South Australian
HERITAGE COUNCIL

BETTER HERITAGE INFORMATION
SUMMARY OF STATE HERITAGE PLACE

COMMENTARY ON THE LISTING

Description and notes with respect to a place entered in the South Australian Heritage Register in accordance with either the *South Australian Heritage Act 1978* or the *Heritage Places Act 1993*.

The information contained in this document is provided in accordance with s14(6) and s21 of the *Heritage Places Act 1993*.

NAME: Parachilna Gorge Geological Monument **PLACE NO.:** 14814

KNOWN AS: Parachilna Gorge Geological Monument [Designated place of geological significance]

ADDRESS: Adnyamathanha Country
Mount Falkland Pastoral Station
Lot 15, Parachilna Gorge Road
Mount Falkland 5730
CL 6179/596 H390400 S42, S43, including Government Road
Hundred of Nilpena

CONFIRMED IN THE SOUTH AUSTRALIAN HERITAGE REGISTER:

9 October 1997

DESIGNATED AS A PLACE OF GEOLOGICAL SIGNIFICANCE:

10 April 1997

STATEMENT OF HERITAGE SIGNIFICANCE

The Parachilna Gorge Geological Monument demonstrates an excellent exposure of a contact typical of the geologically and palaeontologically significant Ediacaran-Cambrian boundary in the western Flinders Ranges. The contact marks the transition between two highly significant geological periods and the turnover and evolution of some of the earliest examples of complex life that occurred at that time. The Parachilna Gorge Geological Monument is also the type section for the Parachilna Formation, containing well-preserved trace fossils of burrowing Cambrian organisms.

STATEMENT OF DESIGNATION

Designated Place of Geological Significance

The geological formations at the Parachilna Gorge Geological Monument are highly significant to ongoing research into the Ediacaran and Cambrian time periods. The site contains a locality where rocks of the older Ediacaran (635-538 million years ago) meet with rocks of the younger Cambrian (538-485.4 million years ago). Here, the Cambrian Parachilna Formation overlies the Ediacaran Rawnsley Quartzite, marking a substantial extinction event, the Ediacaran Extinction, and a subsequent evolution event, known as the Cambrian Explosion, both of which remain the subject of ongoing research. The site contains distinctive trace fossils depicting the evolution of life at that time and is also the location of the type section of the Parachilna Formation. The well-exposed geological formations are highly likely to contribute to our understanding of the geological and evolutionary history of South Australia into the future.

Elements of Significance:

Elements of heritage significance include (but are not necessarily limited to):

- Exposure of contact between the Upper Rawnsley Quartzite and Parachilna Formation,
- Parachilna Formation type section,
- Surrounding cliff face.

Elements not considered to contribute to significance of place include (but are not necessarily limited to):

- Creek bed, road, signage and trails.

INDICATIVE CRITERIA (under section 16 of the *Heritage Places Act 1993*)

(b) it has rare, uncommon or endangered qualities that are of cultural significance

The Parachilna Gorge Geological Monument is a readily accessible, high-quality example of the geological contact between the Ediacaran and Cambrian periods. The geological contact marking the transition between the Ediacaran (635-538 Ma (Million years ago)) and Cambrian (538-485.4 Ma) can be traced through the Flinders Ranges, though clear and easily accessible exposures are rare. There are only two other, well-known examples found in the State, at Brachina Gorge and nearby to the Mern Merna railway siding.

The Ediacaran-Cambrian boundary is geologically and palaeontologically significant for its associations with the disappearance of the Ediacaran biota in a sudden extinction event, and the subsequent emergence of predation and rapid diversification of life in the Cambrian period, an event known as the Cambrian explosion and is highly culturally significant. The Parachilna Gorge Geological Monument is considered rare as a readily accessible, high-quality example of the Ediacaran-Cambrian contact. Pebbles marking the base of the Cambrian are well-presented here but are fragile.

The type section of the Cambrian Parachilna Formation, associated with the contact, contributes to its prominence, being used as a reference point for the Parachilna Formation throughout the state, containing some of the earliest examples of Cambrian Period fossils and sediment.

