
(Figure 1) Forms of extrusive and intrusive igneous rocks.

(Figure 2) Silurian (Upper Llandovery) fossils from the North Esk Inlier. 1. *Acernaspis sufferta* (Lamont) × 1. 2. *Encrinurus expansus* Haswell × 1. 3. *Craspedobolbina (Mitrobeyrichia) impendens* (Haswell), (a) female, (b) tecomorph (male) × 5. 4. *Cyrtia exporrecta* Wahlenberg, internal mould × 1. 5. *Skenidiodes lewisii* (Davidson), shell preserved × 2. 6. *Leptaena* sp., internal mould, pedicle valve × 1. 7. *Eopleciodonia penkillensis* (Reed), (a) dorsal view, (b) brachial valve, internal mould, (c) pedicle valve, external mould × 1.5. 8. *Atrypa resicularis* (Linnaeus) shell preserved × 1. 9. *Visbyella* sp., (a) shell preserved, (b) internal mould of brachial valve × 1.5. 10. *Dicoeodosia verneuiliana* (Beecher), shell preserved × 1.5. 11. *Coolinia applanata* (Salter), shell preserved × 1. *Dalejina polygramma pendantsica* (Davidson). internal mould × 1

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(Figure 6) Salisbury Crags, by C. Anderson.

(Figure 7) Hutton's Rock.

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(Figure 9) St Bernard's Well, by C. A. Hope from 'The Water of Leith', Jamieson 1984.

(Figure 10) Craigeleith Quarry, from 'Views of Edinburgh', Shepherd 1829.

(Figure 11) Harrison Arch.

(Figure 12) Dolcrite erratics.

(Figure 13) Bass Rock from Seacliff.

(Figure 14) 'Duck's feet'.

(Figure 15) Dunbar Castle.

(Figure 16) Columnar basalt, The Battery, Dunbar.

(Figure 17) Catcraig Limekiln from 'Barns Ness', Anon 1972.

(Figure 18) *Cardiopteris polymorpha*.

(Figure 19) Siccar Point. after Sir J. Hall from 'Hutton: The Lost Drawings', Craig et al. 1978.

(Figure 20) Section in Passage Group by R. Munro.

(Figure 21) The Old Town Hall, Bo'ness, and stoop and room workings in the Western Main Coal 15 m below the Old Town Hall, after Cadell 1925.

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(Map 5) Edinburgh city centre.

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(Map 7) Granton and Wardie shore.

(Map 8) Kilspindie shore.

(Map 9) North Berwick to Canty Bay.

(Map 10) Tantallon.

(Map 11) St Baldred's.

(Map 12) Yellow Craig to Cheese Bay.

(Map 13) Garleton Hills.

(Map 14) Belhaven and the Parade.

(Map 15) Dunbar.

(Map 16) Catcraig.

(Map 17) Pease Bay to Cove.

(Map 18) Siccar Point Map.

(Map 19) Lammermuir Deans.

(Map 20) River North Esk.

(Map 21) Bavelaw Castle to Loganlee.

(Map 22) Torphin to Bonaly Tower.

(Map 23) North Esk Inlier.

(Map 24) South Queensferry.

(Map 25) Cramond.

(Map 26) River Avon.

(Map 27) Bathgate Hills.

(Plate 1) Basaltic lavas underlain by red tuffs, Paddling Pool, North Berwick.

(Plate 2) Phonolitic laccolith, Traprain Law, from Pencreig.

(Plate 3) Limestones and mudstones, Lower Limestone Group, cut by basalt dyke and overlain by glacial deposits, Oxwellmains North Quarry.

(Plate 4) The Great Conglomerate, with recent scree fans. Fairy Castle Dean.

(Plate 5) Sill of white trap, altered basalt, intruding Upper Oil-Shale Group sedimentary rocks, South Queensferry.

(Table 1) Olivine-basalt nomenclature

(Table 2) Geological timescale

(Front cover). Arthur's Seat from Blackford Hill.

(Figure DS1) Sketch section along the high-water mark, from Marine Villa to the beach west of the Hanging Rocks. The inset shows detailed relationships at the key locality [NT 5016 8595].

(Figure DS2) Sketch section NW to SE across the Hanging Rocks to illustrate emplacement of pyroclastic breccias of the Weaklaw Vent against younger volcanic rocks by a complex high-angle reverse fault trending parallel to the cliff line. The sketch is a stylised view based upon a photograph of the western face of the western Hanging Rock (Figure DS6). Most of the face above the base of the Marine Villa Tuffs is crumbly and inaccessible and hence parts of the interpretation might be inaccurate.

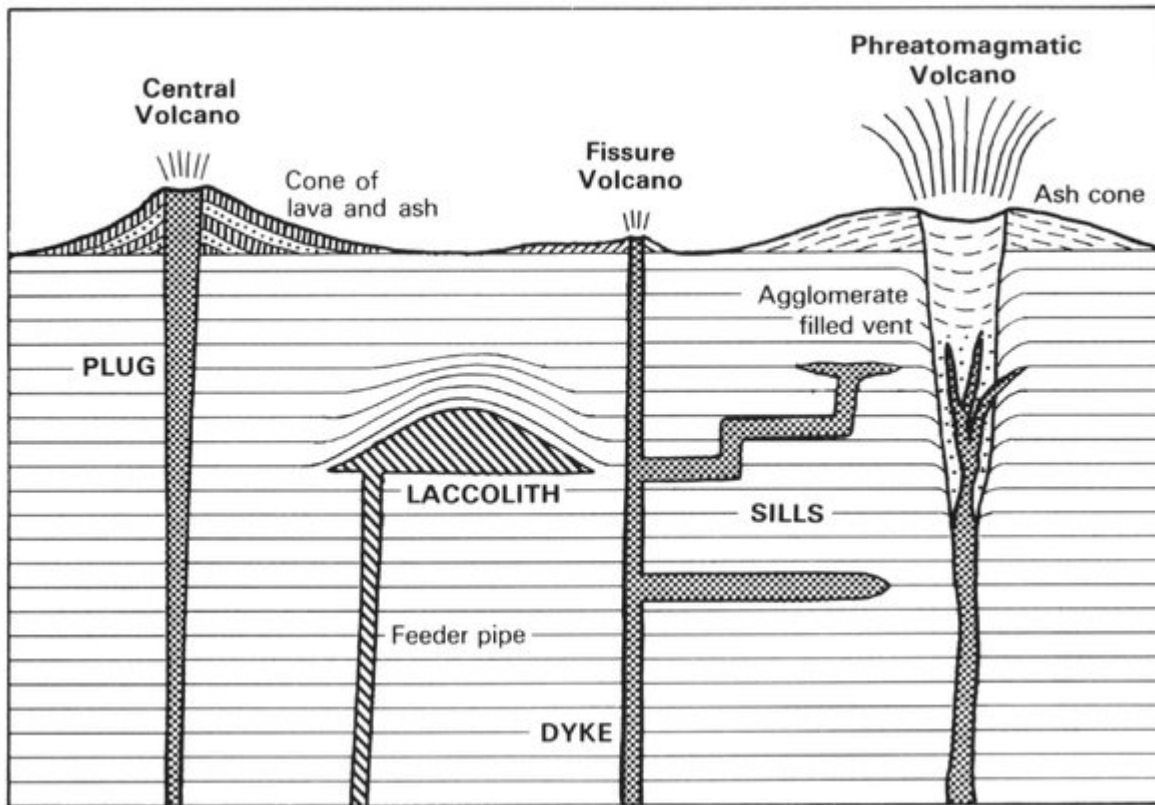
(Figure DS3). The key locality at [NT 5016 8595], viewed towards the south-west. Well-bedded Marine Villa Tuffs in the low cliff on the left dip to the right (north-west) at c. 30 degrees. The fallen blocks lie along the axis of an open syncline. To the right (north-west) of the blocks, a thin 'skin' of Marine Villa Tuffs can be seen draping over a very shallow domed surface (with rucksack) of paler, coarse, massive Weaklaw Tuffs, that is elongated away from the camera. A dark recess in the cliff in the distance marks the overhang where near-horizontal, well-bedded Marine Villa Tuffs overlie Weaklaw Tuffs. Compare with Day (1923, plate XXIII) where, on both photos, the recessed overhang is marked 'x'.

(Figure DS4) The key locality at [NT 5016 8595], viewed towards the north-east. Marine Villa Tuffs in the cliff; blocks along the syncline axis; and thin skin of Marine Villa Tuffs just above point of stick. Note the coarse texture of the Weaklaw Tuffs in the foreground. On the rock platform in the distance (top left) is a horizontal feature formed by the basal Marine Villa Tuffs.

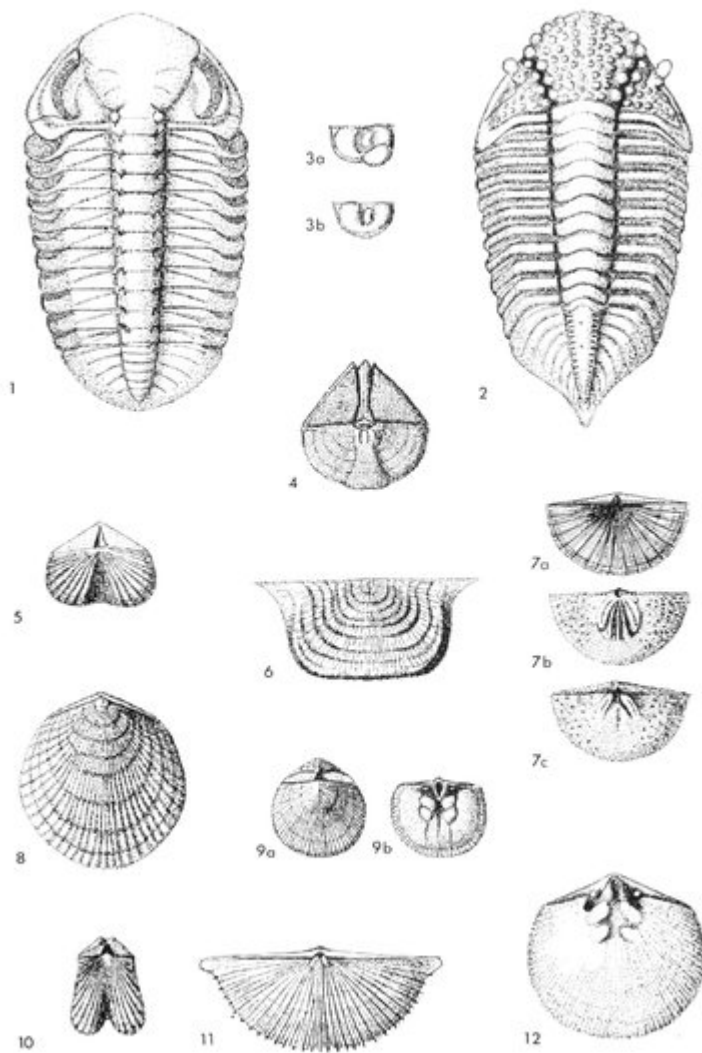
(Figure DS5) The western Hanging Rock. A mass of coarse pyroclastic breccia is juxtaposed against Weaklaw Tuffs at the base of the cliff and bedded Marine Villa Tuffs above by a reverse fault trending parallel to the cliff and dipping towards the camera at 40 to 50 degrees. The cliffs here are crumbly and inaccessible but the higher beds can be seen at the Smuggler's Caves, some 50 m to the west.

(Figure DS6) The western face of the western Hanging Rock, showing the complex reverse fault-zone represented diagrammatically in (Figure DS2).

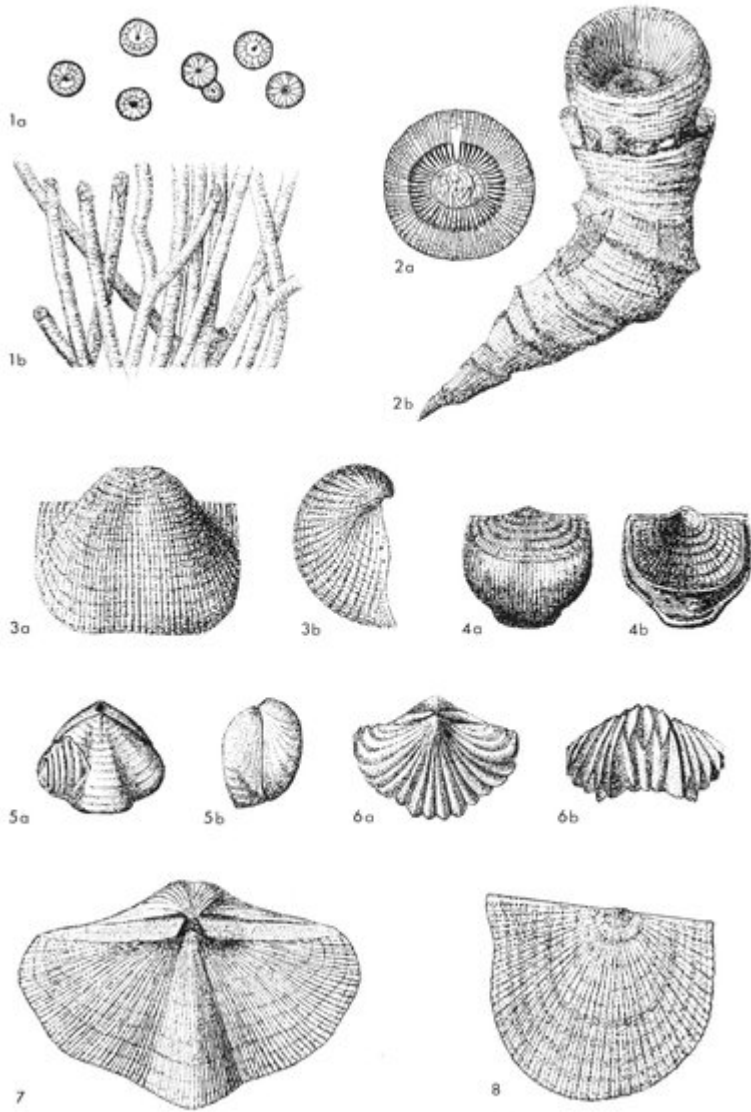
[References](#)



