Geodigest

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Mediaview

Thin ice

The thickness of sea ice in the Arctic dramatically declined last winter for the first time since records began (Julie Jowitt, *The Guardian*, 28 October 2008). Research by scientists at University College London shows a significant loss in the thickness of the northern ice cap after a record loss of ice in the summer of 2007, although the weather was not abnormally warm. The findings raise the possibility that the loss of Arctic sea ice could accelerate, because as the ice recedes the water temperature will rise. This summer the sea ice recorded its second-lowest extent after the record low of 2007 (Fig. 1), again despite relatively cool air temperatures. The study found that the thickness of Arctic sea ice was almost unchanged in the five winters from 2002 to 2006, but then declined 10 per cent, or 26 cm, last winter. In parts of the western Arctic, where the greatest loss was recorded the previous summer, the loss was nearly double the average.

Pakistan earthquake

An earthquake in Baluchistan left thousands homeless, its death toll of 170 expected to climb closer to 500–600. (Sareed Shah, *The Guardian*, 30 October 2008). The 6.5 magnitude quake struck in the early hours of 29 October, centred about 40 miles north-east of the provincial capital Quetta. Aftershocks rippled throughout the day, including a massive tremor of 6.2 magnitude at around 5.30pm local time. The devastating earthquake of 2005 in northern Pakistan claimed around 73 000 lives, while Quetta was flattened in 1935 by a quake that killed 30 000. It is estimated that 30 000 people were affected by the earthquake, with around 15 000 made homeless.

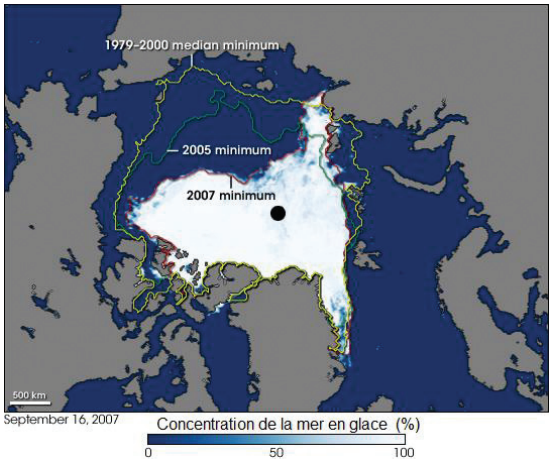


Fig. 1. The Arctic as seen by the Advanced Microwave Scanning Radiometer for EOS (AMSR-E) aboard NASA's Aqua Satellite on 16 September 2007, showing a record minimum. (Image: Jesse Allen/NASA).

How the turtle got its shell

Fig. 2. *Odontochelys semitestacea*, from the Late Triassic of China, the oldest known turtle (Image: Arthur Weasley, aweasley@hotmail.com).

A 220 m-year-old Chinese fossil has helped solve the 'mystery' of how the turtle got its shell (Ian Sample, *The Guardian*, 27 November 2008). Palaeontologists uncovered the remains of three intact adult turtles in Guizhou Province last year. Each has characteristics that have never been seen in turtles before, including teeth and an incomplete upper shell. Before the latest find, the oldest known fossil turtle, *Proganochelys*, was dated to 210 Ma from Germany—and had a fully-formed shell. Scientists have been divided on how the shell originally evolved, with some arguing that the shell grew from bony plates on the skin, which then broadened to form a kind of armour before fusing to the underlying ribs and backbone. Modern reptiles such as crocodiles have bony osteoderm plates, a feature also seen in some dinosaurs, including the ankylosaurs. The latest fossil, named *Odontochelys semistestacea*, ('toothed, half-shelled turtle'), shows that shells formed in two stages (Fig. 2). First, the underside of the shell, the plastron, developed, then the ribs and backbone grew out to form the upper shell carapace. *Odontochelys* has a fully formed plastron but only a partial upper shell extending from its widened

ribs and backbone. According to Dr Xiao-chun Wu from the Canadian Museum of Nature in Ottawa, the new discovery supports the theory that the shell would have formed from below as extensions of the backbone and ribs, rather than as bony plates from the skin as others have theorized.

Fig. 3. The Wittlesbach Diamond (Image: Getty Images).

Blue diamond

A 35.56 carat diamond with a 300-year-old royal history had been expected to earn bids of up to nine million pounds at auction, but went on to break the world record for any diamond sold at auction reaching over 12 million pounds (Urmee Khan, *The Daily Telegraph*, 11 December 2008). The Wittelsbach diamond (Fig. 3) was given to Infanta Margarita Teresa by her father King Philip IV of Spain on her engagement to her uncle, Leopold I of Austria. It was later owned by the Wittelsbach family of Bavaria.

The infanta, a beautiful child with blue eyes and blonde hair, was the central figure in Las Meninas (1656), the most famous painting by Spaniard Diego Velázquez. It depicts the girl, her maids of honour and members of her family and even the artist himself curiously looking out of the painting as if on the viewers themselves. Upon her engagement to Leopold I, who later became the Holy Roman Emperor, her father gave his 13-year-old daughter the diamond as part of the dowry. She died aged only 21, having given birth to four children, of which only one survived beyond childhood. The diamond, reputed to have originated from the Indian diamond mines, passed into the Austrian and then Bavarian crown jewels, before being sold into private hands in 1931. It has been in the current private collection since 1964. According to Christies, no examples of coloured diamonds comparable to the Wittelsbach had ever been offered at auction before.

Beach spider

Scientists working at Oxford University found tiny threads of spider silk encased inside a piece of amber that formed around 140 million years ago. The web appears to be similar to those of modern orb web spiders, which weave a spiral web of silk to catch insect prey (Richard Gray, *Daily Telegraph*, 13 December 2008). The amber was found on a beach famous for fossil dinosaur tracks near Bexhill, in East Sussex, by amateur fossil hunter Jamie Hiscocks. The discovery suggests that orb web spinning spiders existed far earlier than had been previously thought, at a time before flowering plants appeared on the planet and triggered an explosion in flying insects. The scientists believe the web became trapped in conifer resin in the aftermath of a forest fire and then became fossilized inside the resulting amber. They hope that by studying other pieces of amber from the same deposits they may learn more about spiders from that time and the prey they ate. Professor Martin Brasier, a palaeobiologist at Oxford University who led the study, said: 'It is absolutely consistent with an orb web spider. The spacing between the threads suggest they were the structural struts onto which a web was spun.'

