U3A Port Fairy

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Reading the Fitzroy River Landscape

John and I recently revisited the Fitzroy River Estuary. We did this to better understand the strange and beautiful network of fossil tubes described in John's *"Fitzroy Fossil"* note of 25 September. First we had to get a handle on the landscape.

In this discussion we will refer to some events in geological time. At present we are in an interglacial stage, *inter* meaning *between* glacial periods. There is a glacial period in front of us and one behind us. The last glacial peak was 20,000 years ago and the *Last Interglacial* period was about 120,000 years ago. This is commonly abbreviated as the *LIG*. Interglacial periods have high seas levels similar to now and glacial periods have sea levels about 100m lower.

The two epochs in geological time we are interested in here are the *Recent* or *Holocene* meaning the last 10,000 years and the preceding few hundred thousand years of the *Upper Pleistocene* which includes our old friend the LIG. It's a friend because we bump into it often in the local landscape. I will explain more of that later.

There are a few things notable about the Fitzroy River. Around 30,000 years ago the river was displaced to the west side of the *Budj Bim Lava Flow* (host to the World Heritage Budj Bim landscape). Darlot Creek marks the east side of the lava valley which is also known as the *Tyrendarra Lava Flow*. This lava flow and the Fitzroy river continued south onto the continental shelf some 20 km beyond the present shore line; because it could - sea levels were around 50 metres lower and the earth was heading into an ice age.

The Fitzroy River had cut a channel through older stranded shore line sand dunes. We will come back to these stranded dunes later as they form the floor of the modern Fitzroy Estuary.

So how did the Fitzroy get from the west side of the Tyrendarra lava flow to the east side and to the estuary we are looking at? This is 7 km east from where it was. The answer lies in the geomorphology of our Southern Ocean coast – *"Barrier Dunes"*. Such dunes are evident from Nelson, all along Discovery Bay and from Warrnambool to Port Fairy. This explains wetlands like Swan Lake, Bridgewater Lakes, Yambuk Lake and Port Fairy's Belfast Lough.

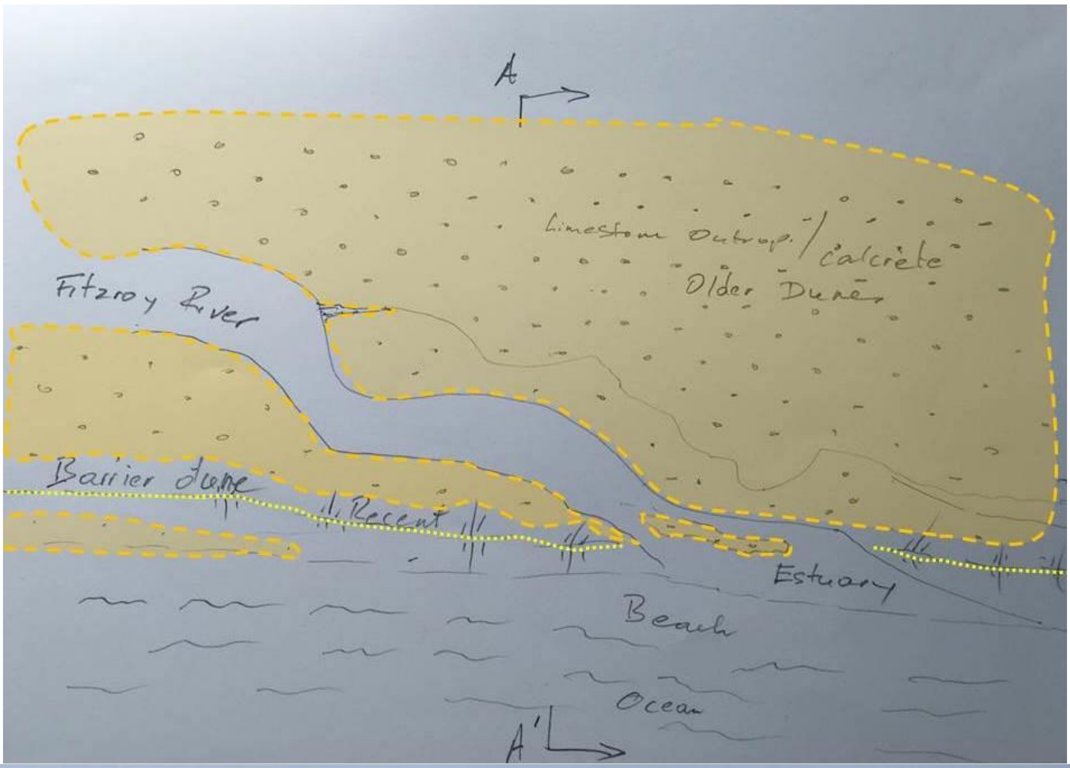
Strong southwest winds build these dunes. Where the coast faces the wind a sand dune forms just where the land meets the sea. These dunes become a barrier to rivers trying to reach the ocean. Such "*Barrier Dunes*" have formed here many times throughout the Pleistocene to the present during interglacial stages. It's roughly akin to a 100m high tide every 100,000 years.

