

Feature

New geological time walk in Ulladulla, NSW

This article describes the planning and construction of a geological time walk at Brodie Park, Ulladulla, NSW, currently the only regional geological time walk in the world. It is hoped that it will encourage others to undertake similar exercises elsewhere in Australia, where there is great potential for geotourism to be added to the ecotourism industry.

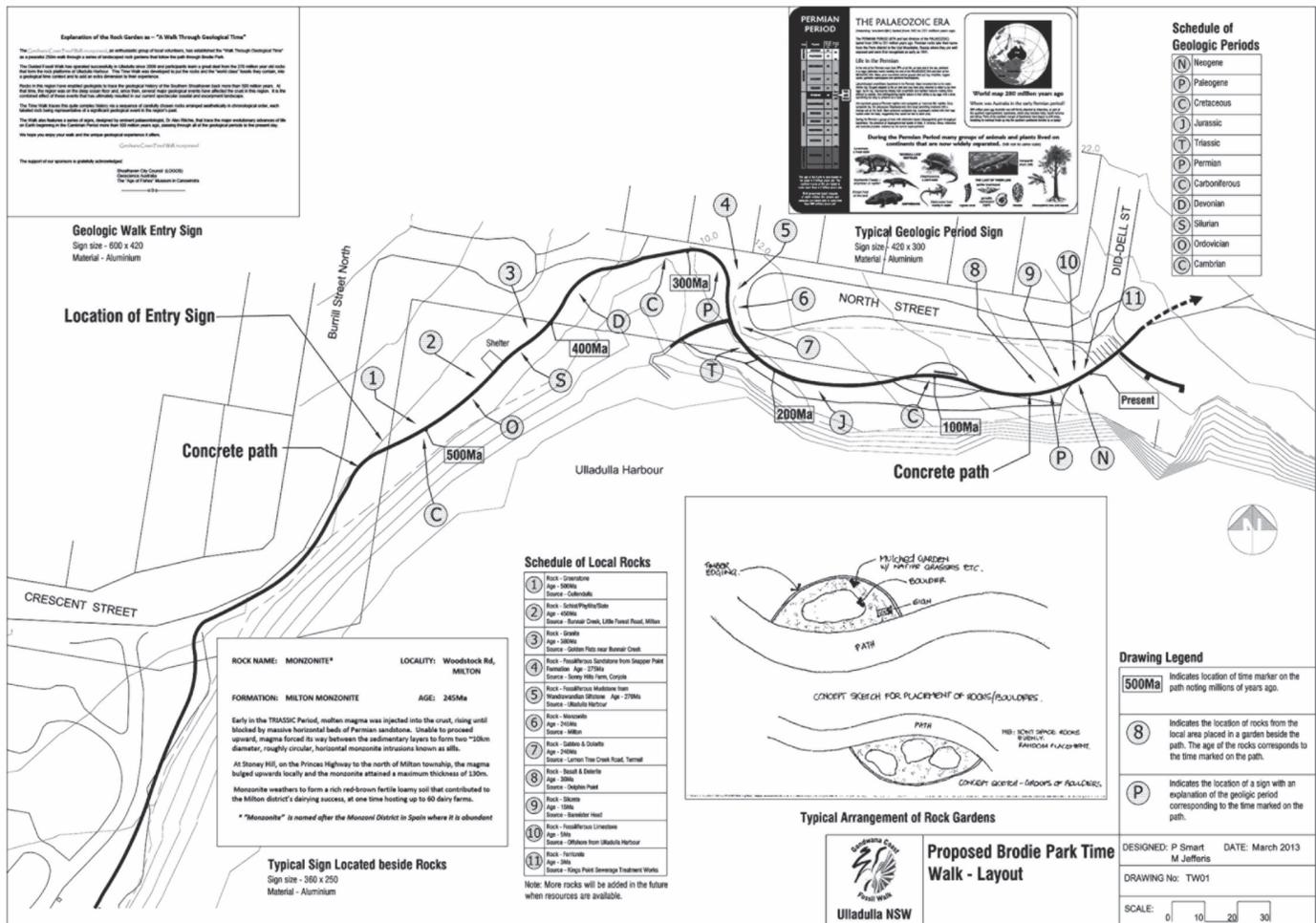
Geological time walks worldwide

In our geology student days, most of us would remember making a toilet-roll time line or condensing the 4 600 million years of Earth history into a calendar year or even into a 24-hour day as aids to understanding the immensity of geological time. Geological time walks, which add features to the time line concept, are a relatively recent development.