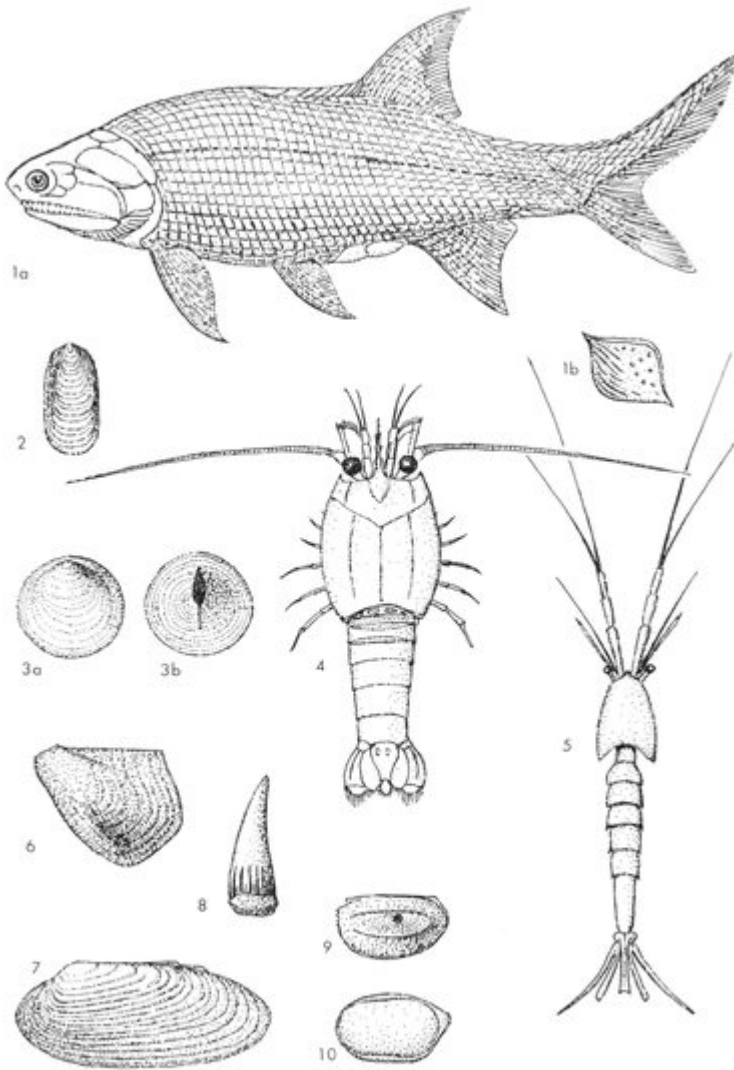
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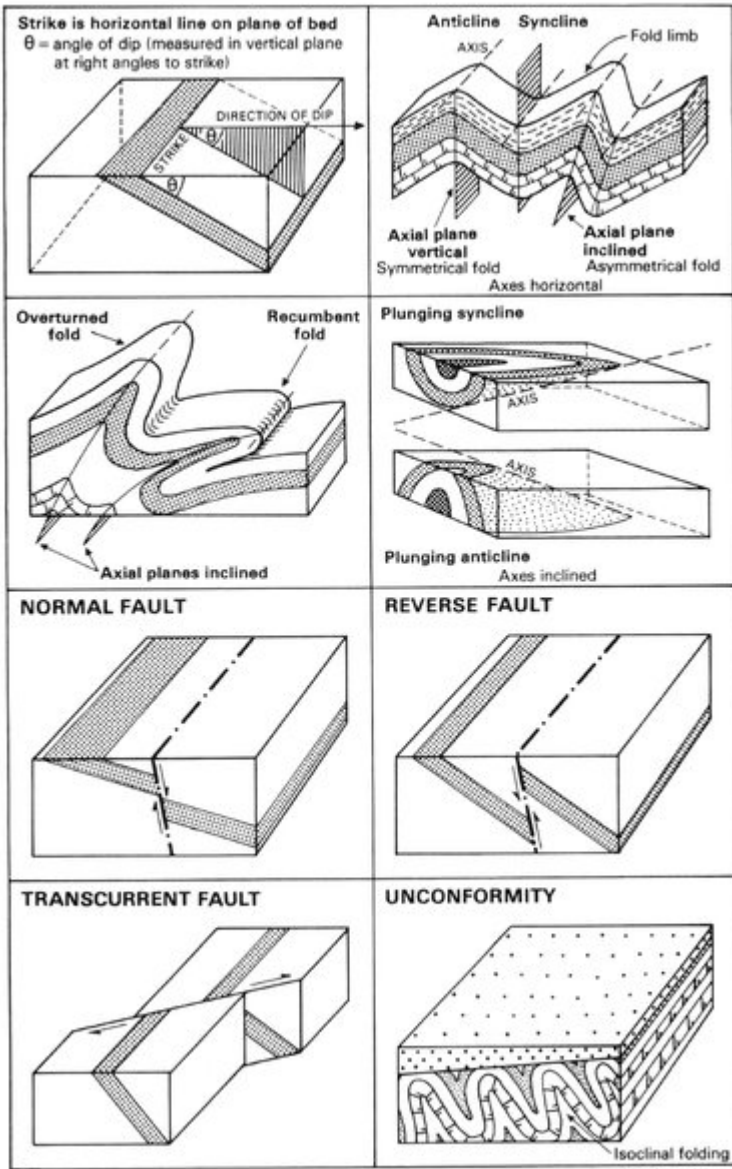
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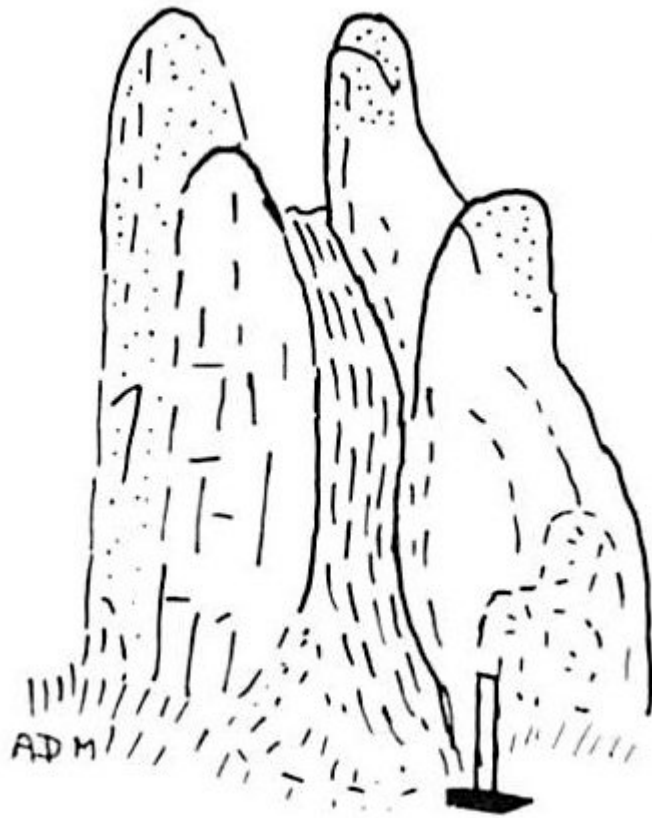
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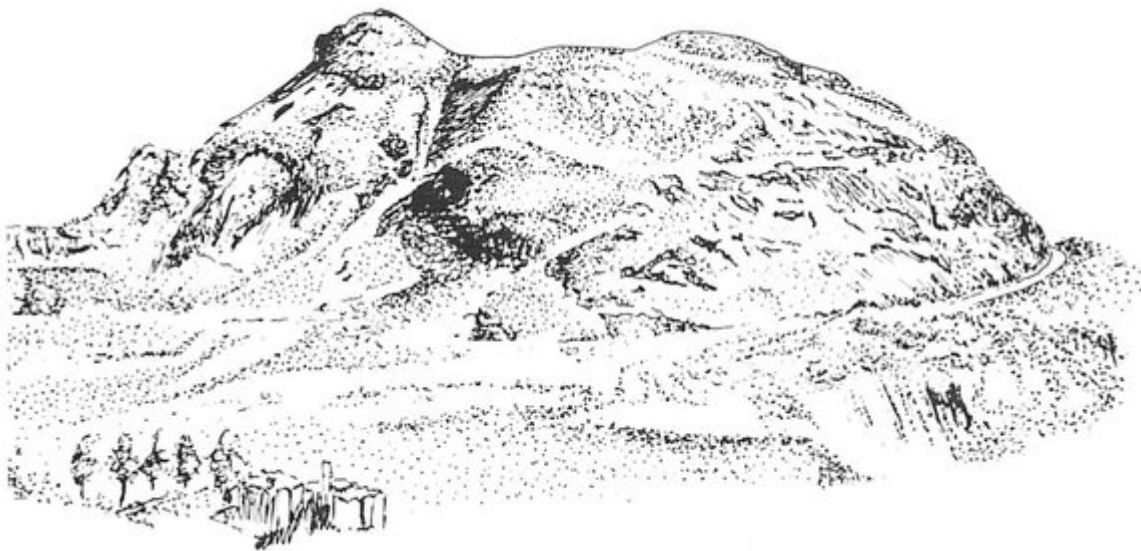
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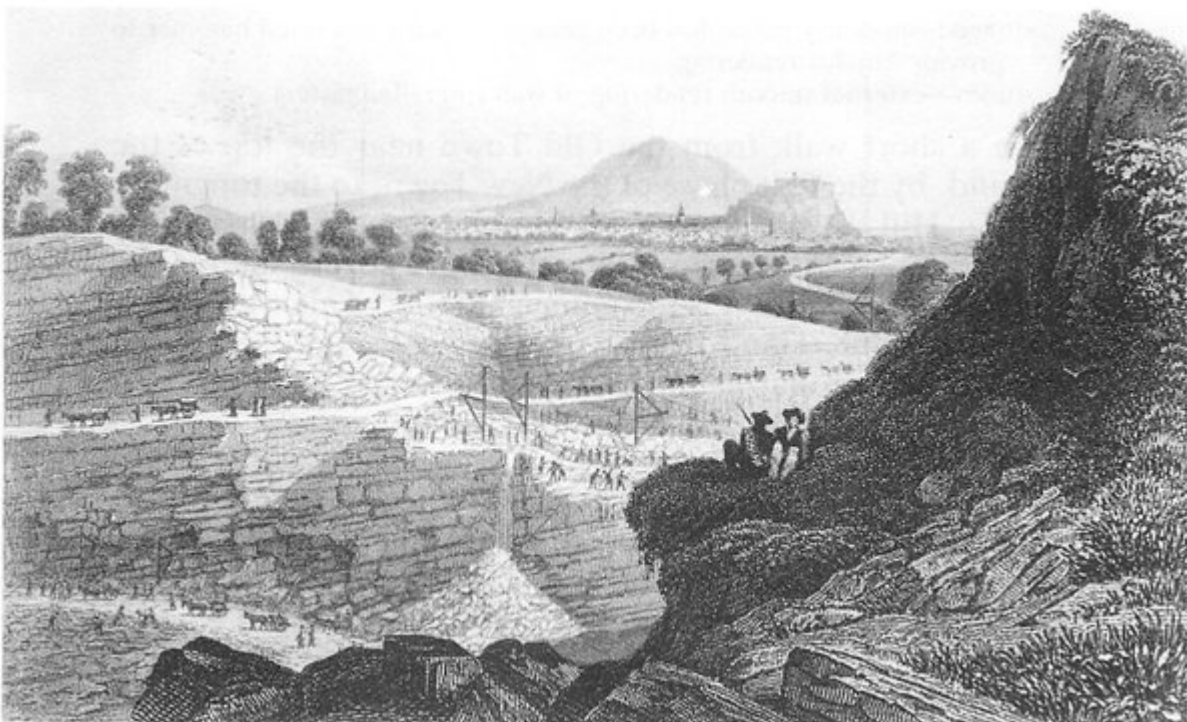
(Figure 7) Hutton's Rock.



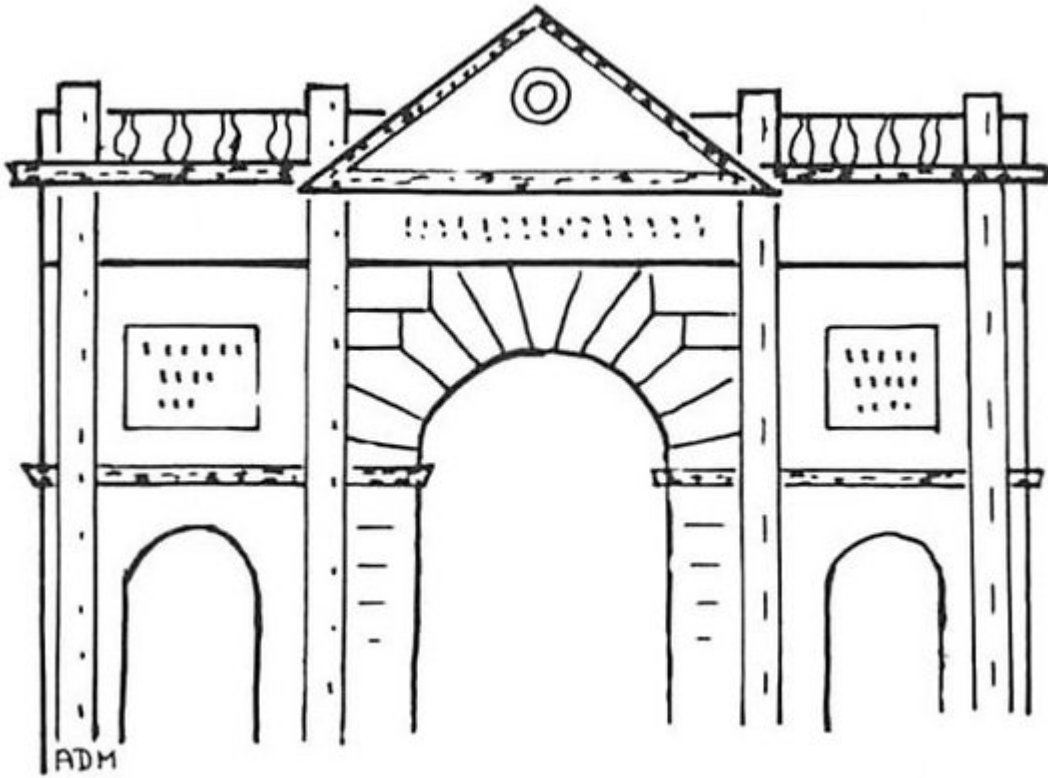
(Figure 8) Arthur's Seat, by C. Anderson.



(Figure 9) St Bernard's Well, by C. A. Hope from 'The Water of Leith', Jamieson 1984.



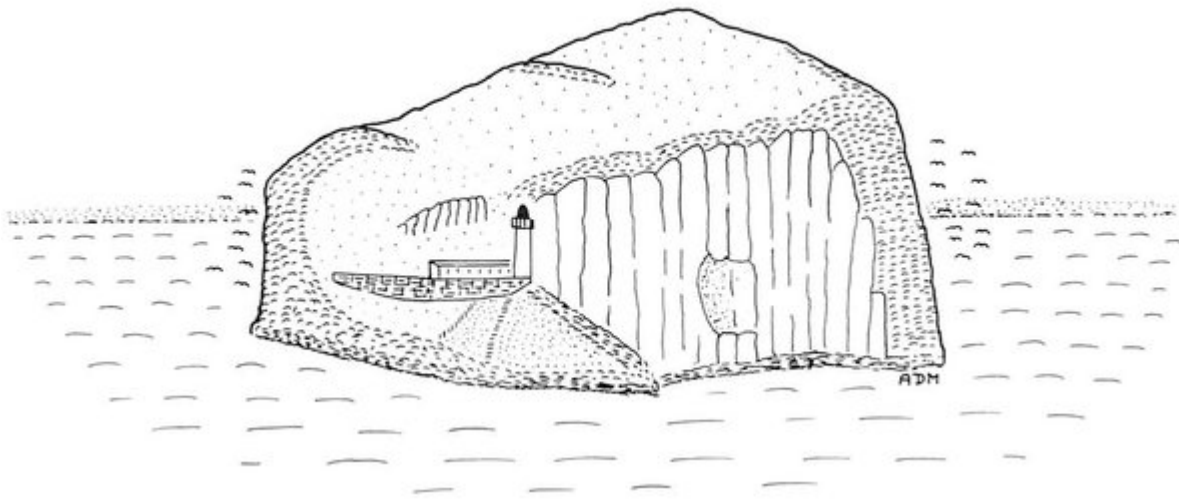
(Figure 10) Craigeleith Quarry, from 'Views of Edinburgh', Shepherd 1829.



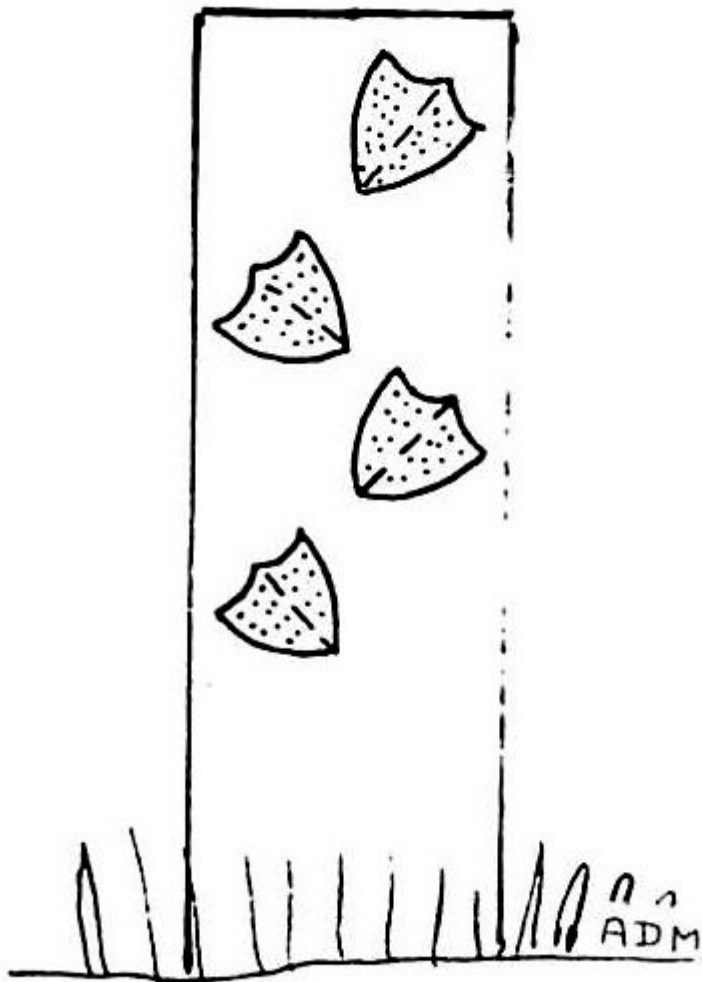
(Figure 11) Harrison Arch.



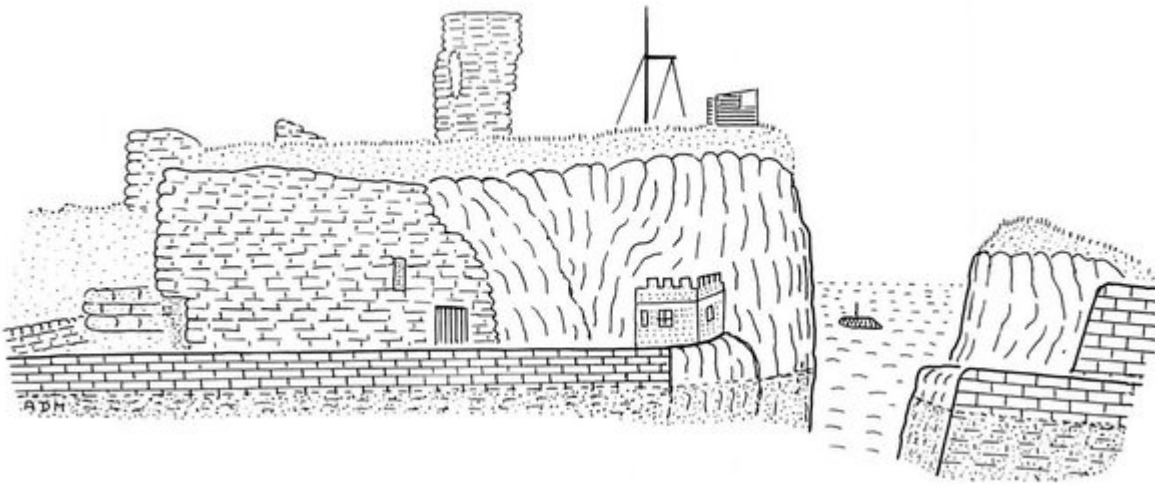
(Figure 12) Dolerite erratics.



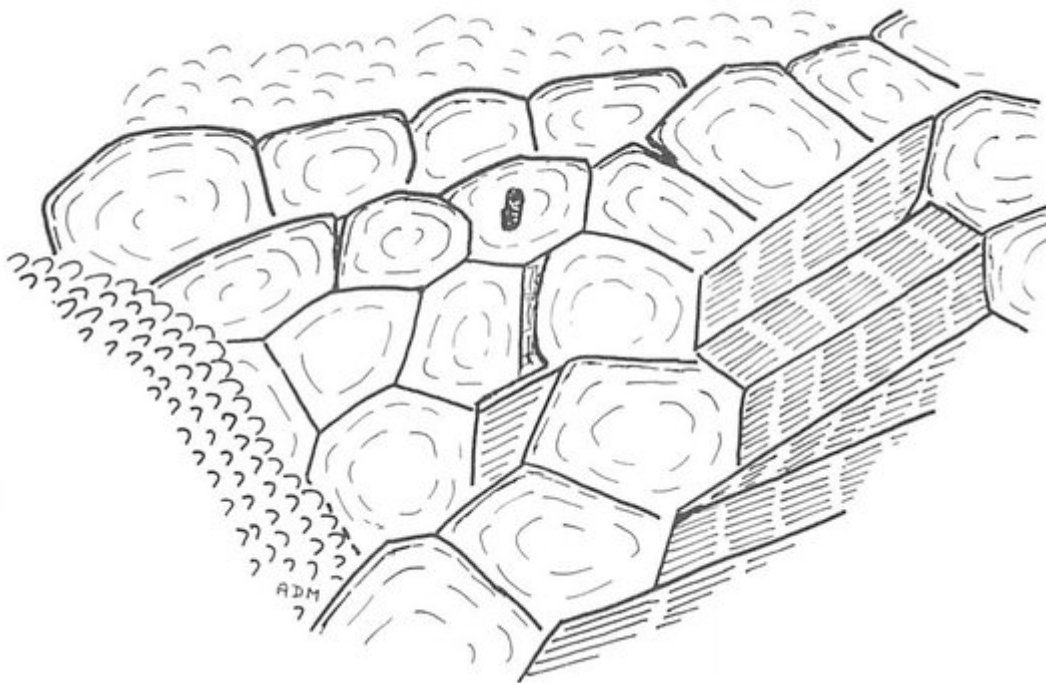
(Figure 13) Bass Rock from Seacliff.



