MEGA GEOLOGY

Western Australia's giant landforms

Millions of years before Aboriginal peoples roamed the land of Western Australia, earth movements buckled and faulted rocks, causing them to rise and lower, creating giant landforms. Some of our favourite natural areas such as the Stirling Range and Karijini have an incredible geological history and significance.

by Professor Ross Dowling AM and Mike Freeman

Some 200 million years ago the supercontinent Pangaea broke into two land masses—Laurasia in the north and Gondwana in the south. Australia was part of the latter supercontinent, known geologically for being 'old, flat and red'. In the west, former mountain ranges have been eroded with the sediments creating large flat areas, or being washed into basins on the edge of the continent.

Delve deeper and we find the landscapes, landforms and rocks of Western Australia show remarkable diversity and significance. WA's national parks contain many different geological provinces as well as many of the State's giant landforms. Some examples are captured in the national parks of Mount Augustus, Karijini, Stirling Range and Cape Range.

MOUNT AUGUSTUS

1109 kilometres from Perth, 474 kilometres from Carnarvon

Mount Augustus (Burringurrah) is in an area between two large and old blocks of the Earth's crust, termed cratons, which form the nucleus of the continent. The southern Yilgarn Craton contains rare mineral grains up to 4400 million years old, the oldest parts of Earth, and were formed in a mere 100 million years—just after the solar system formed from the original solar nebula. The northern Pilbara Craton contains fossil stromatolites, the oldest proven forms of life on Earth dated at 3450 million years old. The Yilgarn Craton and the Pilbara Craton started colliding about 2200 million years ago and continued to collide until about 1800 million years ago. This produced a 250-kilometre-wide area called the Capricorn Orogen.

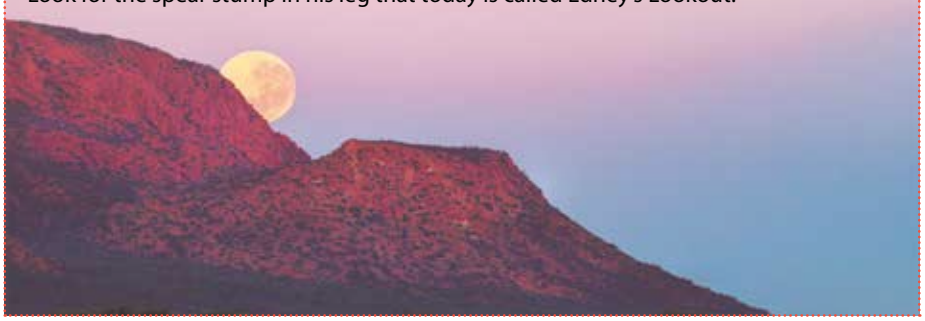
The Orogen was then affected by many periods of earth movements that folded, buckled and faulted the rocks, lowering and raising them—it was a zone of ongoing earth activity starting at the time of the collision and finally ceasing around 900 million years ago.

After the collision, at about 1600 million years, rivers deposited sands and conglomerate eroded from the cratons. Later the ocean flooded the area and more sand was deposited with layers of mud and volcanic lavas. Uplift resulted in erosion of much of these layers, but left a prominent mountain consisting mostly of the river-deposited sand named the Mount Augustus Sandstone. This is Mount Augustus, a prominent elongate inselberg (German for 'island mountain'), a peak rising to an altitude of 1105 metres, about 700 metres above the surrounding landscape.

Mount Augustus and the boy called Burringurrah

Mount Augustus and surrounds are the traditional lands of the Wajarri people. Burringurrah is the Wajarri name for Mount Augustus. In times of plenty, the Wajarri people would roam over a wide area of the Gascoyne. In times of drought, they would return to areas where water was available, such as the natural springs along the base of Mount Augustus. Aboriginal occupation is evident by engravings on rock walls at Mundee, Ooramboo and Beedoboondu visitor sites, and numerous stone tools discovered in these areas. Burringurrah continues to be a significant site for the Wajarri people.