Unlike a geological walk or trail, of which there are many throughout the world, a geological time walk is constructed to illustrate the geological chronology of an area and, ideally, is made to scale.

The first walk through time was the brainchild of Alex Ritchie, former head paleontologist at the Australian Museum. In 2006 he produced a series of illustrated signs arranged sequentially in the grounds of the Age of Fishes Museum in Canowindra, NSW. This walk shows, through a series of animal and plant images, how life on Earth has evolved over the past 600 million years.

Since 2006, several once-a-year time walks, or trails, have been set up for special events such as science festivals, but only six permanent geological time walks have been established. The USA has three; Britain has one and two more have been developed in Australia in addition to the Age of Fishes time walk. Although all the world's seven time walks are laid out chronologically, only three are laid out to scale.



Approved plan of Brodie Park Time Walk. All images courtesy Phil Smart

The geologist designer of the Briscoe Geology Park Time Walk in the grounds of an elementary school in Ashland, Oregon, USA, was forced to introduce the complication of three vastly different scales. These were necessary to make it possible to fit 4 600 million years of Earth history into the limited available space.

Space considerations also made it impractical for the British Geological Survey to use a scale for the 3 300 million year geological history of Britain in a 130 m time walk. Use of a scale was also clearly not appropriate for a mountainous 10 km time trail set up at Mt Diablo in California, which uses 20 illustrated signs to record the region's 180 million year geological history.

The Grand Canyon geological time trail, set up to scale on the southern rim of the canyon by the US Geological Survey in 2012, is the most lavish time trail constructed to date. It covers the 4 600 million year history of Earth along a 4 600 m paved path and is supported by extensive signage, a visitor centre and geological displays in a museum.

In 2009, Geoscience Australia (GA) developed a geological time walk in its grounds in Canberra, covering 4 600 million years of Earth history in 1 150 m at a scale of 4 million years to 1 m. Geologically significant boulders were imported from all over Australia to illustrate major events in the nation's geological past. Signs describe the boulders and their significance, and illustrate the evolution of life through time.

Since 2009, Gondwana Coast Fossil Walk Inc. (GCFW), a group of about 20 enthusiastic local volunteers, has offered regular walks to growing numbers of local residents, visitors, primary and secondary school groups and numerous local and visiting special interest groups.

The first two-hour guided fossil walks took the form of a 500 m stroll on the rock platforms of Ulladulla Harbour, which enabled participants to learn what it was like for the marine creatures living there 270 million years ago. As a former Bureau of Mineral Resources (BMR, now GA) geologist, I developed the walk to make use of the region's wonderful natural heritage and increase year-round geotourism in the region.

This region was also considered ideal for a geological time walk, since it has a very interesting yet understandable geological history, stretching back more than 500 million years. Geological events can be traced from the Cambro-Ordovician and Devonian basement rocks to the richly fossiliferous flat-lying Permian strata of the southern Sydney Basin, to Mesozoic and Cainozoic intrusives, a Neogene shelly limestone and Neogene silcrete and ferricrete duricrusts.



Loading the Termeil Gabbro boulder for the time walk

A time walk could demonstrate how the combined effects of these events ultimately resulted in the region's current spectacular coastal and escarpment landscapes, and would put the Ulladulla rocks and the world-class fossils they contain into a geological time context.

Brodie Park project beginnings

On behalf of GCFW, I presented a proposal to develop a geological time walk in Ulladulla to the tourism board of Shoalhaven City Council in April 2010. The project received initial funding support from Council in May 2010 as an integral part of a \$40 000 geotourism package. The funds were allocated for the development of the guided fossil walk and a self-guided geological time walk in Brodie Park, Ulladulla.