(c) it may yield information that will contribute to an understanding of the State's history, including its natural history

The Parachilna Gorge Geological Monument contains a readily accessible and high-quality exposure of the geological contact between the Ediacaran period (635-538 Ma) and Cambrian (538-485.4 Ma) periods in South Australia. This exposure has been presented as a South Australian example of the Ediacaran-Cambrian contact since 1922, defining its characteristics in a South Australian context. A section of the overlying Cambrian-aged rock has also been recognised as the type section for the Parachilna Formation since 1964.

The Ediacaran-Cambrian boundary is geologically and palaeontologically significant for its associations with the disappearance of the Ediacaran biota in a sudden extinction event, and the subsequent emergence of predation and rapid diversification of life in the Cambrian, an event known as the Cambrian explosion. Examples of the presence of Cambrian life shortly after the Ediacaran contact is

present in the form of Cambrian trace fossils of *Treptichnus pedum* (formerly *Phycodes pedum*) and well-preserved *Diplocraterion* traces including some of the earliest-known evidence of vertical burrowing into soil, an evolutionary behaviour not demonstrated by organisms prior to the Ediacaran-Cambrian contact. Recent research has developed a better understanding of the 'Ediacaran extinction' and the 'Cambrian explosion', though there are still many questions about the development of organisms and the forces for evolution that were occurring at the time. This location is likely to provide further insight into this developing research.

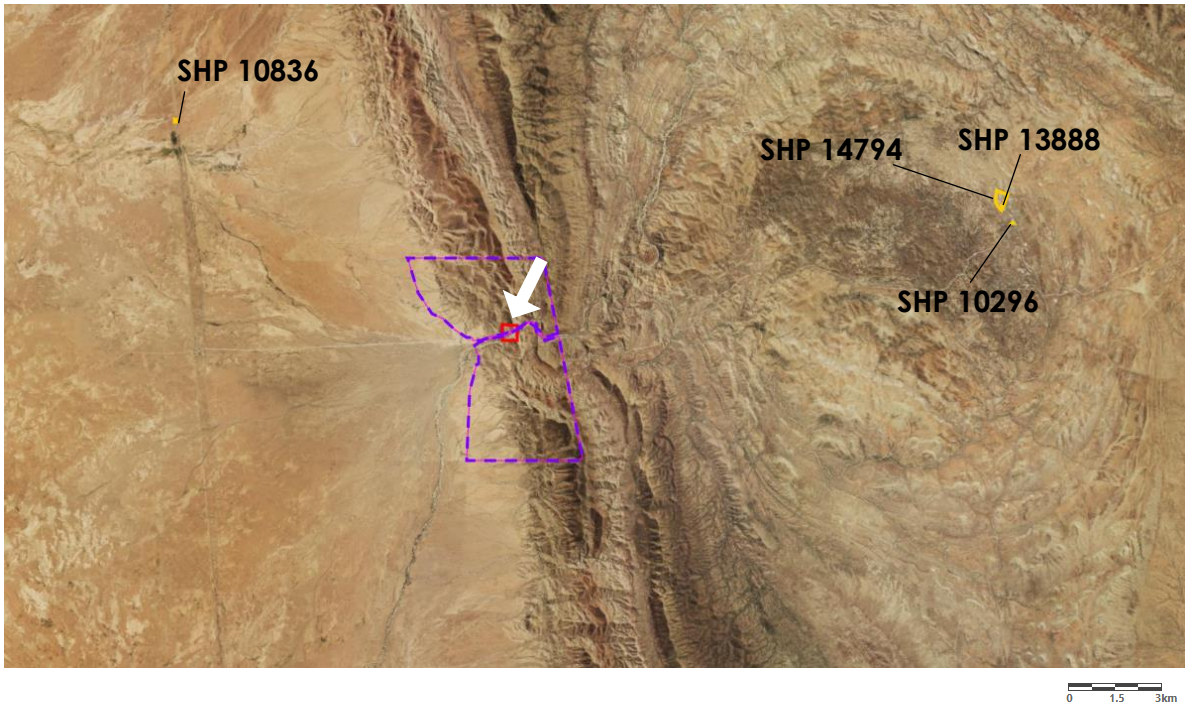
The Parachilna Gorge Geological Monument has, and continues to be, a reference location for the Cambrian Parachilna Formation in a South Australian context along with the highly significant Ediacaran-Cambrian contact providing geological research opportunity to better understand the stratigraphic development and evolution of complex life in South Australia during the late Ediacaran and Early Cambrian.