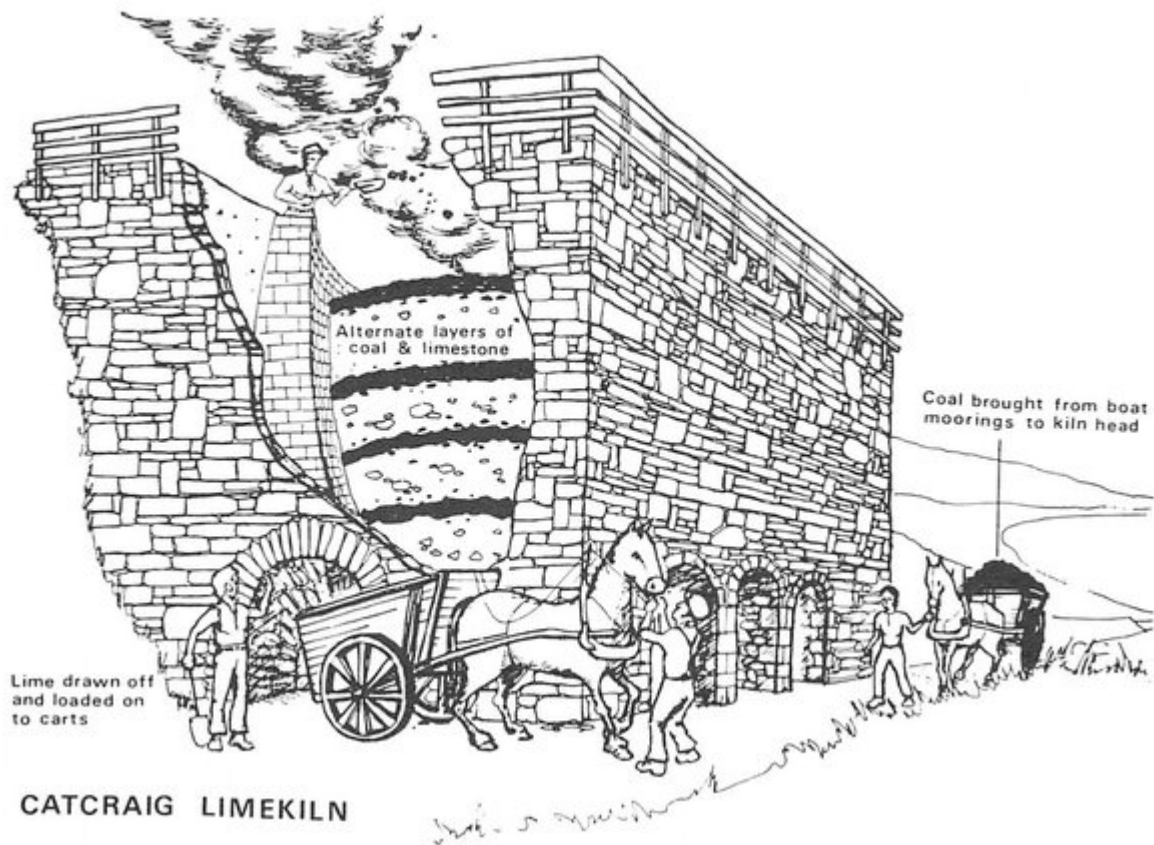
(Figure 14) 'Duck's feet'.



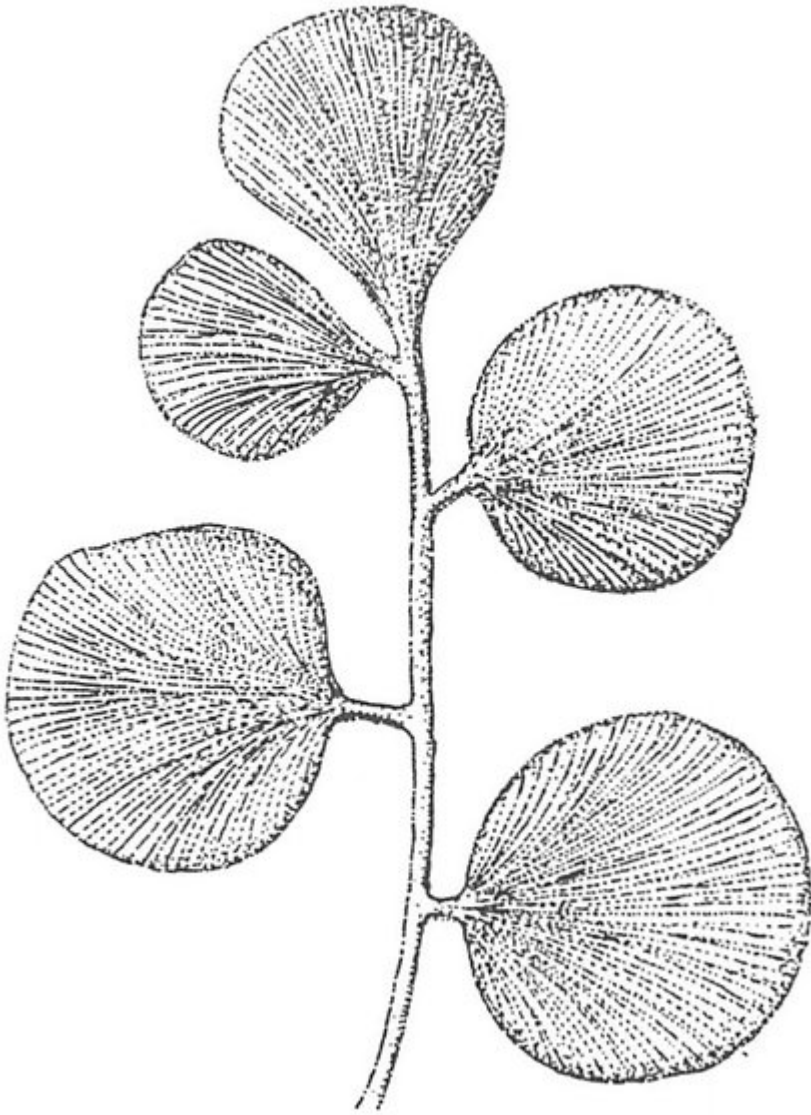
(Figure 15) Dunbar Castle.



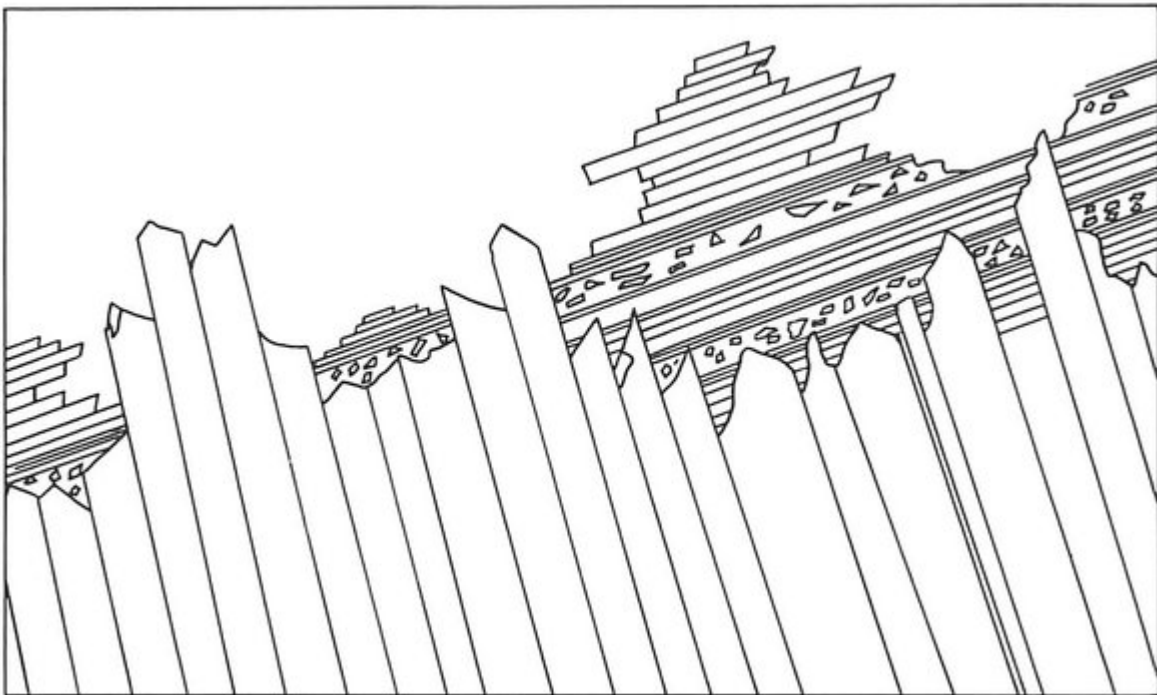
(Figure 16) Columnar basalt, The Battery, Dunbar.



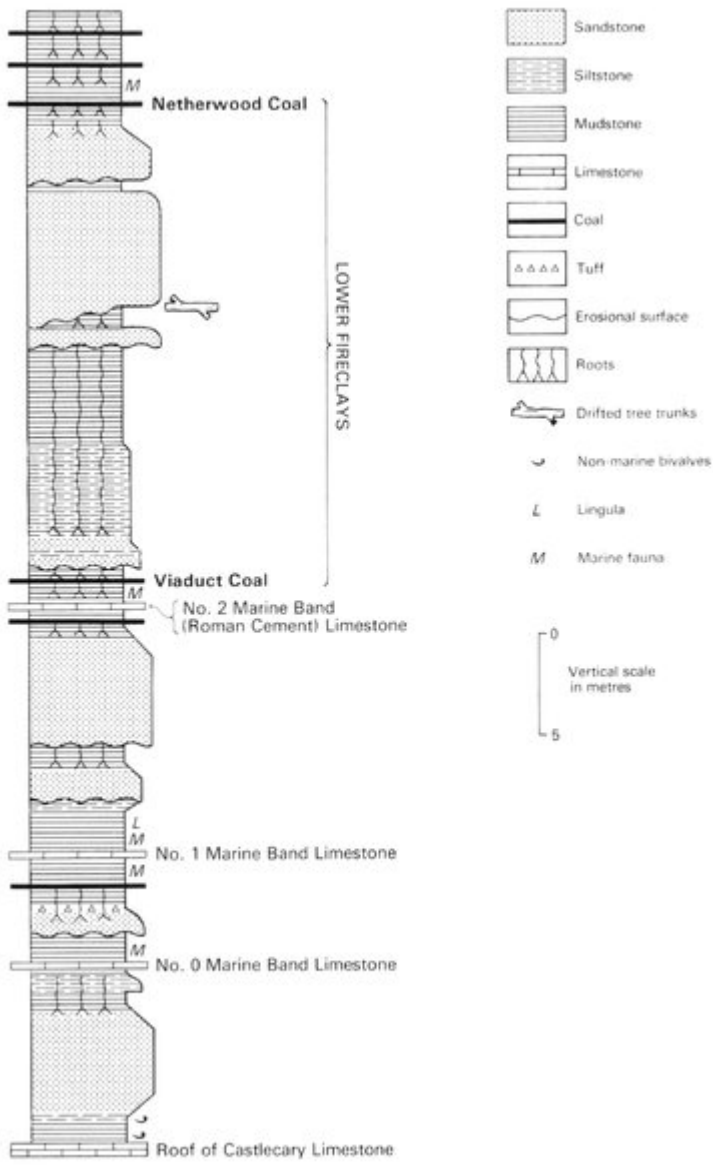
(Figure 17) Catcraig Limekiln from 'Barns Ness', Anon 1972.



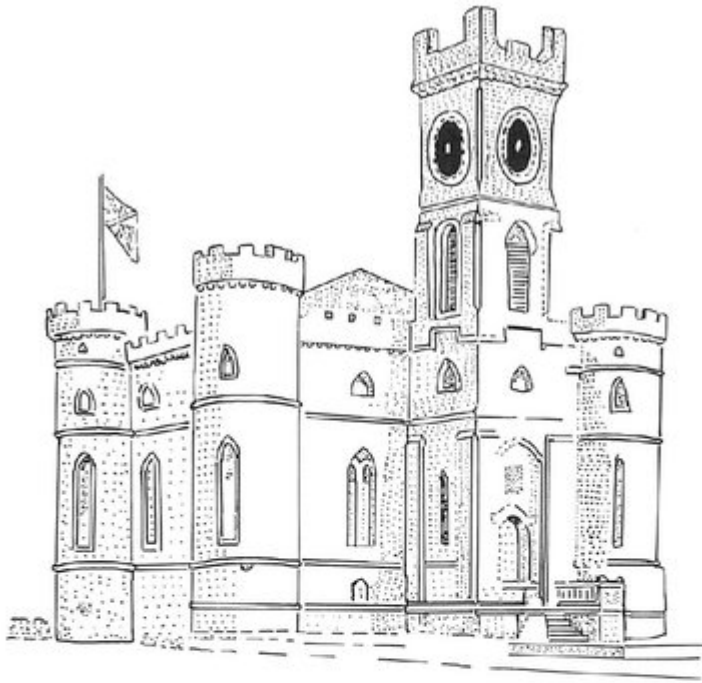
(Figure 18) *Cardiopteris polymorpha*.



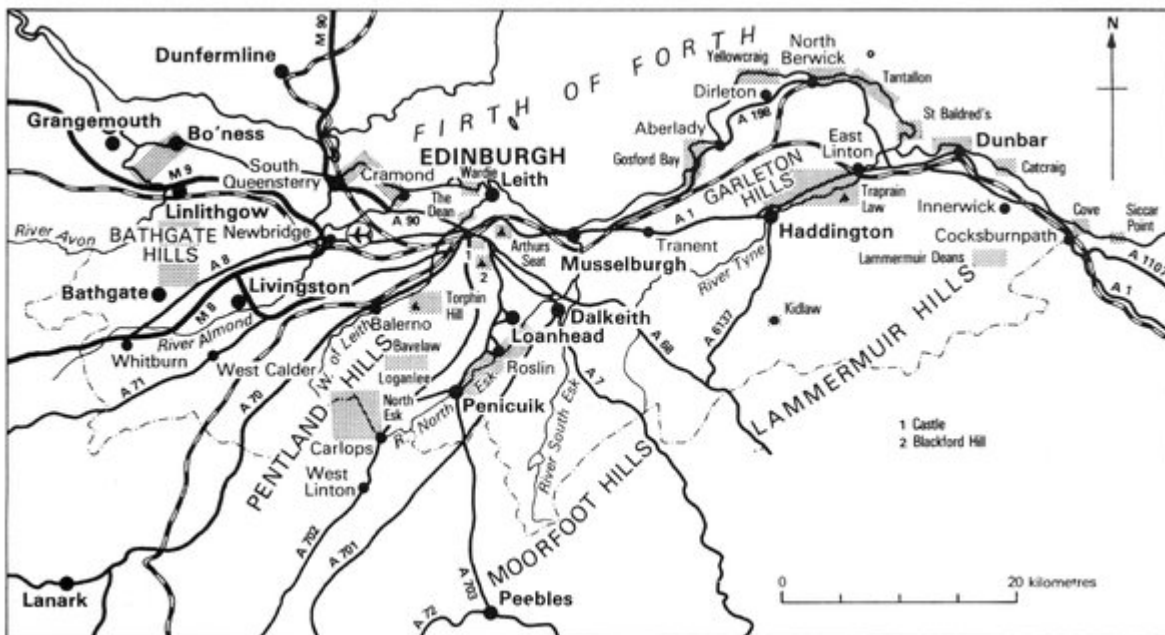
(Figure 19) Siccar Point. after Sir J. Hall from 'Hutton: The Lost Drawings', Craig et al. 1978.



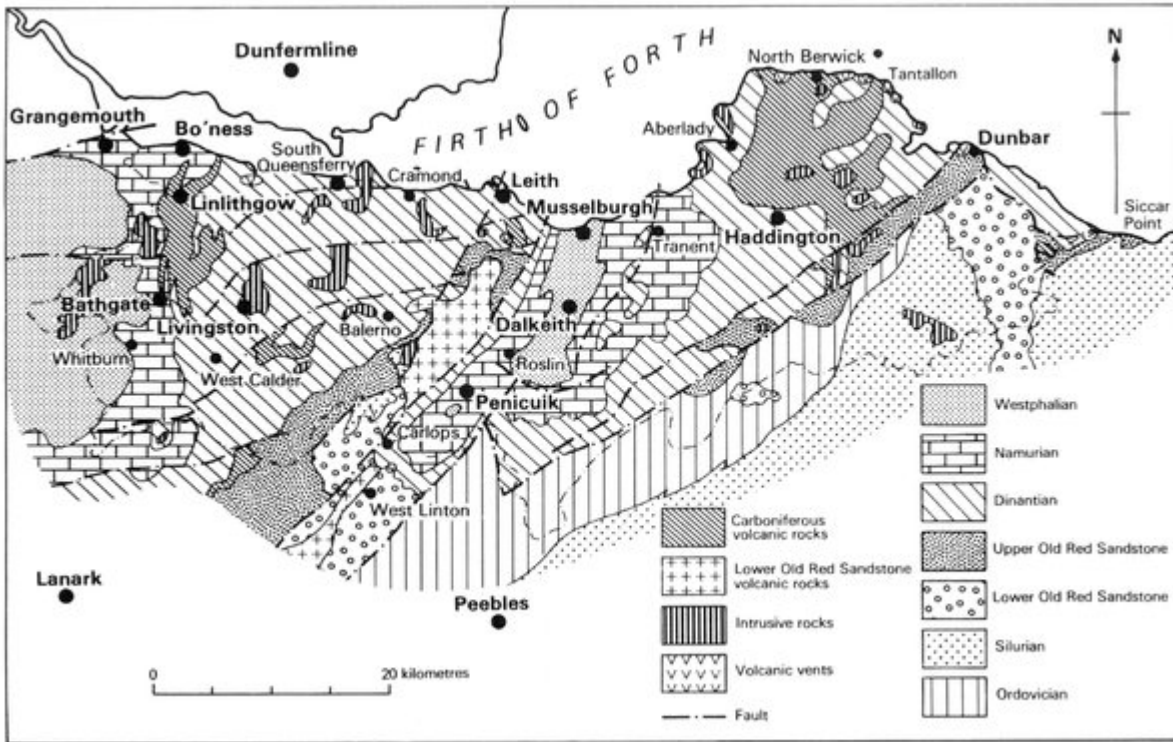
(Figure 20) Section in Passage Group by R. Munro.



