



U3A Geology

Central Goldfields Excursion

2024

Chewton town map



Chewton



Introduction

- The Central Victorian goldfields lie roughly between, Wedderburn, Bendigo, Castlemaine and Ballarat
- the area is strongly associated with 1850s Victorian gold rush
- impact of the gold rush is evident in many localities within the goldfields with mine shafts, mullock heaps and water races extremely common throughout the bushland of the goldfields.

Brief history of Central Victorian Goldfields

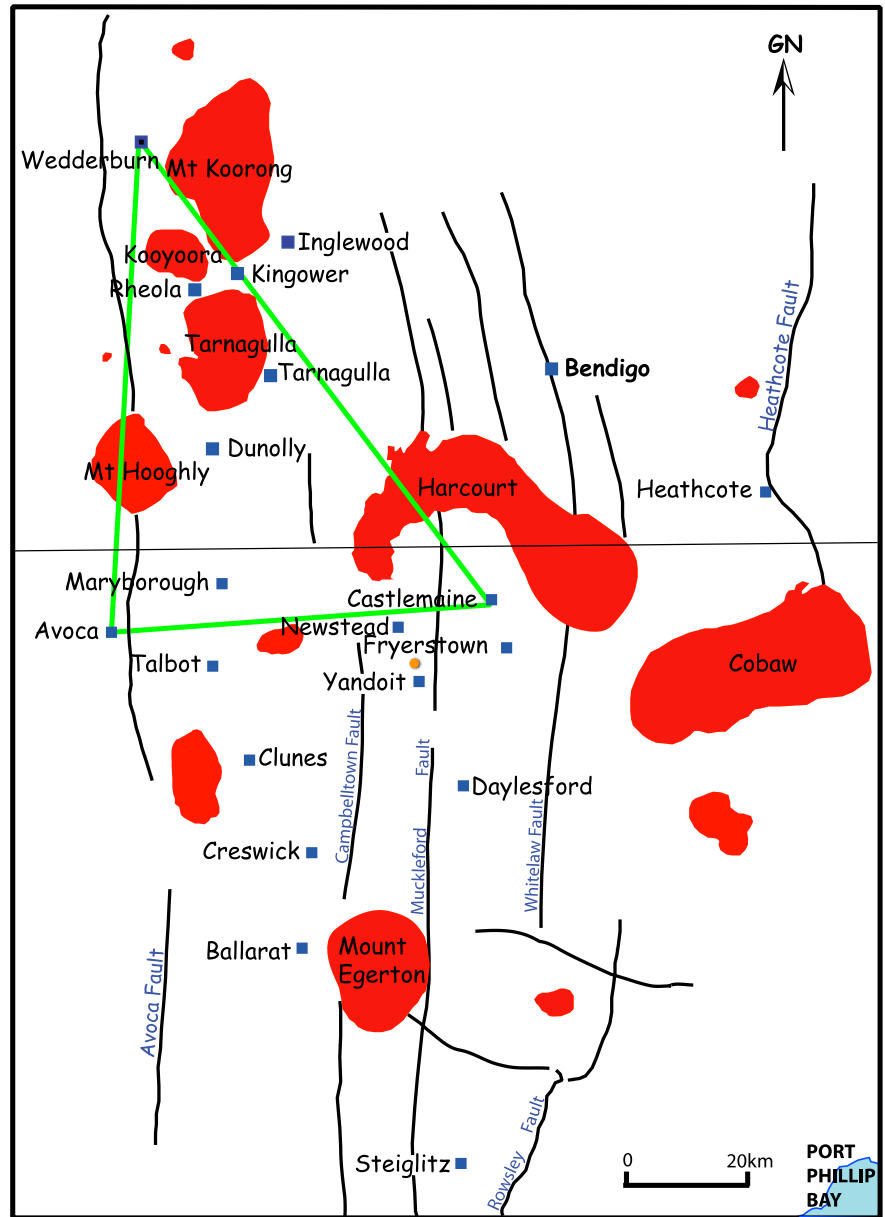
- In 1851, alluvial gold was discovered at Mt Alexander station near Castlemaine → led to Forest Creek diggings
- it was reported that when the first miners arrived at the Mt Alexander goldfield, nuggets could be picked up at the surface without any digging required
- then followed exploitation of alluvial gold in creeks, rivers, river banks and shallow leads
- gold seekers used pans, sluice boxes, puddlers and cradles to separate the gold from dirt
- as shallow gold was depleted, gold seekers were forced to look further underground, → deep leads, quartz reefs (original source)

