Puzzling rock in a sea wall at Penguin, north-west Tasmania.

Most probably a tillite but what's the deal with the parallel Fe-rich layers (presumably originally horizontal) being truncated by the larger clasts?

Here's a tillite from somewhere else…

Comments offered so far:

This 1952 paper by Beryl Nashar (neé Scott) (see attached, the source is https://core.ac.uk/download/pdf/33323693.pdf) refers to tillite at Penguin and has a location map – would this be the same tillite as the rock used in the sea wall? And is the Dundas Group still the correct name for these rocks?

ABSTRACT

Spilitic pillow lavas associated with laminated shales and tillite occur near Penguin, North-West Coast, Tasmania. These are correlated with similar rocks at Smithton and on King Island, which are considered to belong to the Dundas Group and thus to be Cambrian in age.

Ms Scott is a bit obsessed with the lavas, and gives two images of basalt, but she doesn't give a photo of her tillite. My friend looked at this paper and replied "Scott's paper raises some interesting points, namely that volcanism began before, and continued during, deposition of the tillites and other sediments. There is mention of hematite and one can imagine Fe-bearing solutions or fine Fe-rich sediment occurring as pulses forming the layers we see with glacial drop-stones disrupting the Fe layers". Is there a local geologist who might have studied and reported on these rocks?

(The rock is a candidate for the National Rock Garden in Canberra. Several Tasmanian geologists have studied/mapped in the Penguin region and their comments, along with those from other geologists, are set out below. Their identities are, in fashionable parlance, 'redacted' **: -)**

I think the rock pictured looks like part of the Owen Group conglomerates which we had on our list of icons. It's typified by large siliceous clasts in a sandy matrix, with hematite. There are a few outcrops around Penguin, though it may have been quarried elsewhere for use as breakwaters or armouring. I think we could get some large samples without too much trouble, except for transport.

I don't know of any tillites in this area, or any of Cambrian age, despite Beryl's paper. She described the Motton spilite, an Early Cambrian rock, and there are similar rocks on King Island and elsewhere in W Tas. But the rock sequence between Penguin and Ulverstone is notoriously complex with severe deformation, extensive mega-breccias and "Chaos" zones, in late Precambrian to early Cambrian rocks. It's quite possible that some of these breccia zones could be mistaken for tillites.

Ferruginous banding and clast orientations at right angles to it. Clearly a trick of nature as Werner once described fossils 😜 Perhaps the iron banding is a water table feature? Up and down with the seasons etc?? The bottom right hand corner of the picture troubles me. The clear orientation of platy clasts is across the iron banding.

This looks to me like the Late Cambrian-Early Ordovician Owen Conglomerate. It crops out on the shoreline at Penguin. Not sure where the photo is from. There are intra-formational slump-debris flows along with chert "blocks" within basalt (Beryl Nashar's spillite) between Penguin and Ulverstone. But they do not look like this. The basalt is part of ocean floor.

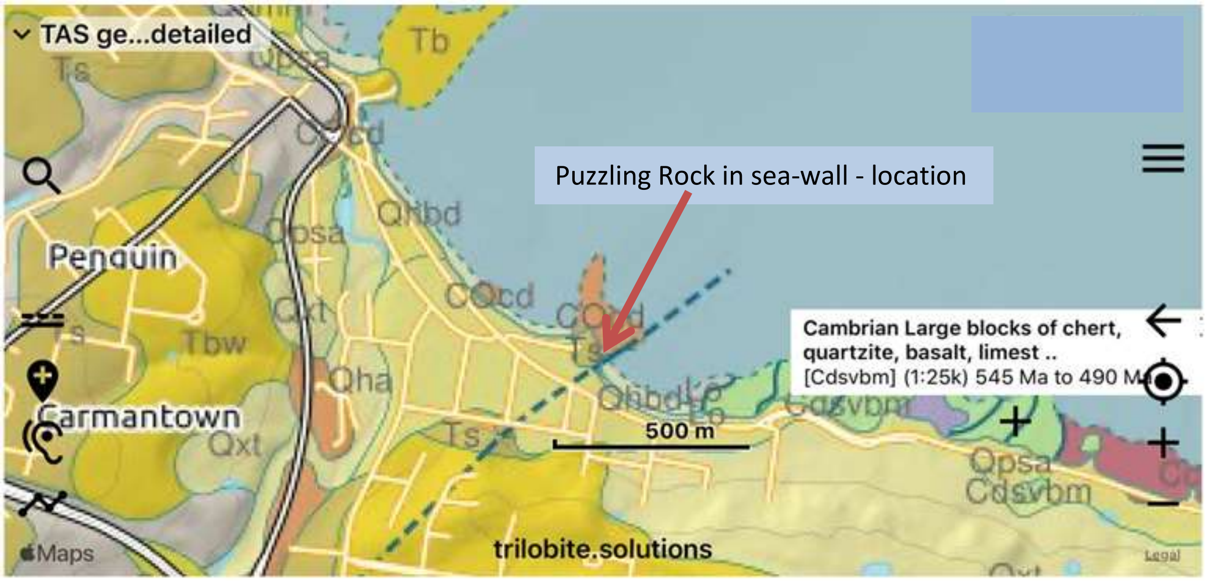
We agree that the rock is likely an angular conglomerate. There is clear stratification in the elongate clasts. The iron banding crosses the apparent bedding and is likely a post-lithification and a post deformation weathering affect related to variable water table heights and oxide deposition. Subsequently also deformed.