According to the Wajarri Dreamtime story, Burringurrah was undergoing his initiation into manhood. The rigours of this process so distressed him that he ran away, thereby breaking Aboriginal law. Tribesmen pursued the boy, finally catching up with him and spearing him in the upper right leg as his punishment. Burringurrah fell to the ground; the spearhead broke from its shaft and protruded from his leg. The boy tried to crawl away but was hit with a mulgurrah (fighting stick). Burringurrah collapsed and died, lying on his belly with his left leg bent up beside his body. You can see his final resting pose when you approach Mount Augustus from the south. The geological fracture lines at the western end of the inselberg indicate the wounds inflicted by the mulgurrah. Look for the spear stump in his leg that today is called Edney's Lookout.



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Main Hamersley Range, Karijini National Park.

Above Mount Augustus (Burringurrah).
Photos – David Bettini

Right Moon setting over Burringurrah.
Photo – Janine Guenther

KARIJINI

1250 kilometres from Perth, 650 kilometres from Exmouth

Karijini National Park is located in the Hamersley Range area of the rugged sedimentary Hamersley Basin, which lies south of and covers part of the granite and greenstone-based Pilbara Craton. The range extends 300 kilometres east-west and comprises mostly horizontal layers of red, iron-rich rocks dissected by deep gorges affording spectacular rugged scenery in ancient geological formations.

The area has been relatively stable for two billion years and is important for its minerals, particularly iron ore. After 1960, large iron mines were developed at Mount Tom Price, Mount Newman, Paraburdoo, Pannawonica, and other sites. By the early 1990s, the range accounted for more than 90 per cent of Australia's iron ore production, which is nearly 40 per cent of the global demand for iron and steel.

In the national park, mountains and escarpments rise out of the valleys. The high plateau is dissected by breathtaking gorges, and stony, tree-lined watercourses wind their way over the dusty plain. Erosion has slowly carved this landscape. There are many beautiful gorges and sites to visit (see 'Rocking the patterns' on page 36) including Dales Gorge with Fortescue Falls, one of a number of permanent waterfalls in the park. It cascades more than 20 metres down a series of natural rock steps before finishing in a large, picturesque pool. Also within the national park is Mount Meharry; at 1249 metres it is the highest mountain in Western Australia.

In an Aboriginal Dreamtime story, Barrimirndi was a Warlu, or giant sea serpent, who emerged from the sea at Coral Bay. He meandered his way across the land, forming waterways as he went. As the legend goes, Barrimirndi became angry with two boys who cooked and ate a parrot. Barrimirndi followed the scent of the singed feathers in search of the boys. Travelling underground, he wove his way up the river now known as the Fortescue, cutting gorges and rivers into the landscape. Sometimes he broke through the surface to check for the scent, creating a waterhole before disappearing underground again.

While the rocks are regarded as being old, they are only about half the age of the Earth, having been deposited between about 2800 million years ago and 2200 million years ago. They were laid down on the Pilbara Craton, mostly in shallow seas. Geologically they contain the world's best-preserved sequence of volcanic and sedimentary deposits of Archean to Proterozoic age. The iron-rich rocks are thought by most geologists to have been deposited in response to the Great Oxidation Event, arguably the greatest environmental change the Earth has ever experienced, when organisms started to enrich the atmosphere with oxygen. However, since deposition of the sediments, the region has been little-affected by earth movements except being uplifted, and so the sedimentary layering is still horizontal.

Above Fortescue Falls, Karijini National Park.
Photo – Jiri Lochman

Above right Hamersley Range viewed from Mount Meharry.
Photo – Cliff Winfield

Right Dales Gorge, Karijini National Park.
Photo – Marie Lochman

STIRLING RANGE

400 kilometres from Perth,
95 kilometres from Albany

The Stirling Range or Koikyennuruff in the south of the State stretches for 65 kilometres from east to west as a series of rugged ranges and isolated peaks. The range is home to Bluff Knoll or Bular Mial, the tallest peak, standing at 1095 metres above sea level and a place where the local Menang people believe the spirits of Noongar people go after death. Several other peaks rise to between 700 metres and 950 metres. The area is within the Stirling Range National Park, originally gazetted in 1916.