Despite this funding, the early years for GCFW were not easy. Until November 2015 the group had been unable to find a suitable permanent home. It had already fitted-out two temporary homes in the Ulladulla Harbour precinct – the first, a shopfront in the Fisherman's Co-op building (where rent was unaffordable) and the second, the Abalone Co-op building, abandoned since 2006 (rent free but requiring a lot of work).

A plan of the time walk had been submitted to Council and was approved in March 2013. However, a start on the challenging project was deferred, as the relatively few volunteers had to focus on day-to-day matters of conducting guided walks and setting up and improving audiovisual facilities and displays in the Abalone Co-op building, even though it was only a temporary home.

An arson attack on the Abalone Co-op building in October 2013 totally destroyed the property and its contents, which were, unfortunately, uninsured. Tragically, 80% of the fossil display collection, all the glass display cases, computer and digital projection equipment were destroyed. Now homeless, the volunteers needed a distraction, so work started on the Brodie Park Geological Time Walk project, demonstrating to local residents and businesses that, far from giving up, GCFW was looking to expand its geotourism activities.

However, in another cruel blow and unbeknown to GCFW, the \$30 500 unspent from the original fossil walk grant had not been carried forward in the Shoalhaven City Council's budget and funds were no longer available for the project. This news came as an enormous shock and stopped further work until funding was available. Clearly, the support of a majority of the 17 councillors was necessary if Council funding for the project was to be restored.



Volunteers excavating a garden bed

Few councillors understood the time walk concept and most were unaware of the geotourism potential of the project. So the group invited the councillors to Brodie Park to hear of our vision and to inspect the progress the volunteers had made. The outcome was a unanimous vote by the councillors at their next meeting to allocate more than had been requested for the project, \$46 000, to allow for professional design of signage.

Brodie Park Geological Time Walk concept

Brodie Park was a little-used long narrow strip of grass (40–70 m wide) stretching from the houses on North Street to the cliff top on the north side of Ulladulla Harbour. A 300 m concrete path, which winds through the park over gentle undulations, proved to be ideal for establishing a time walk covering the 510 million year geological history of the South Coast. The walk uses 255 m of the 2 m-wide path, allowing for a 25 m buffer zone at each end, which was considered preferable to starting the walk at the curb where the path enters the park.

The overall length of the path made choice of a scale easy: 1 m = 2 million years or a primary school pupil's normal step = 1 million years.

A review of the geological history of the region led to a chronological list of at least 16 geologically significant events that should be included on the time walk. From the outset, it was recognised that the best way to present these events would be with sizeable boulders laid out chronologically to scale in garden beds along the path.

Turning concept into reality

The next step was to source suitable boulders that were accessible for removal. Several quarry-owners in the region donated boulders, which saved considerable effort. All other landholders had to be approached, mostly on-site, in order to gain the necessary approvals to uplift 34 boulders. Some of these were in challenging sites, so retrieval required all the bobcat contractor's skills. Precisely positioning each boulder in a garden bed in the park also required great skill.

The approved plan required semi-circular garden beds of modest size to be laid out along the path. Several working bees saw each bed marked out and flexible black plastic edging strip dug in to define each garden. Council supplied eucalypt chip mulch, which was spread in three garden beds after the volunteers had poisoned the grass. However, several problems became obvious: the garden beds were too small to accommodate signage and ensure that the native plantings wouldn't hide the boulders, flexible edge strips were not a satisfactory way to define garden beds in a park and the lightweight organic mulch was blown onto the concrete path and surrounding grass.

Significantly larger garden beds were marked out and a contractor was hired to lay concrete edging at an additional (and unforeseen) cost to the project of \$4 000. The high-quality result was, however, definitely worth the expense.

Instead of organic mulch, it was planned to make a feature of an attractive ferricrete nodule rock mulch in the ferricrete garden bed. The nodules were chosen because they could be gathered easily from an abandoned pit, had interesting shapes and would brighten up the garden with their strong red-brown colour.