Wonder if there are any good anomalies under water in that Cambrian greenstone? I would call an "angular conglomerate" a "sedimentary breccia"

How about an agglomerate?

That's usually reserved for volcanic origins.....there's a name for a non-bomb volcanic breccia... but it escapes me right now.

Here is a Geology map showing Penguin. The COcd is the conglomerate at the eastern end of the beach. The pale green is the Cambrian basalt etc further along the coast



I have no problem with the rock being a tillite. Angular conglomerate would be a similar description. And the clasts haven't travelled far under fluvial influence. The clasts are angular and it's clearly sedimentary. My problem lies with the iron bands.

Curious rock. I agree with whoever it was that talked about long axes of the fragments are mostly aligned and perpendicular to the FeOx bands. Very odd and difficult to explain.

One view: The Fe banding is bedding and disrupted by glacial dropstones which clearly inject themselves into the Fe layers. The boulder has been brought in so the original attitude of the layering is not clear but to my mind Fe represents horizontal and original layers.

Looking forward to receiving detailed alternatives.

The Penguin photos I guess are the Marinoan Glaciation (cf Braemar Iron Formation). During glaciation which was at sea level and at the equator in the Marinoan (~650 Ma), sea ice completely covered the oceans. There was no circulation or oxidation, ferrous iron in sea floor sediments dissolved in ocean water and when the sea ice broke and oxygenated circulation started, the ferrous iron oxidised and precipitated. Because SL waxes and wanes, a rising sea level and open waters would have resulted in hematite precipitation on and in the tillites. There is some interest in South Australia in exploiting these iron ore deposits (which are now magnetite). I have seen from boulder beds in a magnetite rock at one end of the spectrum and tillites like the Penguin ones.

I guess my only question is that some of the other commentators seemed to think they were part of Owen Conglomerate, which would put them into Cambrian/Ordovician rather than late Proterozoic, which then throws the link to global glaciation into question.
That said, in my west coast Tas wanderings I've seen my fair share of Owen C'gte and don't recall any of looking anything like the Penguin rocks, which certainly look like tillites.

Your rock looks like a poorly stratified red bed river gravel. Plenty of hematite layers and shaley fragments. It may be a facies of the fluvial Ordovician Owen Conglomerate. But the pebbles are commonly quartzite in the Owen. The Owen is full of matrix hematite like your example. Whatever the case, there was plenty of oxygen in the atmosphere, not much CO2 and a relatively cold climate at the time. (all research nowadays must be on climate change to get any government funding, so I am practicing)

My feeling is maybe the Fe bands aren't horizontal. There is an alignment of flat clasts from SW to NE across the bottom image. If you look at the left hand top corner the clasts are tabular and right angles to the bands , so maybe the bands involve Fe movement down sub-vertical fractures and when they hit an impermeable large clast they go around it. This could be happening with large clast in bottom left. It looks like some sort of liesegang banding which cuts across fairly chaotic bedding. The rusted clasts may be ironstone source of Fe, or now completely replaced Fe rich clasts.

The Yanks would call them Liesegang rings (bands) but if the FeO is in the permeable till matrix, you'd expect them to not continue through the impermeable clasts. The banded aspect might just be the way they develop, as per the very old attached photo below. Agree on the till.

Yes, it looks like a tillite but could it be from an area of outwash (bit like a delta) with larger pieces tumbling in from the front of the glacier? The larger clasts appear to have an orientation oblique to the “bedding” which is certainly weird. If we knew the age of the rock, we might be able to tie the iron rich layers - I’m taking your word that that’s what they are – to volcanic activity but the clasts don't appear to be bombs. That’s my six penny worth.

