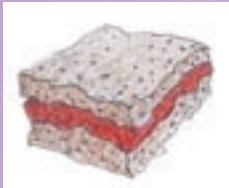


## 1200°C jam sandwich



Molten rock ('magma') injected between layers of existing rock is called a 'sill'. The hot rock is clamped between its cooked neighbours like jam in a sandwich.



305 million years ago, from a source somewhere off Norway, a mass of magma forced its way through solid layers of rock all the way to Central Scotland. It cooled into a huge underground structure, up to 150 metres thick and extending over 1,600 square km. This is the **Midland Valley Sill**. It has been exposed in places by erosion,



The Midland Valley Sill exposed at Craigengaw, on the north side of West Lomond

mostly round its edges. In Fife it forms the prominent steep slope on the Lomond Hills, Bishop Hill and Benarty. The approach roads to the Forth Road Bridge were cut through the Sill.

**The Sill is harder than the rocks it invaded.** Its edge protected the rocks around it, allowing them to survive 300 million years of erosion.

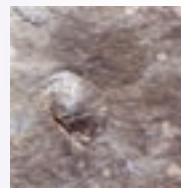
The Sill rock is **quartz-dolerite**, a dense rock which weathers into very distinctive rounded shapes. Air and water react with the minerals in the dolerite, going for its weak spots first, the places where it cracked as it cooled. Weathering works inwards from these weaknesses, rounding off the blocks between the joints. The softened rock flakes off in layers, like onion skins.



Onion-skin ('spheroidal') weathering on the rock-face in Craigmear Quarry

## Sharks in the hills

345 million years ago the piece of crust that we call Scotland lay over the Equator, on its long journey north to its present position. 'Fife' was at the bottom of a warm tropical sea. Lime-rich muds were building up on the seabed, trapping remains of creatures like those in the model below. The little extinct shark in the middle of the photograph is called *Petalodus*. Geologists have found fossils of its teeth in the limestones on the Lomonds.



Fossil sea-shell from East Lomond



Reproduced by kind permission of the Trustees of the National Museums of Scotland

Scotland's journey north has not been smooth. This piece of crust has been bent, buckled, worn away, submerged and up-lifted. Finding old sea-bed at 420 metres above present sea level is not unusual. The sea-floor rocks of the Himalaya have been lifted up more than 8 km!

The pattern of white spots on this rock is **fossil coral**, embedded in hard grey limestone. This layer of old sea-bed runs through the Lomonds and beyond, over to west Fife, Glasgow and the Lothians.



Fossil coral on West Lomond. Pound coin for scale

**Fife RIGS** is a group of amateur and professional geologists working to protect our Regionally Important Geological Sites. Contact c/o British Geological Survey... [www.ukrigs.org.uk](http://www.ukrigs.org.uk)

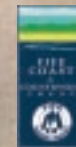


**British Geological Survey**, Murchison House, West Mains Rd Edinburgh, EH9 3LA [www.bgs.ac.uk](http://www.bgs.ac.uk)



**National Museums of Scotland** Chambers Street, Edinburgh, EH1 1JF Tel 0131 225 7534 [www.nms.ac.uk](http://www.nms.ac.uk)

**The Scottish Lime Centre**, 4 Rocks Rd, Charlestown, nr Dunfermline. Tel 01383 872722 [www.scotlime.org](http://www.scotlime.org)



For information about the Regional Park contact: **Fife Countryside Rangers** Pitcairn Centre, Moidart Drive Glenrothes, KY7 6ET Tel 01592 583 240 [www.fifecoastandcountryside.co.uk](http://www.fifecoastandcountryside.co.uk)

### Know the Code ...

Enjoy Scotland's outdoors - responsibly! Everyone has the right to be on most land and water providing they act responsibly. Your access rights and responsibilities are explained fully in the **Scottish Outdoor Access Code**.



Whether you're in the outdoors or managing the outdoors, the key things are to:

- take responsibility for your own actions
- respect the interests of other people
- care for the environment

Find out more by visiting [www.outdooraccess-scotland.com](http://www.outdooraccess-scotland.com) or phoning Scottish Natural Heritage on 01334 654038

This leaflet was prepared with help from British Geological Survey and National Museums of Scotland



# Baked, Buckled and Frozen

## Rock history in the Lomond Hills





## Fife's Twin Peaks...

You can see the Lomond Hills from as far away as the Cairngorms in the north and the Borders in the south. Their profile is Fife's most distinctive landmark.

