
4 The Cheviot—early Devonian rocks, granite and basement

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Purpose

To examine the rocks of the Cheviot volcano, including the basement beneath it, the granite and other intrusions, and the associated hydrothermal alteration and metamorphism.

Logistics

There are two excursions, each comfortably done in a day. The first is along Harthope Burn, the second in Upper Coquet Dale. Both are primarily along roads suitable for minibuses, but with some localities up to 4 km away from the road.

Approach Harthope Burn either from Wooler or the A697 some 4 km south, following the signs to North Middleton. Access from Haugh Head on the A697 is not recommended because of a dangerous ford. Make for Middleton Hall, turning onto the single track road signposted to Langleeford. The road is mostly unfenced. It can be used only as far as Hawsen Burn [NT 9532 2252].

Reach upper Coquet Dale either from Alwinton [NT 9210 0630] or the A68 at Cottonshopeburn Foot [NT 7804 0157]. From the A68 to Makendon [NT 8036 0932] is a military road and access may be barred when the artillery range is in use (check with the Army at Otterburn). For geological convenience this excursion, which is on unfenced, single track public road, is described from west to east.

Maps

O.S. 1:50 000 sheets 75 Berwick-upon-Tweed, 80 Cheviot Hills & Kielder Forest, 81 Alnwick & Morpeth; B.G.S. 1:50 000 Sheet 5 The Cheviot.

Geological background

The Cheviot volcano was erupted during the early Devonian period just to the north of the Iapetus Suture, the boundary between the Laurentian and Avalonian continents that marks the site of the Iapetus Ocean. The first outpourings of this subaerial volcano were of agglomerate and breccia which rest unconformably on a basement of folded sedimentary rocks of Silurian age, but most of the volcano consists of andesite lavas. Rhyolite lavas and thin interlayers of tuff are uncommon. Towards the end of its life granite was intruded into the central vent of the volcano. This is a zoned intrusion and, unusually for a granite, it contains the mineral pyroxene. There are many dykes, sills and laccoliths, which intruded the lava pile either while it was being built or soon after. The country rock adjacent to the granite was thermally metamorphosed during its emplacement, but also associated with it was a phase of intense hydrothermal alteration, locally involving the formation of the mineral tourmaline.

On the Scottish side, the volcanic rocks are overlain by Upper Devonian sandstones, but in Northumberland they are overlain by the Lower Carboniferous Cementstone Group, a cyclical sequence of sandy mudstone, shale, cementstone, dolomitic limestone and sandstone. Basaltic lavas occur at the base of the Carboniferous succession and within the Cementstone Group. In places, there is a basal Carboniferous conglomerate containing cobbles and boulders of andesite and granite. The latter indicates that much of the volcano, perhaps three quarters of it, had been eroded to unroof the granite intrusion before the conglomerate was laid down.

The Silurian sedimentary rocks forming the basement are tightly folded, but the lavas, though tilted gently to the east, are not folded. Many faults and shatter zones cross the volcanic terrain, including a major one along Harthope Burn, traced for 20 km.

The next major event in the area was the Quaternary glaciation. The hills were covered in ice during the late Devensian and remnant spreads of till are common. There are vast expanses of peat bog and head, immediately post glacial in origin. Alluvium and alluvial terraces occur in the valleys.

Rock exposure in the Cheviots is sparse, presenting severe problems for reconstructing the geological history. Thus it is important to accept that there may be other interpretations to those given here.

Excursion details

Harthope Burn

Locality 1, Careyburn Bridge [NT 9747 2501]

Park on a grassy area just before the bridge and follow the footpath along the north side of Carey Burn. In the first 300 m three alluvial terraces are clearly seen on the north side. At the first stile the small valley to the north cuts through till plastered against the lowest slopes of the hillside.

Locality 2 [NT 9698 2508] about 150 m upstream of the island in Carey Burn is the first exposure of solid rock

It is a dark purplish grey, splintery porphyritic andesite with small phenocrysts of white feldspar and dark pyroxene. The valley narrows just beyond here. There is plenty of rock on both sides, but the main rock types can be seen in the numerous screes along the path. Besides the dark purplish grey andesite, there is a common variety with big white feldspar phenocrysts (up to 1 cm long) and smaller pyroxene phenocrysts in a fine-grained reddish buff groundmass. The burn crosses the metamorphic aureole of the Cheviot granite and many of the rocks show signs of metamorphism. Feldspar phenocrysts are replaced by yellow epidote and the pyroxenes by pale green tremolite or dark green chlorite. There are often small crystals of black, flaky biotite. Spots of yellow epidote and patches of green chlorite occur in the groundmass.

