A deep, narrow valley near Carmel Head which was cut into the bedrock by pressurised meltwater flowing beneath the ice.

Anglesey (Ynys Môn)

600 million years of Welsh history

Helen Burke using a tablet PC to record data in the field.

Earth scientists from the British Geological Survey (BGS) are applying new techniques to advance our understanding of the geological evolution of Anglesey, North Wales, unravelling over 600 million years of Earth history. Now into their third year of study, they have already made some startling new discoveries about processes at opposite ends of the geological time scale. David Schofield, Emrys Phillips and David Beamish tell us more.

To many people the island of Anglesey, with its rocky headlands and sandy beaches, is a favourite holiday destination. To others, it's simply a place to pass through on the way to or from the ferry port at Holyhead, en route to Ireland, or perhaps known only from news articles covering the recent patronage by the Duke and Duchess of Cambridge. However, among the geological community it is widely known as a hotbed of geological controversy.

Although it is widely accepted that Anglesey holds the key to understanding many of the fundamental processes that have shaped the British Isles, for the last hundred years Earth scientists have been locked in a sometimes-intense debate about precisely how to interpret the rocks preserved there, and the relationships between them.

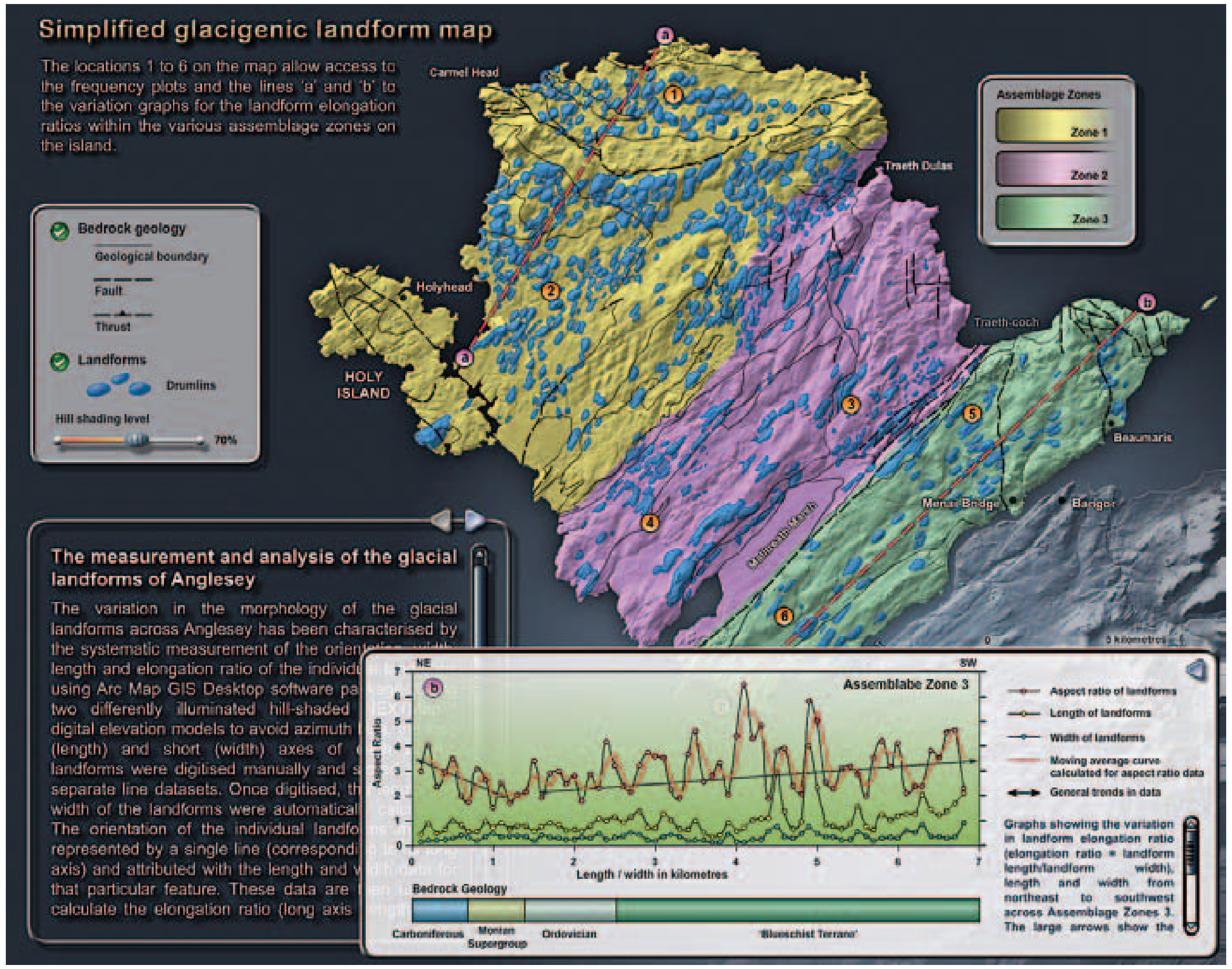
Hidden beneath the rolling hills of this relatively small island is evidence of the major geological processes which have helped create the Welsh landscape. It tells of the opening and closing of ancient oceans, the growth and eventual death of volcanoes, the blossoming of life in shallow tropical seas, through to the formation of huge ice sheets that grew and then eventually melted away in response to recent changes in our climate. Together, these have left behind a complex collage of different rock types, geological structures and landforms that have fascinated geologists for at least the last 150 years.