East Lomond (also known as Falkland Hill) is 434 metres high. West Lomond (522 metres) is the highest point in Fife. They lie near the edge of a high plateau which tilts down to Glenrothes and the Firth of Forth.



### Why are they here?

These hills have survived 300 million years of erosion, thanks mainly to a hard layer known as the Midland Valley Sill (see '1200°C Jam Sandwich' on the back page).

Find out more on the walk described in this leaflet, between Craigmead and East Lomond car parks. It covers a distance of about 5.5 km out and back. You can find the numbered stops using the map, text and photographs.

The path to East Lomond summit is steep in places. You can miss it out if you want and go from sites 4 to 6 along the old Limekiln Track. The views are still very good from this path. There is also a steep section between Craigmead and point 2. Please use an OS map for more detail. Strong footwear and outdoor clothing are recommended.



### 1 Cooked Contact

In Craigmead Quarry you can get close to the contact between the Midland Valley Sill and the older rock beneath it. The rounded, blocky brown rock is the Sill. As molten rock ('magma') at 1200°C, it forced its way between layers of sandstone, mudstone and limestone, setting slowly into **quartz-dolerite**. The grey rock at the base of the cliff is sandstone baked hard by the Sill.

The quarry is across the road from Craigmead Car-park. Go up the East Lomond path a short distance and turn right through the trees.

### 2 Walking on the Sill

You can walk on top of the Sill where the East Lomond path steepens above Craigmead. There were once hundreds of metres of sandstone, limestone and mudstone above this level. They have been worn off by 300 million years of rain, flood, wind and ice.



### 3 Dumped by the Ice

18,000 years ago, a kilometre of slow-moving ice was grinding its way over and round these hills, flowing east to the North Sea. Armed with rock fragments, the ice-sheet sculpted the land surface below. Today the hills are littered with large stones, dumped as the ice melted 14,000 years ago. The old dry-stane dykes which criss-cross the hills were mostly built from these rocks.



### 4 The Limekiln

During the 18th and 19th centuries, limestone was quarried wherever it was found at the surface in the hills. It was burnt with local

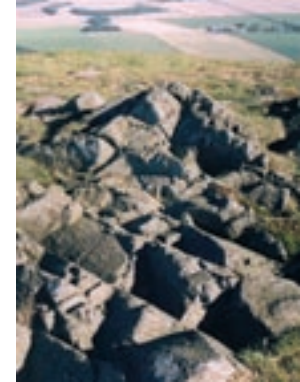


Tiny fossil shell fragment from the mudstones near the Limekiln

coal to make lime for fertiliser and building materials. The old Limekiln on East Lomond has been restored and an interesting trail tells the story of the site and the people who worked there. (See back page for more about Lomonds limestone.)

### 5 Volcanic Plumbing

At the summit of East Lomond you are standing on the feeder pipe of an extinct volcano. 10 million years after the Midland Valley Sill event, molten rock punched its way through the Sill to the surface, building ash and lava cones hundreds of metres high. As the volcanoes died down, magma and debris hardened inside them, setting as 'plugs' in the pipes. East and West Lomond are the worn stumps of two of these plugs. The volcanic cones are gone.



30metres west of the summit: columnar joints developed in the plug as it cooled and contracted

### 6 Where are you?

East Lomond is one of the best viewpoints in Central Scotland. From its summit you can relate your position to the rest of Fife, the Highlands, Edinburgh and the Borders. Looking out over the landscape, questions may come to mind. Why is the Howe of Fife beyond Falkland so flat? What created the hills and mountains to the north? Why are there so many small islands in the Firth of Forth? The sources listed on the back of this leaflet may help provide answers...



The villages round the hills were mostly built from local stone. This old wall in Falkland Library car-park contains a superb collection of rocks, held together with mortar probably made from Lomonds limestone.

Please leave rock outcrops as you find them. Hammering and digging destroys material for future research and spoils the appearance of the rocks for other visitors.