Chinese bonanza

The 'worlds biggest deposit' of dinosaur bones has been found in China (David Stanwey, *The Guardian*, 31 December 2008). Located in the old city of Zhucheng, in the Shandong Province along China's east coast, the fossil bonanza was uncovered as workers were digging along a 300-metre slope on the outskirts of the city. According to the official news agency, 7600 'samples' had been discovered, the fossils dating back to the Late Cretaceous. Dinosaurs were first discovered in the area during the 1960s, when oil prospectors uncovered another collection of the prized fossils. The new finds include a large ceratopsian skull, and bones belonging to club-tailed ankylosaurs, amongst many others.

A round up of media opinion; the views expressed do not necessarily reflect those of the editorial board of Geology Today. *With thanks to David Nowell and Peter Perkins. If you spot a news item worthy of inclusion send it to the* Geology Today *editorial office, or e-mail to geologytoday@btinternet.com.*

News

News from New Zealand

Philip Andrews writes Recent excitement was aroused in the New Zealand media by the finding of sub-fossil bones identified as from the extinct eagle, *Harpagornis moorei*, one of the largest birds of prey in the world and unique to this country (Fig. 4). The find was made during an unusual archaeological event:

Fig. 4. Artists' reconstruction of the Giant Haast's eagle (*Harapagornis moorei*) attacking moa (Image: John Megahan).

archaeologists were seeking a suitable location to repatriate Maori skeletal remains excavated nearly seven decades ago from one of the earliest known settlement and burial sites in the country, at Wairau Bar on the east coast of Marlborough, South Island.

In 1939 schoolboy Jim Eyles uncovered an ancient burial site on the boulder bar that is flanked by sea and lagoon. His finds included a human skeleton, a necklace of whale tooth ivory and a complete moa egg perforated at one end. Professional excavations followed and some 40 skeletons, mostly male, were uncovered, together with thousands of artefacts. The site has been dated to around 700 BP. While excavating for a site to re-inter the bones of ancestors of the Rangitane people, the archaeological team uncovered bones of the so-called Haast eagle, *Harpagornis moorei* (from the Greek *harpago*: hook for seizure, plunder).

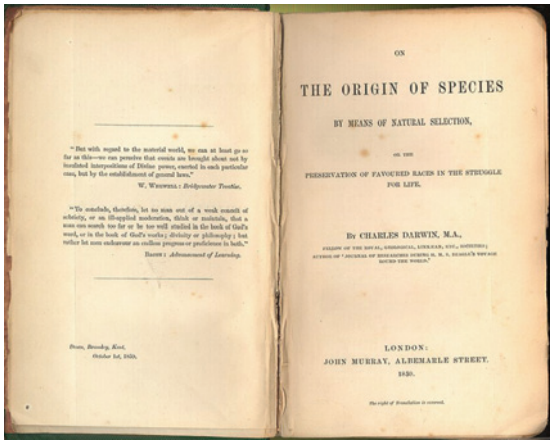
Prominent geologist Julius von Haast first found bones of this bird in 1871 in a swamp on Glenmark Station, in Canterbury. The trivial name of *moorei* was in recognition of one of the station's partners, G.H. Moore, who donated many moa remains to Haast's Canterbury Museum and whose men assisted Haast with his excavations. Incidentally, another notable find in the area has been a 700-year-old adze of Tahanga basalt, identified as having come from a Maori quarry site over 700 km away, in the North Island, on the Coromandel Peninsula, showing the wide network the Polynesian settlers had already established all those years ago.

Maori lore retains memories of the extinct eagle, variously named as a flying taniwha or hokioi, a monster that snatched away women and children to their death. Such events were quite possible since the 15 kg Haast's eagle had a wingspan estimated at 3 m, with claws reaching to 75 mm. The main prey of this forest eagle would have been moa, even the giant species, which succumbed to the 60 to 80 km/h swoops.

It has been suggested that the bird was, however, more of a scavenger, feeding off swamp-trapped moa and occasionally getting bogged in swamp itself, as at Glenmark. Only one complete skeleton has been found, in a mountain cave. It seems likely that *Harpagornis* became extinct no later than 500 years ago.

Respect for the young Charles Darwin

Eric Robinson writes In what will surely be a Darwin year, 2009, there will be many references and quotations from his *Origin of Species* published 150 years ago (Fig. 5). Many people will claim to have read it from cover to cover (like the Bible, equally doubtful), yet few will have seen the letters that he wrote at the age of 25 to his mentor Professor Henslow back in Cambridge in the days before the *Beagle*. These were printed by the Cambridge Philosophical Society in November 1835 as a separate pamphlet, and were reissued in 1960.


ON

THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE

PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE.

By CHARLES DARWIN, M.A.,

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1859.

Fig. 5. *The Origin of Species.* Darwin's 'big idea' is 150 years old this year.

What is striking about the letters must be the confidence in a young man with the most cursory of acquaintance with geology. His years in Edinburgh with Jameson must have introduced basic ideas, many of which were due to be challenged and even overturned by the thoughts of Sedgwick, Whewell and Grant. His meetings with Charles Lyell, a primary influence in the build up to the *Origin* in 1859, only took place as he was unpacking his collections from the voyage in 1836. Wherever he acquired his geology, what clearly comes from the letters of 1833–34 is an ability to reason from observed facts in the field, and a spontaneity in writing far from libraries or like-minded individuals. He expresses a real appreciation of sea level changes throughout recent times (centuries or greater periods) and a relationship between long-dead mammals and shells to be compared with the contemporary on the coasts of Patagonia.