Locality 3 [NT 9638 2553] is a waterfall in the burn

Solid rock is exposed for about 200 m below it. The geological map shows many dykes in this area. They are difficult to recognize and in the Geological Survey memoir the authors confess that sharp, intrusive contacts are rarely seen. The top of the waterfall consists of dark grey andesite, the bottom is a reddish buff fine-grained porphyritic rock, which may be one of the dykes. The contact between the two is not at all clear.

Locality 4, Hawsen Burn [NT 9532 2252]

It is prohibited to drive beyond here. There is ample space for parking above and below the bridge and a turning area about 100 m beyond it. The burn runs along the contact between granite and country rock. Follow the stream itself, not the path parallel to it.

The first exposure is pink microgranite about 300 m up. A further 50 m beyond, a very small exposure in the stream shows a sharp contact between pink microgranite and dark purplish grey porphyritic andesite. This illustrates the nature of this contact, which is a complex series of dykes and veins of microgranite penetrating the andesite.

Locality 5 [NT 9501 2281] is 10 m beyond the first tributary coming in from the north

An exposure of andesite shows many features of contact metamorphism — close joints, splintery when struck, small dark spots in the groundmass. Upstream from here exposures of microgranite and andesite alternate.

Locality 6 [NT 9473 2296] is about 200 m below a circular, stone sheep fold

A big boulder of quartz with haematite stringers is in the stream adjacent to a breccia separating microgranite from rotted and quartz veined andesite. Veinlets of black tourmaline are in the microgranite. This locality marks the site of a

west-northwest fault that is roughly coincident with the granite boundary.

Locality 7 [NT 9456 2302] is about 50 m below the sheepfold

A denuded patch of hillside, 3 m high, immediately above the stream is deeply hydrothermally altered, rotten andesite with 3 cm thick veins and stringers of tourmaline and lumps of massive epidote. This altered rock continues upstream adjacent to a crush zone first seen too m beyond the sheep fold. Two crush zones intersect here. A wall of breccia trending east–west stands at the foot of a steep slope which consists of crushed andesite up to 2 m wide with north–south quartz veins. Tourmaline, crystalline quartz, haematite and limonite are abundant. These crush zones are common in the Cheviots and are always associated with hydrothermal alteration.

Climb up to the footpath to return to the road. From there, the prominent Hausey and Long Craggs on the east side of the Harthope valley to the southeast are roof pendants of hornfelsed volcanic rocks resting on granite. These, and a roof pendant of volcanic rocks actually on The Cheviot show that the exposed granite is the roof zone of the intrusion.

Walk along the road to Langleeford, then the track on the north side of the burn.

Locality 8 [NT 9450 2168]

Near the edge of the wood on the north of the track is the first exposure of granite in the burn. It is pink and medium grained with pink feldspar, translucent quartz and black shiny flakes of biotite. There are 1 cm thick veins of sugary-textured aplite and 23 mm thick veinlets of black tourmaline. The granite intrusion has been divided into three main components arranged more or less concentrically. The Marginal Variety is not easy to access, but the Granophyric Variety of the next zone in is the one exposed here and for the next 2.5 km along the burn. It is a true granite in composition.

Locality 9 [NT 9333 2089] is at the gate across the track above Langleeford Hope

On both sides of the valley there is a spread of till. Looking south the spread ends where the hillside suddenly steepens. The till forms scarp faces along the burn, indented by landslides and their scars. This is the principle mechanism of erosion of the till sheet, the slipped material being dumped into the stream and carried away to be redeposited in the alluvial floodplain. A secondary process is solifluction, forming terrace-like features commonly described as sheep tracks. These are best seen upstream of the farm.

Locality 10 [NT 9279 2029] is the first waterfall in Harthope Burn

The contact between the Granophyric Variety and the Standrop Variety at the centre of the intrusion occurs in this area. Fine to medium-grained granophyric biotite granite occurs in the falls, containing areas of blotchy porphyry that have been described as volcanic xenoliths. Above the falls, near the stone sheep fold, the Standrop Variety appears. This is an even, medium-grained rock rich in dark minerals. Compositionally, it is a granodiorite and the commonest dark mineral is the pyroxene diopside. This rock continues upstream for some distance.

Upper Coquet Valley

Locality 1 [NT 8059 0952]

Silurian basement is exposed at the bridge over the River Coquet about 350 m northeast of Makendon. Park at the bridge to traverse down-stream to Fulhope. A couple of metres below the bridge, in the left bank, is an anticline in interbedded greenish-grey silty mudstone with beds of fine sandstone up to 30 cm thick. The fold is open, upright and the axis trends 290°. A good, vertical axial plane cleavage is present in the silty mudstone, but not in the sandstone. A few metres upstream of the bridge, on the right bank, are several sandstone beds in silty mudstone. The sandstone units, up to 1 m thick, contain thin mudstone seams indicating they are composite beds. The medium to coarse-grained sandstone is composed of poorly sorted, subrounded to subangular grains of quartz, feldspar, rock fragments and dark minerals (?pyroxene), visible with a hand lens. Compositionally, it is typical of greywackes. Most of the greywacke beds here are

massive (i.e. structureless), but some are faintly laminated and one or two show flute casts and load structures on the base indicating that the beds are the right way up. No fossils have been found here, but the rocks are thought to be Silurian in age.