Parachilna Gorge Geological Monument provides excellent opportunity for research and education and is highly likely to yield information about South Australia's geological and palaeontological history.

SITE PLAN

Parachilna Gorge Geological Monument **PLACE NO.: 14814**

Lot 15, Parachilna Gorge Road, Mount Falkland 5730



Aerial view of the Parachilna Gorge Geological Monument and surrounding State Heritage Places (SHP).

N ↑

LEGEND

- Elements of Significance
- Parcel boundaries (Indicates extent of Listing)
- Existing State Heritage Place(s)

SITE PLAN - DETAIL

Parachilna Gorge Geological Monument **PLACE NO.: 14814**

Lot 15, Parachilna Gorge Road, Mount Falkland 5730

Aerial view of Parachilna Gorge Geological Monument. Homestead can be seen to the west.

N ↑

LEGEND

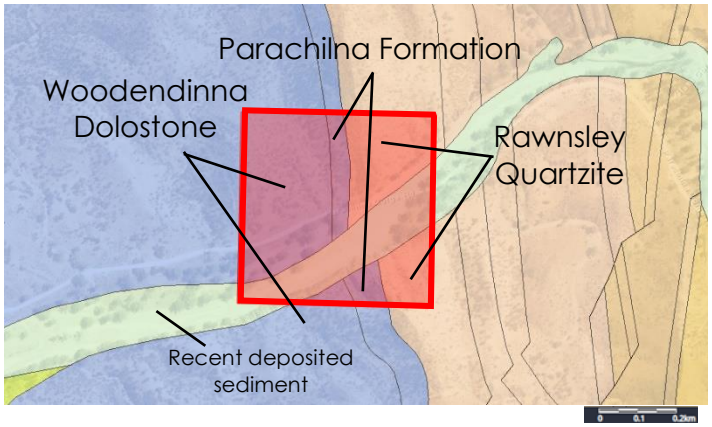
- Elements of Significance
- Parcel boundaries (Indicates extent of Listing)
- Existing State Heritage Place(s)

PHYSICAL DESCRIPTION

Parachilna Gorge Geological Monument is located approximately 1.5km to the east of Mount Falkland Station Homestead on Parachilna Gorge Road. The State Heritage Place is located close to the western end of the Parachilna Gorge. The boundaries of the State Heritage Place measure approximately 500m x 500m, encompassing part of Parachilna Gorge, Parachilna Gorge Road and the Parachilna Creek.

The creek bed is approximately 50m wide and predominantly dry with small, transient pools of water that appear after rain. The banks are shaded by endemic river red gums (*Eucalyptus camaldulensis*).

On the southern bank of Parachilna creek is a 60m high cliff where beds of the Cambrian Parachilna Formation are exposed. Further east, where the cliff rises to approximately 100m high,[1] the Ediacaran-period Upper Rawnsley Quartzite, part of the Pound Subgroup, is exposed underlying the Parachilna Formation, with the contact between them clearly visible for a distance of ~120m along the cliffside.[2] The contact is marked by the presence of fragile pebbles in the cliff face and is typical of other exposures of the Ediacaran-Cambrian contact within the Flinders Ranges.[3] While the exposure contact is good, the pebbles, marking the contact are up to 20cm in diameter,[4] are noted as being fragile.



Geology of the Parachilna Gorge Geological Monument

Source: adapted from Department for Energy and Mining, South Australian Resources Information Gateway (SARIG) Map (N.D.)

