South Queensferry–Cramond

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O.S. 1:50000 Sheet 65 Falkirk and West Lothian

B.G.S. 1:50000 Sheet 32W Livingston

Route: (Map 24), (Map 25)

Introduction

The object of the excursion is to study the Dinantian oil-shale bearing sediments of West Lothian, as exposed along the coast from South Oueensferry to Cramond, and to look at relics of the vast industry based on exploitation of the oil-shale. Also well displayed are teschenite sills of Namurian age and quartz-dolerite sills of Stephanian age, and their intrusive relationships to the sediments.

The area lies near the centre of the basin in which the oil-shale bearing beds were deposited. The basin was open to the north-east, from which direction sediment was derived, and cut off by Lower Palaeozoic rocks of the Southern Uplands to the south-east. In other directions it was enclosed by volcanic piles. In the cyclical sediments the lagoonal oil-shales are underlain by marine or freshwater limestones and mudstones and succeeded by thick mudstone-siltstone-sand-stone sequences of fluvio-deltaic origin. Coals are rarely developed. The strata are divided into the Lower and the Upper Oil-Shale groups (Carruthers *et al.* 1927), the boundary being taken at the base of the freshwater Burdiehouse Limestone. The rocks belong to the Asbian and Brigantian Stages of the Visean. The main marine marker band is the lowest widespread marine horizon in the local Carboniferous, the Pumpherston Shell Bed. It is found throughout West Lothian and is recognised in Midlothian and East Lothian as the Macgregor Marine Bands and Cove Marine Bands (Wilson 1974). Beds below and including the Pumpherston Shell Bed belong to the TC miospore zone, higher beds to the NM zone.

Four half-day excursions are listed, which can be combined to make one or two day excursions. Excursion A is the Paraffin Young Heritage Trail which starts at Grangemouth.

Leaflets describing the route should be obtained beforehand from the Forth Valley Tourist Board, County Buildings, Linlithgow, West Lothian, EH49 7EZ. The other excursions start either from South Queensferry where ample parking is available on the promenade west from Hawes Pier, or from Cramond where there is a large car park in the village. South Queensferry can be reached by Eastern Scottish service buses and Cramond is served by Lothian Region Transport buses. Travellers planning to use the Cramond Ferry should note the timetable (currently till 1900 in summer, 1600 in winter—not Fridays). Notice should also be taken of the landowner's requirement that no picnics be taken, or picnic haversacks carried between the Cramond Ferry and Long Craig Gate. While the sections are seen best when the tide is low, most exposures on the coastal excursions are near High Water Mark (HWM).

Excursion A—Paraffin Young Heritage Trail

Paraffin Young Heritage Trail

The trail was first established by Lothian Regional Council and BP Oil Grangemouth Refinery Ltd to depict the story of this remarkable man and the West Lothian shale oil industry. The trail starts at the former BP Oil Grangemouth site and winds for 60km along the side roads of West Lothian by seven information notice boards.

INEOS Grangemouth Exhibition Centre (Location of former BP Oil Grangemouth Information Centre) [NS 941 814]

Travel by the M9 Motorway to Grangemouth. Turn off at Junction 5 and follow the B9143 (Grangemouth Industry). Turn left at the first roundabout, right at the second roundabout, then after 50 m right into the BP car park. The Information Centre (open Monday to Friday, 0900 to 1700) houses an exhibition of the shale industry, a contemporary documentary film of mining in the 1920's and an exhibition of the modern oil industry.

1. Bathgate [NS 966 673]: An industry is born, the secret works

This house on the road south of Bathgate, once his secret laboratory, is all that remains of Young's original oil-works. It opened in 1851 using torbanite, and only later was attention turned to using oil-shale.

2. Five Sisters [NT 005 641]: The story of a bing

The Westwood Bing, viewed from the B7015, is typical of the massive red spent shale spoil-heaps, produced from retorting the oil-shale. The substantial remains of the Westwood Works are still occupied by other enterprises. The five 'peaks' of the bing result from the method of tipping, green swards being from recent restoration.

3. Limefield House [NT 034 643]: Paraffin Young, his life and times

James Young lived in this pleasant mansion, now a private home, just south of the A71 at Polbeth. The miniature Victoria Falls across the nearby stream commemorates his lifelong friendship with the missionary. David Livingstone.