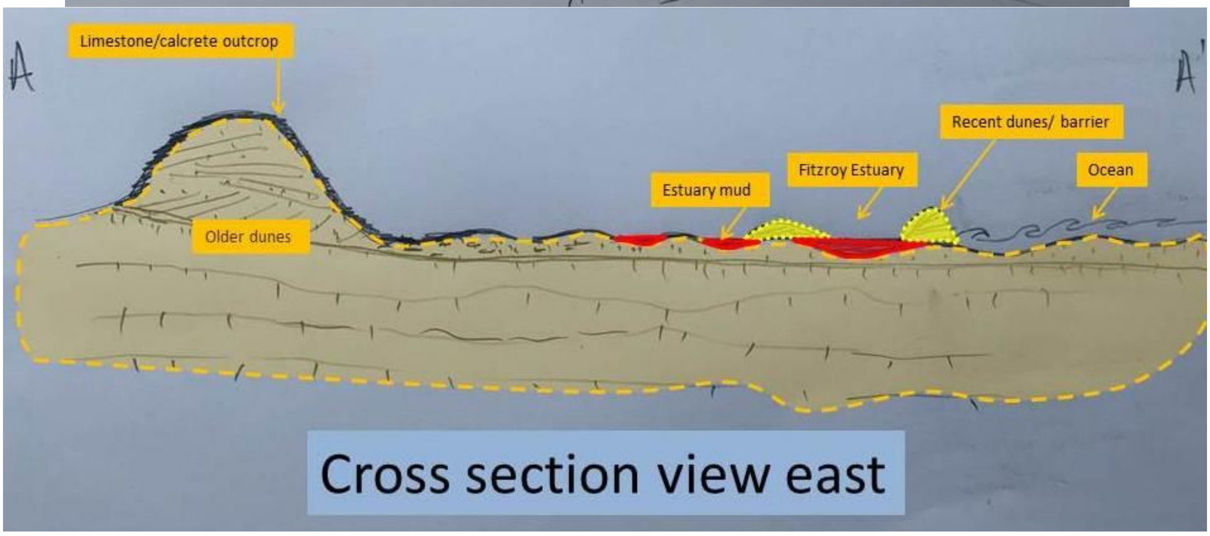
And that is exactly what happened at the Fitzroy River some 9,000 years ago. By then sea levels had risen again after the last ice age. The shoreline formed where it is now. A sand barrier covered the Tyrendarra lava flow forcing the river to turn at right angles east and ultimately find a way out to the sea at our estuary 7 km from where it used to be.

But there is a bit more to this story. The Fitzroy River and the loughs that define it are now trapped between two barriers as it heads east. The sand dunes on the north side (now hardened limestone hills and low ridges) were stranded inland during the previous interglacial periods including the Last Interglacial (the *LIG* – peaked 7m higher than present seas so these dunes are a bit further inland). The sand dunes on the south side block the rivers way to the sea. These are recent, of *Holocene* age, no more than 10,000 years old, and they also overlie the older dunes.

The older sand dunes have hardened over time. Remember, these older barrier dunes were left behind over 120,000 years ago by receding ocean cycles. The sand grains making up these dunes are composed of calcium carbonate (mostly derived from ground up molluscs) and when stranded in a desert landscape the loose grains will self-cement if given enough time in the weather. It takes about 20,000 years to turn loose sand into hard rock. Calcrete is the name for this type of limestone which forms just below the soil surface and covers all the older dunes in a thin hard mantle.

The diagrams below illustrate the landscape bounding the estuary.