Elements of Significance:

Elements of heritage significance include (but are not necessarily limited to):

- Exposure of contact between the Upper Rawnsley Quartzite and Parachilna Formation,
- Parachilna Formation type section,

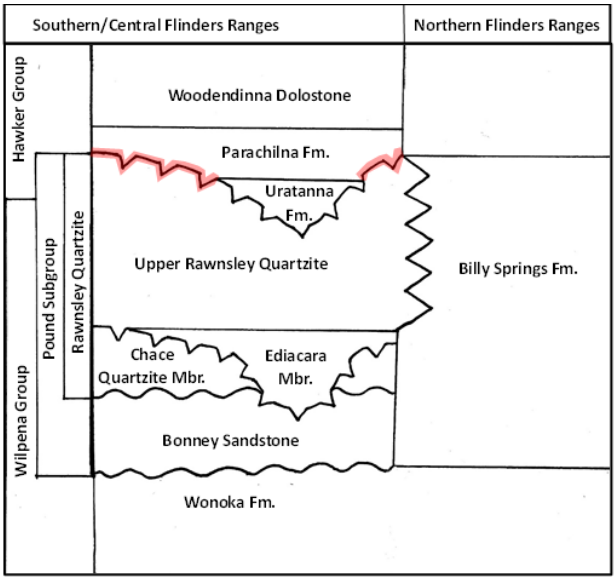
- Surrounding cliff face.

Elements not considered to contribute to significance of place include (but are not necessarily limited to):

- Creek bed, road, signage and trails.

HISTORY OF THE PLACE

During the Ediacaran Period 635-538 Ma (million years ago) the area that now comprises the Flinders Ranges was covered by a warm, shallow sea, home to many sessile (immobile) organisms that required few defences as predation did not yet exist. Sediment deposited over tens of millions of years during the Ediacaran Period formed as sedimentary packages and due to heat and pressure during compaction are today metamorphosed rocks of their original precursor. In the central Flinders Ranges, the Ediacaran Pound Subgroup comprises the Bonney Sandstone and the Rawnsley Quartzite.



Simplified interpretation of the relevant geology of the Flinders Ranges. The red denotes the contact between the Ediacaran and Cambrian preserved in the SHP.

Source: Interpreted from Abbott, S (N.D.), Retallack et al. (2014), Sappenfield, A, Droser, ML and Gehling, JG (2011), Coutts, FJ (2019).

Of the Pound Subgroup, only the Upper Rawnsley Quartzite is exposed within the boundaries of the Parachilna Gorge Geological Monument. Elsewhere in the Flinders Ranges, the Rawnsley Quartzite in turn contains the highly fossiliferous Ediacara Member, which preserves evidence of Ediacaran biota,[5] the first complex multicellular life on earth. The Rawnsley Quartzite is predominantly composed of sandstone plus some of which contains feldspar.

The environment for Ediacaran organisms was broadly warm shallow sea environments. The Ediacaran biota disappeared in an extinction event ~538 Ma, bringing the Ediacaran Period to a close.[6] Predation developed during the following Cambrian period 538-485.4 Ma, leading to the evolution of defences such as hard shells (trilobites) and burrowing abilities (worms). The sudden diversification of life which occurred at this time is known as the Cambrian Explosion.

The geological contact between the Ediacaran Period Upper Rawnsley Quartzite and the Cambrian Parachilna Formation is an excellent example of the Ediacaran-Cambrian boundary in South Australia and is highly significant. The contact provides a rare insight into the transition between the Ediacaran Period and Cambrian and the massive and still poorly understood transition, evolution, and proliferation of life.

A sea level rise around ~533 Ma lead to the deposition of sediments that formed the Parachilna Formation, a transgressive sequence (formed during the migration of a shoreline onto land) comprising sandstone formed in shallow water with fine-grained siltstone forming muds deposited in a deeper marine shelf environment.[7] The Parachilna Formation overlies the Upper Rawnsley Quartzite disconformably,[8] (a break in recorded geological time between parallel formations due to erosion or non-deposition between deposition of the sedimentary layers), and contains Cambrian trace fossils, most notably *Diplocraterion,* known only by evidence left behind by its burrowing, and *Bemella*, a kind of mollusc.[9] The *Diplocraterion* fossils demonstrate some of the earliest instances of vertical burrowing into soil demonstrating a clear evolutionary difference between Ediacaran (sessile, non-vertical burrowing organisms) and Cambrian organisms (some capable of vertical burrowing, and with emerging prey-predator dynamics). This location was also chosen for the type section for the Parachilna Formation as the gorge provides excellent exposures of the geological formation.