Some idea of the Darwin enthusiasm for his new science comes across in an early letter of 1832, when he records a visit to the Cape Verde Islands:

> 'At St Jago... we spent three weeks. The geology was pre-eminently interesting, and I believe quite new; there are some facts on

Fig. 6. Reconstructed *Megatherium* in Paris.

> a large scale, of upraised coast that would interest Mr Lyell. St Jago is singularly barren, and produces few plants or insects; so that my hammer was my usual companion.'

St Paul Rock off Bahia in the South Atlantic is a very dangerous hazard to shipping, just off the line of the Mid Atlantic Ridge. Often awash, few people regard it as a safe landfall. Darwin in the early weeks of the voyage suffered sea sickness, to the point that he welcomed the opportunity to land on the Rock, to record: '...touched at the Rock of St Paul. This is a serpentine formation.'

Arrival in Argentina saw the beginning of remarkably sound observations in the field of coastal changes, and the relationship between an abundance of fossil mammal bones in gravels, with extant species living on the pampas. That living fauna must have been something of a surprise to an English huntsman and novice zoologist:

> 'I have been lucky with fossil bones; I have fragments of at least six distinct animals. I have paid all the attention I am capable of, to their geological site. First the tarsi and meta-tarsi, very perfect, of a cavia; second the upper jaw and head of some very large animal, with four square hollow molars and the head greatly produced in front. I at first thought it belonged either to the megalonyx or megatherium [*sic*]. In the same formation, I found a large surface of the osseous polygonal plates which observations have shewn belong to the megatherium. Immediatley I saw them I thought that they must belong to an enormous armadillo, living species of which genus are so abundant here.'

Already, Darwin demonstrates an awareness of the ground sloth *Megatherium* (Fig. 6), bones of which had been sent to the King of Spain and described by Cuvier in 1797. The 'four square molars' and the 'head greatly produced in front' were to become the rhinoceros-like *Toxodon platensis*, the osseous polygonal plates, the armoured *Glyptodon* (Figs 7, 8)

The voyages of 1832 took the *Beagle* to the Falkland Islands:

> 'I had here the good fortune to find amongst the most primitive looking rocks, a bed of micaceous sandstone, abounding with *Terebratula* and its subgenera, and *Entrochites*. As this is so remote a locality from Europe, I think the comparison of these impressions with those of the oldest fossiliferous rocks of Europe will be pre-eminently interesting.'

Be that as it may, it was the evidence of changes in sea level within comparatively recent times that struck Darwin as he ventured inland from Buenos Aires and into the foothills of the Andes in 1834 and early 1835. There had been earthquakes and physical changes in the countryside as a result, so it was clear in his mind that there had been upheaval of the land, as much if not more than changes in sea level. In all of these situations, it was the shell fauna that was conclusive to him:

> 'I have been much interested by finding abundance of recent shells at an elevation of thirteen hundred feet; the country in many places is scattered over with shells, but these

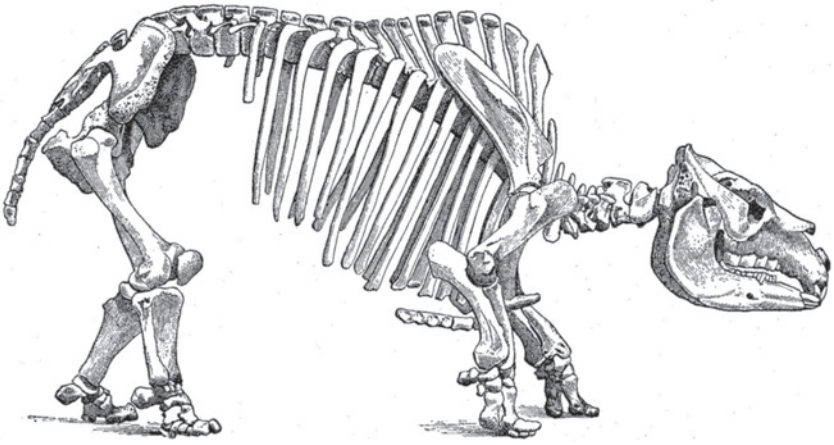


Fig. 7. *Toxodon*, a large, extinct Argentinean mammal, the size of a Rhino.

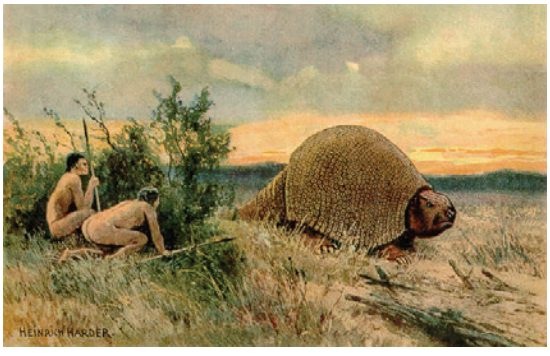


Fig. 8. Artist's reconstruction of the giant 'armadillo', *Glyptodon*.

> are all *littoral* ones! So that I suppose the thirteen hundred feet elevation must be owing to a succession of small elevations such as in 1822 [the date of a recent earthquake].'

In 1835, the *Beagle* passed into the Pacific and worked out of the Chilean port of Valparaiso, before returning to Argentinean waters (Fig. 9). Darwin made several journeys into the Andes, as high as the high passes, traveling by mule—with many stops to study the geology. He was fascinated by the clarity of the stratification, and the obvious faults, folds and disturbances that were so evident. It was these traverses and observations that still win the respect of Argentinean geologists, to the extent that they have raised a monument at Agua de La Zorra to 'Carlos R. Darwin'.

As a 26-year-old novice geologist, Charles Darwin performed with a grasp of principles that commands respect. His observations clearly challenged some of the ideas current at the time, and he recognized this. He was faced with the evidence that had been before Leonardo da Vinci in the foothills of Florence—marine shells at elevation as evidence of uplift.