Geology of the Central Goldfields

- Bulk of Central Victorian Goldfields is located within Bendigo-Ballarat zone of the Lachlan Fold Belt
- Bendigo-Ballarat zone lies between west dipping Avoca and Heathcote thrust faults
- zone composed of thick pile of Cambrian to Ordovician quartz-mica turbidite rocks estimated to be more than 5km thick
- rocks were deposited in deep marine environment along eastern edge of the Australian craton
- during the Late Ordovician to Late Devonian, the zone underwent crustal shortening resulting in extensive folding, reverse faulting

Geology of the Central Goldfields

- Ordovician metasediments have been intruded by a number of Devonian granitoids
- mineralised vein systems of the Bendigo-Ballarat regions formed ~445Ma followed by widespread events at 410Ma and 370Ma
- within the goldfield, mineralisation occurs across at least 3.2km of stratigraphic succession
- the Bendigo-Ballarat zone has yielded >60% of Victorian gold production from both alluvium and quartz reefs
- although the zone is famous for its large nuggets, they only represent a small proportion of gold recovered



Bendigo-Ballarat Zone

Gold panning

- Gold was recovered from alluvium using several simple implements
- Gold panning → traditional form of extracting placer gold using pans
- alluvium scooped into pan → soaked, fingered, aggressively agitated whilst being washed
- heavy minerals sink to bottom of pan, light material washed over the side



Gold panning

Sluice boxes

- Sluice box → rectangular wooden box with open top and riffled bottom
- auriferous dirt is shoveled into downward sloping box
- a constant stream of water flows through the box carrying away sediments leaving gold to be caught by gravity in riffles
- sluice boxes can be wooden troughs several hundred metres long and ~30cm wide
- the longer the sluice box → higher the gold recovery

Sluice boxes

Modern sluice box



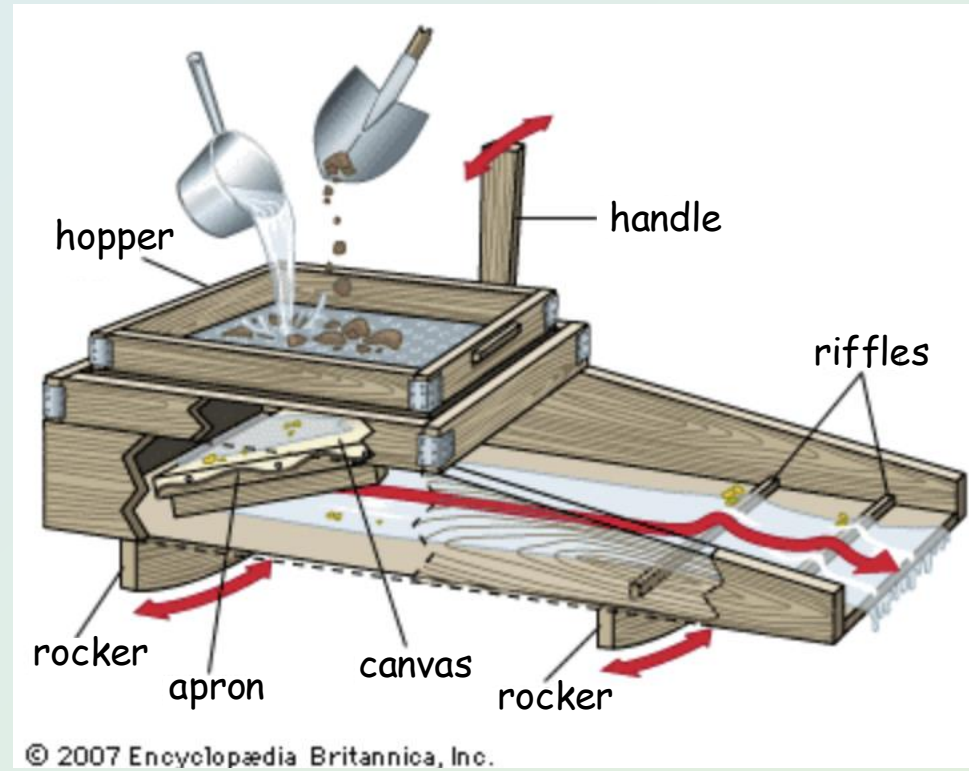
Long sluice trough



Gold cradle (rocker box)