4. Pumpherston [NT 071 695]: A Central Refinery

Pumpherston is a shale village built by the Pumpherston Oil Company. The company retorts and refinery, below the bings east of the village, are still the site of oil-related manufacture and the production of bricks from spent shale. In contrast along the banks of the River Almond nearby lies the beautiful wooded Almondell Country Park.

5. Middleton Hall [NT 061 716]: Former Scottish Oils headquarters

Just south of the A89 in Uphall, the Hall, now a care home, stands surrounded by housing. originally built for oil company technical and managerial staff.

6. Broxburn [NT 080 722]: Shaleopolis

The story of how the shale industry transformed Broxburn from a small rural village to an industrial boom town with rows of brick-built houses is detailed on the trail noticeboard in the centre of the town on the A899.

7. Winchburgh [NT 088 748]: A Shale Company village

The B8020 passes through one of the largest shale bings and by the road the final trail point describes this typical mining village with its high quality brick-built miners' rows.

Excursion B. South Queensferry Shore

The shore section exposes westerly dipping sediments of the Upper and Lower Oil-Shale groups, including oil-shales, limestones and marine and non-marine shell beds. Sills of white trap cut the sediments while further east are the Mons Hill teschenite sill and the Hound Point quartz-dolerite sill. The excursion starts at the Hawes Pier opposite the Hawes Inn (featured in R. L. Stevenson's Kidnapped).

1. Hawes Pier: Dunnet Sandstone

The pier and the south end of the Forth Railway Bridge (opened 1889) are built on the 90 m thick Dunnet Sandstone. Best seen just east of the bridge, the beds consist of pale brown and brown, fine to medium-grained, massive and

cross-bedded deltaic sandstones. Layers in the sandstone contain ochreous plant stems and debris. U-shaped burrows near the top indicate local marine inundation. Sand-filled Stigmaria, hair-roots, sun-cracks and worm tracks show periodic exposure to air and establishment of forests. The steep dip of the basal sandstones is associated with faulting.

2. Port Neuk: Camps Shale, Burdiehouse Limestone

East of the sandstone outcrop poor exposures of the dark fissile Camps Shale and the hard grey Burdiehouse Limestone can be found among the shingle. The limestone has numerous ostracods, fish and plant fragments, and near L.W.M. it has been bored by modern molluscs.

3. East of Port Neuk: Sill, White Trap, algal limestone

The foreshore on the east of the bay is formed of thick brown and white fine to medium-grained deltaic sandstones showing various bedding structures. Near the top a brown-weathered pale grey altered dolerite sill, 90 cm thick, can be distinguished from the sandstone by polygonal jointing. Sun-cracks are prominent in the underlying dark baked sandstone near the sea-wall. In the cliff 40 m further east is a striking outcrop of 'white trap', a sill of completely altered dolerite. The pale 60 cm thick sill, while generally concordant, also shows transgressive junctions with the dark hornfelsed sediments above and below. Thin dolerite sills intruded into carbonaceous mudstones, oil-shales or coals can become altered to white trap. The rock now consists mainly of carbonates of lime, magnesia and iron, kaolin and muscovite, but the original crystal structure of the dolerite can be seen in ordinary light under the microscope. Heat from the intrusion drove off from the carbonaceous beds by destructive distillation gases which altered the minerals in the dolerite.

A metre thick pale brown fine-grained ripple-bedded sandstone lies between the white trap and 1.1 m of thin finely laminated lagoonal cementstones which crop out round the point. Prominent algal patches near the top have rounded upper surfaces and flat bases. Lower down a thin desiccation breccia indicates drying out. Minor thrust faults at the point have caused fracturing with slickensides in sandstones and cementstones, but folding in the mudstones.

4. West of Long Rib: mudstones, Pumpherston Shale

Underlying the cementstones are 25 m of dominantly argillaceous strata well-exposed in cliffs and foreshore. A marine mudstone 8 m from the top contains the bivalve *Naiadites obesus* and the branchiopod *Euestheria* sp. near the base, just west of the small stream, the Pumpherston Shale, seams of economic oil-shale with thin ironstone ribs, forms three prominent reefs.

Oil-shales can be identified in the field by the following characteristics: a brown streak or brown colour when scratched instead of the grey of normal mudstones, a toughness and resistance to weathering, a leathery appearance, a wooden sound when hammered, and parings cut with a knife curl up and do not crumble. Oil-shales have been classed as plain, in which the bedding is regular, or curly, in which the bedding shows penecontemporaneous contortion.

