

Carlops and Habbie's How

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Carlops lies on the very western tip of the Midlothian coalfield, exposing sediments of mid-Carboniferous age. These are faulted against the Pentland Hills and some of the deformation associated with the Pentland Fault is exposed. The landscape includes superbly developed channels interpreted to be of sub-glacial origin including the gorge of Habbie's Howe.

Logistics

There is a small carpark at the west end of Carlops, and limited parking along the minor road to Kittleyknowe. Habbie's How (a glacial channel running to the east and south of Carlops) is a Local Geodiversity Site for Midlothian, though as the country boundary runs along the valley, one half is in East Lothian.

The Pentlands fault separates the uplifted lower to mid-Palaeozoic sediments from the Carboniferous basin to the southeast and east, and supposedly has a reverse geometry. The fault itself is not generally exposed but here at least some of the associated 'damage zone' can be inspected. A granule conglomerate exposed within a few 10's of metres of the assumed line of the fault could be interpreted as a basal conglomerate to the onlapping Carboniferous sediments, now generally removed by erosion on the Pentlands side of the fault. The overlying Carboniferous sediments include limestones developed within a few hundred metres of the fault, suggesting that the Pentlands area was not always exposed at the time of deposition. The limestone and formation names are taken from the [BGS Geology Viewer](#).

Both Carlops and the south side of Habbie's Howe are in the Scottish Borders Region, however they have not been described as a part of this region, and so are included here. The glacial features on the Borders' side of the boundary are described on [BGS Earthwise](#) as an excursion from Carlops to Dolphinton.

W	Coal Measures	Upper Coal Measures	
		Middle Coal Measures	
		Lower Coal Measures	
N	Clackmannan Gp	Passage F ^m	
		Upper Limestone F ^m	
		Limestone Coal F ^m	
V	Strathclyde Gp	Lower Limestone F ^m	
		West Lothian Oil-Shale Formation	H
			C
		Gullane F ^m	
T	Inverclyde Gp	Clyde Sandstone F ^m	
		Ballagan F ^m	
		Kinneswood F ^m	

Table 1: Carboniferous stratigraphy of East Lothian; Gp = Group; F^m = Formation. The red bar indicates the approximate age of the exposures. From Browne et al. (1999). W = Westphalian; N = Namurian; V = Visean and T = Tournasian; C = Calders Member; H = Hopetoun Member.

1: Early Devonian lavaflow in Carlops Quarry car park.

The c. 10m high cliff in the small carpark is unmissable, despite the barriers that prevent close examination of the main face (NT 1612 5589). Rock is available for close inspection in a quarried alcove to the left, though finding a clean surface is a challenge. The margins of the body are not exposed, but it is mapped as a fault-bounded sliver of lava of 'Lower ORS age' by the BGS (Sheet 24 'Peebles', 1954 reprint). Both this map and the [BGS Geology Viewer](#) also show a NNE-trending dyke some 10's of m to the E of the car park, that is curiously identified as being a tholeiite of Paleocene age on the [BGS Geology Viewer](#).



Fig 1: Lavaflow in Carlops Quarry carpark

The corresponding cliff on the opposite (W) side of the road is less obvious. The gap between the two cliffs has been enlarged to accommodate the road, so isn't natural. The village of Carlops lies in a north-south oriented channel, the banks of which are just visible behind the houses. The channel does not carry a stream at present but joins the North Esk river just to the north of the village. As the other channels in the area are interpreted to be of sub-glacial origin (Sissons, 1963), so presumably is this section.

3: Overgrown Limestone Quarries

Leaving the car park turn left and left again though a community area (looks initially like a private car park) to gain the minor road to Kitleyknowe. The road runs down a flat-floored channel with steep sides and a small stream, which is typical of the other channels in the area.

The road passes 2 very overgrown limestone quarries on the right hand side (south) in the Hurlet limestone, which marks the base of the Lower Limestone Formation (NT 1660 5584 and 1667 5589). There are loose blocks of a brown sandstone which probably overlay the limestone in the first of these, but electric fences make close inspection uninviting. There are also old quarries out of sight to the south of the road with no public access. The 1856 OS map shows a working face c. 250m long, but modern satellite imagery shows only a relatively small remaining depression.

Continue along the road to the hamlet of Kitleyknowe, where the surfaced road takes a bend to the right (NT 1703 5595). Habbie's Howe is down the left-hand track, but there are 2 worthwhile locations that can be visited first if time allows.