Because of the unsuitability of organic mulch, matching rock mulches were used in the garden beds. Suitable sources for these materials had to be identified at more than a dozen sites and, once again, landholders had to be contacted for necessary approvals.



Paleogene basalt garden bed before excavation



Excavated granite garden beds before mulching



Palaeogene basalt garden bed

Two garden beds presented a real challenge. The Neogene Shelly limestone boulder on the time walk had been dredged up by local fishers. It had lain about 300 m under water, on the edge of the continental shelf 30 km east of Ulladulla, where it formed part of a horizontal limestone bed. When asked if they would bring up another boulder big enough to crush into a mulch, the fisherfolk advised the group to seek another solution. Lateral thinking led to a beach in Meroo National Park, south of Ulladulla, which had been mined for shell grit over many years. NSW Parks and Wildlife approved our request and sufficient shell grit was recovered from the beach.

252 MYA 'THE GREAT DYING' OCCURS. 96% OF MARINE SPECIES & 70% OF LAND SPECIES WIPED OUT. MASSIVE VOLCANIC ERUPTIONS IN SIBERIA, CLIMATE CHANGE AND SEA LEVEL RISES ARE BLAMED.

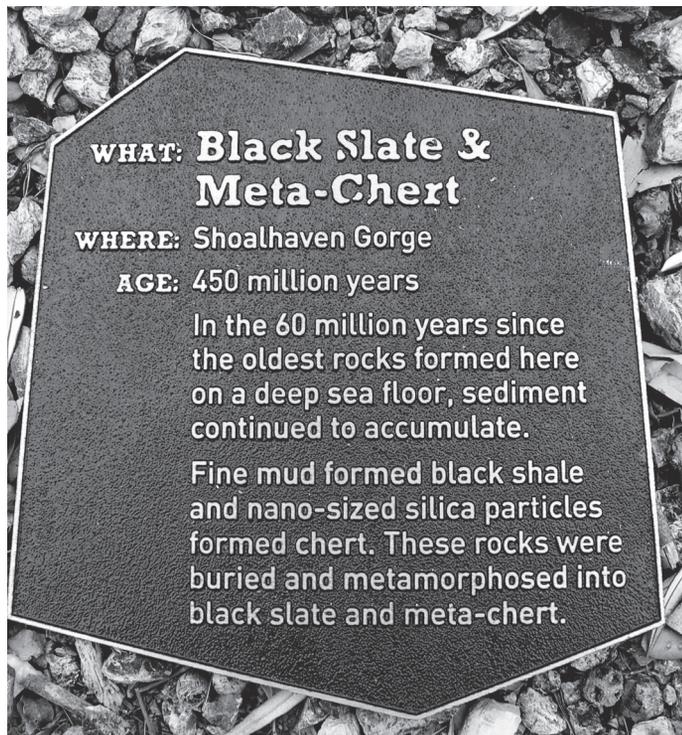
Bronze strip showing the end-of-Permian extinction. All five major mass extinctions and the arrival of hominins are marked with similar strips.

There were 64 silica mining leases in the district in the early years of the 20th century, and the Neogene silcrete was mined from several of them for more than 50 years. A source of large lumps of silcrete was located at one of the mines, but preparing a suitable mulch from this very hard, flinty material was a different matter. Breaking it up with a sledgehammer was very hard work. Lateral thinking was again required to find an easier solution.

For many years, silica from the Conjola Mine was carried by train to a wharf on the north side of Bannister Head, where it was crushed and loaded onto ships by a narrow conveyor belt. Historic photos suggested a great deal of spillage would have occurred, and on inspection, 90% of the cobbles and boulders on the shore were well-rounded silcrete washed up by waves. Permission to use these was obtained, and the easily gathered cobbles made very attractive rock mulch.

Time walk signage

The entrance sign is a slender column that defines the start of the walk. It briefly describes the scope of the time walk and outlines its two parallel themes – the geological history of the South Coast region and the evolution of life on Earth from the beginning of the



Rock description sign

Paleozoic era. The reverse side of the column is a colourful Phanerozoic time scale, outlining major evolutionary changes in each geological period.