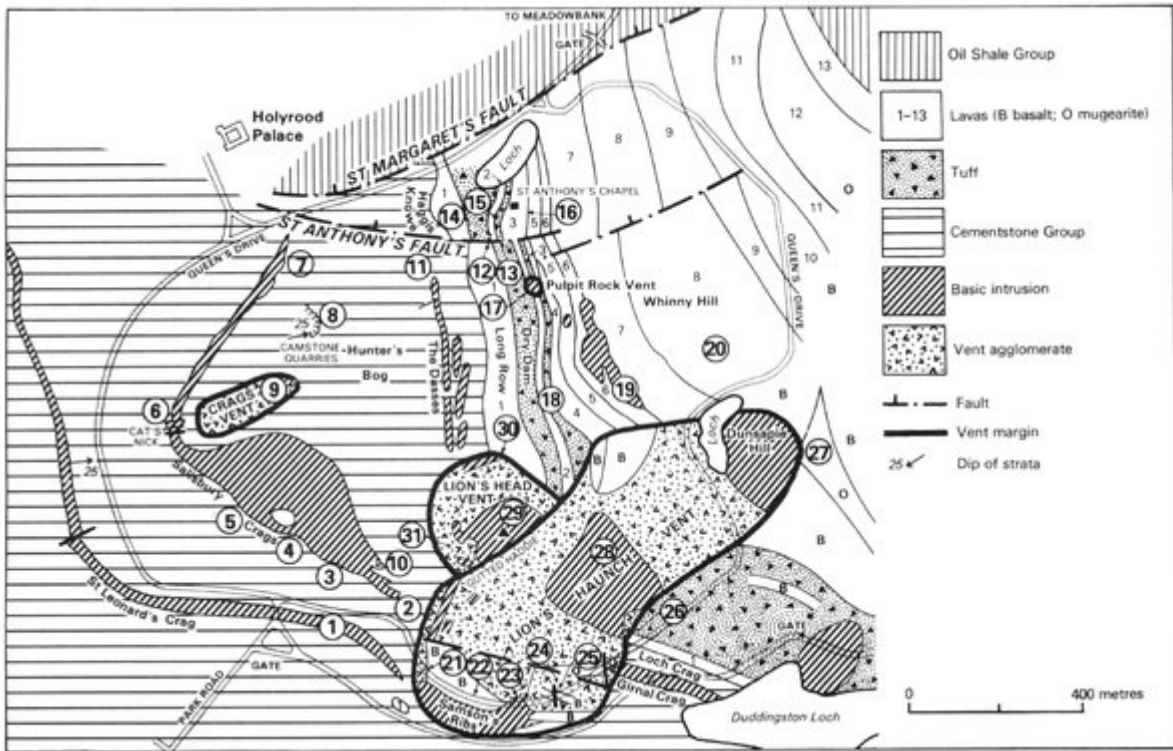
(Figure 21) The Old Town Hall, Bo'ness, and stoop and room workings in the Western Main Coal 15 m below the Old Town Hall, after Cadell 1925.



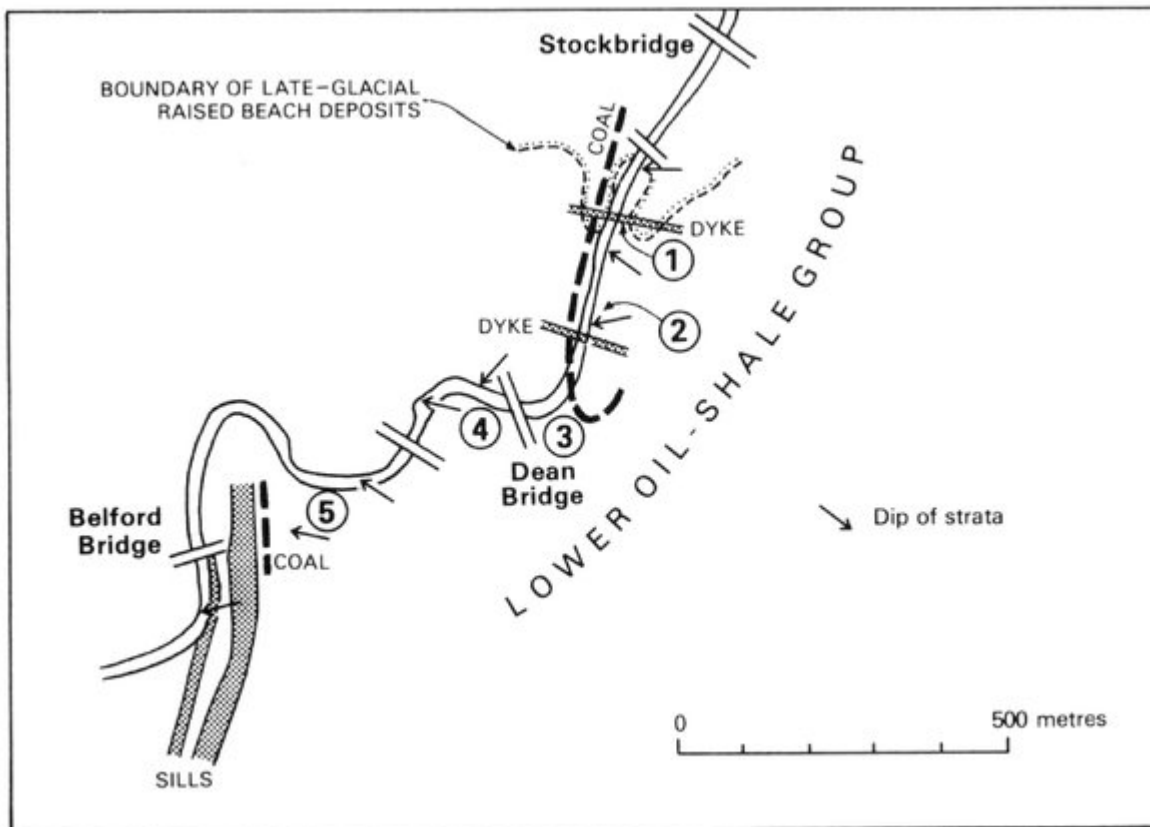
(Map 1) Lothian Region and the location of the excursions.



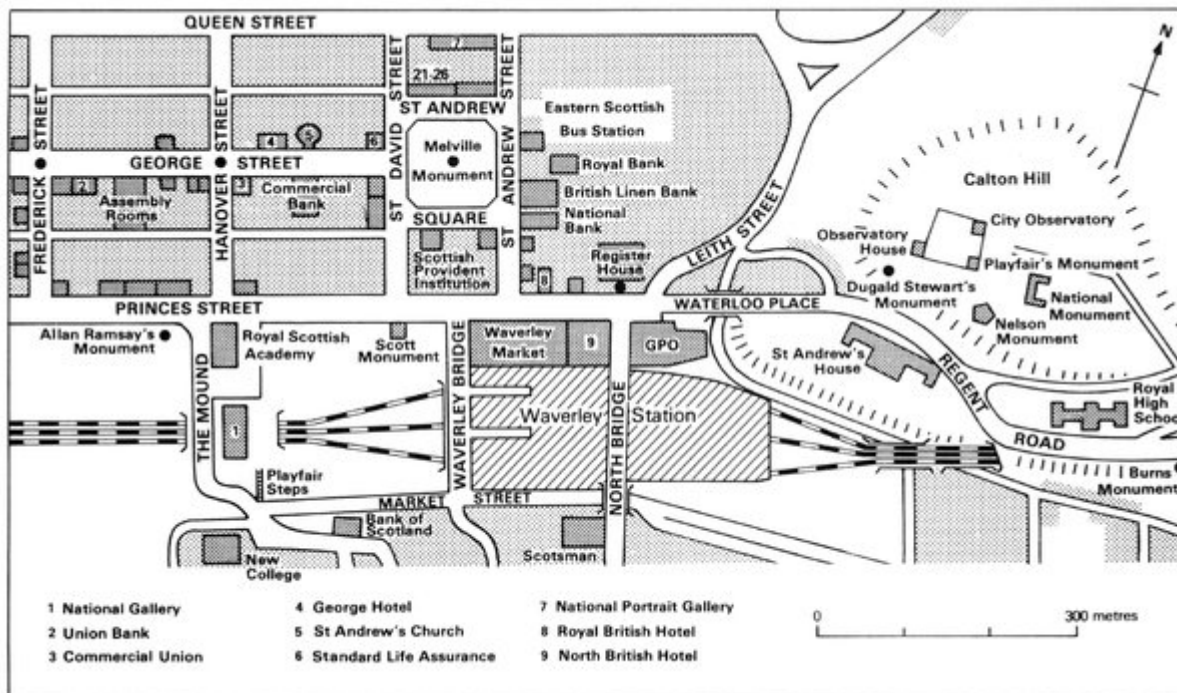
(Map 2) Geological map of the Lothian Region.



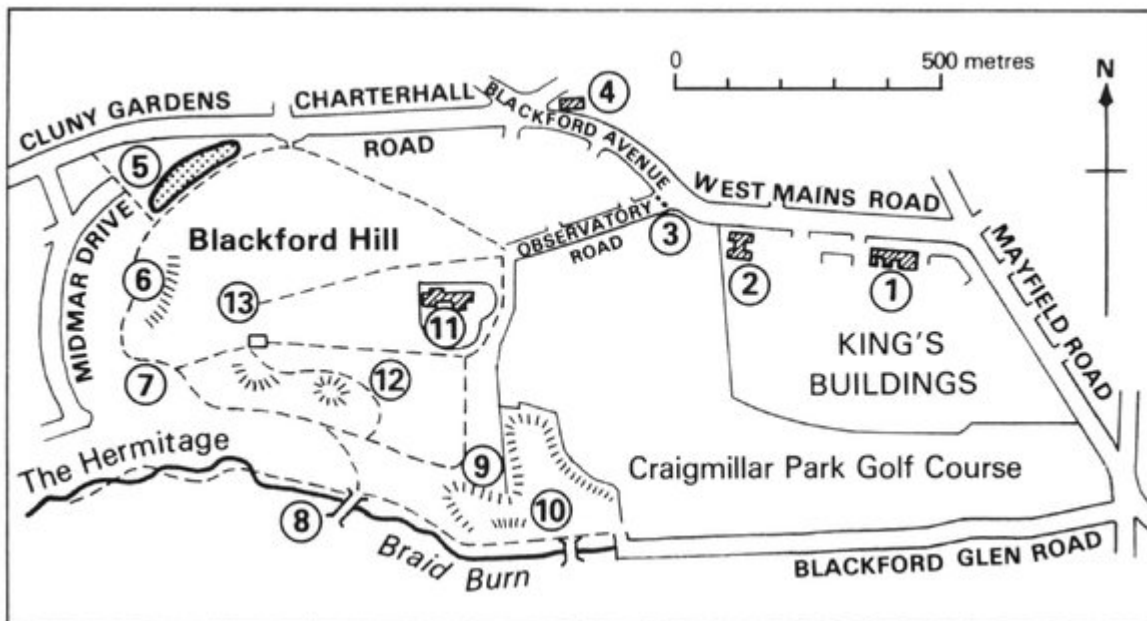
(Map 3) Arthur's Seat.



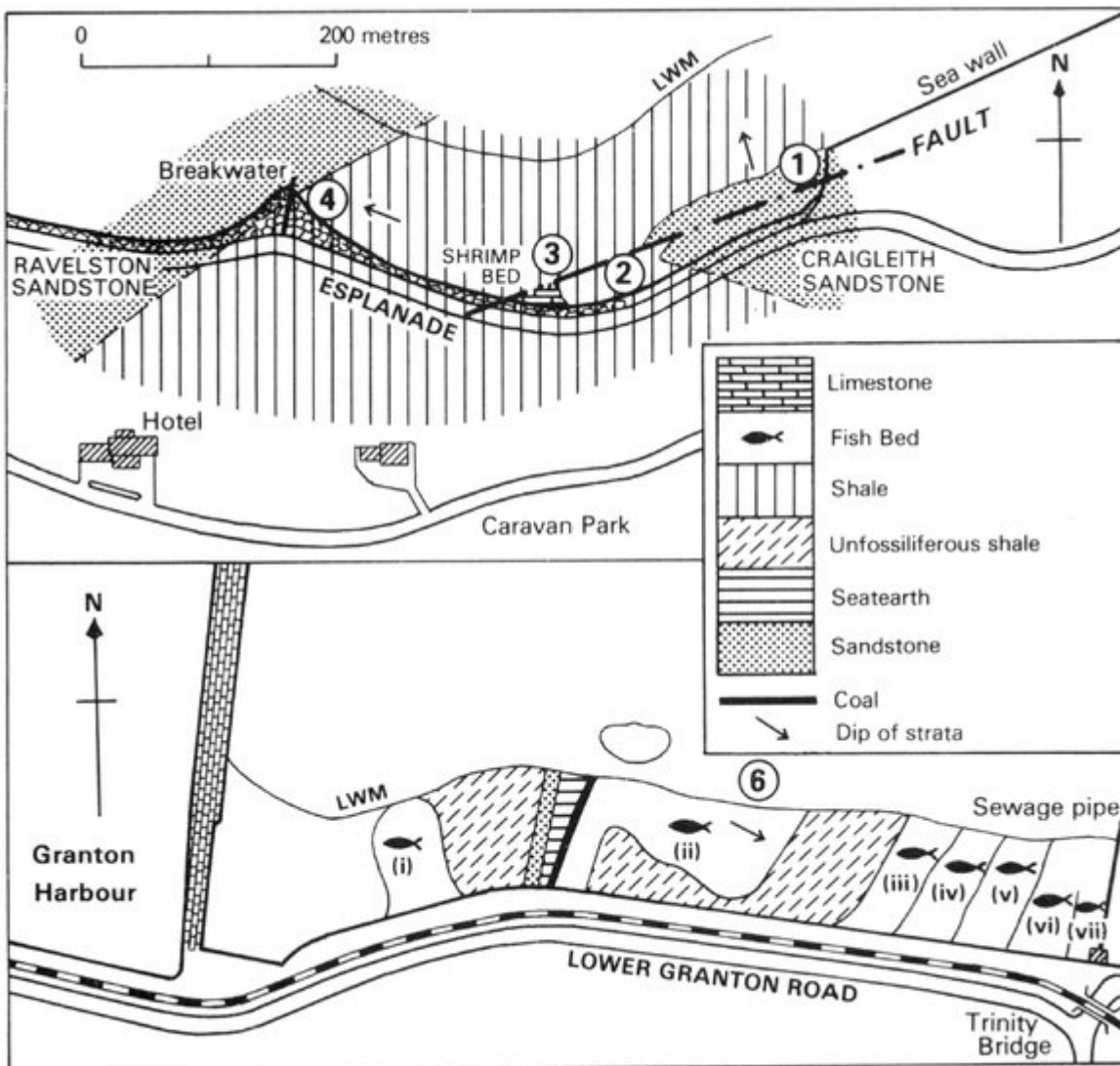
(Map 4) Water of Leith valley.



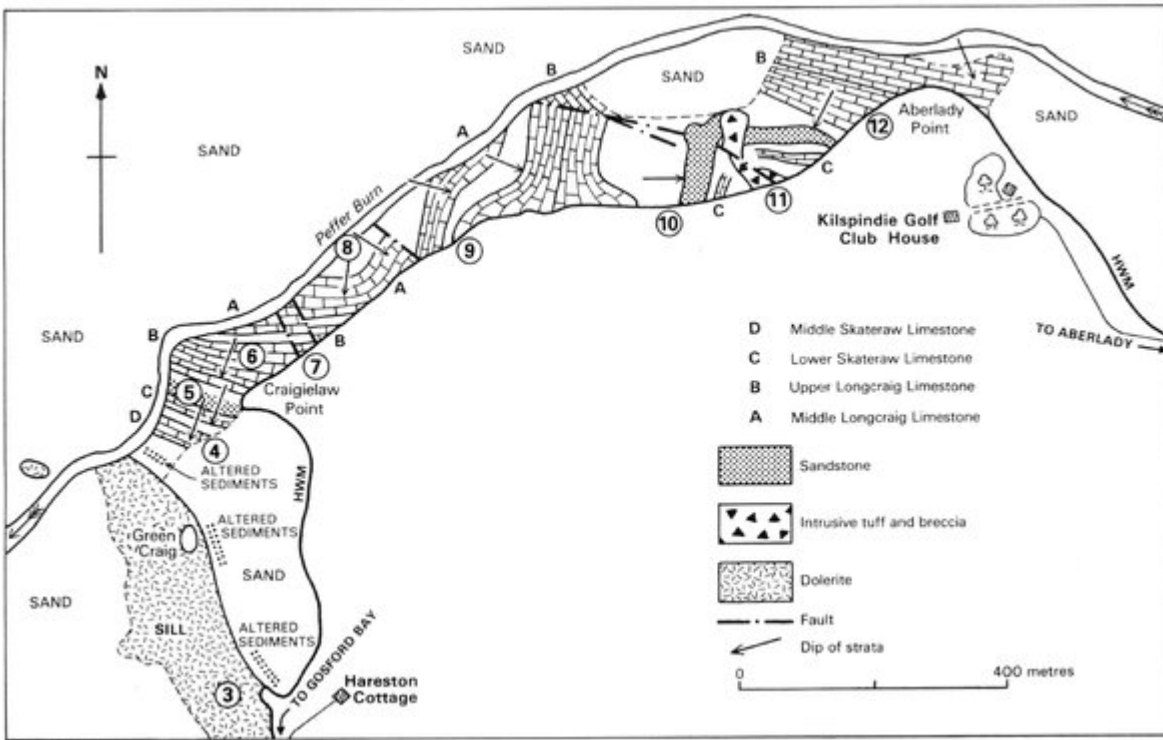
(Map 5) Edinburgh city centre.