- Gold cradle → mining implement for separating alluvial placer gold from sand and gravel
- consists of high-sided box with riffles and usually carpet
- sieve on top screens out larger rocks
- between sieve and lower sluice section → baffle that ensures aggregate material is evenly distributed before entering sluice section
- entire device sits on rocker → allows rocking from side to side

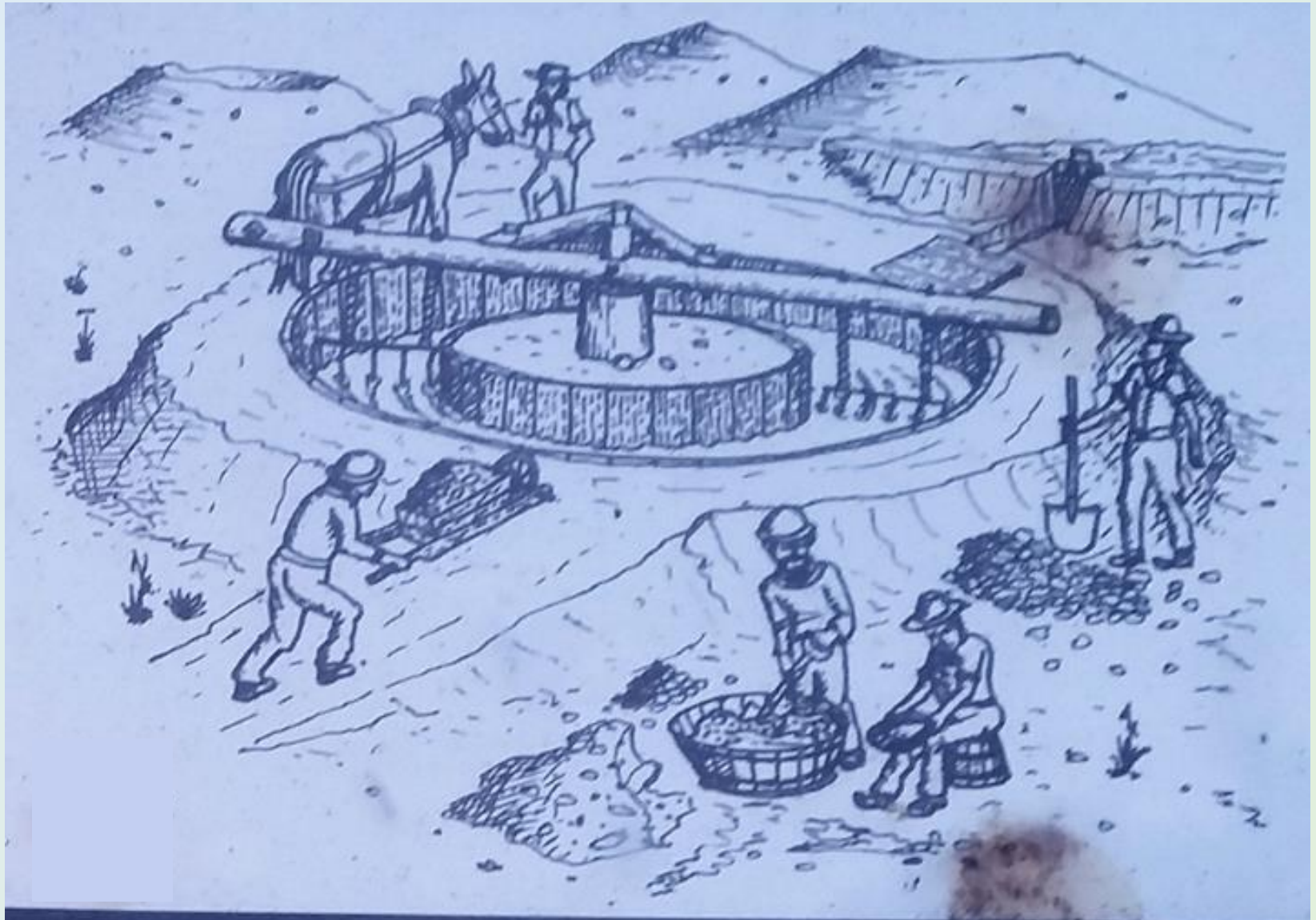
Alluvial gold - cradle



Puddling machine

- Clay earth in the goldfields proved a problem for 19th century miners