Back in Cambridge, the significance of those Tertiary strata ('the main bed is somewhere about the meiocene [*sic*] period, using Mr Lyell's expression'), and older strata of Mesozoic age probably contributed to the Lyellian hypothesis of gradual changes culminating in spectacular effects, even mountain building over extended geological time. In some ways, Darwin's published letters to Professor Henslow, brief as they are, are more impressive than his *Origins of Species* of 1859, or his account of the *Voyage of the Beagle* of 1846. If anything, his writing in 1835 was more direct, and wonderfully clear.

Whose oil is it anyway?

David Nowell writes When it comes to North Sea Oil, the question of which of the separate nations of the United Kingdom owns it has either been ignored or played up for political purposes since the first exploration licenses were issued in 1964. Historically a nation's territorial waters were limited to the first three and then 12 nautical miles from the coast, limits that could to some extent be policed and defended relatively easily from the land (Fig. 10). However, given the risk of conflicts of interest, once nations wanted to extend economic control beyond these limits—first over fishing and then mineral rights, as offshore drilling became a commercial possibility—the United Nations Continental Shelf Convention was drawn up in 1958, coming into force in 1964 after ratification. Becoming Law of the Sea in 1982 it has been gradually modified, so recently there has been a rush of claims to extend these exclusive economic zones (EEZ) beyond the originally agreed limit of 200 nautical miles (370.4 km) from land.

Fig. 9. HMS *Beagle* at Tierra del Fuego, painting by Conrad Martens.

In the North Sea, a series of bilateral agreements were negotiated, based usually on the simple principle of equidistance from the land of each respective nation, and thus a median line runs down its middle separating the United Kingdom sector from the Norwegian, Danish, German and Dutch sectors in turn (Fig. 11). However, in other cases, such as Belgium and the limits of the German sector (which was extended to the median line in 1970 after international arbitration), these boundaries can depart from the usual pattern based on the dividing line being drawn halfway from each country. Another example is the sea around the Channel Islands, as the French exclusive economic zone divides them from UK waters in the English Channel. At one stage Rockall—a tiny rocky outcrop 19 m high and up to 28 m wide in the North Atlantic (57°36′N 13°41′W) some 370 km west of the Outer Hebrides—formed the basis of a 200 mile claim until the rules were revised to exclude uninhabitable rocks, though the 12 nautical mile limit around United Kingdom territorial waters was retained (Fig. 12). However, Rockall lies within the exclusive economic zone arising from St Kilda some 294 km away (Central Rockall Basin, BGS 2002 bedrock 1 : 500 000 sheet 56°N 15°W), and if the difficulty of imaging potential sedimentary structures beneath a blanket of Palaeocene lavas (associated with the final rifting and opening of the North Atlantic) can be overcome, then these waters would have some hydrocarbon potential, even if the logistical difficulties of working in such a hostile environment would be immense.

When it comes to the divisions within the British sector of the North Sea, things are nearly as complex, as the shoulder of the Northumbrian coast south of Berwick-upon-Tweed, including Holy Island (Lindisfarne), sticks out and pushes the equidistant line be-

Fig. 10. The North Sea, target for oil exploration and exploitation.

tween England and Scotland northeastwards before it swings eastwards to meet the median line at 56°36′N. At this point it is clear the median line changes direction as the Scottish coast around Aberdeen comes into play with the Norwegian sector. As a result the English sector includes a number of oil fields such as Auk and Argyll, in addition to the now declining but substantial natural gas (mainly methane) fields of the southern North Sea off the Yorkshire and Norfolk coasts. On the other hand, the Scottish sector includes most of the really significant oil fields (Fig. 13), until you consider the Shetland question, as under existing arrangements the island council gets a small royalty for each barrel of oil which comes ashore at Sullom Voe oil terminal on their mainland. With talk of independence things could become rather tricky for the Scottish nationalists: in the March 1979 devolution referendum the Shetland Islands voted 73 per cent against it, along with 72 per cent in Orkney. This was a very high proportion of no votes, as overall, 52 per cent of people in Scotland voted yes to devolution. In fact, the requirement of a 40 per cent of the electorate needed to vote yes scuppered devolution until September 1997, when 74 per cent voted in favour of a Scottish Parliament, including 63 per cent in the Shetlands. While Scottish independence may