Subsequently, the Woodendinna Dolostone was deposited approximately 538-521 Ma in a shallow-water shelf environment,[10] allowing shales and stromatolites (stony structures built by cyanobacteria) to form.[11] Woodendinna Dolostone lies conformably (deposited in succession without interruption) above the Parachilna Formation. Both the Parachilna Formation and the Woodendinna Dolostone are exposed within the boundaries of the Parachilna Gorge Geological Monument.

Exposures of the Parachilna Formation and its contact with the then-unnamed Rawnsley Quartzite was noted in 1922 by Prof Walter Howchin, retired lecturer in geology and palaeontology, University of Adelaide.[12] Howchin's research placed the fossiliferous Cambrian sediments of the Parachilna Formation into a stratigraphic context.[13] The Pound Subgroup was described in 1938 by geologist Douglas Mawson and was initially named the Pound Quartzite.[14]

In 1939, geologist R. W. Segnit noted the disconformity between what is now known as the Rawnsley Quartzite and the Parachilna Formation.[15] In 1946, Reginald Sprigg recognised Ediacaran fossils in the nearby Ediacara Hills,[16] leading to the recognition and formalisation of the Ediacaran Period.

In 1964, part of the exposure of the Parachilna Formation within the boundaries of the State Heritage Place was identified as the type section by geologist Charles Robert Dalgarno, due to the excellent exposures provided by the Parachilna Gorge.[17] A type section is the part of a geological formation that is used to define the characteristics for its identification elsewhere. Later, in 1972, the underlying Rawnsley Quartzite was described and in c.1980, the Pound Quartzite was renamed the Pound Subgroup.[18]

Parachilna Gorge Geological Monument was named a Geological Monument by the South Australian division of the Geological Society of Australia in 1981, due to the presence of the type section for the Parachilna Formation and for the contact between the Ediacaran Period and Cambrian presented there. Subsequently, the Parachilna Gorge Geological Monument was provisionally entered in the South Australian Heritage Register and designated a place of geological significance on 10 April 1997, adopting the boundaries of the Geological Monument delineated by the South Australian division of the Geological Society of Australia. The Parachilna Gorge Geological Monument was confirmed in the Register on 9 October 1997.

CHRONOLOGY

Year	Event
635-538 Ma	Ediacaran Period.
579 ± 32 Ma	Bonney Sandstone deposition.
556 ± 24 Ma	**Rawnsley Quartzite deposition.**
~538 Ma	Ediacaran extinction.
538-485.4 Ma	Cambrian period.
~538-521 Ma	Woodendinna Dolostone formation.
~533 Ma	**Parachilna Formation deposition.**
1922	Exposures of Parachilna Formation and the contact between the Formation and the then-unnamed Rawnsley Quartzite noted by Prof Walter Howchin.

1938 Pound Quartzite, now known as the Pound Subgroup, is described by geologist Douglas Mawson.

1939 Disconformity between what is now known as the Rawnsley Quartzite and the Parachilna Formation is noted by geologist R. W. Segnit.

1946 Reginald Sprigg noted Ediacaran fossils in the nearby Ediacaran Hills, leading to the recognition and formalisation of the Ediacaran period.

1964 Exposure of the Parachilna Formation within the Parachilna Gorge Geological Monument is identified as the type section by geologist Charles Robert Dalgarno.[19]

1972 Rawnsley Quartzite is described and named.

c.1980 The Pound Quartzite is renamed the Pound Subgroup.

1981 Parachilna Gorge Geological Monument is named a Geological Monument by the South Australian division of the Geological Society of Australia.

1995 31 August, Identified to the State Heritage Authority

1997 10 April, the Parachilna Gorge Geological Monument is provisionally entered in the South Australian Heritage Register and designated a place of geological significance.*

9 October – the Parachilna Gorge Geological Monument is confirmed on the State Heritage Register as Parachilna Gorge, Mount Franklin Station (original registered name).