- gold trapped in hard lumps of clay needed to be broken up to recover gold → gold puddler commonly used
- puddler → circular trough in ground lined with bark or wood and filled with clay and water
- in centre of puddler was a pole with rotatable harrow attached
- gold released from clay → sinks to base of trough and clay suspension drained from the top
- residue at base of trough → cradled for gold

Illustration of puddler



Puddling machine in operation, drawn by Robert Kaufman.

Puddler

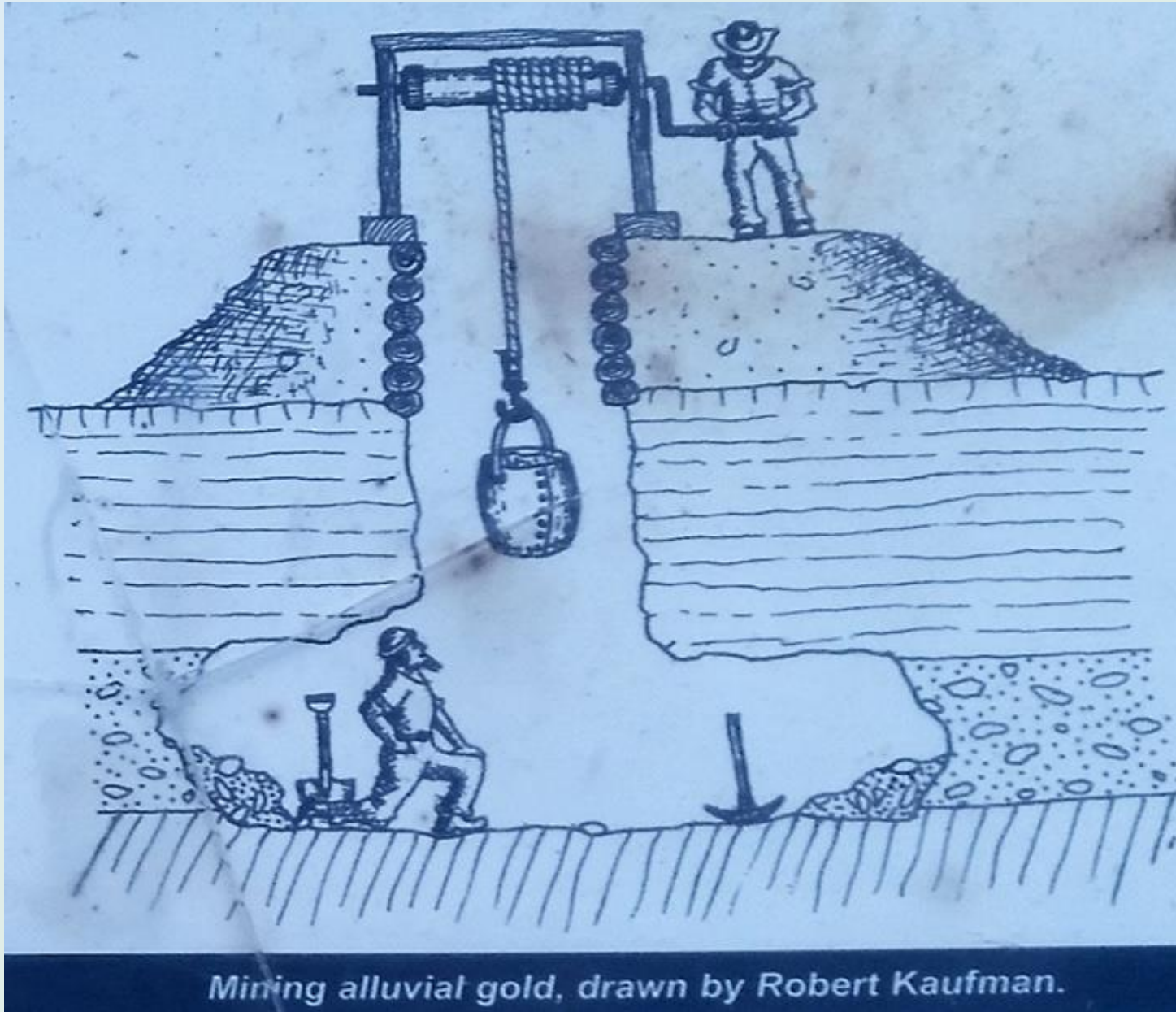


Puddler remains, Maryborough, Vic.