5. Long Rib: Pumpherston Shell Bed, Queensferry Cements

East of the stream the Pumpherston Shell Bed occurs in strata locally with steep to vertical dips. The shell bed comprises a 50 cm soft dark mudstone with yellow sulphurous efflorescence on a 3 cm limestone, both parts of which can be traced towards L.W.M. The fauna, mostly pyritised in the mudstones, includes the bivalves *Aviculopecten*, *Pernopecten*, *Pteronites*, *Sanguinolites*, *Schizodus* and *Streblopteria*, small *Lingula*, the gastropod *Euphemites*, orthocone nautiloids and ostracods.

Below a further metre of dark mudstones, two cementstones, the Queensferry Cements, form Long Rib, a conspicuous ridge running out to sea. The upper bed is a 35 cm yellow-weathering oolitic cementstone. The intervening grey mudstone is a metre thick. The lower cementstone is 1.2 m thick, is brown-grey but weathers yellow, and has cavities, some filled with bitumen.

Mudstones below the Queensferry Cements contain further cementstones and thin oil-shales. A 15 cm bedded cementstone forming an overhang in the cliff has mudstone flakes and brown coprolites containing fish fragments. Contorted mudstone just above this band could indicate a bedding-plane fault. The oil-shales include the Dalmahoy Shale, the lowest named oil-shale in the West Lothian shale field. The strata are mostly obscured by shingle towards Long Craig Pier, which is built on hard brown fine-grained sandstones dipping westwards at 25°.

6. Whitehouse Bay: metamorphosed sediments

Shingle obscures most of the sediments in the bay. Near H.W.M. 300 m east of Long Craig Gate, and opposite the grey hut on the road, are outcrops of greenish and greyish indurated spotted mudstones. These gently dipping strata were baked by the underlying teschenite sill, but the contact is obscured.

7. Whitehouse Point: Mons Hill teschenite sill

Outcrops of a differentiated teschenite sill form a kilometre of rocky foreshore between Whitehouse Bay and Peatdraught Bay. Detailed petrographic descriptions of the sill are given by Flett (in Peach et al. 1910) and by Walker (1923), who recognised several zones or modifications in a sill over 100 m thick. Joints however indicate that the sill dips gently and undulates and suggest it is much thinner, so that some of the zones may be lateral equivalents. Seen in descending order the principal rock-types are:

- Dark medium-grained theralite, small kersutite needles, undulating top
- Surface, angular joints, black and pink segregation veins; fairly sharp unchilled junction.
- Compact mottled sub-ophitic teschenite, angular joints; sharp basal contact at Whitehouse Point.
- Coarse to very coarse-grained mottled augite-tesehenite, purple ophitic titanaugite crystals up to 15 cm x 1 cm, analcimised plagioclase,chlorite, pink segregation veins and druses with zeolites, rounded joints; forms main bulk of sill between Whitehouse Point and the next point to the east.
- Dark sub-ophitic augite-teschcnite, angular joints: supposed to lie beneath the main part of sill, but mainly lie above it.
- Pale medium-grained theralite, small kersutite needles.
- Coarse-grained hornblende-teschenite, nepheline absent; seen just east of small stack; sharp unchilled junction.
- Dark medium-grained augite-teschenite. Idiomorphic, titanaugite, crystals, angular joints; base ohscured by sand.

8. Hound Point: quartz-dolerite sill

Sand in Peatdraught Bay covers sediments between the Monds Hill Sill and the Hound Point Sill. On the coast the westerly-dipping Hound Point quartz-dolerite sill is 20 to 30 m thick but thickens inland. Fine-grained blue-grey dolerite near the sill top is exposed in reefs near L.W.M. The bulk of the sill is dark medium-grained, columnar-jointed quartz-dolerite. East of Hound Point dark indurated mudstone with plant remains and fish scales is intercalated in the lower part of the sill. The base is transgressive and the underlying sandstone baked and tilted.

The excursion can be completed by returning along the inland track, or by continuing eastwards for the excursion to Cramond.

Excursion C. Cramond shore

Along this stretch of coast the interest includes sedimentary sequences and structures, intrusions and their contacts, raised beaches and the buried channel of the River Almond. This excursion follows on from Excursion B, or can be reached by crossing the Cramond Ferry and taking the path to Snab Point, Barnbougle Castle or Hound Point.