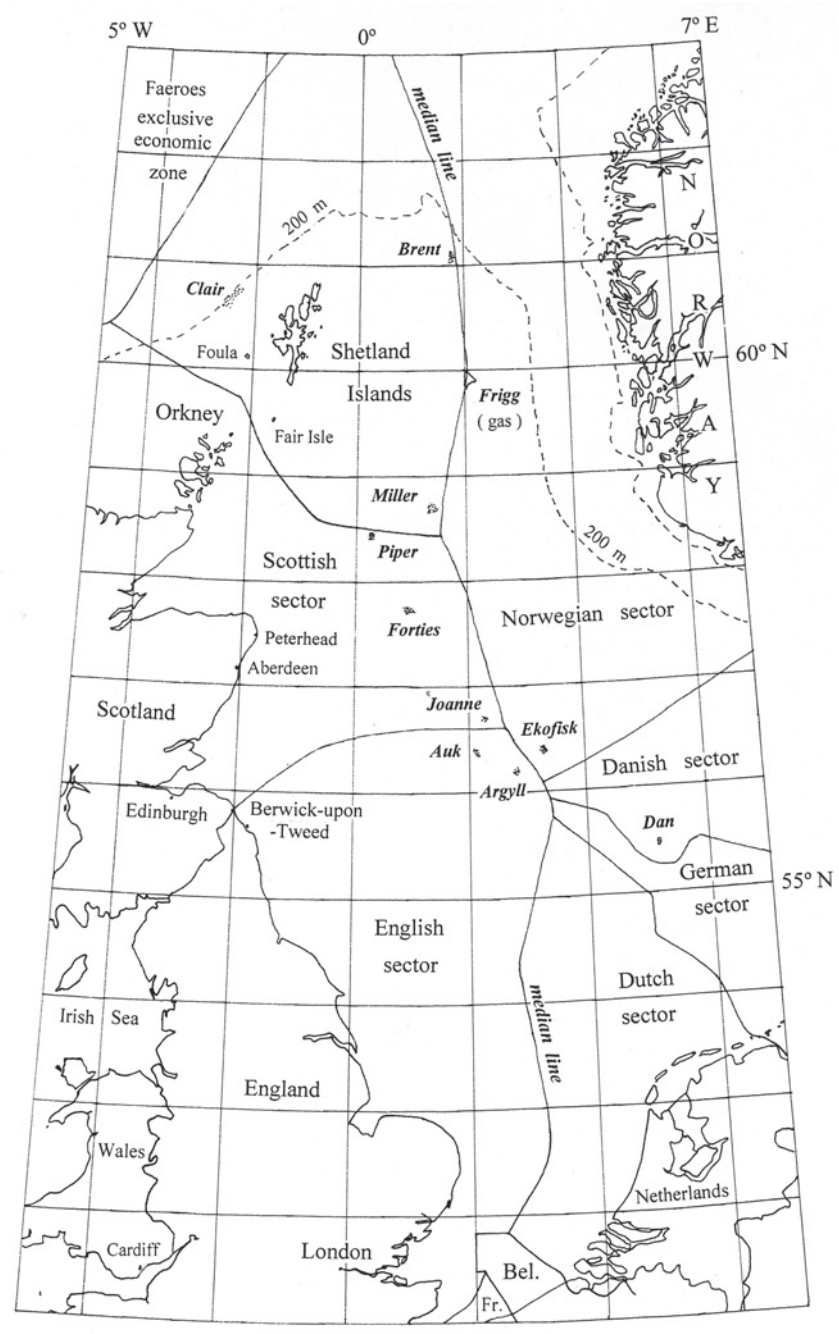


Fig. 11. North Sea sectors in relation to selected oil fields.

seem a distant prospect, if this happened it is possible that the roughly 22 000 islanders might consider all their options, including wishing to remain within the rest of the United Kingdom, on a similar basis to the Faeroe Islands, a largely self governing Danish territory with around 47 000 people roughly halfway to Iceland. Were this to happen, the Shetlands would retain a huge chunk of the North Sea and Atlantic margin including the Clair and Miller oil fields, and this division would be slightly enhanced by Foula and Fair Isle, which are both sparsely inhabited islands.

Looking at some admittedly old data in the excellent British Geological Survey series of *United Kingdom Offshore Regional Reports*, supplemented by the third 1990 edition of the *Introduction to the Petroleum Geology of the North Sea* (K.W. Glennie editor, published by Blackwell), it is possible to come to a crude estimate of how the oil and gas resources could be divided up. But once these boundaries are defined, like the Frigg gas field that straddles the median line, these resources can then be apportioned exactly between different sectors. Thankfully the BGS reports follow the same boundaries as those used by the Department of Energy, so that most of the northern North Sea is in Shetland waters, while the Moray Firth ties in with the Scottish mainland along with the northern half of the central North Sea. Thus while only 5 per cent of the original oil reserves, some 767 million barrels (mb), are English, the waters around Shetland contain 10 682 mb of oil or 65 per cent of the total. However, if gas is brought into play then—(assuming 170 cubic metres equals one barrel of oil), as the southern North Sea originally had 880 billion cubic metres of gas when these fields were discovered—the combined English oil equivalent jumps to 5973 mb or a quarter of the total, as Shetland waters still dominate with 12 445 mb, which is still over half, and 4971 mb were found in the rest of the Scottish waters, which is only a fifth of the overall total.

Now that the North Sea is a mature petroleum

Fig. 12. Claiming the rock for the crown, Royal Navy personnel raise the union flag over Rockall, 1955. This increased UK territorial waters.

Fig. 13. Beryl Alpha platform in Block 9/13a in the UK sector of the North Sea approximately 335 km north east of Aberdeen. The Beryl Alpha began production in 1976.

province and production is declining, and once again the United Kingdom is a net importer of oil and gas, it might be easy to dismiss its future potential even though the recovery of the remaining oil reserves could be improved with carbon dioxide. Unfortunately a proposal by BP in 2005 to capture carbon dioxide from a specially built gas-fired power station near Peterhead in order to enhance oil recovery in the Miller field has already been abandoned due to dithering over financial support. This vital scaling-up of the technology could have been up and running in under five years with up to two million tonnes of carbon dioxide being injected into this oil field each year to produce an additional 40 to 60 million barrels (one barrel = 42 US gallons, or nearly 159 litres) of high quality oil over two decades. Even if this were burned without any capture, twice as much carbon dioxide would have remained sequestered underground than the amount emitted into the atmosphere. This project would also have been a significant boost to our balance of payments with up to £3 billion in oil revenues at $100 a barrel and would have allowed Britain to take a decisive lead in reducing its carbon emissions.

In the more distant future, the deep Carboniferous coal seams under the southern North Sea could be exploited by displacing methane out of the coal, as its fabric will preferentially absorb and retain twice the volume of carbon dioxide than the methane it originally contained. The 1999 BGS 1 : 1500000 Coal Resources map of Britain also shows (on an insert map) extensive areas with Mesozoic coal and lignite in the south, central and northern North Sea as well as the Moray Firth, along with Cenozoic lignite in the waters around Shetland and further south off Peterhead. But as these carbon deposits are less mature it is doubtful if methane recovery would be viable, and as they are found in shallower layers carbon gas escape would be a serious risk. Finally, looking beyond the carbon economy, Scotland should become an alternative energy hub, as its coasts are awash with wave energy and strong tidal streams, in addition to offshore wind, and so Scottish electricity exports may get the last laugh when North Sea Oil is a distant memory.

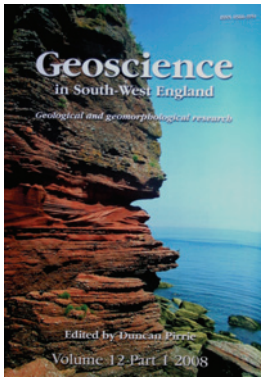


Fig. 14. *Geoscience in SW England*, published by the Ussher Society, has just gone digital.

