

St Andrews Geological Trail



R E Garton & J Allan

Explore the fascinating world of the local geological heritage.

See fossil trees and worm burrows, and evidence of ancient volcanoes and earthquakes.

See the results of earth forces which twisted and contorted rocks over 300 millions years ago, at a time when Fife lay close to the equator and was covered by tropical swamps, seas, rivers and lakes.



geoHeritage Fife
(incorporating
Fife RIGS)



UKRIGS
SCOTLAND



GEOCONSERVATION
ASSOCIATION

geoHeritage Fife

was set up in 2000 to:

- * publicise Fife's geological heritage
- * provide educational resources in geology
- * promote geotourism

If you would like to assist with these aims, consider joining the group by contacting:

geoHeritage Fife
01334 828623

Scottish Charity No. SC 032509

Other geological trails:

St. Monans, Dura Den, Ladybank cairn, Holy Trinity Church (St. Andrews), Historical Geoscientists (St. Andrews).

Fife RIGS

RIGS are Regionally Important Geological (and Geomorphological) Sites.

The scheme was devised to encourage local involvement in the identification, designation and monitoring of sites of local and national educational and scientific importance. Fife RIGS is concerned with identifying and assessing the localgeodiversity, and notifying the statutory planning authority about these sites.

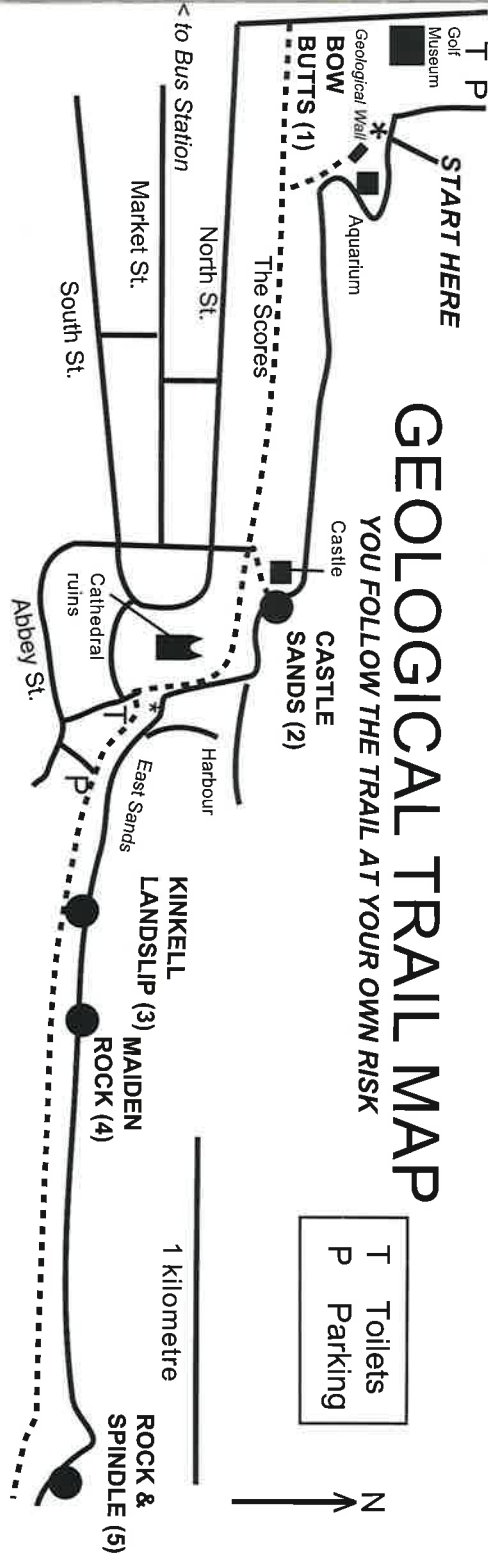
Fife RIGS was incorporated into geoHeritage Fife in December 2005.

Mike Browne, (Chair, UKRIGS)
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Transport Information

St. Andrews is served by Stagecoach buses: Services 99 - Dundee and Leuchars; 95 - Leven, Anstruther and Crail; 64 - Falkland and Auchtermuchty; 23 - Stirling; X24 - Glasgow; X59 - Edinburgh, Glenrothes and Cupar; F1,F2 - Newburgh.

First Scotrail train services call at Leuchars from most stations between Aberdeen and Edinburgh.