9. Barnbougle Castle, Dalmeny House: raised beach, buried channel

Westward-dipping brown fine-grained sandstones crop out at H.W.M. 800 m east of Hound Point and at Barnbougle Castle. The Buchans, reefs near L.W.M. are formed of green and purple amygdaloidal columnar basalt lava and red,

brown and grey sandstone. The post-Glacial raised beach with its well-defined back-feature is narrow as far as Barnbougle Castle and widens out in front of Dalmeny House. This magnificent Tudor-Gothic style house was built in 1815 by William Wilkins for the Earl of Roseberry. It contains the Roseberry and Mentmore collections and is open during afternoons in summer. The statue is the horse King Tom. Low ground south-east of the house lies along the pre-glacial channel of the River Almond blocked by glacial deposits.

10. Snab Point: quartz-dolerite sill, sedimentary sequence

Leaving the low raised beach, the path climbs sharply up the dip slope of the Snab Point quartz-dolerite sill. The top of the sill forms a dramatic slope of hard, black well-jointed dolerite dipping WNW at 25° into the sea. Just east of Snab Point the basal contact of the sill against baked mudstones is exposed at H.W.M.

Starting 200 m east of the sill is a cliff section of sedimentary rocks, dipping westwards at 15°. The highest 3 m comprises thin brown sandstones overlying grey mudstones and siltstones with plant fragments and irony ribs and nodules. Below these a 15 cm coal seam is underlain by 5 cm of grey seatclay. Most of the section is formed of a massive brown sandstone. 8.5 cm thick, showing large-scale cross-bedding. Loose blocks have fine rippled surfaces. The lowest 9 m of the section consists of grey siltstones with bands of pale brown sandstone.

11. Eagle Rock or Hunter's Craig: sandstone

As well as the historical interest, for the defaced figure of an eagle carved on the rock is supposed to be of Roman origin, the stack demonstrates sedimentary structures of a fluvio-deltaic sandstone. The main face shows 3.6 m of laminar sandstone on 1.8 m of cross-bedded sandstone with an irregular 5 cm irony rib along the junction. On the seaward side are ancient ripples similar to modern ripples in the beach sand. Another rock further west shows 3 m of slumped contorted sandstone on 1.8 m of laminar and cross-bedded sandstone.

12. Cat's Craig: teschenite sill

Looking at first like an old stone wall the craig is the outcrop of the thin upper leaf of a teschenite sill. During post-Glacial raised beach times the craig formed an intertidal reef.

13. Coble Cottage: teschenite sill

The ferry house and jetty stand on a cliff formed by the lower leaf of the teschenite sill, the same rock-type that forms Cramond Island offshore. Coble Cottage sits on the middle of three raised beaches on the west side of the River Almond. Cross the river by the ferry and visit Cramond Heritage Trail Centre.

Excursion D. Almond Valley

This excursion follows along the pleasant riverside walks of the Cramond Heritage Trail. The geomorphology of the Almond valley can be studied as well as thick sandstones. complex sills and their contacts. The excursion starts at the Heritage Trail Centre, near the ferry landing point.

14. Cramond Heritage Trail Centre: Ravelston Sandstone, raised beaches

On the path outside the centre is a pale brown cross-bedded sandstone correlated with the Ravelston Sandstone. Two raised beaches east of the River Almond are evidence of higher sea-levels. The lower, post-Glacial, beach forms the terrace with a steep back slope on which the promenade stands. Material from the higher late-Glacial beach can be seen on the banks behind Cramond Boat Club, consisting of brown silty clay with pebbles, numerous oyster shells and a few Pecten and gastropod shells.

15. Quarries: sill-sediment relationships

Quarried cliffs above the path show two thin teschenite sills. the upper at least 3.5 m thick. the lower 1.8 m thick, dipping at 30° to north-west. The 60 em mudstone between the sills has a pale grey hard baked ceramic look and has been welded on top of the lower sill. Below the teschenite is a white rusty-mottled fine-grained sandstone over 8 m thick well exposed in a quarried face. Vertical drill holes at the north end are relics of the quarrying. At the weir the milllade has been cut into a further outcrop of teschenite.