Exposure continues downstream, the rocks striking roughly east–west and dipping steeply south. At intervals groups of several greywacke beds, 15–40 cm thick occur.

Locality 2 [NT 8100 0984] is a big meander after a long straight stretch

Thin beds of laminated greywacke in greenish-grey cleaved silty mudstone dip south at the first bend, but north at the second. Close examination will reveal a 4 cm thick dark sandy bed which has filled small channels scoured into the top of a paler grey laminated sandstone bed. The tops are to the south showing that these beds are overturned.

Locality 3 [NT 8111 0992]

In a steep, rocky slope behind a wire fence above the stream is the base of the volcanic succession. The grassy slopes on the west contain debris of Silurian rocks. Clearly overlying these is a volcanic breccia, the first eruption of the Cheviot volcano. The base of the breccia and surfaces that appear to be bedding within it dip about 15° northeast, proving the unconformable relationship with the tightly folded Silurian basement rocks. The breccia is made up of rubbly angular to subangular clasts, mostly of acid volcanic rocks from a few cm in diameter to over 1 m, set in a very fine-grained pink recrystallized clastic matrix. A careful search will reveal some Silurian clasts in the breccia. This lowermost unit in the volcanic pile is 30 to 60 m thick hereabouts.

Locality 4 [NT 8167 1017]

About 200 m above Fulhope, is an exposure of deep purple rhyolite (or mica-felsite) with small phenocrysts of white feldspar and less common black biotite. The rock is severely altered to limonite. A prominent subhorizontal platy jointing, 1–3 cm apart, is sometimes filled with quartz veinlets. This is a primary feature caused during cooling of the lava flow. The rock weathers dark grey. Looking back, a line of small exposures of it can be seen at the base of a step feature that can be traced for several hundred metres west, overlying another step feature formed by the basal breccia.

Locality 5 [NT 8240 1078] is an old, small quarry at the start of the path along Buckham's Walls Burn

Park on an area of hard standing near the bridge. The rock is typical andesite, dark purplish grey with large white feldspar and small pyroxene phenocrysts, and clots of dark minerals. It is a massive, structureless rock, but it is closely jointed. The joints are planar on the west but curved, convex to the southeast, on the east. This phenomenon often occurs parallel to the base or sides of a flow.

Locality 6 [NT 8307 1087] is in the stream opposite the houses at Blindburn

In the waterfall just downstream of the houses and in exposures upstream is volcanic breccia. The rock consists of matrix-supported angular to subangular clasts, mostly of green andesite up to several tens of cm in diameter. The matrix is greenish grey, fine grained and full of small, irregular shaped, chlorite-filled amygdales. Rock the same as the matrix occurs alternating with exposures of deep purple andesite downstream to the junction with Gable Burn [NT 8342 1105]. Units of breccia and finer-grained tuffs occur throughout the andesite pile. They have not been studied in recent years. At Blindburn the textures visible in outcrop suggest the rock might be a pyroclastic flow breccia rather than an air-fall deposit.

Locality 7 [NT 8919 0649], at Linbriggs, is the best of the many exposures of andesite in the river

Park near the farm buildings and start with the roadside exposure on the east side, about 30 m south of the bridge. At the southern end of the exposure is massive, purplish grey porphyritic andesite, which passes northwards into finely brecciated, amygdaloidal rock marking the top of the flow. Above and to the north is a second flow of rubbly andesite. This rock is purplish brown and highly amygdaloidal with epidote and chlorite-filled irregular vesicles. Blocks and 'pillows'

are set in hydrothermally altered, rotted andesite, but the flow has a core of massive rock some 6 m long and 2.5 m high. In the gorge, upstream of the bridge, the general southerly dip to the pile of flows is clearly seen. Good, polished exposures of amygdaloidal and flow-banded andesite are present in the river bed.

Locally 8 [NT 9040 0648] is a cattle grid 1.5 km beyond Alwinton

The southern boundary of the Cheviot Volcanic Group is faulted. The road from here to Linbriggs is close to and parallel to the fault. Small craggy exposures in the steep hillside on the north of the road are andesite. On the southern side of the Coquet valley, on Barrow Scar, subhorizontal, well-bedded Carboniferous rocks are clearly visible (Excursion 9). Note at the eastern end of the exposure the prominent upper limestone bed has sagged as a result of landslipping. The fault can be positioned to within a metre in the stream running down to the road here from the north. Here, about 50 m from the road, a small exposure of sandstone is a metre from andesite.

[Bibliography](#)