GEOLOGICAL TRAIL MAP

YOU FOLLOW THE TRAIL AT YOUR OWN RISK

Total walking distance: Bow Butts to Rock & Spindle and back = 8km (5 miles). Allow three hours for the whole excursion. Follow the coastal footpath to the Rock & Spindle. * At the Inner harbour, cross the iron footbridge for access to the East Sands. The path becomes rough in places so sturdy footwear with a good tread and waterproof clothing are essential. These localities are important sites and many are protected as Sites of Special Scientific Interest (SSSI). Hammering of outcrops is NOT permitted and collecting must be restricted to loose material on the foreshore. The Maiden Rock and Rock & Spindle localities are best explored at low- or mid-tides. Tide times are available from the Tourist Information Centre (70 Market Street), the "St. Andrews Citizen" newspaper and at the Harbour noticeboard.

Locality 1. Bow Butts



ANCIENT & MODERN RIPPLES

An outcrop of sandstone, to the left of the cliff fence and down the grassy slope opposite the Geological Wall (see below), is 350 million years old and shows fossilised sand ripples formed on an ancient sea or river bed. Ripples and dunes form when sand is moved by flowing water or the wind. At low tide you can compare these ripples with their modern equivalents which form on the sandy beach below. Ripples are aligned parallel to the waves which wash the shore.

FOSSIL EARTHQUAKES

Now look up at the rock face behind the wooden seat nearby. On the vertical face you will see some wavy lines in the sandstone rock. Sandstone is formed by the deposition of layers of sand, usually under water, though sometimes in deserts.

The zig-zag lines may have been caused by an earthquake shaking wet sand and allowing water to escape, resulting in the sand layers slumping and forming these weird shapes.



GEOLOGICAL WALL OF FIFE

In 2000, the St Andrews Geological Heritage Project built a wall which contains examples of major rock types from all over Fife. It is sited just up the footpath from the last locality.

A plaque lists all the rock names and a detailed explanatory leaflet can be obtained from major tourist outlets (British Golf Museum, Town Library, local hotels, Tourist Information Centre).



< Return to The Scores road and walk eastwards to the Castle >

Locality 2. Castle Sands

<Descend the steep path immediately east of the Castle, to the beach below>

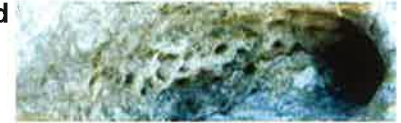


HOT & STEAMY JUNGLES

About 350 million years ago Scotland lay near the equator and East Fife was covered by tropical forests and swamps, an environment similar to that found in SE Asia today. When trees died, they formed peat which was buried by layers of sediment and, through time, converted into coal seams.

In the cliff on the right of the beach, a coal seam is underlain by a white sandstone called a seatearth, containing black rootlet marks like thin hairs. These are the remains of tree roots. The mould of a thick root stem can be found in this layer, with dark dimples representing smaller rootlets.

Stigmaria mould



WORMS

Under the ramparts of the medieval St Andrews Castle, there is a sloping expanse of brownish sandstone, the top surface of which is marked with many paired small holes, making the rock feel very rough to the touch.

These are the remains of tubes dug into the sand by burrowing worms or other animals.

Lugworms burrow in the similar fashion today on the nearby beaches.



<Return to the road and proceed east past the Cathedral walls and descend by the left-hand path to the harbour. Cross the iron footbridge to the East Sands path, keep on the path beside the beach and follow it uphill as it climbs up to the caravan park. >

Locality 3. Kinkell landslip

As you approach the eastern boundary of the caravan site note that the path has been displaced by a land slip in the cliff. In the mid-1990's this part of the cliff slumped down suddenly, an example of coastal erosion in action. The aerial view on the right shows the landslip clearly in the centre of the picture.

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The group of people is standing on the slipped portion, which has dropped about 0.7 metre. The two figures in the centre of the picture are standing on the original surface. The dark band beneath them is the slip surface exposed.



<Continue eastwards along the coastal footpath>

Locality 4. Maiden Rock

The Maiden Rock is a sea stack - a remnant of the old sea cliff when sea level was relatively higher than it is today. The rest of the cliff has been eroded away by the wave action of the sea.