16. Cockle Mill Weir: Hailes Sandstone, faulting

Beyond the weir is a long 5 m high quarried face of sandstone dipping east. Note the change of dip from the previous outcrop, due to a fault just above the weir. The cliff of pale brown, part thinly bedded, part large-scale cross-bedded sandstone is broken up by two fault zones of disturbed rock. A prominent 30 cm dark purple band is hematite-stained sandstone.

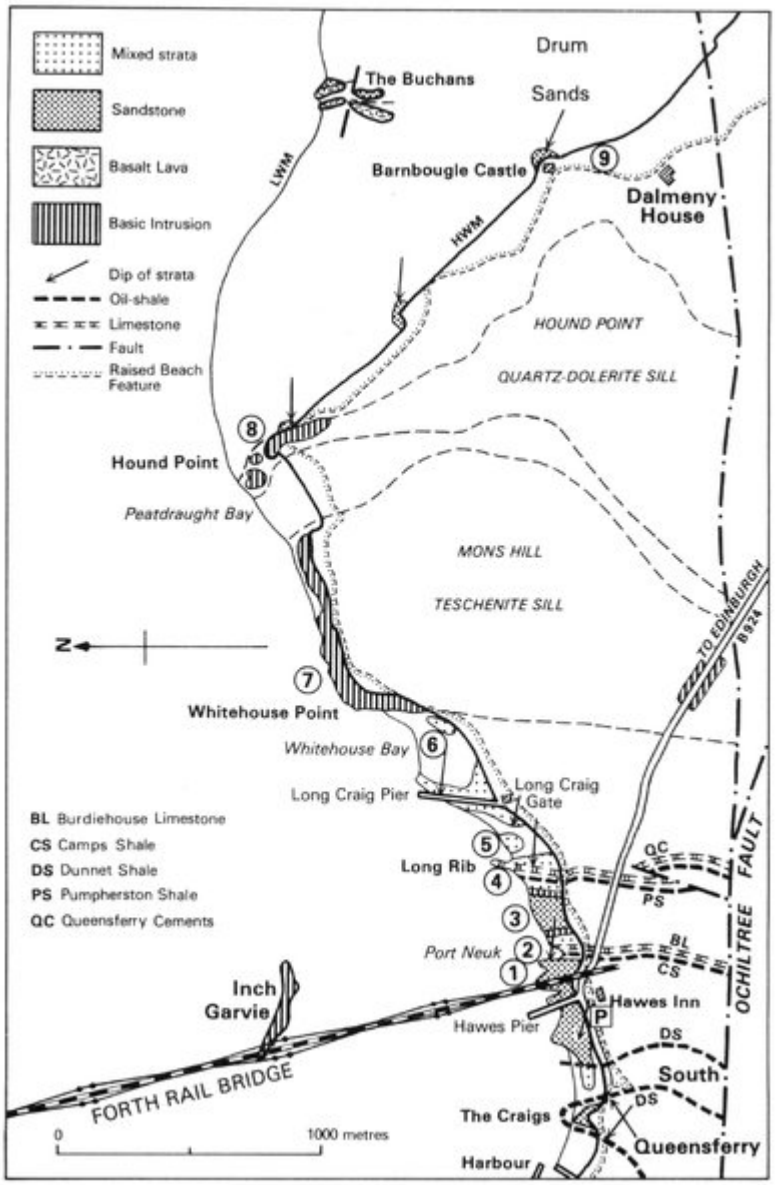
17. Fairafar Iron Mill: Hailes sandstone gorge

At first sight looking as if built with red sandstone, this ruined mill was in fact built of a local pale brown sandstone. The red irony skin was formed during operation of the foundry, and stones on the weir are similarly affected. For the next 300 m the river flows through a gorge with steep sandstone walls 10 m high. The pale brown sandstone shows laminar and cross-bedding. It was exploited in Craigiemill Quarry across the river. Glacial till forms the tree-covered upper slopes of the valley. Exposures of the dark clay till, with pebbles such as sandstone, dolerite and vein quartz, can be seen at the top of the upstream steps. Beyond the gorge thicker glacial till forms gentler valley sides, upriver of Peggy's Mill.