4: Quarry in fluvio-glacial sands

Take the unsurfaced road east (straight on) for around 500m, when a disused quarry becomes visible on the right, opposite ruined buildings (NT 174 561). The cliff face is c. 10m high, and exposes pale yellow, poorly consolidated sands with well-developed crossbeds and occasional dark shale interbeds. The sands are mapped as fluvio-glacial by the BGS. As the sands lie topographically above the meltwater channel of Habbie's Howe, it is difficult to see how deposition could have taken place while the channel was active. The sands must therefore pre-date the cutting of the Habbie's Howe channel.



Fig. 2: Cross bedded sands

The sands have a nodular calcite cement which is more resistant to weathering than the surrounding sandstone. The nodules are clearly of diagenetic origin, but detailed study would be needed to throw light on their origin.



Fig. 3: Cemented interval, pen for scale at the top

5: Pulpit Rock or Harbour Craig (NT 177 560)

Return to the cross roads at Kitleyknowe and turn south. The metalled track soon becomes unsurfaced, and bends to the right (SW; NT 1714 5571). Go straight through the gate on the bend, from where a ruined stone building is visible some

600m away on a bearing of 100°, a useful landmark. Follow the field boundary to the SE and bending around to the NE. Go through the field gate on the right (NT 1734 5577), cross the Back Burn on a small bridge and follow the small path along the deepening gully to the left (NE then E).

Sporadic exposures of sandstone are worth examining though the state of these depends upon minor landslipping and wash from above. A waste tip from a disused coal pit is exposed in the banks of the burn at NT 1742 5588. There are numerous other disused shafts in the surrounding area. Around 10m further downstream is c. 5m of pale poorly consolidated sandstone with SW-directed cross beds, though the cliff is so flat that an accurate reading is tricky (NT 1743 5588). The sandstone is fairly well sorted but has a scattered white clay matrix that may be infiltrated kaolinite.



Fig. 4: Cross-bedded sandstone in Back Burn.

The exposures show that the sandstone is at least 10 - 15m thick and extends for at least 100's of m laterally. The erosive base may be exposed at a small overhung exposure in the left bank at NT 1750 5596 where a coaly-shale is exposed. Other scattered exposures suggest that the stream has cut to around the base of the sandstone at the E end of the gully.

The topography of the lower reaches of the gully are marked by irregular hollows and mounds and may owe more to exploration and the exploitation of coal than to natural processes. There is the orange ochre associated with acid mine drainage at NT 1788 5605.

The Back Burn gully opens out into the channel of the Harlawmuir Burn after c. 500 m, with Harbour Craig on the right. It is claimed that [Covenanters](#) held their open-air conventicles at this rock in the

1600's, hence its alternative name of Pulpit Rock. There is historic 'grafitti' here, do not hammer. This is a medium – course grained sandstone in the Limestone Coal Formation, with a cross-bedded lower section and a more parallel bedded upper section which weathers into a distinctive undulating surface.



Fig 5: Pulpit Rock

What may be the same sandstone is exposed further south, at a prominent spur that deflects the Harlawmuir burn eastwards (NT 1788 5576). What appear from a distance to be large loose boulders all dip the same way (40 / 260°) so are in-situ. The bedding is similar to that of the upper sections of Pulpit Rock, but are topographically lower. The steep dip could be due to rotational slipping into the Harlawmuir channel (though there is no obvious topography to support this) or fault drag assuming that the channel follows a N-S fault here.



Fig 6: Steeply-dipping sandstones

There is a surprisingly well-constructed track down the spur, which ends at a c. 50m long, flat-topped section that could be an overgrown spoil heap.

6: The Talla Aqueduct

A worthwhile diversion is to walk back E then S and SE along the W edge of the channel carrying

the Harlawmuir Burn for almost another 1km to NT 1810 5514, which gives a superb view of a meander in the channel.

Also visible from here are features associated with a remarkable feat of underground engineering, the Victorian [Talla Aqueduct](#). Note that to an engineer, an aqueduct is not just a bridge carrying water, but is any channel that carries water.

The Talla Aqueduct runs from the hills of the Borders to the city of Edinburgh, running largely in tunnels with a gradient of c. 1:4000 for 45km ([New Civil Engineer](#)). A ventilation shaft, two small concrete sheds that probably held explosives, and a spoil heap are visible. It appears that the tunnel housing the aqueduct was here dug by driving a shaft down to the desired depth, and then driving the tunnel horizontally, presumably to meet up with other sections. A stone-built pillar on the E side of the channel was for surveying the route of the aqueduct. The line of the largely-subterranean aqueduct is marked by such towers in areas of difficult topography.



