



Gondwana

The great supercontinent

The Earth's surface does not consist of a motionless crust but rather of large crustal plates which move and jostle against each other. There are seven large plates and many smaller plates (100 to 150 km thick) that drift around the Earth's surface, highlighted in the diagram below.

Continental drift

Continental drift is apparently a result of these crustal plates being dragged along by movement in deeper layers of rock in the mantle.

Volcanoes and earthquakes all provide evidence for the Earth's wandering continents. The continents actually move as a consequence of volcanic processes in oceanic areas known as mid oceanic ridges where basalt oozes out onto the sea floor, forcing adjacent plates apart.

Another mechanism driving the movement of the Earth's plates are large convection currents in the Earth's mantle.

Did the supercontinents really exist?

Alfred Wegener, a German meteorologist, proposed the original theory in 1912, after noticing that there were similar glacial deposits in the southern continents, which had a rational distribution when plotted on a geometric reconstruction of these continents known as Gondwana.

Their distribution is very difficult to explain unless all the continents were linked together. There is also a remarkable jigsaw puzzle fit between many of the southern continents which Wegener noticed and so proposed the then radical theory of continental drift.

This theory was discredited for decades by geologists until the 1960s but is now widely accepted as the theory of plate tectonics.

Australia in the northern hemisphere?

It seems quite absurd to suggest that the land which is now Australia was once situated in the northern hemisphere, that a couple of hundred million years later it was slowly moving to the south pole, and that in 20 million years time the northern tip of Australia should

reach the equator. This is what continental drift is all about with continents coalesce and segregate colliding and diverging. Supercontinents form and break up over time as the continents move.

What was Gondwana?

Gondwana was the great southern landmass that formed as a result of the division of a much larger supercontinent known as Pangea about 250 million years ago. This Gondwanan supercontinent consisted of present day landmasses: Africa, South America, India, Madagascar, Australia and New Zealand. The other section of Pangea, known as Laurasia, comprised what are now Europe, Asia and North America.

The Big Rip

The Gondwanan landmass started to disperse about 165 million years ago. The dispersal caused great tension in the Earth's crust and volcanic activity followed as conduits were created in the continental crust, tapping the molten rocks (magma) in the Earth's mantle.

The dolerites that outcrop over extensive parts of central and eastern Tasmania, together with similar igneous rocks in South Africa, South America and Antarctica, are the solidified evidence of the magma from the Gondwana break up.

The Australian plate took a very long time to separate from the Antarctic plate. In fact they were the last of the major Gondwanan continental plates to split, only 45 million years ago. As a result, Tasmania has more geological similarities with Antarctica than most of Australia.

By this time Tasmania had also taken on its triangular shape and developed many of its valley and mountain systems, which formed as a result of similar faulting events which created the Bass Strait.

Australia, with its freight of Gondwanan plants and animal's started being dragged northwards about 45 million years ago while the first glaciers were forming in Antarctica. However it still took until about 5 million years ago for Antarctica to completely freeze over. This was the first extensive ice to have formed in Antarctica since the Permian glaciations 300 million years

before, which also affected parts of the other southern continents.

Continents still on the move?

The Australian plate is moving northwards at about 3cm per year. The Himalayan mountain belt is forming today as a result of India colliding with Asia.

Tasmania's Gondwanan elements

Plant evidence: Fossil evidence suggests that temperate rainforest was widespread in Australia, Antarctica, South America and New Zealand around 45 million years ago. Such fossils and the surviving species in Tasmania provide evidence of the ancient link to Gondwana.

There are a number of examples of fossils with a Gondwanan connection, the most recent was the discovery of fossilised foliage of the giant conifer *Fitzroya tasmanensis* near Cradle Mountain. Presently this tree only grows in Chile, but this discovery provides excellent evidence for the similarities in forest types across Gondwana. These Gondwanan forests most likely included King Billy pine, pencil pine and other Tasmanian gymnosperms.

Flowering plants arrived in Gondwana about 100 million years ago and expanded rapidly across the supercontinent.

The most successful was the myrtle or southern beech (*Nothofagus*) which provides arguably the strongest evidence for the Gondwanan landmass. There are about 40 living species left today distributed across a number of land masses- three species in Australia, nine in Chile and Patagonia, five in New Caledonia, 14 in New Guinea and four in New Zealand.

The protea family is another with its origins in Gondwana, with relations extending from Australia to South Africa and South America.

Animal Evidence: There are numerous examples of animals in Tasmania that have their closest relatives living today in land masses that were once part of the Gondwanan supercontinent.

The invertebrates provide the most abundant evidence of this. Possibly the best known example is the mountain shrimp (*Anaspides tasmaniae*) which is very similar to Triassic (230 million year old) fossils. Currently, its closest relatives are found in New Zealand and South America. The Tasmanian cave spider is considered to be one of the most primitive spiders in the world, and is the only member of its family outside Chile.

Another most amazing discovery in recent time was the vertebrate and invertebrate marine fauna of the Port Davey/Bathurst Harbour area in the southwest, which are also considered Gondwana relics. One of these animals, the Port Davey skate, is unique, as it is the world's only brackish water skate, and its closest relatives are found in New Zealand and Patagonia.

Platypus and echidnas evolved from ancient ancestors which inhabited Gondwana. Close relatives of marsupials thrive in South America and fossil platypus have also been discovered in South America.

Further information

Gondwana map: refer to

< www.geology.er.usgs.gov/eastern/plates>

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