One of our teams of scientists has been carrying out a careful survey of a region of Ordovician rocks, formed between about 470 and 450 million years ago, that crop out in the central part of the island. These ancient sedimentary rocks were deposited in a depression that formed during the closure of an ancient ocean as one tectonic plate overrode an adjacent one, forcing it to bend. Unravelling their evolution is providing new insights on the ancient plate collisions that led to the final assembly of Anglesey.

Geologists have interpreted the origins of the ancient sandstones, mudstones and conglomerates (made of small fragments of stone cemented together by softer rock) on Anglesey by comparing them to sediments being laid down on modern seabeds. For instance, the sandstones exposed across central Anglesey preserve sedimentary structures, such as ripples, and fossil shells similar to those found in shallow marine shelf environments or beaches. Yet along the north-east coast of the island, black, thinly-layered mudstones are like those found in the deepest parts of modern ocean basins.

The planktonic flora – made up of microscopic marine algae – that is preserved in these rocks include many species that are known to have evolved rapidly, so that their populations can be shown to change through successive geological layers and effectively give us a way of comparing the relative ages of the Ordovician rocks in different places.

All this new information has let us build up a detailed picture of what was once a deep marine sedimentary basin that is now preserved in a very narrow tract, no wider than 10km across. It clearly shows how the different parts of this once much wider



A screenshot of part of the Anglesey interactive digital map or i-map.

basin were telescoped and squeezed together as the ocean closed around 400 million years ago.

While one group of geologists has been plumbing the depths of ancient ocean basins, another team has been examining the landscape left behind after the last glaciers swept across Anglesey some 24,000 years ago. Digital elevation models and high-resolution geophysical data, including measurements of magnetism, natural radioactivity and electrical conductivity, are helping to reveal a changing pattern of ice movement across the island when Anglesey was buried beneath the margin of a fast-flowing 'corridor' of ice.

This fast-flowing 'ice stream' filled the Irish Sea and fed ice from its source in central and south-west Scotland as far south as the Isles of Scilly. We already know that ice streams play an important role in regulating the size, shape and behaviour of modern ice sheets including those in Greenland and Antarctica.

The Irish Sea ice stream helped drain a major ice sheet that once covered a large part of the British Isles. The low-lying, gently rolling hills of Anglesey preserve the unique 'fingerprint' left by this fast-moving corridor of ice. Changes in the size, shape and distribution of the glacial landforms, such as the egg-shaped or elongated hills known as drumlins, show that the speed of the overriding ice was highly variable.

The changes in the shape of the land have been shown to have been locally controlled by large-scale faults and major boundaries between different types of stone within the bedrock. Less durable rocks, such as the Carboniferous sandstones that underlie the lowland area of Malltraeth Marsh, control the location of relatively faster flowing portions of the ice stream.

Over the next two years we intend to integrate the results of our research on Anglesey, developing a new, updated geological map and creating 3D computer models of this complex island. The first of these products, the interactive web-based Anglesey 'i-map', is bringing geological maps into the 21st century and provides an exciting new way of presenting geological and environmental information to users ranging from members of the public, school teachers and academics to regional and local government bodies.