Fig 7: Ventilation shaft cover for the Talla Aqueduct

If the burn can be crossed (there is a handy stepping stone 5m N of where the wire fence crosses), then 10m N of the concrete sheds is an exposure of c. 1m of thinly bedded sandstone with silty or shaley partings (NT 1818 5523). Coal is present as fragments at the N end. Further N on the same E side of Harlawmuir Burn (NT 1817 5532) is c. 2m of shale (badly weathered) with at least 2 lines of siderate concretions, overlain by flaggy then more massive (c. 1m) bedded sandstone, with a cumulative thickness of 5+ m. The sequence is an overall coarsening and thickening one, typical of prograding small deltas or meandering river channels.



Fig 8: coarsening and thickening sequence

The return to Kitleyknowe is best performed by retracing the outwards route as far as the ruined building. Walking back along the base of the channel is surprising wet and difficult, and not recommended. From the ruined building, a short cut can be taken along the wire fence (do not cross this) NW-wards to the small bridge over the Back Burn.

7: Hopetoun Member Lava Flow

Back at the Kitleyknowe cross-roads, take the unsurfaced track to the north, pausing to admire the sandstone gateposts. Follow the track then through the right-hand gate at NT 1690 5623. Note on the descent a small exposure of flaggy sandstone on the right (NT 1691 5626). While the exact angle of the bedding is tricky to ascertain, it is clearly steep with an 040° strike.

At Mill Bridge, the stratigraphically lowest exposure, the lava flow in the Hopetoun Member, is visible c. 300m to the NW. If the burn is easily crossable, this can be accessed by walking on the S bank, crossing and gaining the field with the exposure. If the burn cannot be safely crossed, then a diversion is needed as the way along the N bank of the burn is blocked by fallen trees, and is in any case steep and loose. For those who are determined, follow the main track as it climbs to the east, until just before this gains level ground (NT 1700 5636) and turn left along the top of the gorge on a good track. Just before this passes through a gate (NT 1689 5648) leave the track and

descend a steep ridge with signs of a path, from where the field with the exposure can be accessed. Many may decide this diversion is unwarranted, and a search of the bed of the burn may reveal distinctively vesicular lava samples.



Fig. 9: Vesicular basalt

The lava exposure (NT 1668 5655) has a worrying lack of level places to stand, but is a dark grey, locally vesicular basalt, and is clearly extrusive. Although the vesicles are empty here, loose blocks in the stream have been found where the vesicles are filled with chalcedony or agate. The contacts of the lava are not exposed, however a line of loose blocks some 15m to the N leads more-or-less directly downhill, suggesting a virtually vertical orientation if this is more-or-less *in-situ* rock and not a collapsed field-boundary dyke. The BGS map suggests that the lava flow is terminated by a fault at the base of the slope.

8: Folded sediments in the Hopetoun Member

The best exposure of deformed sediments lies only 100m W from Mill Bridge, but is frustratingly difficult to access and view. It is not visible from the bridge. For a close-up view, proceed along the north bank of the stream. A steep and narrow 'path' passes immediately below the exposure with sandstones and shales with dips varying from vertical to horizontal on a scale of a metre or few metres (NT 1687 5644). The deformation is assumed to be associated with the Pentland Fault, which here lies some 250 m to the NW.

Alternatively, and more safely, the exposure can be viewed from the other (SW) side of the burn, but willow trees make for poor visibility even in winter; binoculars are helpful here. A thrust runs at a low angle though the exposure.



Fig. 10: Small-scale folding, blue arrows show bedding orientation.

On the opposite (SW) side of the stream a m-scale exposure in the stream bank is easily located below a lone tree (NT 1684 5644). This has poorly preserved mm-scale fossils (unidentified) in a silty dark shale. There is what appears to be the crest of an isoclinal fold with an E-W crest and axial plane that is steeply inclined at c. 60 – 70° to the N. Evidently, the more ductile beds in the sequence are highly deformed.

Assuming that the stratigraphy of the area is largely intact despite the obvious deformation, then the Hurlet limestone should occur between here and the next locality. The limestone is either not present; not exposed or is faulted out. The limestone would mark the base of the Lower Limestone Formation.

9: Mill Bridge

Return to Mill Bridge (NT 1690 5640) to inspect the exposure of the Blackhall Limestone which lies within the Lower Limestone Formation. It is a crystalline cream - yellow calcite limestone with occasional crinoid stems, corals and brachiopods visible in loose blocks. Irregular beds of 10 cm to more than 1 m dip at c. 80° towards the south-east, again presumably associated with the Pentlands Fault which is here some 350 m to the NW.



Fig 11: The Blackhall limestone dipping to the right, a steep bedding plane runs up and left from the person.