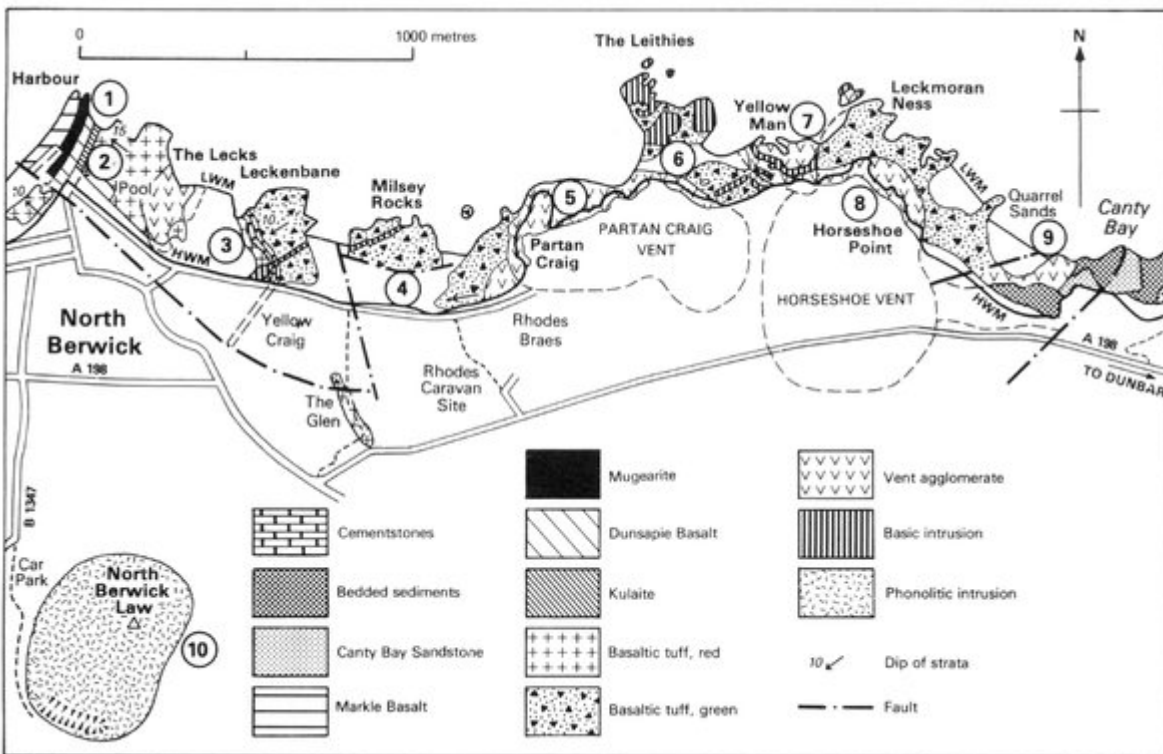
(Map 6) Blackford Hill.



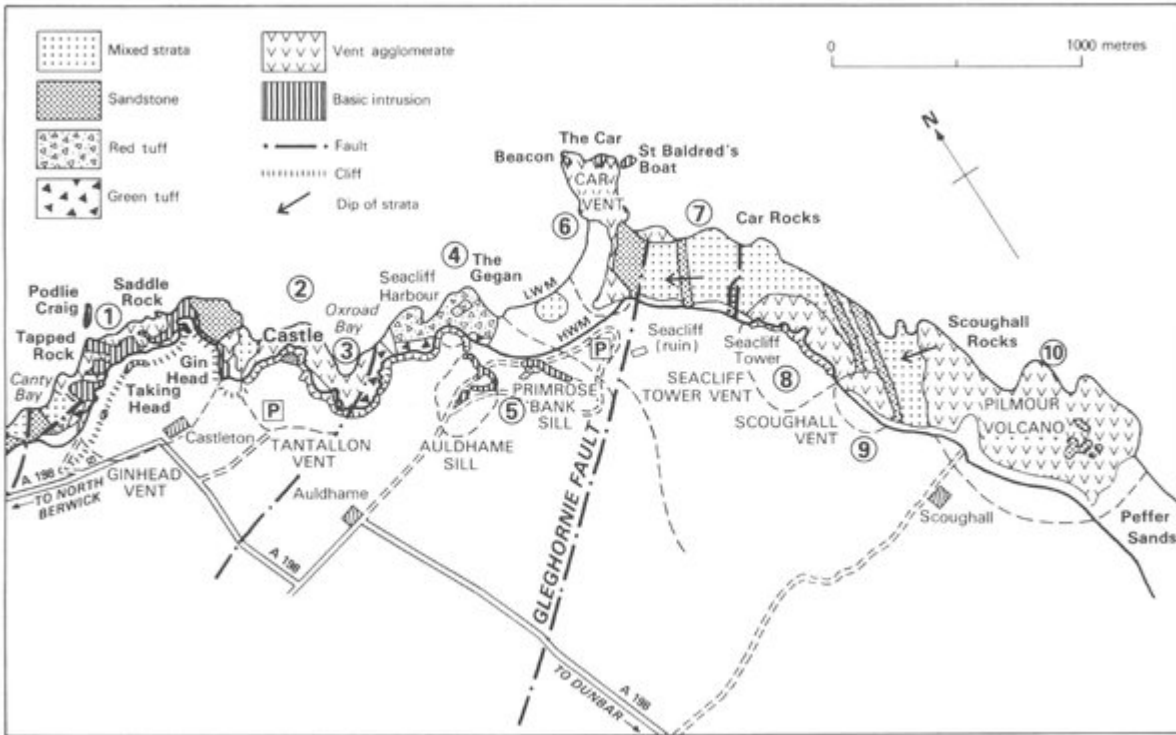
(Map 7) Granton and Wardie shore.



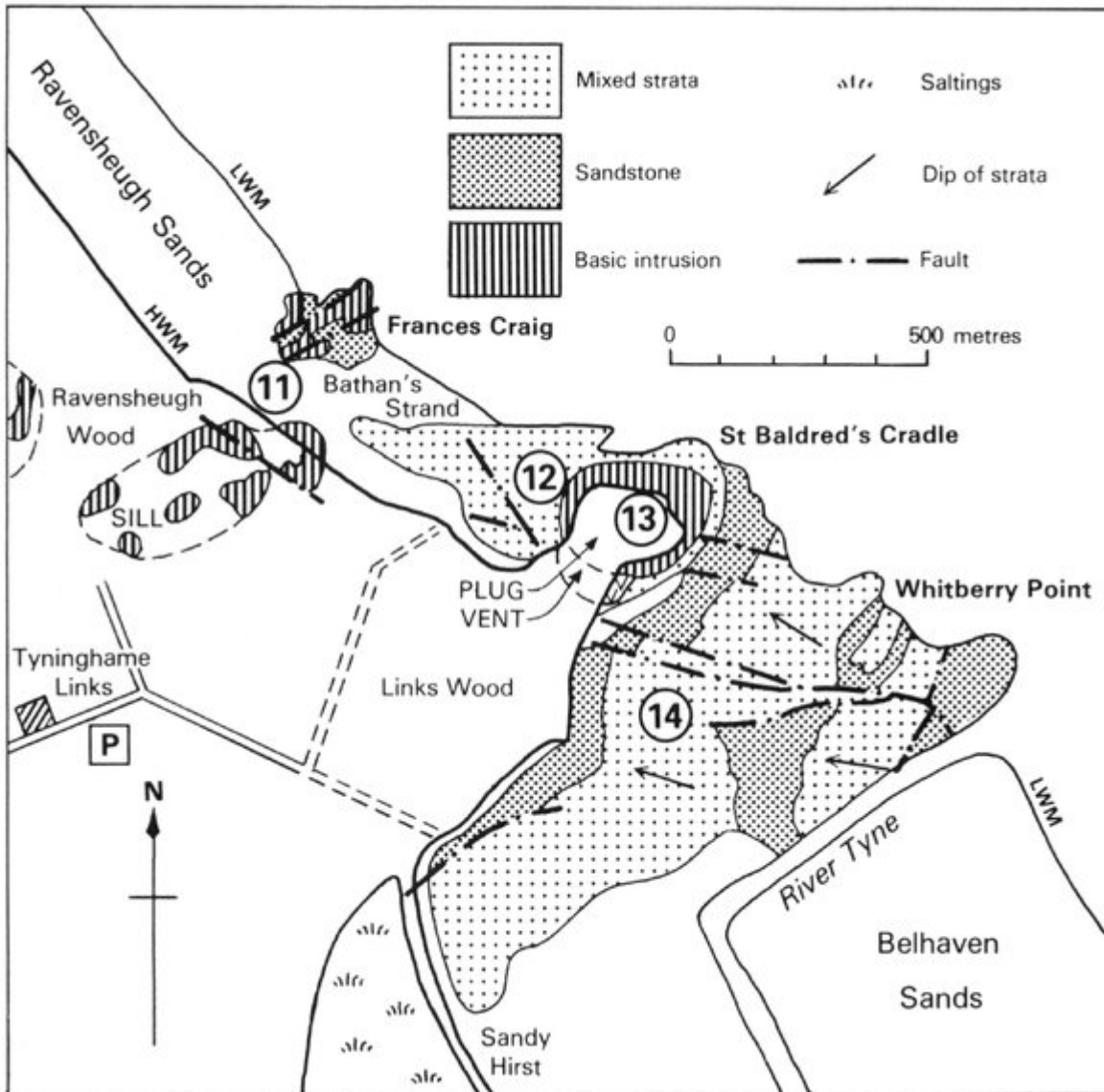
(Map 8) Kilspindie shore.



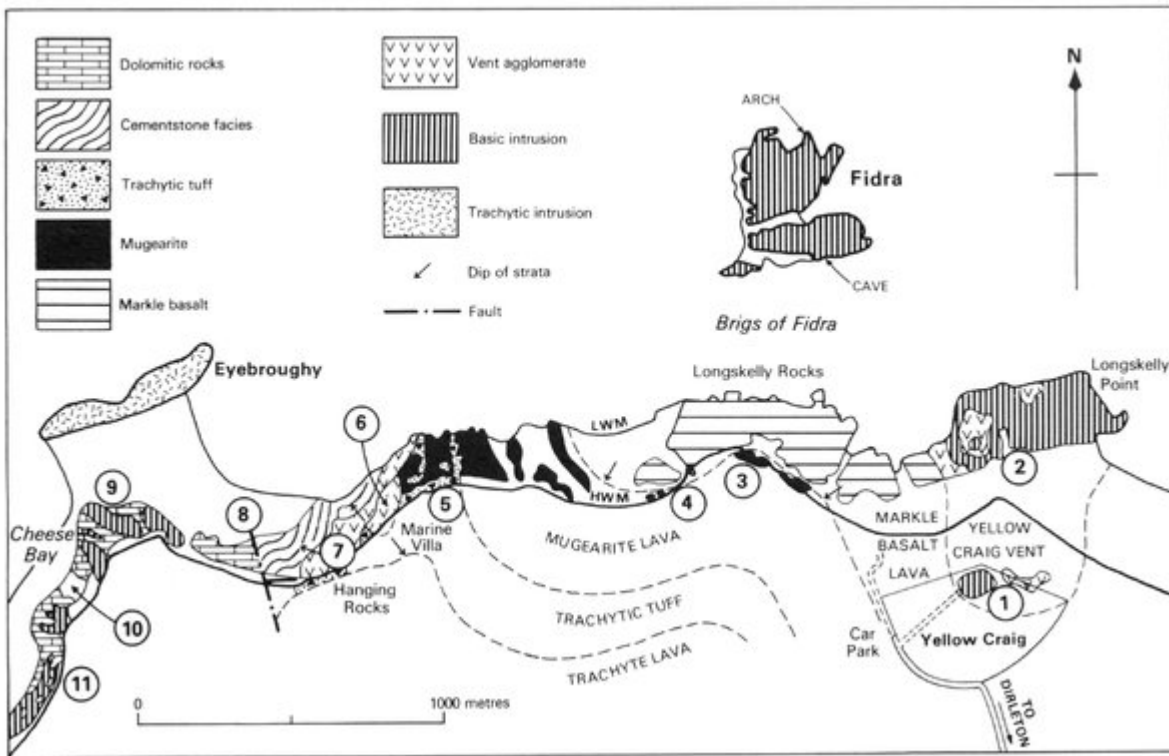
(Map 9) North Berwick to Canty Bay.



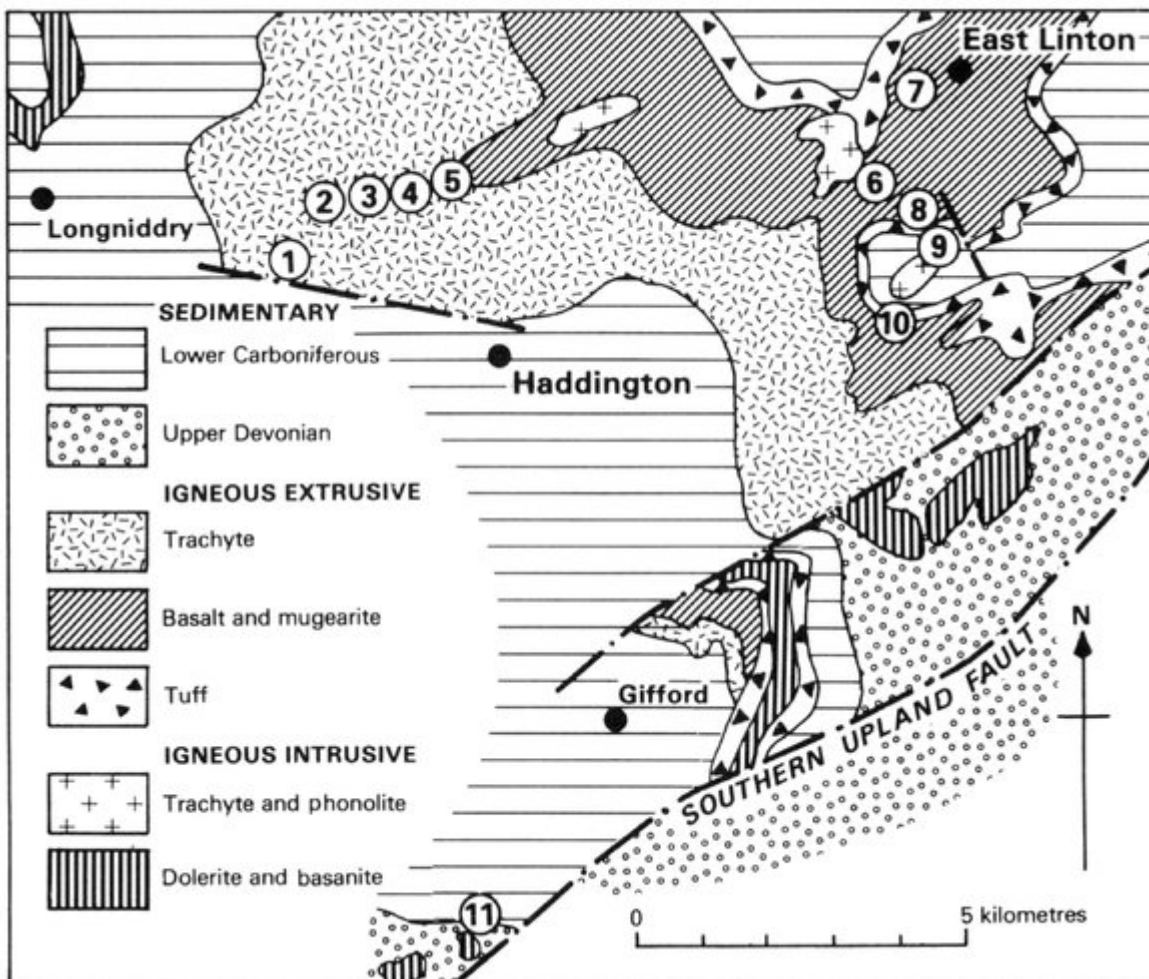
(Map 10) Tantallon.



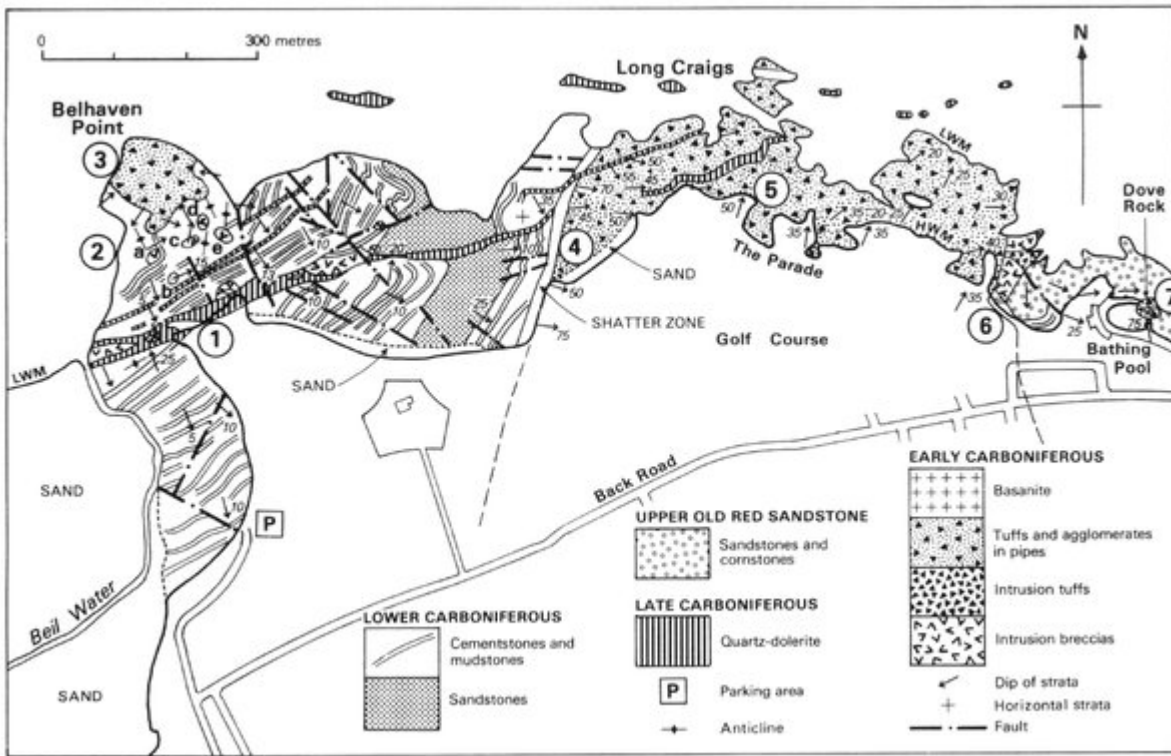
(Map 11) St Baldred's.