2004 Ediacaran Period recognised officially.

*Parachilna Gorge was provisionally listed under the *Heritage Act 1993* that came into effect on 15 January 1994.

Under Section 17(3)(a) of the *Heritage Act 1993*:

17—Proposal to make entry in Register

(3) The Authority may designate a place provisionally entered in the Register as—

(a) a place of geological or palaeontological significance;

Hence, the State Heritage Place was designated in April 1997, prior to its confirmation as a State Heritage Place in October 1997.

REFERENCES

Scientific papers

Cooper, BJ and Jago JB (2007), 'History of Cambrian investigations in South Australia with particular reference to the biostratigraphy', *Memoirs of the Association of the Australasian Palaeontologists*, Vol. 33, pp.1-27.

Darroch, SAF. Smith, EF, Laflamme, M and Erwin, DH (2018), 'Ediacaran Extinction and Cambrian Explosion', *Trends in Ecology and Evolution*, Vol. 33, pp.653-663.

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Howchin, W (1922), 'A Geological Traverse of the Flinders Range from the Parachilna Gorge to the Lake Frome Plains', *Transactions and proceedings of the Royal Society of South Australia*, Vol. 46, pp.46-82.

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Kenefick, CM (2013), 'A sequence stratigraphic approach to interpreting the $\delta^{13}C$ record using an Early Cambrian carbonate platform', *Honours thesis*, The University of Adelaide, Adelaide, South Australia.

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Websites

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Images

Abbott, S (N.D.), 'Figure 4. Simplified Wilpena Group Stratigraphy. Members have been omitted for clarity but are included in the legend of Figure 3.', In: 'The Wilpena Group (Flinders Ranges, South Australia); Stratigraphy, Correlation, and Geological History', *Teacher Earth Science Education Programme*, Case Study 1.001.

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Other

DEW Files, 14376 Wilpena Pound Geological Landform

SITE DETAILS

Parachilna Gorge Geological Monument **PLACE NO.: 14814**

Lot 15 Parachilna Gorge Road, Mount Falkland

DESCRIPTION OF PLACE:	Ediacaran – Cambrian Contact, Geological type section	
DATE OF CREATION:	Between 635-485.4Ma	
REGISTER STATUS:	Identified to the State Heritage Authority 31 Aug 1995 Provisionally entered 10 April 1997 Designated 10 April 1997 Confirmed 9 October 1997	
CURRENT USE:	Pastoral Land	
LOCAL GOVERNMENT AREA:	Pastoral Unincorporated Area	
LOCATION:	**Street No.:**	Lot 15
	Street Name:	Parachilna Gorge Road
	Town/Suburb:	Mount Falkland
	Post Code:	5730
LAND DESCRIPTION:	**Title Reference:**	CL 6179/596 H390400 S42, S43, including Government Road
	Hundred:	Hundred of Nilpena