Alluvial gold shaft

- In 1852 miners on the gold diggings had to pay the government 30 shillings per month
- for that sum they were entitled to work a section of ground 2.5m square
- this was just enough to dig a shaft 1.5m wide and pile up earth removed from the shaft
- mined gravel was brought to the surface in a bucket attached to a winder
- some shafts produced 1,000oz or more Au, others → barren

Alluvial gold shaft



Hydraulic sluicing

- Hydraulic sluicing → directing high-pressure jets of water onto a gravel slope to dislodge sediments
- water washes down fine auriferous sediment that is directed into sluice boxes
- Romans used low-pressure sluicing called hushing to erode away overburden and gain access to ore
- water pressurised jets were first used in 1850s in California gold rush
- hydraulic sluicing was first used during Australian gold rushes in the 1850s and early 1900s

Hydraulic sluicing



Garfield waterwheel

- Remains of large water wheel erected by the Madame Garfield mining company to power stamp batteries at their Chewton mine
- wheel operated between 1887 and 1903 it was 22m in diameter, 64cm wide and carried 22 buckets
- one of 7 water wheels that operated in Castlemaine-Chewton district and largest water wheel ever constructed in Victoria
- prior to construction, stamp batteries at the mine were operated by steam engine
- establishment of Coliban System of Waterworks diverted water from Coliban River → hundreds of km of water races were constructed in Castlemaine - Chewton district