For example, teachers can use the i-map as an interactive teaching resource during physical geography lessons to show how the landscape can be used to reconstruct ancient glaciers and ice sheets, so it will help inspire the next generation of Earth scientists. Together, the studies on Anglesey form part of a wider effort to provide modern geological information for Wales which will help us understand some of the processes which shaped its dramatic landscape. ■

MORE INFORMATION

Dr David Schofield is Chief Geologist for Wales at BGS. Dr Emrys Phillips is a geologist based at the BGS Edinburgh office. Dr David Beamish is a BGS geophysicist.
Email: dis@bgs.ac.uk

NEWS

Great snipe is the fastest migratory bird ever discovered

Apart from its long, elegant beak, the great snipe looks just like any other wading bird. But researchers have found that this ordinary-looking creature could well be the fastest bird on Earth – over long distances at least.

After following the birds' migration south from Sweden to central Africa using tiny tracking devices, Swedish scientists found that the birds fly non-stop over a distance of around 4200 miles (6760km) at a phenomenal 60mph (97kmh).

A lot of birds fly either far or fast, but few can do both. The peregrine falcon is possibly the fastest bird on the planet: it reaches a startling 200mph (322kmh), but only while diving to catch its prey. The Arctic tern migrates further than any other bird – around 50,000 miles (80,500km) from the Arctic to the Antarctic and back again. It's an incredible feat for such a small bird, but it doesn't fly particularly fast.

Logger on the leg of a great snipe.

Raymond Klaassen

'We know of no other animal that travels this rapidly over such a long distance,' write the authors in their report, published in *Biology Letters*.

Also unusual is that the great snipe's migration route takes it over land that is perfectly suitable for a stopover.

'We never expected record-breaking flights for this ordinary bird. Along its routes, the snipes have plenty of opportunity to stop over and feed on earthworms, insects and other invertebrates and this is exactly what land birds normally do,' says Dr Raymond Klaassen from Lund University in Sweden, lead author of the study.

Migratory birds almost always choose to stop over during their migrations if they can, so they can rest and refuel before continuing their epic journeys.

Even though Arctic terns fly over the Atlantic, they still stop to fish on the way. On the other hand, the bar-tailed godwit flies from Alaska to New Zealand with no stopover, 'because it has no choice', says Klaassen.

After the breeding season, but before the annual migration, the researchers fitted ten male great snipes in Sweden with tracking devices. A year later, they managed to retrieve the geolocators from three birds when they returned to Sweden.

One bird flew 4225 miles (6800km) from Sweden to central Africa in just 3.5 days. The other two birds flew 3833 miles (6169km) in three days, and 2870 miles (4619km) in two days.

New group of hidden fungi found in pond

Scientists have discovered a major branch on the fungal tree of life they didn't know existed until now.

The finding reveals that there are nearly twice as many species of fungi around as previously thought and changes scientists' understanding of how this diverse group of organisms evolved.

The fungi in the new group don't fit the standard fungal body plan at all. Nearly all previously-known fungi have a cell wall, which scientists thought was an essential feature, critical for their success.

The only exception was a fungus called *Rozella*, thought to be one of the earliest types to evolve and an evolutionary enigma due to its lack of a cell wall.

Now it turns out that *Rozella* is a typical member of the new group, for which having just a cell membrane and no cell wall seems to be quite normal.

'To think that we've studied fungi in great detail for 150 years, it's a surprise we've missed nearly half of the kingdom,' says Dr Thomas Richards, a member of the research team from the University of Exeter and the Natural History Museum, London. 'It seems that plenty of fungi thrive without using a cell wall.'

Rather than secreting enzymes to break down dead plants, trees or animals, like other fungi, members of the new group may feed by engulfing their target just as a white blood cell in your body might devour a bacterium.

For the moment, the new branch is known as *cryptomycota* – Greek for 'hidden fungi'.

'We probably know about one to ten per cent of the microbes actually out there. We've missed a minimum of 90 per cent,' Richards says. 'It's a similar situation with the insects we've classified. There are many we know nothing about.'

Together with colleagues from the Natural History Museum, the University of Cambridge, Harvard Medical School and the Institut de Ciències del Mar in Barcelona, Richards made his finding after analysing samples from a pond at the University of Exeter. The study is published in *Nature*.