My initial observations are that at first glance this looks like a genuine tillite (ie. poorly-sorted angular fragments in a rock flour matrix) – but then why are the angular fragments all aligned with their long axes roughly parallel to each other ? So I immediately thought that they must all be “drop stones” from the melting of debris-carrying sea ice, but then what is their timing and relationship to the Fe-banding in the matrix ?

So to cut to the chase, I see two possible explanations……….

1. The rock is a tillite, and the brown Fe banding is either due to sedimentary deposition synchronous with the glaciation event that formed the in-situ tillite (a little hard to believe), or more likely the brown Fe banding is secondary and may be some form of liesegang banding during a later weathering event. This explanation does not explain why the fragments are aligned with each other, unless that alignment of the fragments represents the orientation of the original horizontal “bedding” of the tillite?

2. The rock is not a tillite, and while sedimentation was depositing the brown Fe-rich layers on the sea floor, the melting of sea ice resulted in the dropping of angular glacial debris to mix with the sea floor Fe-rich depositional event. Some of the fragments appear to distort the Fe-rich banding which supports their interpretation as drop stones. Alternatively, the Fe-rich layers may indeed be liesegang banding which fortuitously has replaced the original sedimentary “bedding” in the matrix – an equally valid possible origin for the banding.

My gut feeling is that my second (drop stone) interpretation is more likely.

Maybe when The Rock is on display in the NRG we can all meet there to debate our views?

To me, the rock looks like a sediment. The drop stones are angular so relatively local provenance and little washing. But dripstones don’t appear to perforate the iron rich layers but in places the bigger ones almost so the iron rich layers were softish. I can’t see a drop stone interrupting more than one iron rich layer. The iron rich layers appear to be fairly regularly spaced but affected by strain like an axial plane “cleavage”. In summary, the sediment is possibly due to seasonal outwash from glacier and the iron rich layers are the last episode of the outwash event. Some soft sediment deformation and post burial structural “cleavage”.

Location

Given that we don't know the original attitude of the rock, what is revealed if we look at it rotated? Drop stones penetrating ferruginous layers or fragments being draped by ferruginous pulses?

Owen Conglomerate Reminders


and at Mount Murchison…

The Last Word, from Keith Corbett

This damn rock really bugs me! I'm almost certain it has to be derived from the Owen Conglomerate, which the map shows outcropping at Beecraft Point, along the nearby beach to the east, and as a narrow belt inland to the Dial Range.

The clasts look to be predominantly chert, rather than quartzite, but the Owen on the Dial Range is also predominantly chert-derived. The chert is part of the underlying Cambrian sequence.

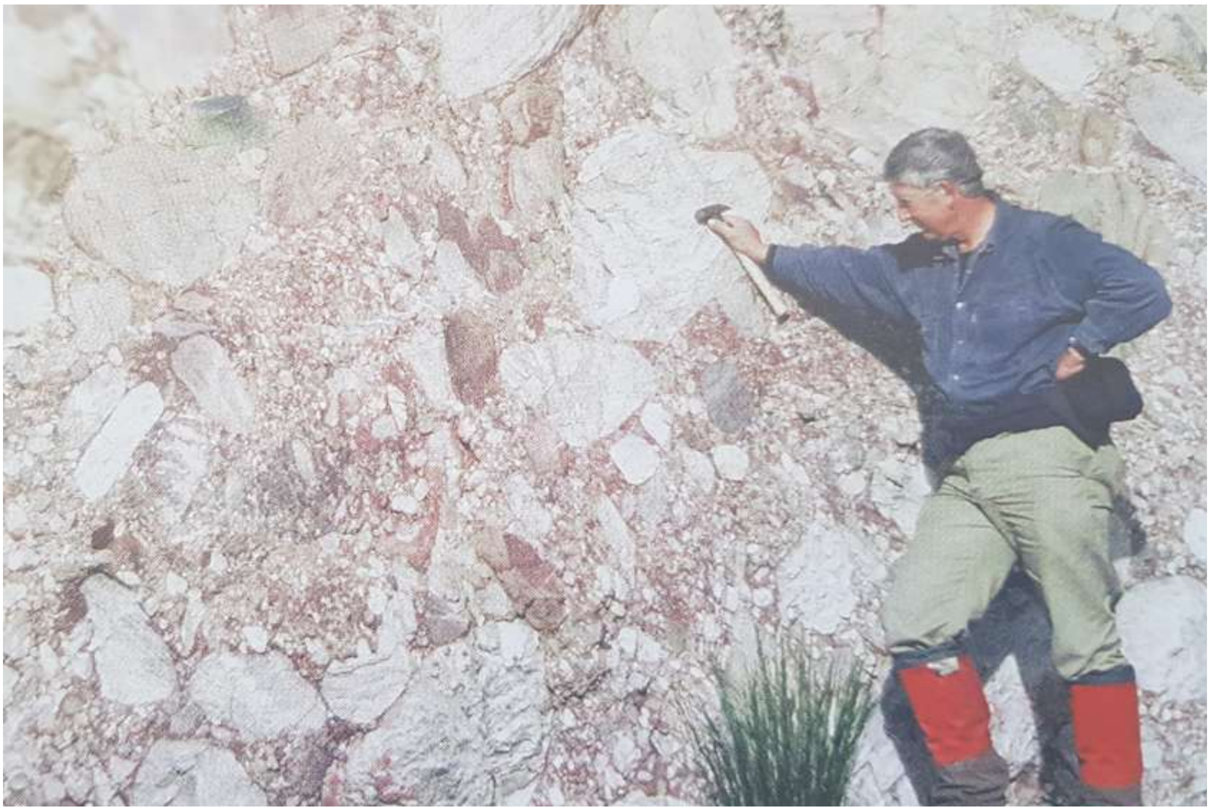
There are also hematite clasts, which is typical of the Owen in many places.