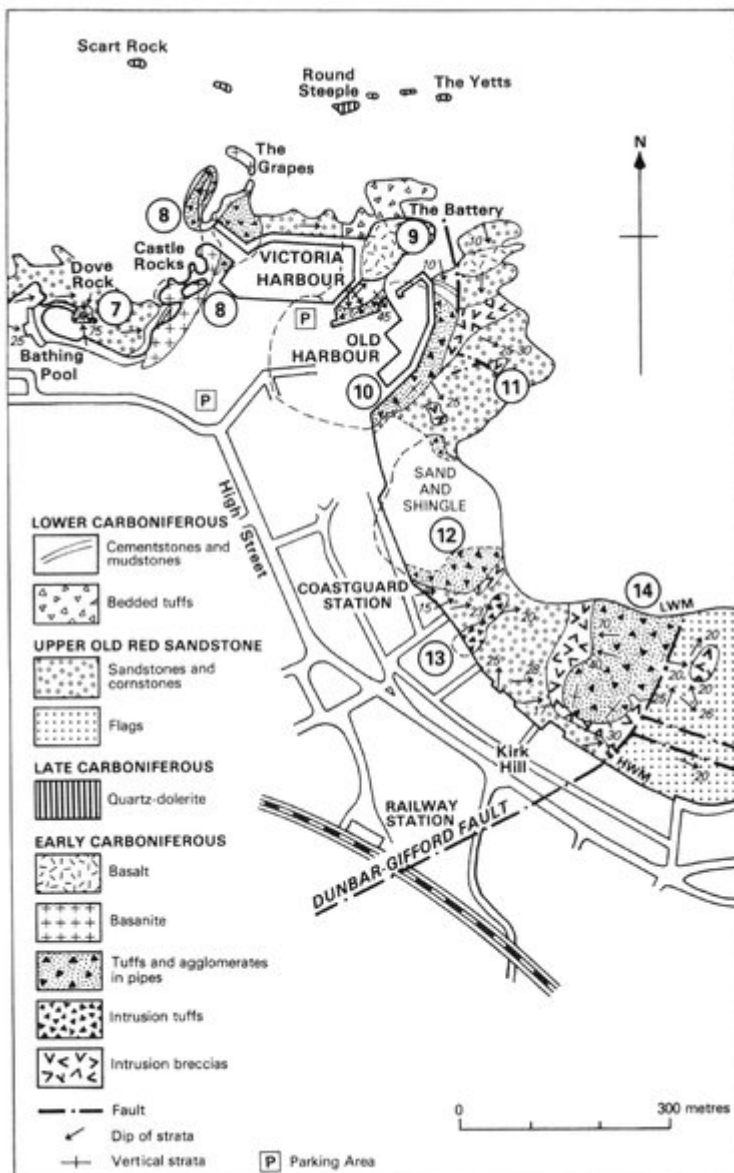
(Map 12) Yellow Craig to Cheese Bay.



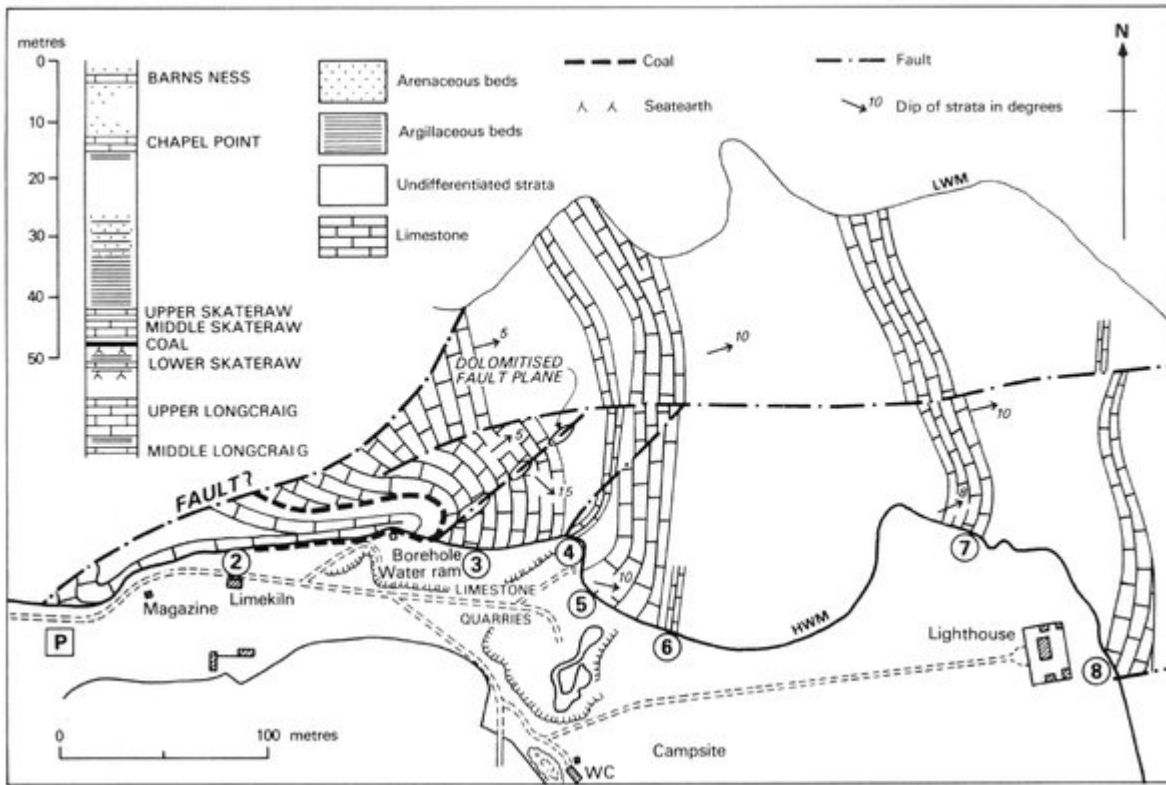
(Map 13) Garleton Hills.



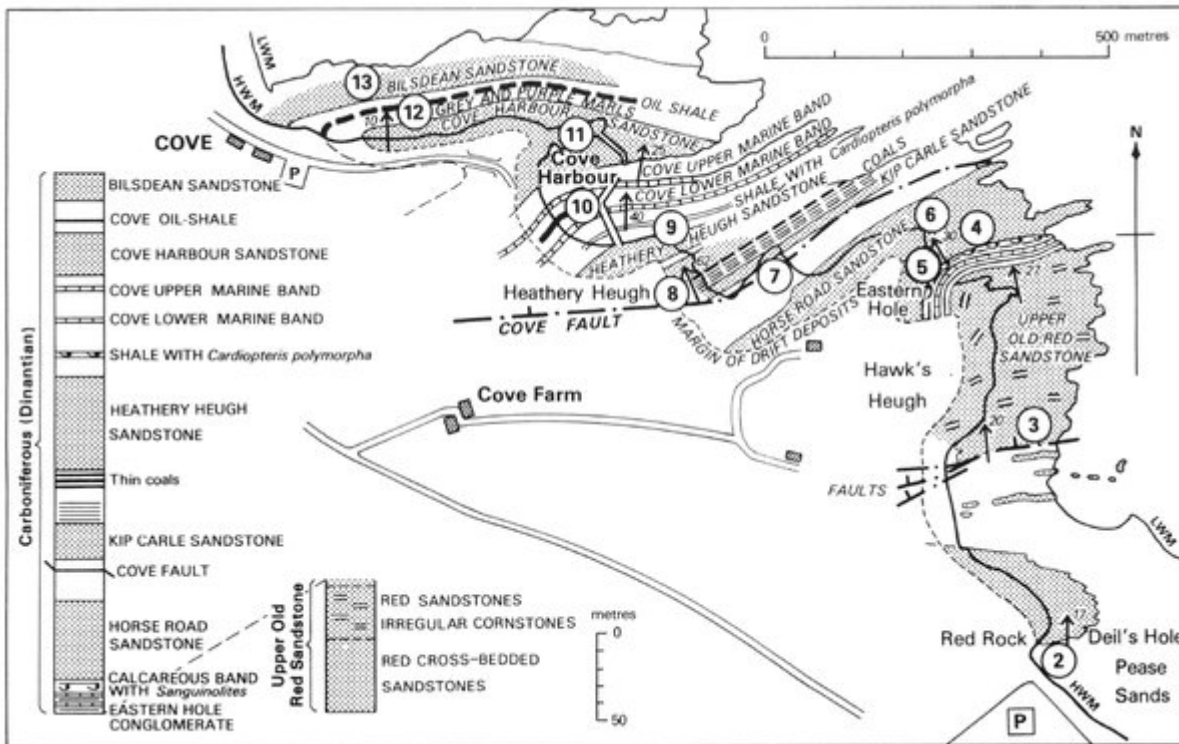
(Map 14) Belhaven and the Parade.



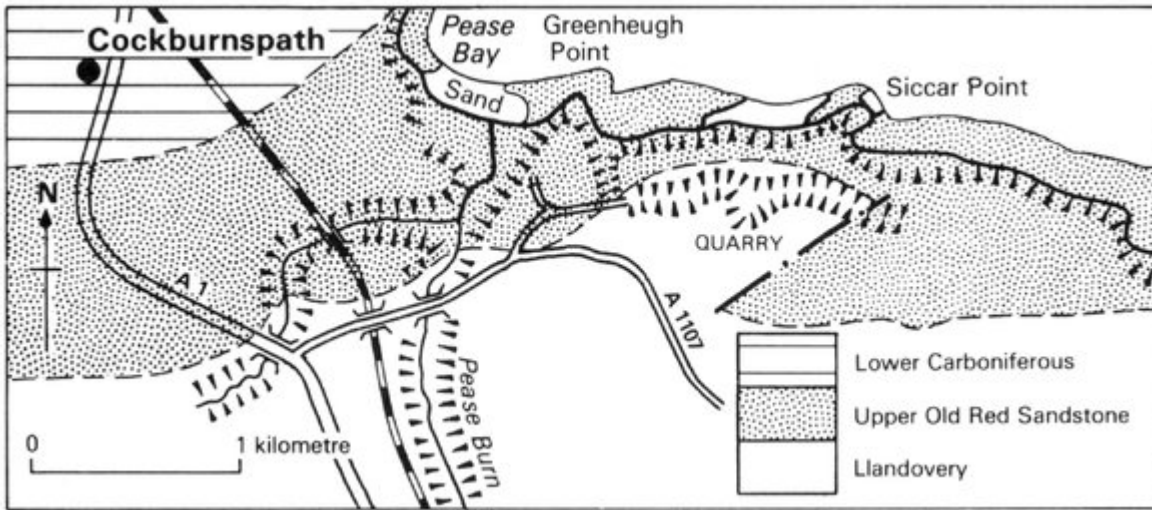
(Map 15) Dunbar.



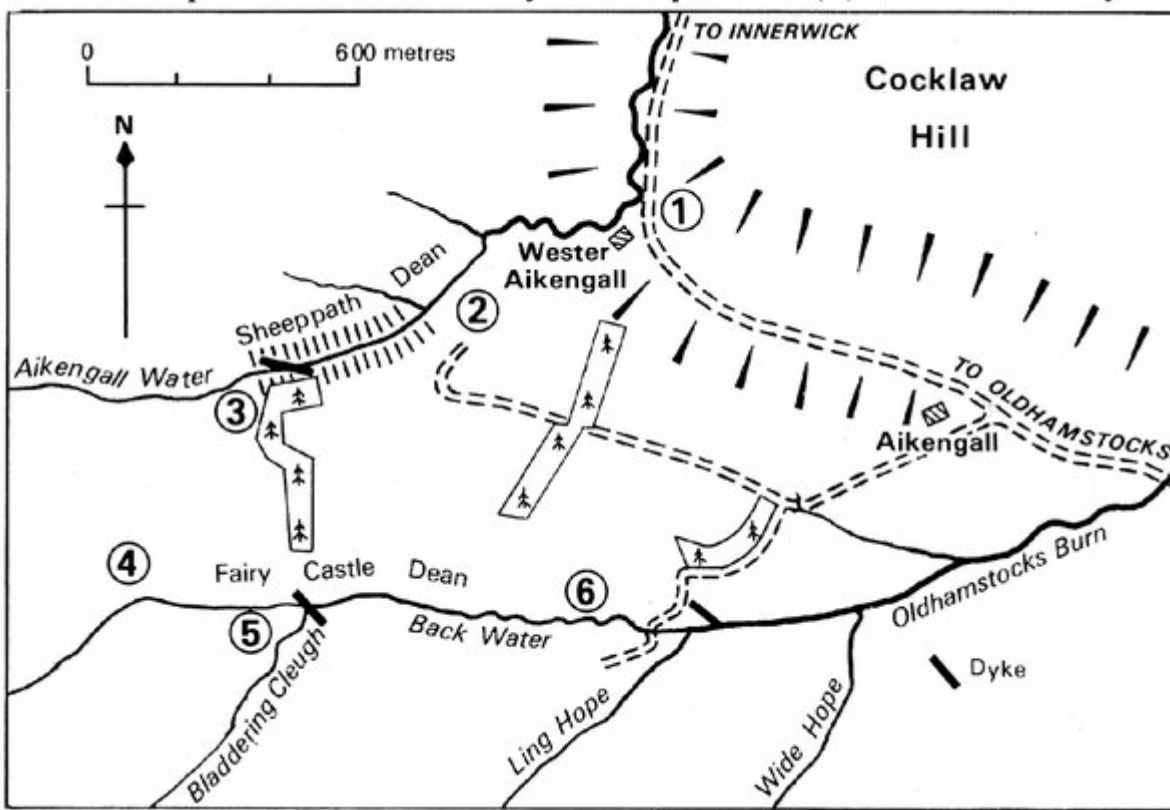
(Map 16) Catcraig.



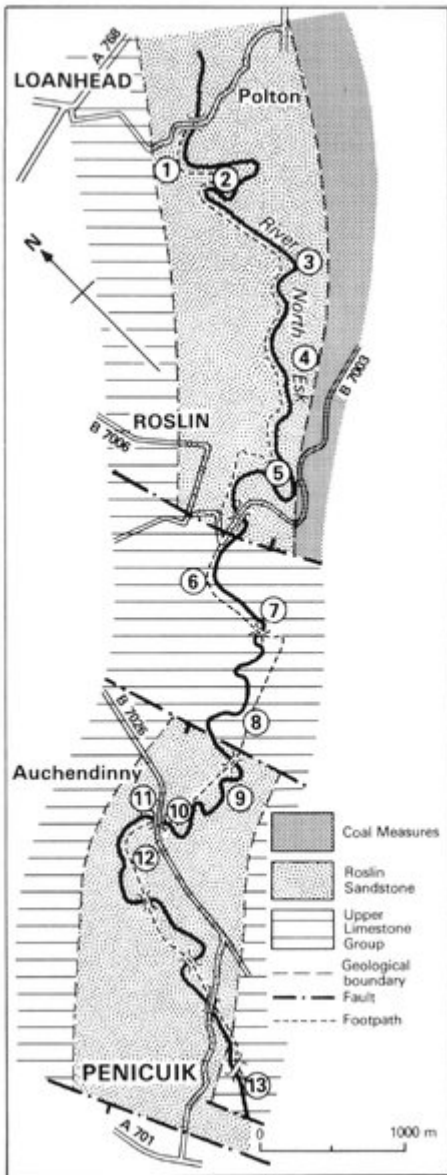
(Map 17) Pease Bay to Cove.



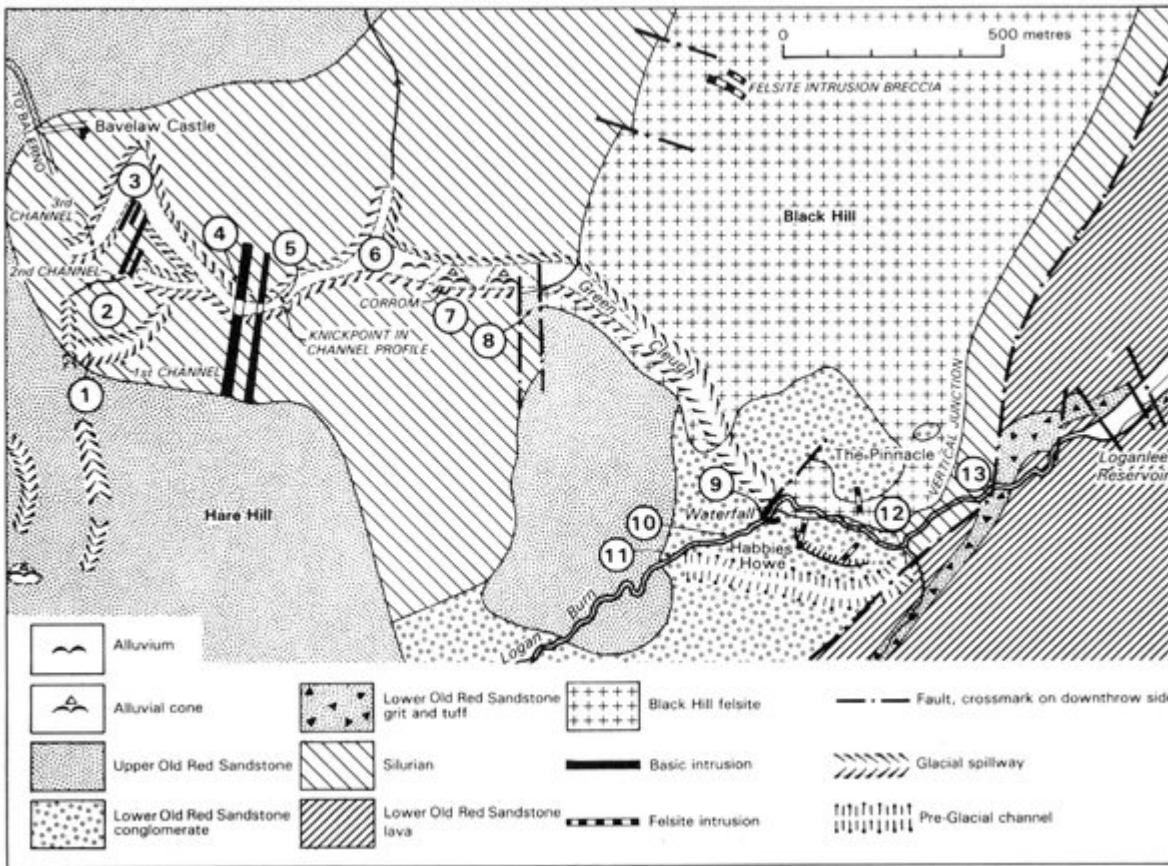
(Map 18) Siccar Point Map.