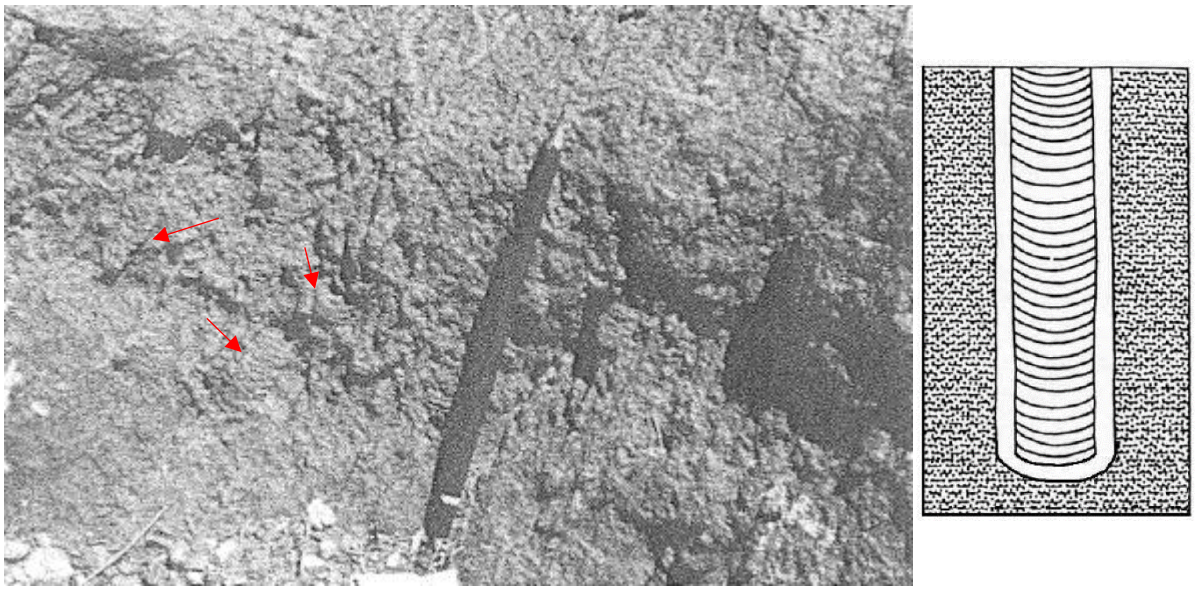
PHOTOS

Parachilna Gorge Geological Monument **PLACE NO.: 14814**

Lot 15 Parachilna Gorge Road, Mount Falkland

Southern face of Parachilna Gorge, location of the Parachilna Formation type section

Source: DEW Files



Trace fossil burrows of *Diplocraterion*, some examples denoted in red, found within the Parachilna Formation (left) with a comparative drawing from Richter (1926) (right)

Source: DEW Files, Richter (1926)

[1] McBriar EM, Giles, CW and Mooney, MD (1981), 'Geological Monuments in South Australia Part 4', On behalf of the *Geological Monuments Subcommittee of the SA Division of the Geological Society of Australia Incorporated*, pp. 133--136.
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[3] McBriar EM, Giles, CW and Mooney, MD (1981), 'Geological Monuments in South Australia Part 4'.
[4] McBriar EM, Giles, CW and Mooney, MD (1981), 'Geological Monuments in South Australia Part 4'.
[5] DEW Files, 14376 Wilpena Pound Geological Landform
[6] Recent research questions whether this extinction was a catastrophic extinction event or a transition of biological life; see Gehling, JG *et al.* (2019), 'Ediacaran-Cambrian transition: sedimentary facies versus extinction', *Estudios Geológicos*, International Meeting on the Ediacaran-Cambrian Transition – 2019, Guadalupe, Spain, Vol. 75, 10.3989/egeol.43601.554; and Darroch, SAF. Smith, EF, Laflamme, M and Erwin, DH (2018), 'Ediacaran Extinction and Cambrian Explosion', *Trends in Ecology and Evolution*, Vol. 33, pp.653-663.
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[12] Howchin, W (1922), 'A Geological Traverse of the Flinders Range from the Parachilna Gorge to the Lake Frome Plains', *Transactions and proceedings of the Royal Society of South Australia*, Vol. 46, pp.46-82.
[13] Cooper, BJ and Jago JB (2007), 'History of Cambrian investigations in South Australia with particular reference to the biostratigraphy', *Memoirs of the Association of the Australasian Palaeontologists*, Vol. 33, pp.1-27.
[14] Australian Government (N.D.), 'Stratigraphic Unit Details – Pound Quartzite', *Australian Stratigraphic Units Database*. From: < https://asud.ga.gov.au/search-stratigraphic-units/results/15520>.
[15] Cooper, BJ and Jago JB (2007), 'History of Cambrian investigations in South Australia with particular reference to the biostratigraphy'.
[16] Australian Government, (N.D.), 'National Heritage Places – Ediacara Fossil Site - Nilpena, *Department of Climate Change, Energy, the Environment and Water*. From: < https://www.dcceew.gov.au/parks-heritage/heritage/places/national/ediacara>.
[17] McBriar EM, Giles, CW and Mooney, MD (1981), 'Geological Monuments in South Australia Part 4'.

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[19] Dalgarno CR and Johnson, JE (1964), 'Wilpena Group', *Quarterly Geological Notes*, Vol. 9, pp.12-15. The Geological Survey of South Australia.