Ussher in the digital age

In early January every year for the last 47 years, a stalwart group of geologists and geomorphologists have met under the banner of the Ussher Society, to hear the latest Earth Science research on south-west England. The annual meeting is attended by academics, industry geologists, consultants, students and amateurs alike, and the Society membership is going from strength to strength. Recently, the Society have released to its membership, the first edition of a fully searchable CD (Fig. 14), covering the first 25 years of *Proceedings of the Ussher Society* (1962–1987); this will be followed later this year by Volume 2 of the CD covering *Proceedings of the Ussher Society* and *Geoscience in south-west England* from 1987 to 2002; details of more recent papers published in *Geoscience in south-west England* are available via www.ussher.org.uk. Together these two CDs will be an invaluable tool for anyone interested in the geology and geomorphology of south-west England.

Scientific American Earth 3.0: a new publication

Rasoul Sorkhabi (University of Utah) writes *Scientific American* has been an active and valuable publishing institution in the field of Earth science (see my report in *Geology Today*, March–April 2007, pp.43–44). *Scientific American Earth 3.0*, a new magazine published six times a year (Fig. 15), is the latest effort by this science publishing enterprise. Why Earth 3.0? In an editorial in the premier issue of the new magazine (published in October 2008), Editor-in-Chief John Rennie gives an answer: 'Earth 1.0 was the world that persisted and evolved for billions of years, up until recently. The environment was dominated by closed ecological loops and a few geological and astronomical processes... That changed two centuries ago with the arrival of Earth 2.0, when the industrial revolution gave the human race the leverage to achieve unprecedented health and prosperity but at the price of wanton consumption of natural resources... Earth 3.0 is thus a new way forward that we need to establish, one with the prosperity of 2.0 but also the sustainability of 1.0'. In other words,

Fig. 15. *Scientific American Earth 3.0*, a new magazine published six times a year; the latest effort by this science publishing enterprise.

Earth 3.0 is no longer simply the home planet for humans, but also a creation of human technology and population. While this view conveys some truth about human impact on Earth, it also masks the fact that other life forms have also exerted planetary affects on Earth. Consider for instance, how plants have changed the entire atmospheric chemistry by releasing oxygen and withdrawing carbon dioxide. Can we as geologists think that within a span of merely three centuries our planet has gone from Earth 1.0 to Earth 3.0? If yes, is not this yet another anthropocentric position in our thinking toward the world? Let's suppose that the human species becomes extinct in a million years or so, is the planet then going back to Earth 1.0? These conceptual questions aside, *Scientific American Earth 3.0* offers many interesting and up-to-date articles, news and views on various issue of earth science written by experts for the general public. The magazine is subtitled: 'Solutions for Sustainable Progress'. This new publication by the *Scientific American* is very welcome and will be of utmost use for school and public education about earth and environmental science.

If the first two issues of the magazine published respectively in October and December 2008 give any guidelines for the format and content of the *Earth 3.0*, we can say that each issue (about 90 pages) is divided into feature articles and departments (including Inspirations, View, Front Lines, Future Solutions, EcoTravel, Being Green, Buying Green, Resources, and Role Model). Feature articles are about energy, environment, natural resources, climate change, biodiversity, politics/national affairs, urban planning, and habitat. The overall tone of the magazine is positive, trying to find and offer solutions to the problems rather than painting deterministic gloomy futures for the planet and human race. For example, in the category 'Inspirations' we read many good news and solution-based developments. Another important characteristic of the new magazine is that it links earth science and the environment to social, economic and political policies. For instance, in the its October 2008, when the US presidential campaign between Barack Obama and John McCain was in process, there is an article by John Holdren of Harvard University about what the elected president must do to mitigate the global warming. And in the December 2008 issue, after Barack Obama won the election, Shirley Ann Jackson of Rensselaer Polytechnic Institute argues that President Obama should take initiatives to tackle the US energy problems in his first 100 days of the office. Indeed, the magazine's 'Front Lines' section gives a valuable opportunity for expert opinion on various issues facing our world.

Readers will also find in-depth science-based articles. For instance, in 'Catch-22: Water vs. Energy' (October 2008), Michael Webber of the University of Texas at Austin argues that while water is needed to generate energy and energy is needed to deliver water, both resources are limiting the other, and both may be running short. In 'Can Nuclear Power Compete?' (December 2008), Matthew Wald of the *New York Times* argues that new nuclear reactor designs could reduce global warming and fossil-fuel dependence but that electric companies are grappling with whether nukes make market sense.

Annual subscription for *Scientific American Earth 3.0* is US$19.95 for six issues (news stand cover prices is $5.95) in the US. Elsewhere the subscription is $30. To obtain more information about the magazine's contents, editorials and subscription visit the website: www.sciam.com/special-editions.

Research

Calcite granules from earthworm activity

The importance of earthworms is well recognized by all gardeners, but their ability to secrete up to mm-sized granules of calcite is less well known. It is probably fitting in this year of celebration of Darwin's 200th birthday on 12 February 2009, that granules have been known since his literally ground breaking work in 1881. More recently, Martin Lee, Mark Hodson and Graham Langworthy have described in detail the mechanism of granule formation (*Geology*, 2008, v.36, pp.943–946). Initially amorphous calcium carbonate is precipitated within the earthworm calciferous glands, and then crystallizes before the granule leaves the earthworm (Fig. 16). The granules show complex internal zonation, possibly as a result of the incorporation of different trace elements into the calcite, as a result of changing fluid properties within the earthworm with a time scale of tens of minutes. How-

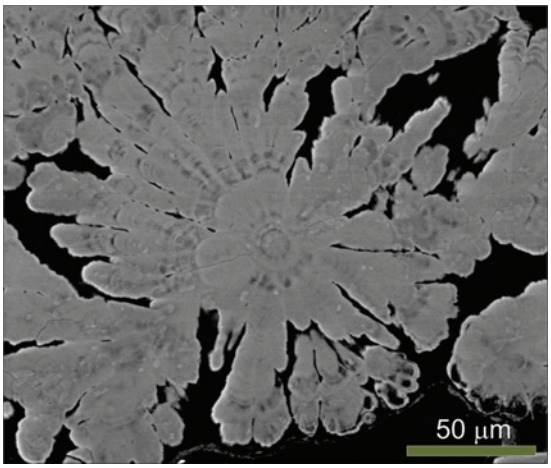


Fig. 16. Backscattered electron (BSE) image of a complexly zoned earthworm calcite granule. Zonation reflects changing chemistry within the calcite granule as it was precipitated within the earthworm.

ever, to date, we still don't know why earthworms secrete large volumes of calcium carbonate.