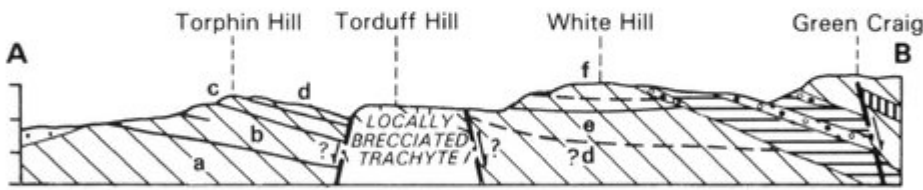
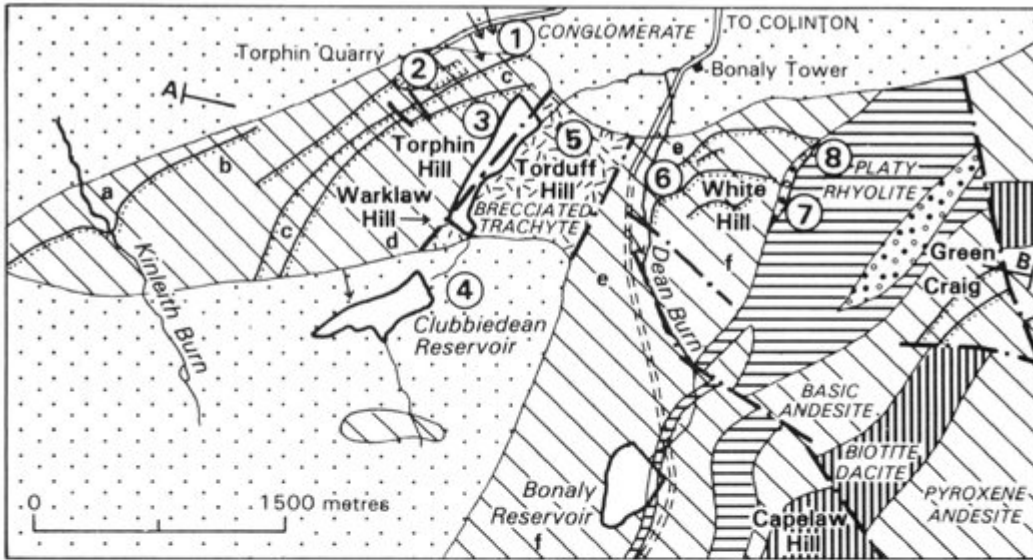
(Map 19) Lammermuir Deans.



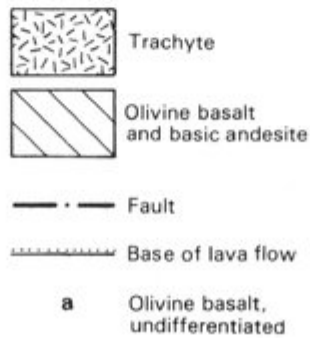
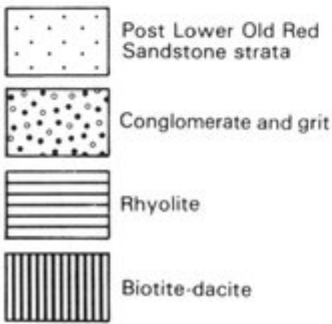
(Map 20) River North Esk.



(Map 21) Bavelaw Castle to Loganlee.

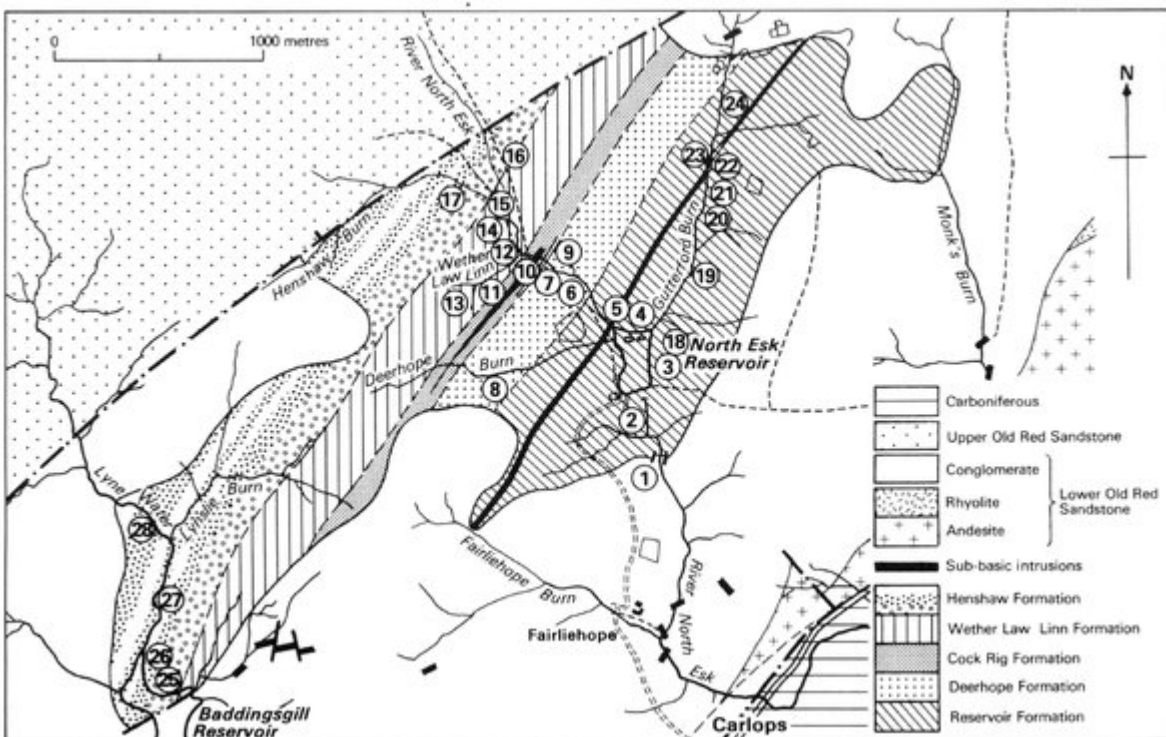


Section A - B

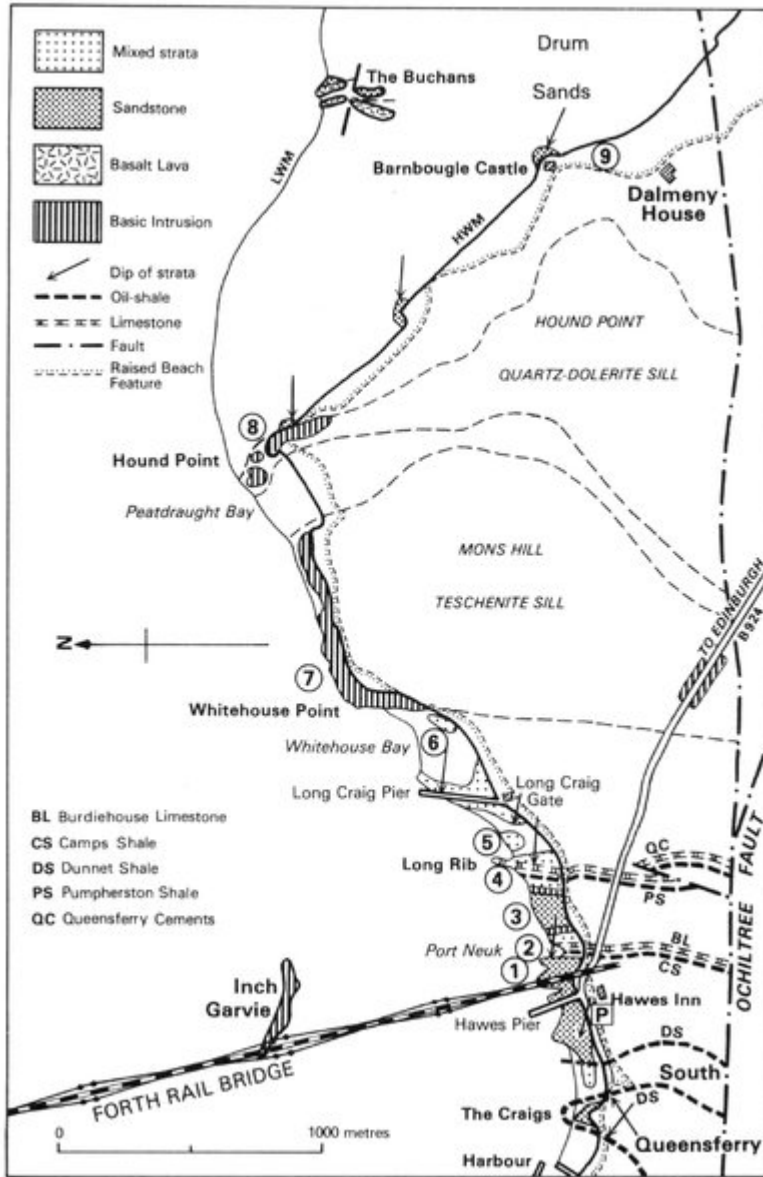


- b Microporphyritic olivine basalt
- c Macroporphyritic olivine basalt with large feldspar and altered olivine phenocrysts
- d Macroporphyritic olivine basalt with large feldspar phenocrysts
- e Andesite and basalt with large feldspar phenocrysts
- f Andesite and basalt, undifferentiated. Some subordinate trachytes

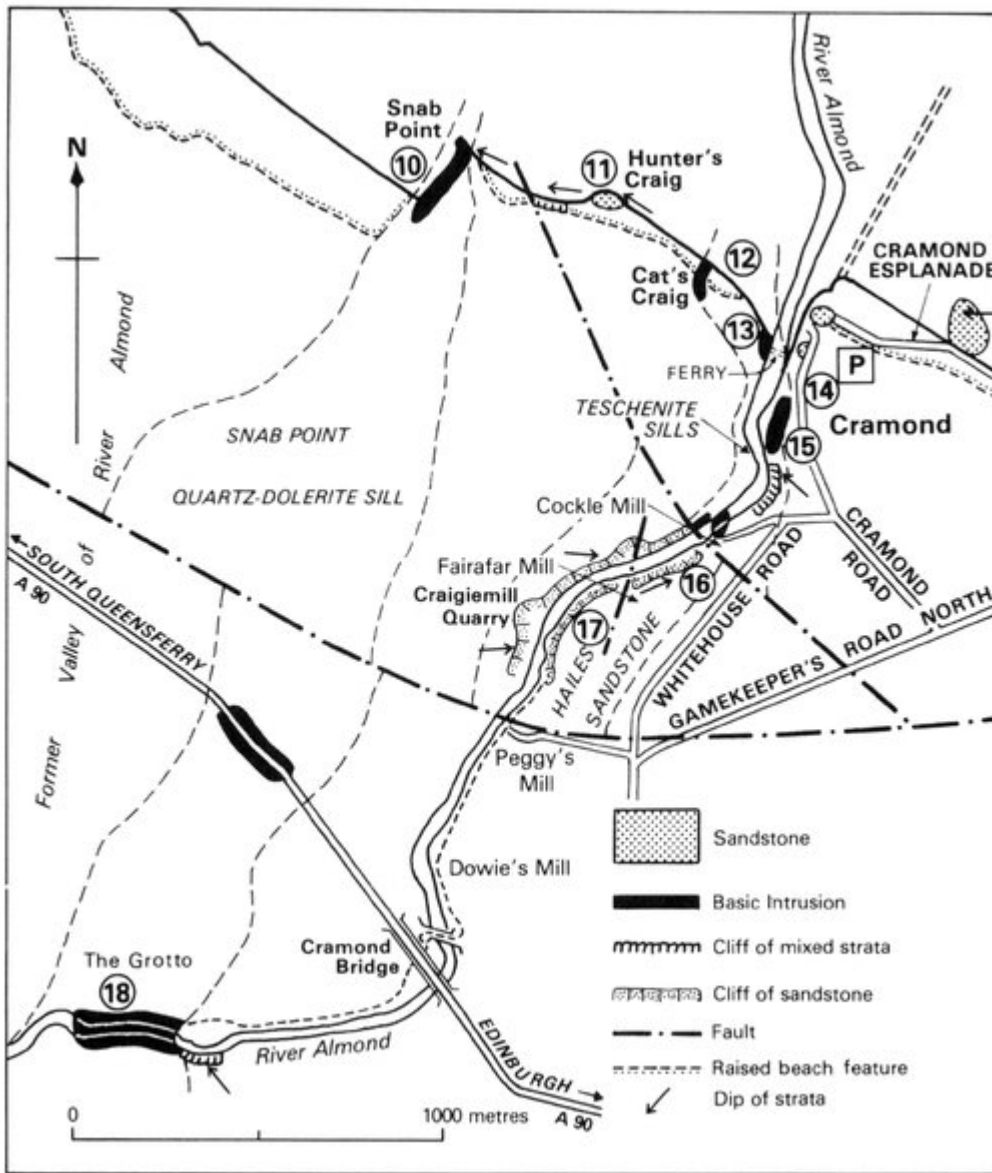
(Map 22) Torphin to Bonaly Tower.



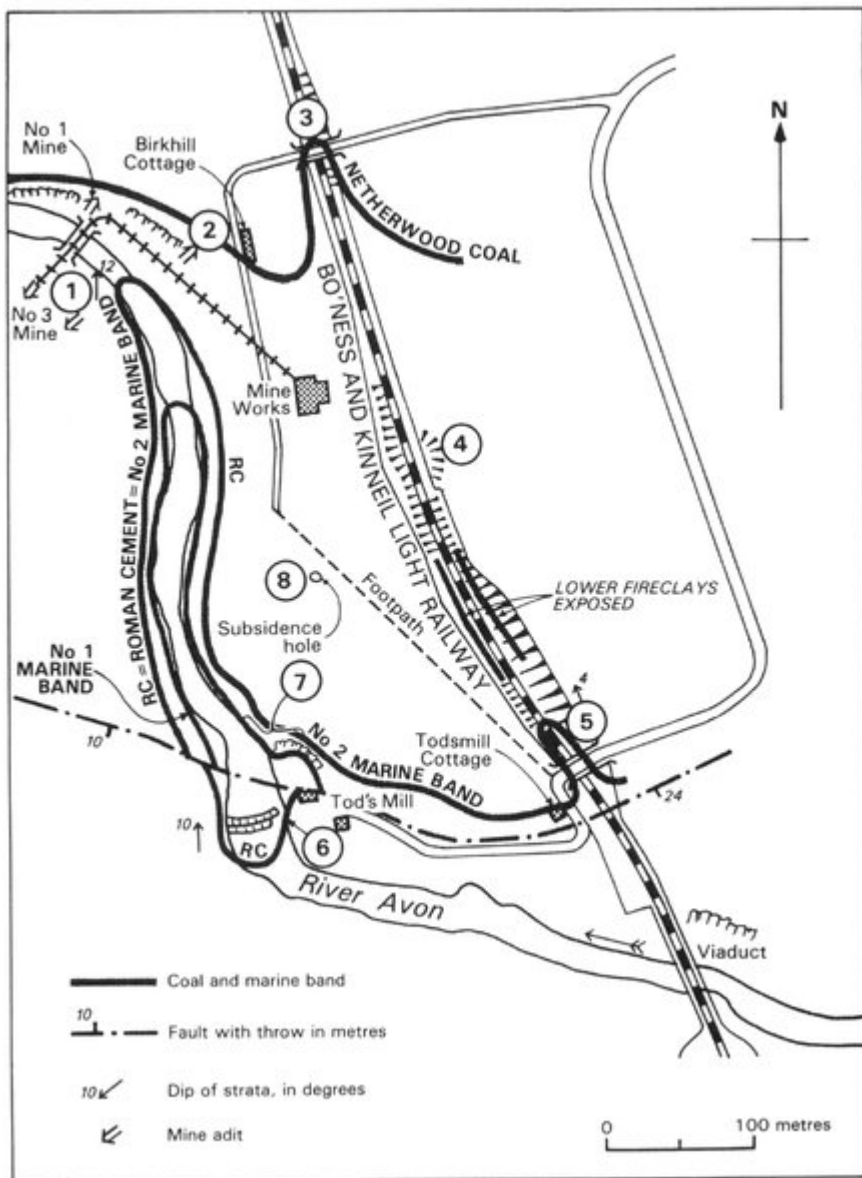
(Map 23) North Esk Inlier.



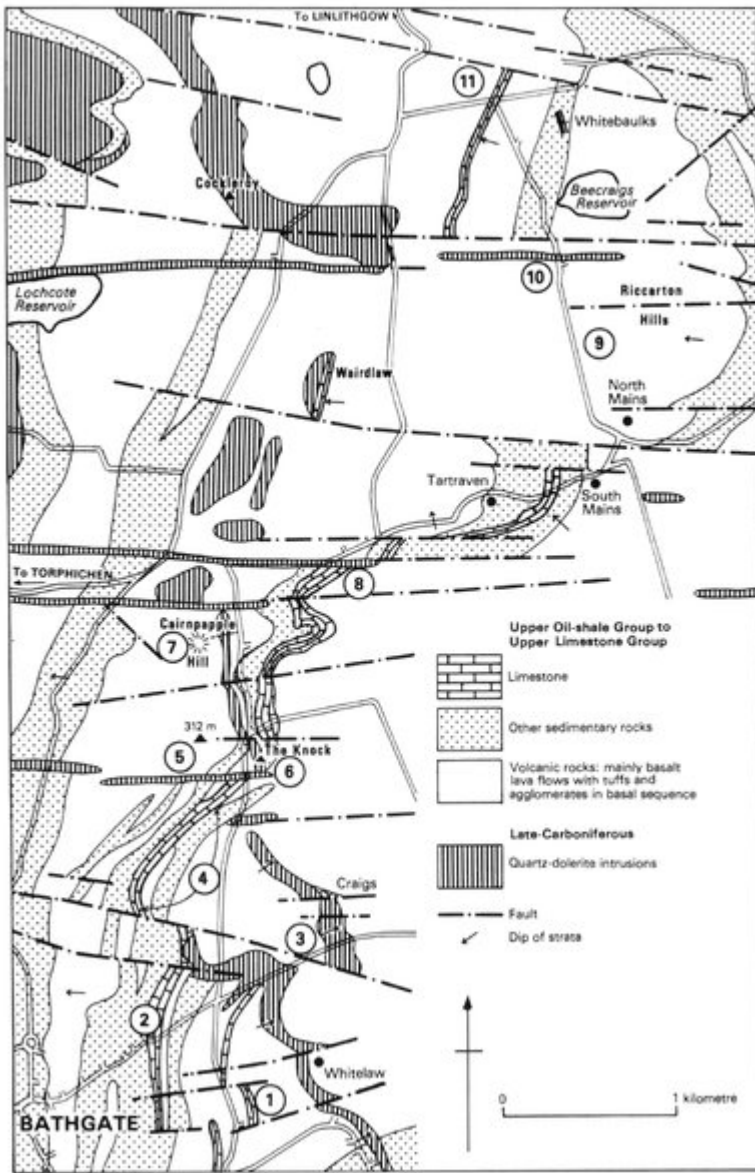
(Map 24) South Queensferry.