The bedrock of the Stirling Range consists of quartzite, sandstone, shale and slate. These were sediments deposited in a sea possibly as early as 2000 million years ago. Later, at about 1140 million years they were subjected to earth-movements and heating that metamorphosed the sedimentary rocks, converting some of the shales to slates and sandstones to quartzite. This occurred when the range was thrust upwards to its present elevation. The quartzite is tough and resists erosion and is the rock that preserves the highest peaks. The geological setting is enigmatic and still not clearly understood. The Stirling Range rocks sit on Yilgarn Craton rocks, which are at least 500 million years older, and are on the northern margin of the Albany-Fraser Orogen, the site of a collision between two continental plates between 1300 and 1100 million years ago. There are suggestions similar rocks occur in India as the Indian subplate once was connected to the west coast of Australia that split apart during one of the Gondwanan break-ups about 130 million years ago.

When first upthrust, the range was originally much higher than it is today. The large amount of erosion that removed much of the former range has carved the present range into various spectacular formations, especially on the craggy higher peaks. Being so high and surrounded by lowlands between 150 metres and 250 metres altitude, the range creates a climate of its own and, along with that, there is a huge diversity of more than 1000 species of wildflowers, more than 100 of which are unique to the Stirling Range.

Top left Talyuberlup Peak, Stirling Range National Park.
Photo – Jiri Lochman

Left White mountain myrtle (*Hypocalymma phillipssii*).
Photo – Ann Cochrane

Below View from the top of Bluff Knoll, Stirling Range National Park.
Photo – Marie Lochman

CAPE RANGE

1300 kilometres from Perth,
50 kilometres from Exmouth

The Cape Range peninsula lies within the Carnarvon Basin geological province, the host to the huge oil and gas reservoirs of the North West Shelf. The range was formed as a result of uplift associated with tectonic compression during the break up of Gondwana. This tectonic uplift has resulted in an anticline extending for 100 kilometres in a north-south direction with a structural relief of 450 metres comprising spectacular limestone hills, gorges and coastal scenery.

The range hosts an extensive karst system of national and international significance, its importance being that it was formed over a sequence of different climatic phases from wet to arid conditions. This has been an important driver of biological evolution as demonstrated through the significant speciation and adaptation evident in the subterranean fauna of the area (see 'Endangered! Subterranean animals of the North West Cape', *LANDSCOPE*, Spring 2001). Of major note is the presence of unique local biodiversity in different cave systems, showing the evolution of the troglofauna and stygofauna (animals that live in caves, either in the air or under water) in isolated cave systems and did not mix with other systems along Cape Range.

Local cavers have recorded more than 580 caves in this karst landform. It is important because it is a relatively young limestone whereas most other karsts in Australia are formed in older limestone. The karst system is still active, particularly on the flanks of the range and beneath the coastal plain, and it demonstrates simultaneous erosional and depositional karstic processes.

Bundera sinkhole lies within the Cape Range peninsula anchialine system and hosts rare and unique aquatic subterranean animals. It is the only known habitat of remipedes in Australia; a class of blind, colourless crustaceans (*Kumonga exleyi*).

While the State's national parks contain magnificent fauna and flora, they are also home to some wonderful landscapes, landforms and geologic features, many of which have been interpreted on sign boards and brochures within the parks. So, next time you visit one of WA's parks, take time to appreciate the landscape and landforms as they underpin all that lies above.

Above Bundera sinkhole, a Cape Range peninsula anchialine system.
Photo – Tiffany Taylor

Above right Cape Range National Park.
Photo – Tourism WA

Right Yardie Creek, Cape Range National Park.
Photo – Cliff Winfield

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WA's beloved Bush Book series features publications about the geology and landforms of Pilbara and South-West. You can purchase them for $6.95 each from shop.dbca.wa.gov.au.