Sedimentological significance of the Mediterranean region

The latest issue of *Sedimentology* (2009, v.56, n.1) is dedicated to the significance of the Mediterranean region in sedimentary geology. The region has been the testing ground for many areas of geology, and papers in the thematic issue touch upon topics ranging through Neogene stratigraphy, cyclostratigraphy, the Messinian salinity crisis, bolide impact at the K-T boundary, pelagic sedimentation and ophiolites of Tethys, carbonate platform sedimentation, dolomitization, tufas and travertines, black shales, turbidity currents and olistostromes. Many papers show that the area was critical for the development of early theories, but that the same outcrops are today providing new insights. For example Judith McKenzie and Crisogono Vasconcelos (*Sedimentology*, 2009, v.56, n.1, pp.205–219) revisit the Dolomite Mountains, and discuss the recent recognition that microbes can mediate dolomite precipitation (Fig. 17), and may provide an alternative hypothesis to the long-running question about how large scale dolomitization might have occurred in the ancient rock record.

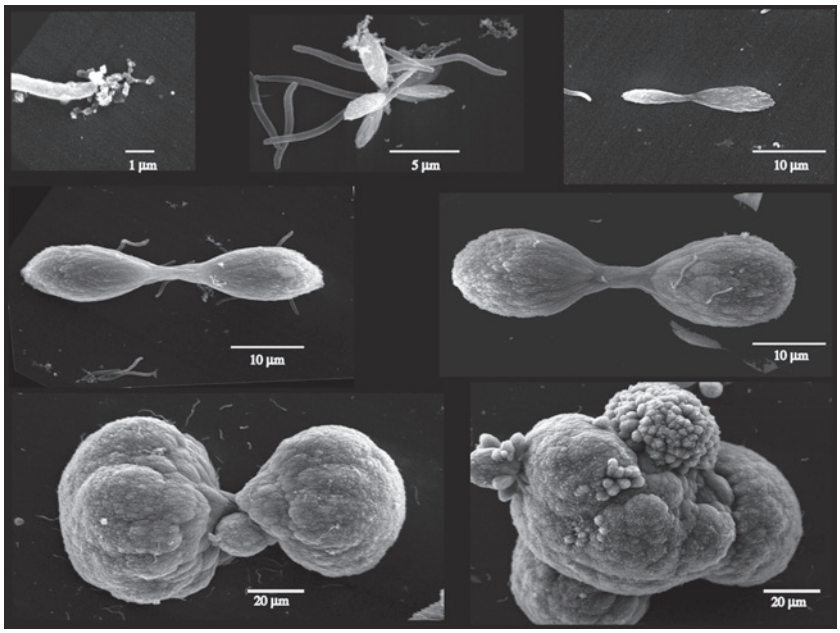


Fig. 17. Scanning electron microscope images of the sulphate reducing bacteria that are associated with the precipitation of dolomite with a dumb-bell morphology.

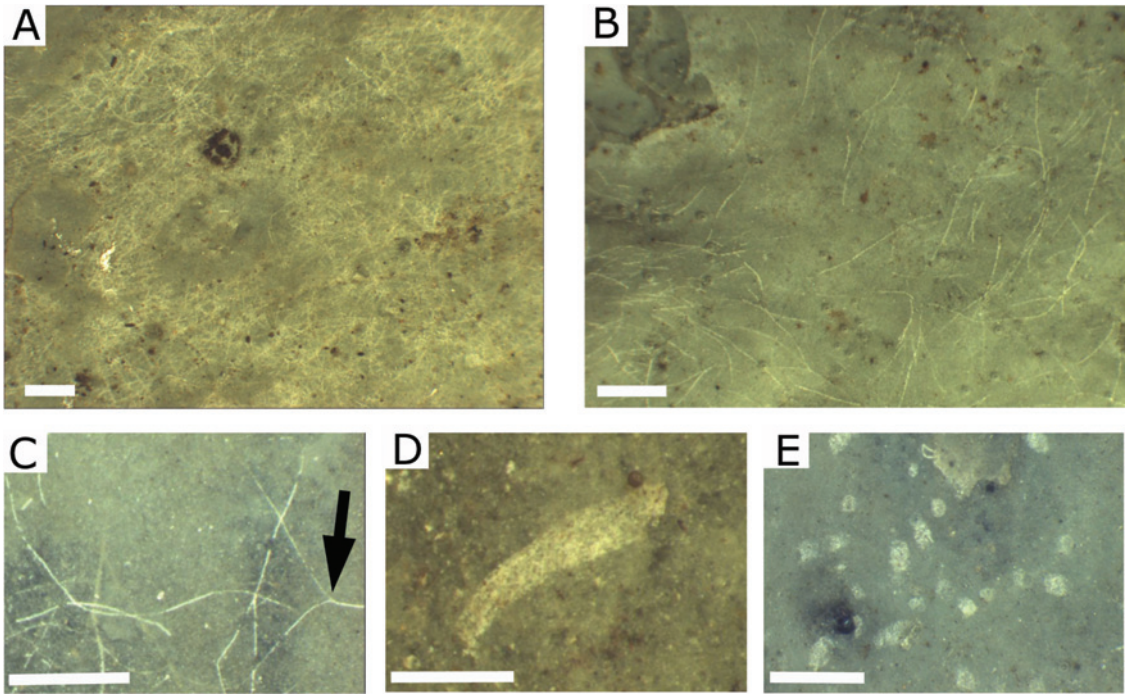


Fig. 18. Filamentous algae from the late Precambrian of Shropshire, UK.