(Map 25) Cramond.



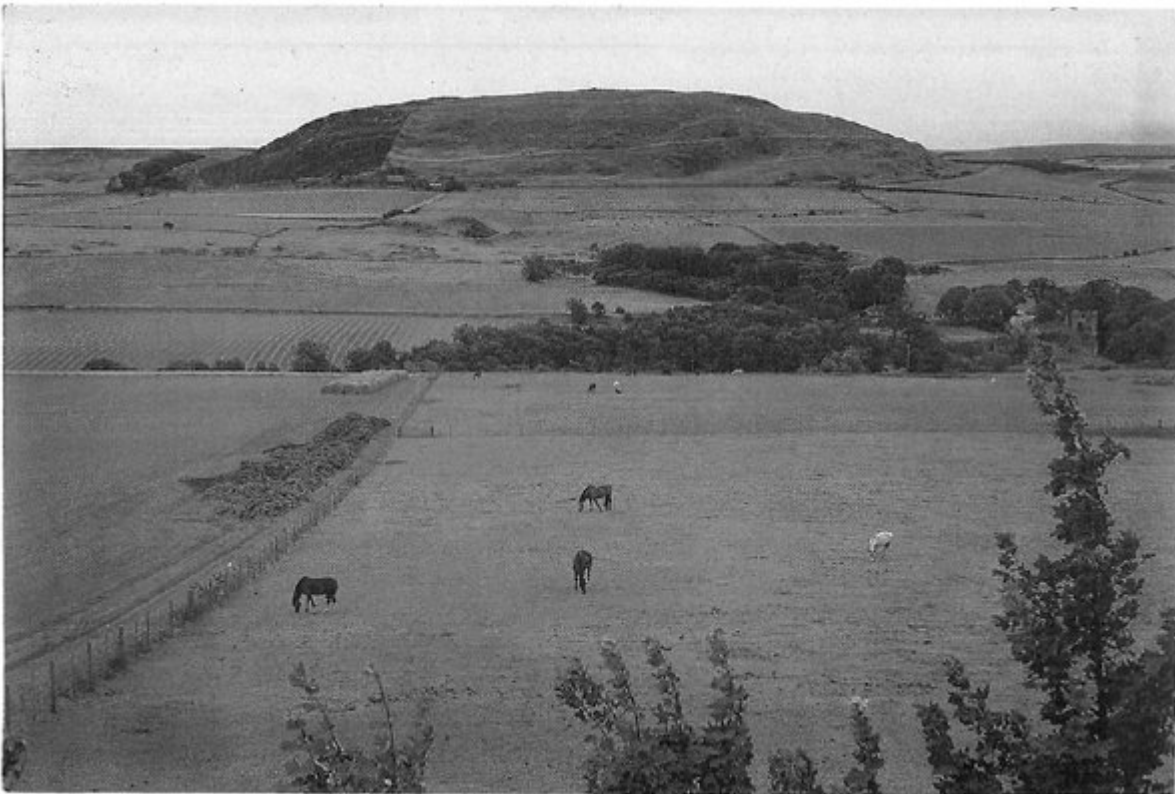
(Map 26) River Avon.



(Map 27) Bathgate Hills.



(Plate 1) Basaltic lavas underlain by red tuffs, Paddling Pool, North Berwick.



(Plate 2) Phonolitic laccolith, Traprain Law, from Pencairg.



(Plate 3) Limestones and mudstones, Lower Limestone Group, cut by basalt dyke and overlain by glacial deposits, Oxwellmains North Quarry.



(Plate 4) The Great Conglomerate, with recent scree fans. Fairy Castle Dean.



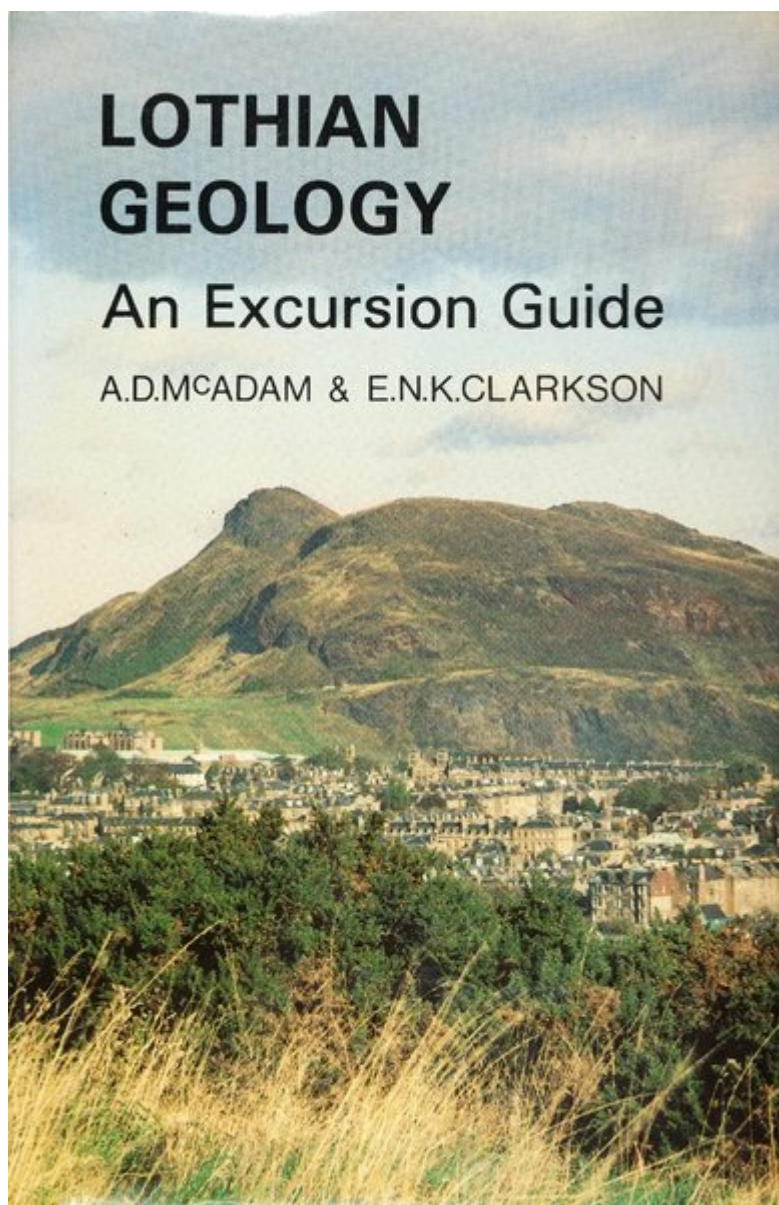
(Plate 5) Sill of white trap, altered basalt, intruding Upper Oil-Shale Group sedimentary rocks, South Queensferry.

	MacGregor (1928)	Phenocrysts		Macdonald (1975)
		abundant	may occur	
Macroporphyrritic (>2 mm)	Markle	plagioclase	olivine iron oxides	macroporphyritic: olivine-plagioclase ± iron oxides-phyric basalt, basaltic hawaiite or hawaiite
	Dunsapie	plagioclase clinopyroxene olivine	iron oxides	macroporphyritic: olivine-plagioclase- clinopyroxene-iron oxides-phyric basaltic hawaiite or olivine-clino- pyroxene-plagioclase-phyric basalt
	Craiglockhart	clinopyroxene olivine		ankaramite
Microphyritic (<2 mm)	Jedburgh	plagioclase olivine	iron oxides	microphyric: olivine-plagioclase ± iron oxides-phyric hawaiite, basaltic hawaiite or occasionally basalt
	Dalmeny	olivine	plagioclase clino- pyroxene	microphyric: olivine-basalt or olivine- plagioclase-clinopyroxene-phyric basalt
	Hillhouse	olivine	clino- pyroxene	microphyric: olivine-basalt or olivine- clinopyroxene-phyric basalt

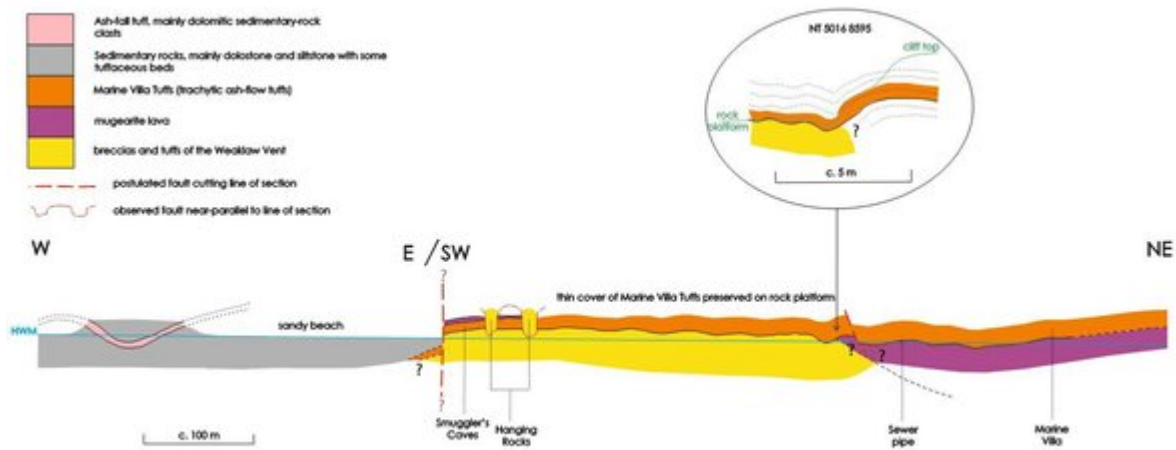
(Table 1) Olivine-basalt nomenclature.

PERIOD	EPOCH/SERIES	AGE	ENVIRONMENT	TYPE OF ROCK/DEPOSIT
QUATERNARY	Post-Glacial	<i>Present day</i>	Temperate land High sea level	River alluvium Low raised beach
	Late-Glacial	<i>10 000</i>	Sub-arctic Very high sea level	Peat High raised beach
	Glacial	<i>15 000</i>	Arctic	Sands and gravels
TERTIARY CRETACEOUS JURASSIC TRIASSIC PERMIAN	Glacial	<i>1 million</i>	Ice-cap with interglacials	Boulder clay (till)
	(Gap in geological record)		Land, temperate to desert Earthquakes Mountain building	
CARBONIFEROUS	Coal Measures Passage Group Upper Limestone Group Limestone Coal Group Lower Limestone Group Upper Oil-Shale Group Lower Oil-Shale Group Arthur's Seat Volcanic Rocks Cementstone Group	<i>280 million</i>	Coal swamps, seas, deltas Rivers, deltas Coal swamps, deltas, coral seas Freshwater lagoons, deltas	Igneous intrusions Coal-bearing sediments Sandstones, fireclays Mixed strata Coal-bearing sediments Limestone-bearing sediments Oil-shale-bearing sediments Oil-shales, sandstones Lavas, tuffs, vents Mixed strata
DEVONIAN (OLD RED SANDSTONE)	Upper Old Red Sandstone Pentland Hills Volcanic Rocks Lower Old Red Sandstone	<i>345 million</i>	Volcanic eruptions Coastal, shallow lagoons	Red sandstones Lavas, tuffs, intrusions Red conglomerates
SILURIAN	Wenlock Llandovery	<i>395 million</i>	Rivers, arid desert Volcanic eruptions, earthquakes Desert, floods, rivers	Red sandstones Fossil-bearing mudstones
ORDOVICIAN		<i>435 million</i>	Earthquakes, mountain building	
CAMBRIAN		<i>500 million</i> <i>570 million</i>	Barren land Shallow tropical seas	

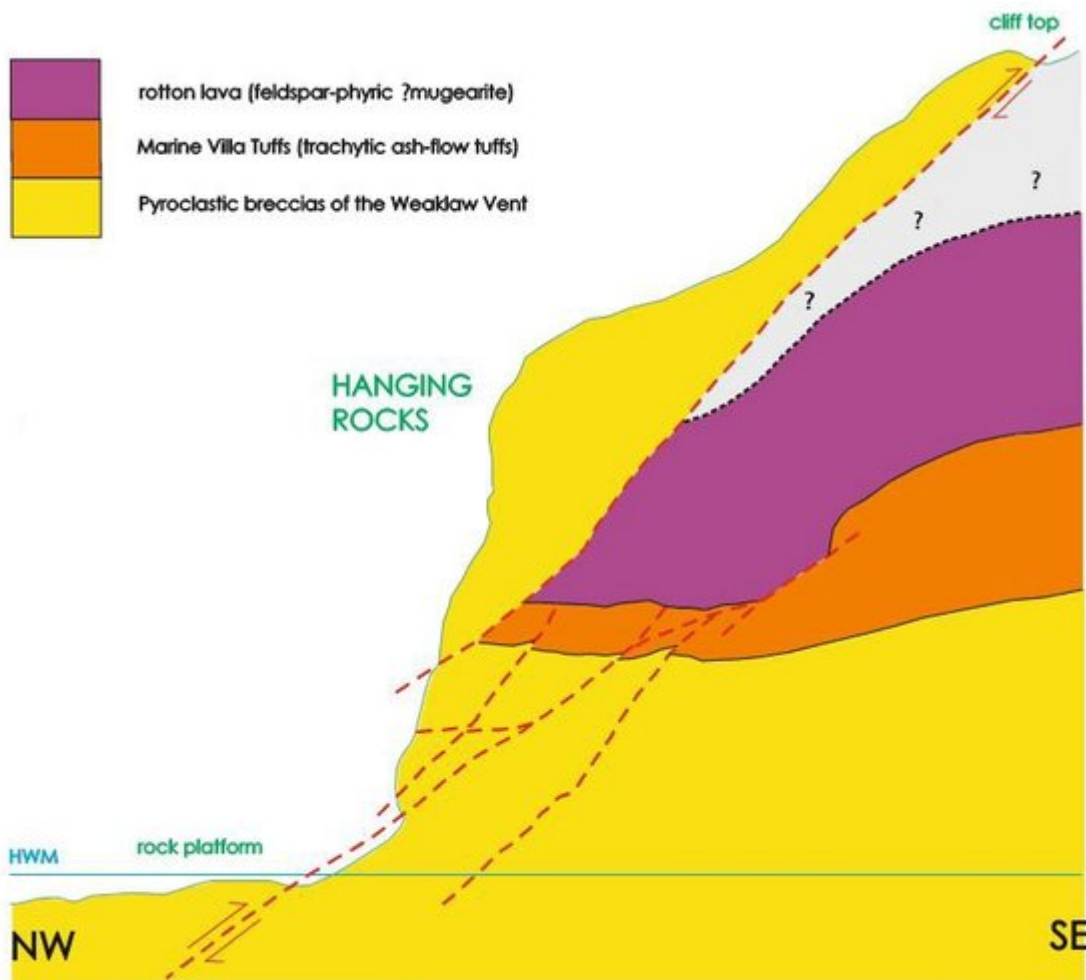
(Table 2) Geological timescale.



(Front cover). Arthur's Seat from Blackford Hill.



(Figure DS1) Sketch section along the high-water mark, from Marine Villa to the beach west of the Hanging Rocks. The inset shows detailed relationships at the key locality [NT 5016 8595].



(Figure DS2) Sketch section NW to SE across the Hanging Rocks to illustrate emplacement of pyroclastic breccias of the Weaklaw Vent against younger volcanic rocks by a complex high-angle reverse fault trending parallel to the cliff line. The sketch is a stylised view based upon a photograph of the western face of the western Hanging Rock (Figure DS6). Most of the face above the base of the Marine Villa Tuffs is crumbly and inaccessible and hence parts of the interpretation might be inaccurate.



(Figure DS6) The western face of the western Hanging Rock, showing the complex reverse fault-zone represented diagrammatically in (Figure DS2).



(Figure DS3). The key locality at [NT 5016 8595], viewed towards the south-west. Well-bedded Marine Villa Tuffs in the low cliff on the left dip to the right (north-west) at c. 30 degrees. The fallen blocks lie along the axis of an open syncline. To the right (north-west) of the blocks, a thin 'skin' of Marine Villa Tuffs can be seen draping over a very shallow domed surface (with rucksack) of paler, coarse, massive Weaklaw Tuffs, that is elongated away from the camera. A dark recess in the cliff in the distance marks the overhang where near-horizontal, well-bedded Marine Villa Tuffs overlie Weaklaw Tuffs. Compare with Day (1923, plate XXIII) where, on both photos, the recessed overhang is marked 'x'.



(Figure DS4) The key locality at [NT 5016 8595], viewed towards the north-east. Marine Villa Tuffs in the cliff; blocks along the syncline axis; and thin skin of Marine Villa Tuffs just above point of stick. Note the coarse texture of the Weaklaw Tuffs in the foreground. On the rock platform in the distance (top left) is a horizontal feature formed by the basal Marine Villa Tuffs.



(Figure DS5) The western Hanging Rock. A mass of coarse pyroclastic breccia is juxtaposed against Weaklaw Tuffs at the base of the cliff and bedded Marine Villa Tuffs above by a reverse fault trending parallel to the cliff and dipping towards the camera at 40 to 50 degrees. The cliffs here are crumbly and inaccessible but the higher beds can be seen at the Smuggler's Caves, some 50 m to the west.