I don't think it's a tillite. The Permian Wynyard Tillite doesn't outcrop at Penguin, and has quite a different texture. There are no known Proterozoic tillites in the area either.

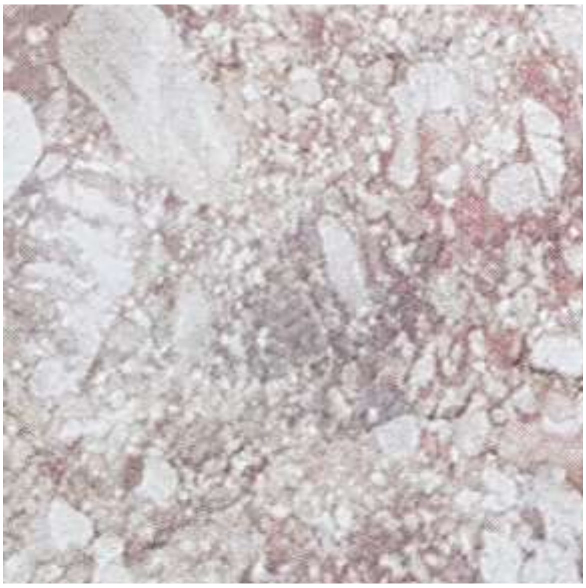
The big issue is to explain the right angle discrepancy between the 'internal' bedding shown by the many elongate clasts - bottom left to top right - and the apparent bedding shown by the iron oxide bands top left to bottom right. I think the latter must be some form of later leisegang banding, but they are not typical. The zones between the ironstone bands seem almost leached and white, whereas in most leisegang situations there is a gradation between the bands, out to the furthermost band, after which the rock has its normal colour. Some very strange chemistry happening?

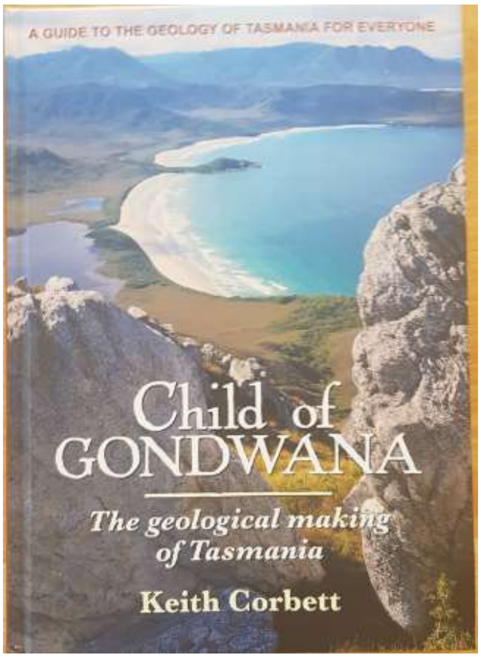
It would be good sometime to have a look at the outcrops of Owen along the beach etc, and see if they give any further clues.

But isn't it good that there are still some mysteries in the world?



Keith Corbett geologising at a large boulder of coarse Lower Owen Conglomerate on the slopes of Mount Owen ~ 1987





[Child of Gondwana The geological making of Tasmania Keith Corbett]

Other contributors: Mike Smith, David Edgecombe, David Evans, Ian Plimer, Ross Large, Ian Morrison, Glenn Coianiz, Bret Ferris, Russell Meares, Greg Corbett, David Gray, Ted Ambler, Jock Gilfillan, Kim Stanton-Cook, Tim McConachy.