Microbes, wrinkles and Darwin's dilemma

It looks as though as many Earth scientists as possible are joining in the Darwin birthday celebrations by citing his early works. That aside, Richard Callow and Martin Brasier (*Journal of the Geological Society of London*, 2009, v.166, pp.1–4) present an important paper on the discovery of filamentous and sphaeromorph microfossils from the late Ediacaran Longmyndian Supergroup of Shropshire, UK. Early work by the Geological Survey palaeontologist J.W. Salter in 1856 and 1857 (also published by the Geological Society) first noted the presence of possible trace fossils in these beds, and Darwin commented on their presence when trying to explain away the absence of Precambrian life as a problem to the theory of natural selection. Callow and Brasier describe a range of filamentous and possibly sphaeromorph microbes (Fig. 18), preserved in three ways: 1, as carbonaceous films; 2, with three dimensional replacement by an Fe-K aluminosilicate, or 3, as impressions or moulds. The significance of the presence of these microbes is twofold; first they support the interpretation that wrinkle marks and similar enigmatic sedimentary structures are of microbial origin; and second, that the Ediacaran fossil record appears to be biased towards exceptional preservation.

Ductile shearing of mineral grains

Soumyajit Mukherjee (Mumbai, India) writes Inside a muscovite host mineral, two nucleated muscovite grains of unequal sizes underwent ductile shearing in a top-to-southwest sense, giving rise to their asymmetric shapes and notches (mouths) (Fig. 19). A pair of cleavage planes of the host muscovite grain envelops these nucleated minerals and efficiently acted as ductile shear planes. The sense of shearing matches with rarely observed S-C fabrics elsewhere in the thin-section. The nucleated grains could either be categorized as asymmetric shear fracture boudins or mineral fishes. One of the constraints of boudinage is that there should be competency contrast between the clast and the matrix. The peculiarity in this case is that the host and the clasts belong to the same mineral species, indicating negligible contrast in competency between them. (msoumyajit@yahoo.com)

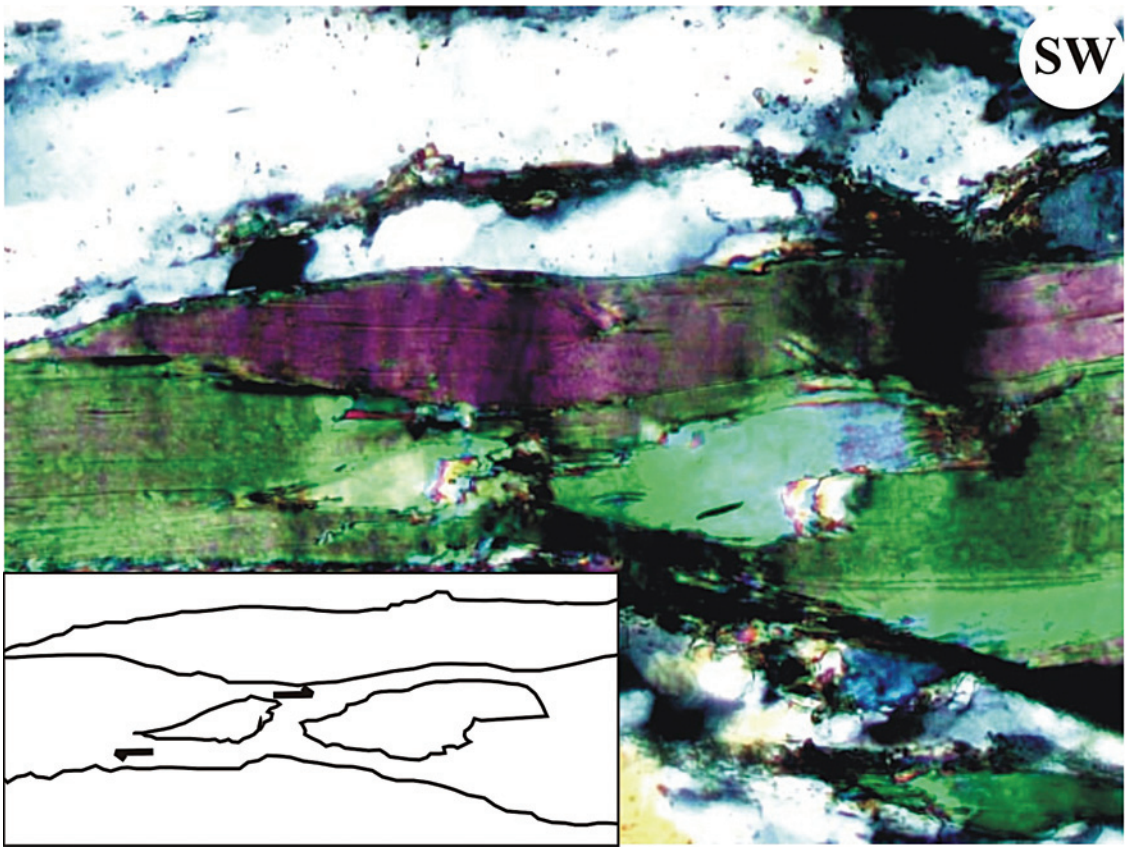


Fig. 19. Photomicrograph illustrating mineral host and clasts belonging to the same mineral species, indicating negligible contrast in competency between them. Host rock: gneiss. Length of the photograph: 1 mm. Cross-polarized light. Sample location: Padam, Zanskar Shear Zone, western Indian Himalaya. Line sketch added. The thin-section is oriented perpendicular to the main foliation (ductile primary shear plane or the C-plane) and parallel to the stretching lineation. Both the C-planes and stretching lineations dip towards northeast.