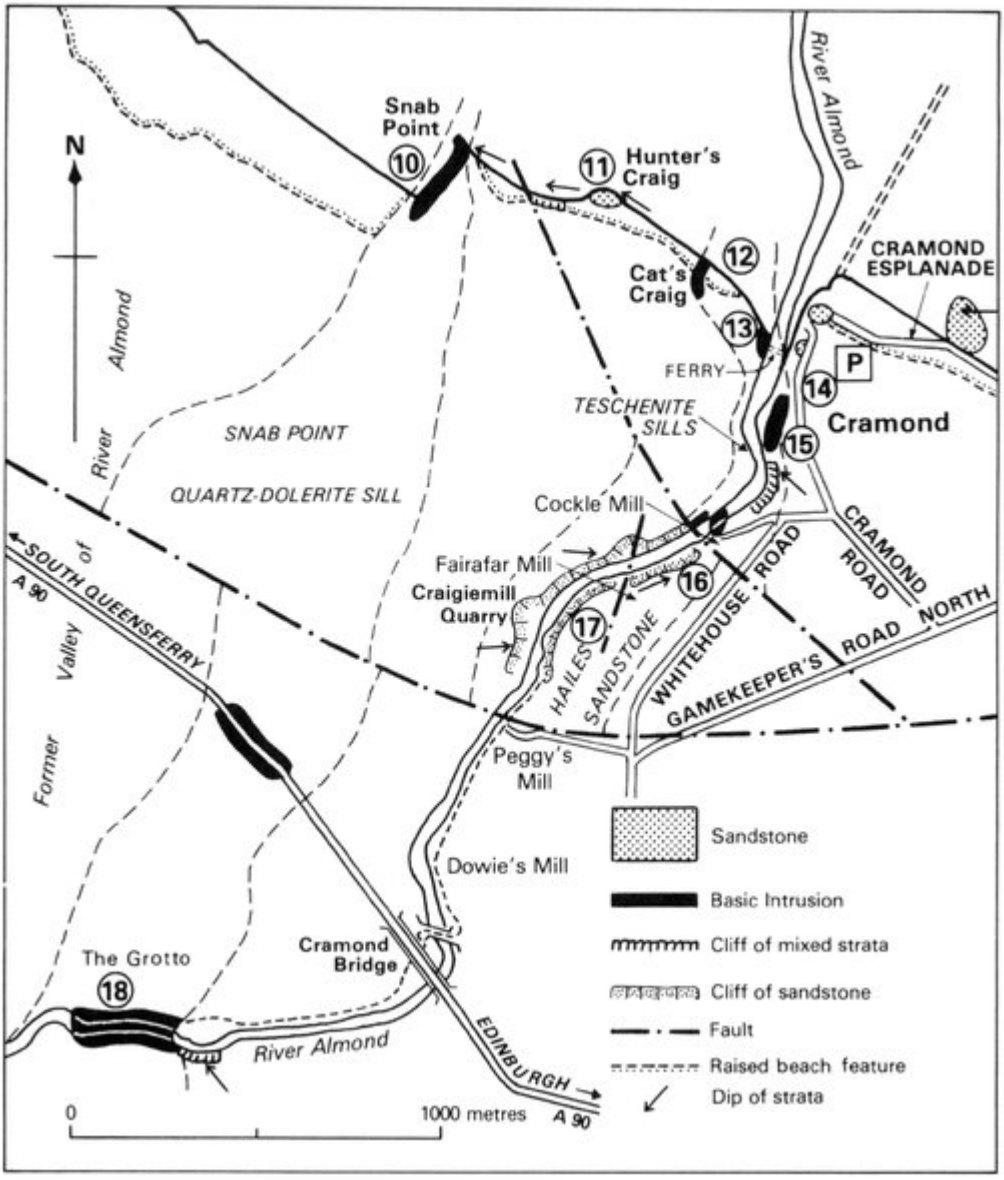
18. Grotto Gorge: mudstones, quartz-dolerite sill, buried channel

Cross to the north side of the river at Cramond Bridge and take the path to the left opposite Willowbank to rejoin the riverside walk. At the start of the rock gorge a cliff of bedded mudstones can be seen on the opposite bank dipping at 15° to the west under the Snab Point quartz-dolerite sill. A fine view from the bridge shows the gorge cut in jointed quartz-dolerite dipping west. The sill forms ridges north and south of the river. Upstream the open valley marks thick glacial deposits which blocked the former valley of the Almond and forced the river to cut the rock gorge. Return to the A90 at Cramond Bridge or all the way to Cramond.

References



(Map 24) South Queensferry.



(Map 25) Cramond.