a mix of poorly sorted clasts. In some places they appeared unstructured while in others large-scale crossbedding could be discerned.

We arrived at the Ardtornish Estate and walked a little way along the coastal track to have lunch beside the beach – and in the drizzle! – before continuing to the "Fossil Burn" on the east shore of Lochaline.

In the burn we found hard Jurassic limestone pavement, abundant with fossils in its bed, on its banks and on its many scattered boulders. By now we were walking along the base of huge 'Morvern lava' cliffs, and beside basaltic boulders which had tumbled down the slope. Many of these had clearly polygonal shapes and had obviously originated as basalt columns on the hill above.

Basaltic boulders with clearly polygonal shapes.
Maggie Donnelly

Finally, we came to the path up to "Tennyson's waterfall" which flows over basalt terraces. The hardy and intrepid members of our party set off and completed the climb; the less adventurous decided to avoid this challenge and had a leisurely stroll back to the cars. After we had all returned we headed back to the hotel for dinner and a well-earned rest.

Monday 24th April, am
Report by Jim & Lynne Martin

Twelve of us boarded the 10:00 Corran Ferry and met our leader and Breach (handsome Border terrier) at the Holly Tree Hotel Kentallen. After coffee, we crossed the busy A828 and ascended the Malcolm Shepherd Way to the viewpoint where Lochaber Geopark information panel gives a comprehensive description of the geological aspects of the location and its environs.
Panel 22 can be viewed on the following web page:
http://lochabergeopark.org.uk/explore-lochaber/rock-routes/

The surrounding rocks are Kentallenite. They are creamy coloured with a rough texture due to their olivine crystals having been weathered out. Kentallenite is a course grained igneous rock "of unusual chemical composition. It is rare to find pyroxene and olivine, rich in magnesium, in a rock with large amounts of potassium feldspar". A nearby erratic was determined to be an explosive breccia displaying fragments with flow patterns evidenced by streaked vesicles.

reference

1. Excursion Leader's Handout – Dr. Con Gillen.
2. GCR Dalradian volume, PGA, vol. 124, no. 1-2, 2013.
3. Trewin, Nigel (Ed.). (2002). *The Geology of Scotland, 4th edition, pp 443-5.* The Geological Society.