Stainless steel markers are positioned along the edge of the path at 100 Ma intervals. When funds are available, we plan to place additional stainless steel markers at 10 Ma intervals to make it easier for walkers to keep track of geological time.

Each boulder or cluster of boulders is described on a bronze plaque in the garden bed. Each plaque gives only essential information: what the rock is, where it is from, its age and, briefly, how it formed – all in under 50 words.

Twelve geological period signs show the stages in the evolution of life from the Cambrian to the Quaternary. These are largely based on the excellent signs prepared by Alex Ritchie for the Age of Fishes Museum Time Walk at Canowindra.

Two-metre-long by 130 mm-wide bronze strips placed across the path announce each of Earth's five major mass extinction events, and another shows when hominins first appeared.

Supporting brochures

The time walk has been operating in a partly completed form for about two years, attracting schools from Canberra, Wollongong, Shellharbour, Bomaderry, Nowra and Batemans Bay. Years 11 and 12 environmental and earth science classes and a Year 11 geography class visiting Ulladulla for the guided fossil walk have all included a guided tour of the Brodie Park Geological Time Walk in their field days. In all cases feedback has been excellent.

Since signage (at this early stage) is minimal, a six-page leaflet has been produced in the interim to provide additional information about the boulders and the events they represent. This leaflet is still in use and is available for download at: <http://www.gondwanacoast-fossilwalk.com.au/fossil-walks/geological-time-walk/time-walk-brochure/> through the Ulladulla Visitor Centre or the recently acquired new home of the Gondwana Coast Fossil Walk, 'Fossil House', in Ulladulla.

Signage text for the walk has been deliberately kept brief. For those wishing to know more about the region's geological history, a 12-page illustrated glossy brochure is available from Fossil House in Ulladulla and will be available for download through the website. The brochure is more technical than the signage and, although it is intended mainly for secondary school and university student groups, many other visitors may find it useful.

Cambrian Period (541Ma to 485Ma)

“Cambria” is the old name for Wales.

Rocks found there contain abundant fossils of some of the oldest animals with hard parts.

LIFE IN THE CAMBRIAN

- Most major animal groups first appeared and diversified during this period. The “Cambrian Explosion” led to the evolution of many new species of marine organisms, including numerous trilobites and other arthropods as well as brachiopods, molluscs, echinoderms, sponges, worms and graptolites
- Some of the best known fossil sites are in the Canadian Rockies (Burgess Shale); Yunnan Province in China; and Kangaroo Island in South Australia (Emu Bay Shale)

THE CLIMATE

- Earth’s climate was on average 7°C warmer than today’s average during the Cambrian period.
- The level of atmospheric oxygen increased to about 12% (i.e. $< 2/3$ current level). The carbon dioxide level was ~0.45% (almost 12 times modern day levels).
- During this period, sea levels were high and the sea covered large parts of most continents, including Australia.

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The first animals to develop hard parts (skeletons and shells) also left lots of fossils!
(NB not to same scale)



Pikaia – early chordate,
possible relative of
vertebrates

“Terror of the Cambrian Seas”
Anomalocaris - (no living relative)



Paradoxides -
trilobite



Brachiopod



Polychaete worm



Sanctacaris – early
relative of scorpions
and spiders



Vauxia - sponge



Hallucigenia – a velvet worm



Priapulid - a burrowing worm

Sign describing features of the Cambrian

Operating the time walk

The Brodie Park Geological Time Walk is mainly intended to be self-guided, supported by the six-page leaflet or 12-page brochure. However, schools or other groups can book a guided walk through the GCFW website at Fossil House, the Ulladulla Visitor Centre or <http://www.gondwanacoastfossilwalk.com.au>.

The Brodie Park Geological Time Walk was officially opened by the Shoalhaven mayor in front of a crowd of 200 on 8 December 2015.

Guests at the launch were invited to try the walk and feedback was very positive.

Because of the unique features of this regional time walk, we hope it will attract many interstate and international geoscientists and geotourists.

PHIL SMART

President, Gondwana Coast Fossil Walk Inc.