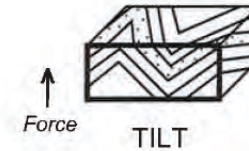
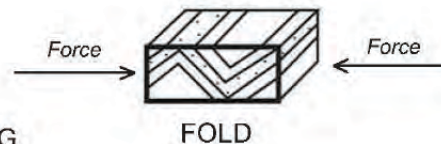
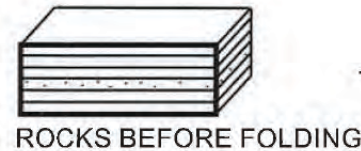
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When continental masses collide, the rocks become bent into folds or broken, forming faults. In the aerial view (left) you can see the results of squeezing: rocks, originally horizontal, have buckled into folds, which were then tilted. After erosion, the rocks are exposed as a zig-zag.



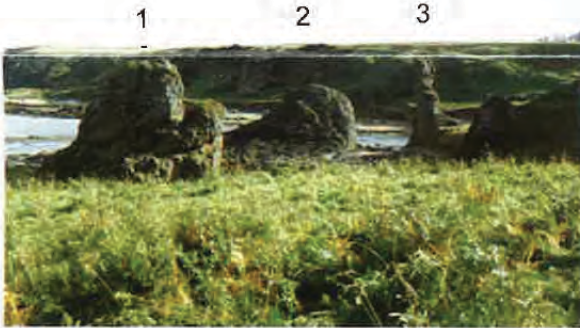
A little further east along the path is the Saddleback Anticline. An anticline is a fold in which the rocks have been buckled up into an arch shape. Here the arch has also been tilted and now looks like an upturned boat.



<Continue eastwards along the coastal footpath>

Locality 5. Rock & Spindle

As you approach this locality, you will see in the distance a cliff profile, the top of which represents an old raised beach. This feature reflects the relative rise in the land following the removal of the weight of glaciers by melting after the last Ice Age. In the foreground there are three tall sea stacks, numbered 1, 2 and 3 in the photograph, made up mainly of solidified volcanic ash (tuff). These represent the remains of an ancient submarine volcano.



This volcano erupted in the sea over 300 million years ago. A modern example is the Icelandic volcanic island of Surtsey which grew out of the sea in 1963 amid clouds of black ash and steam.

Stack 1 is made up of black tuff which contains blocks of lava and mudstone, and lumps of limestone with fossils in it. These blocks were plucked off the adjacent rocks by fast-moving ash and gases.

The tuff in Stack 2 is layered vertically. This material formed part of the inner throat of the volcano along which hot gases escaped on their journey to the cone.

Surtsey 1963



Stack 3, the "Rock & Spindle" represents the last phase of volcanic activity. The Spindle, with its radiating columns of basalt, formed as the last pulse of molten rock solidified inside the vent.

If you look closely at the dark basalt rock, you should see small black crystals of a mineral called pyroxene, a calcium, iron and magnesium silicate.

The aerial view on the right shows the concentric rings of ash which accumulated as the volcano grew. This view is a cross-section of the volcano.



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This is a block of mudstone with small white fragments of fossil shells. This rock must have been plucked from the adjacent rocks. Because it is younger than the surrounding rocks it is believed to have fallen into the volcano's throat from a higher level.

A closer inspection of the ash deposits, especially in Stack 1, will yield evidence of the violent, and eruptive nature of this volcano.



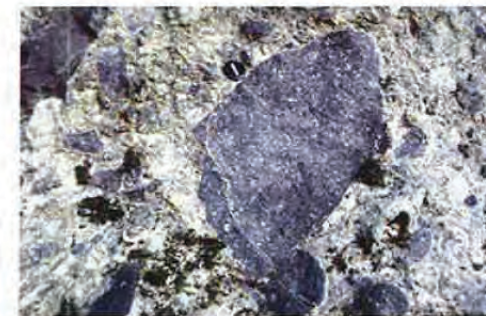
This view shows the contact between tuff (above) and mudstone (below), visible at the low 3m cliff on the landward side of the beach.

A piece of white sandstone has become trapped in the tuff. It could have come from any depth, as sandstone is the major rock type in this area.



These inclined layers of tuff are seen in Stack 1. The fact that they are layered indicates that the ash could have been laid down under water, although this is open to debate.

Blocks of material which have come from elsewhere indicate the power and force of the eruption. These five pictures show various features to look out for.



The dark bluish lump of rock shown here is not a sedimentary rock. Look closely and you will see small crystals. This is a piece of basalt plucked by the eruption from a pre-existing layer of cooled lava.

<Return to St Andrews by following the same footpath westwards>