The open area to the SE of Mill Bridge could be an old quarry, but isn't marked as such on the oldest available OS maps (1850's).

It is not possible to easily follow the stream downwards into Habbie's Howe, so walk back up the track towards Kitleyknowe and head along the path at the top of the gorge towards the SW. From here there are 2 features visible in the landscape of broad geological and environmental interest.

10: Viewpoint for the Talla Aqueduct

At the top of the gorge, look to the southeast, where stone-built towers a few metres high can be seen in the distance. The pillars were built for surveyors building the Talla Aqueduct to gain views across the surface terrain.

The black 'bings' on the horizon that resemble spoil heaps are in fact peat, cut for commercial use. The area to the S and SW of Carlops has extensive post-glacial peat deposits.

11: Peggy's Pool

Take the first path that descends downwards, passing various limestone blocks enroute. Cross the stream by a bridge and head back upstream.



Fig. 12 – Peggy's Pool in damp conditions

The stream flows over the Blackhall Limestone into Peggy's Pool (NT 1709 5633), which is sufficiently deep to discourage close examination in all but the driest conditions. The bedding dips gently to the west, certainly at a much lower dip angle than at previous localities, suggesting that the intense deformation associated with damage zone of the Pentland Fault does not extend this far, approximately 500 m.

12: Habbie's How gorge

Downstream from the waterfall the North Esk flows in a steep-sided gorge 15 m deep. This is usually interpreted as a glacial meltwater channel.

13: Fold in the Blackhall Limestone

Moving downstream, the Blackhall Limestone is exposed as crags on both sides of the stream. The dip varies, the most spectacular exposures appear to form a SE-plunging anticline with the crest close to a footbridge downstream from the waterfall at NT 1726 5638. Interestingly, the structure is clearly shown on the 1859 geological map (BGS sheet 32, Edinburgh, available online through the National Museum of Scotland) but is not at all apparent on the modern version.



Fig. 13: The Blackhall Limestone

14: Minor fault

Locally steepened dips of c. 30 ° to the SE at NT 1737 5646 possibly correspond to a minor fault that crosses the gorge. This corresponds to a gully in the N bank, presumably eroded along fractured rocks along the fault.



Fig 14: dipping sandstones at a minor fault

15: Limestone Coal Formation sandstone

West of locality 10 the exposures are mostly of a sandstone within the Limestone Coal Formation, the youngest formation exposed here. Dips are negligible, now some 750 m away from the line of the Pentland's fault. The sandstone is medium to coarse grained, only poorly consolidated and trough cross-bedded. The best exposure is probably that within a small cave (actually an arch) that may well be man-made, associated with 18th Century landscaping (NT 1749 5647).



Fig. 15: the cave entrance

The gorge ends at c. NT 1783 5657 where the valley widens at Craigy Bield. Old plans in the collections of the National Museum of Scotland show that there was a scheme to dam and flood both Habbie's Howe and the glen which here joins from the south (Lonelybield) to provide a reliable supply of water to the paper mills of Penicuik, which lie downstream.

16: Carboniferous conglomerate

After returning to Carlops, there is one remaining exposure which may illuminate the structure of the Pentlands Fault. From the Quarry Car Park, walk north along the main (A702) road until a gap between two houses sign-posted to Kitleyknowe leads to a vehicle track that ends at Rogersrig Farm. Just before the track bends to the right into the farm, negotiate the gate into a field (Right of Way) and carefully descend the banks of the

channel that lies between the farm and the main road. There is a west-facing cliff a few metres high that is not visible until you are next to it (NT 1630 5617). Based on the BGS map, this is Calders Member of the West Lothian Oil Shale Formation. This identification clearly implies that the stratigraphy of the Carboniferous sediments is preserved intact even this close to the Pentlands fault, which is here mapped along the line of the main A702 road, only a few 10's of metres away.

The dip of the sediments is 10 – 15° to the NE which is sub-parallel to the Pentlands Fault. This is not consistent with the simple fault-drag model that might explain the dips of the sediments seen further away from the fault zone in Habbie's How. One interpretation is that this is a fault-bounded sliver within the fault itself. In this case, there is no reason to think that the exposure is in stratigraphic continuity with the sediments further to the SE, leaving the age of sediments unresolved.

The sediments are a buff sandstone and granule conglomerate, with cross beds. Many of the clasts are of a white or pale chert, confirmed by thin-section examination. Given the position, then one interpretation would be that the chert is a residuum from weathering Devonian lavas from the Pentlands to the immediate NW. This could make this rock a basal (micro-) conglomerate associated with the transgression of the Carboniferous basin over the eroded remains of the Pentland Hills.

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