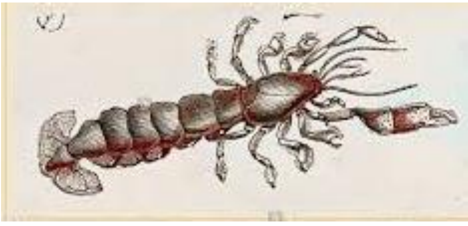


The estuary fill is shown in the cross section above in red. It is made up of clays and mud which have been washed down the Fitzroy River and then settled in estuarine lakes that were open to the sea at some times and closed and stagnant at other times. So, the estuarine lakes may be very saline at some stages and almost fresh at others. These lakes overlie the older dunes and formed behind the coastal barrier of the recent dunes. On approach to the mouth, older cemented dunes can be seen as islands in the mud. Some of the recent dunes can now be seen to have blown also over the dark clays in the estuary.

Some of the black muds we see in the lagoon are not only anoxic (lacking in oxygen) but also euxinic or sulfidic (hydrogen sulphide).

The age of these sediments could be anywhere from recent to 10,000 years old, when the barrier dunes first formed. Something in the range of 2,000 to 5,000 is very likely. This is also the age of well-established aboriginal occupation of these shores from dating of middens in the region.

So that makes me wonder if John's little creatures were also food for the locals?



An ancient ghost shrimp *Callianassa* was his best guess as the occupant of the strange holes he found in the mud. They could have made a meal because the holes in the mud that started all this speculation are quite large.

Here are the holes in the grey muds. The sequence of strata contains variously coloured muds from pale grey to black, generally in distinct layers indicating periods of changing oxidation in the estuarine lakes. The casts left by the shrimp are tubes about 20cm long and 3 cm in diameter.

It is believed that the tubes, which are hard and brittle, are formed from faecal matter which the ghost shrimps plastered to the walls of the tubes. The result was a very smooth inner surface and a rough-cast exterior.

Many of the tubes were formed in a "Y" indicating that there would have been a network of interconnected tubes and tunnels throughout the estuarine mud.

The plastering of the tube walls also embedded and preserved fragments of the surrounding estuarine environment which gives us further clues as to the environmental conditions at the time of construction.

It is assumed that the molluscs embedded in the tube walls were present at the time that the tubes were constructed by the ghost shrimp.

Five mollusc species were extracted from the tube walls.

Family	**Species**	**Common name**	**Characteristic**
Sphaeriidae	*Pisidium (Euglesia) tasmanicum* (syn: *Pisidium caesertanum* in Smith and Kershaw 1979)	Pea-shell	Minute bivalve to 2mm
Planorbiidae	*Glyptophysa sp,* (syn: *Physastra gibbosa)*	Pond snail	Sinistral gastropod to 15mm
Hydrobiidae	*Ascorhis tasmanica* (syn: *Hydrobia buccinoides)*		Small dextral gastropod ca 3mm – opaque porcelaneous shell – pointy spire
Hydrobiidae	*Potomopyrgus antipodarum (syn: niger)*		Small dextral gastropod to 3mm – semi-transparent shell, pointy spire
Hydrobiidae	*Coxiella sp. (probably striata)*		Small dextral gastropod, tightly coiled, flat-top spire

Pea Shell *Pisidium caesertanum* (scale 1mm sections)

Pond Snail *Glyptophysa sp*

All of the extracted mollusc species exist today, and all are associated with estuarine conditions. Unsurprisingly the same assemblage of species, plus a few others which are larger but also very fragile, also occurs in the Belfast Lough.

So, based on the shells embedded in the ghost shrimp tunnels, it would appear that they were constructed in an estuarine environment.

Conclusion

The Fitzroy River provides us with a fascinating story of the evolution of the river estuaries of Victoria's south-west coast. A quick glance at air photos along our coast shows that the rivers on the flat plains west of Warrnambool have a characteristic right-angle bend just before they enter the ocean. The bend results from barrier dunes which developed over the last 10,000 years or so forcing the rivers to flow parallel to the coastline before they find a weakness and finally make it to the sea.

The bend and slowing of the rivers have resulted in the development of estuaries which we can see in all stages of development from the broad open water of Belfast Lough on the Moyne River to the narrow and mostly buried old estuary of the Fitzroy. The estuaries are teeming with life and the fossil remnants of species from earlier times.

The geomorphology and species assemblages are just like a book – they tell a story of what has gone before……..you just need to know how to read it.