Garfield water wheel



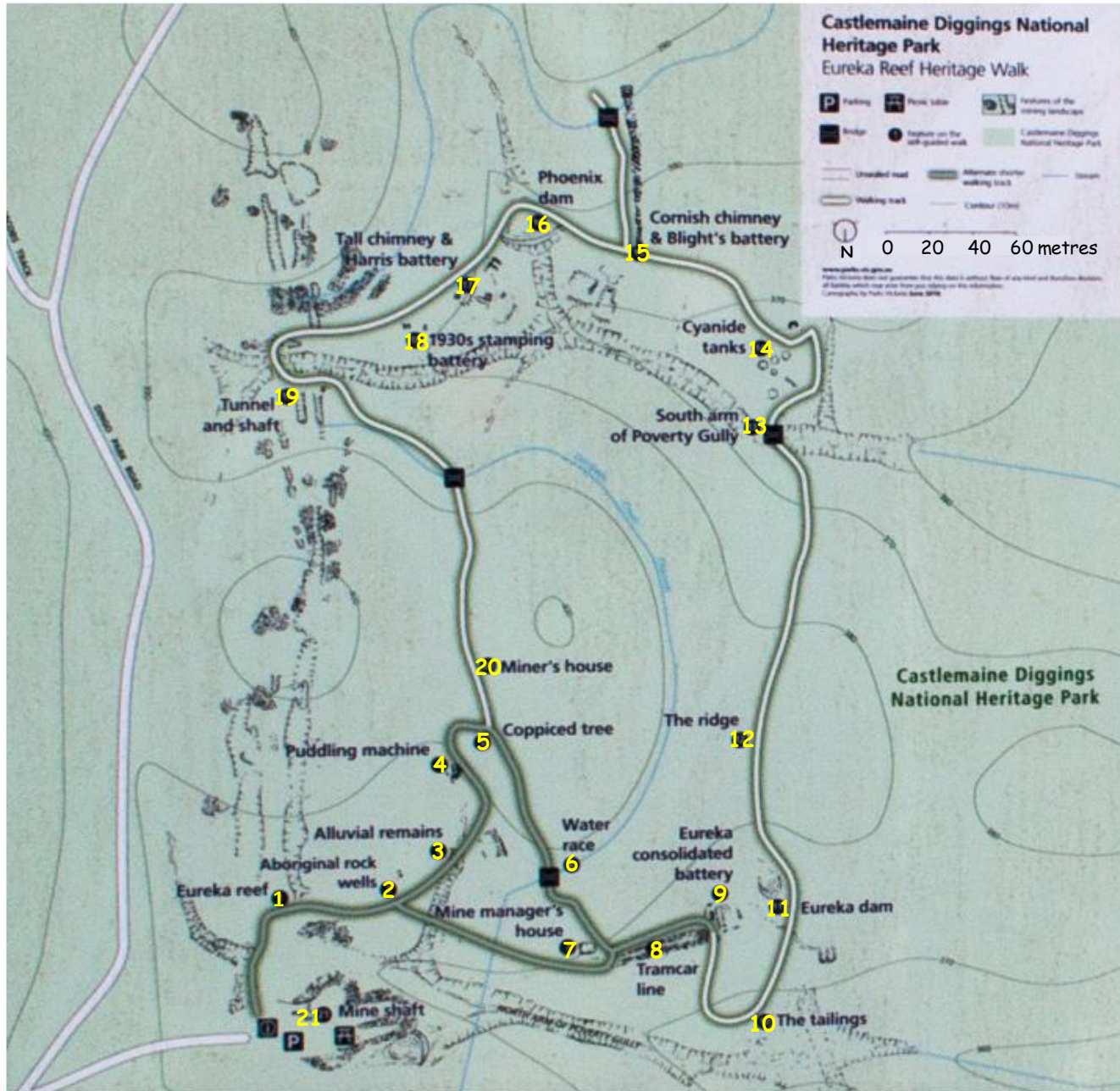
Garfield water wheel

- Water flow to Garfield wheel was via 258m long flume, 45cm wide and 25cm deep, mounted on a timber trestle
- the flume was connected to a branch water race near the top of an adjacent hill
- tail water from Garfield wheel powered another water wheel 400m away belonging to the Manchester mine
- the wheel was started by filling buckets part way up the wheel, once motion was achieved water flow was applied to upper buckets

Eureka Reef

- Before it was worked by miners, Eureka Reef was a huge outcrop of white quartz exposed as a ridge cutting across hills
- in the 1850s and 1860s it was mined as an open cut
- the Eureka Reef was opened in 1854 and divided into 300 mining claims
- the average width of the reef was ~1.7m with regular walls and carrying spurs on both the hanging and footwalls
- Au grades were generally lower than other auriferous reefs in the district

Eureka Reef walk



Forest Creek workings

- Forest Creek diggings → site of mining alluvial gold from a gravel bed of a former course of Forest Creek
- alluvial gold from the Tertiary gravel bed of Forest Creek formed millions of years ago in Ordovician Period
- alluvial mining in the diggings began in 1852 and by 1854, miners were using puddling machines to release gold from ancient river gravels
- at a later date, hydraulic sluicing was used to release gold from ancient river gravels
- Forest Creek walk → shortish, easy, brilliant

Forest Creek diggings



THE FOREST CREEK DIGGINGS, MOUNT ALEXANDER, PORT PHILLIP.

Two native policemen stand observing the diggers at work "The Forest Creek Diggers, Mount Alexander, Port Phillip" La Trobe Picture Collection, State Library of Victoria.

Hydraulic sluicing Forest Creek diggings

- Water cannon was used in the following way:
 - (1) jet of water directed to top of cliff, soaked for several days
 - (2) base of cliff undercut by hard water jet → until gravel fell onto bedrock
 - (3) nozzle then directed onto collapsed mass washing fine gravel and muddy water into sluice box
- jet of water sufficiently powerful to cut away hardest sediment
- force of water could be heard 3km away
- when operating at night quartz rocks smashed against each other creating sparks

North British Mine

- Alluvial Au first discovered in Maldon in 1853 followed by quartz reef Au in 1854
- until early 1870s alluvial and quartz mining employed roughly equal numbers of miners
- after mid 1870s reef mining major employer
- North British mine situated on Parkin's Reef, is one of the best preserved historic mine sites in Victoria
- mine spanned 73 year period (1855 - 1928)
- in 1860 it was purchased by three men, James Ward, John Robinson and Robert Dent Oswald

North British Mine, Maldon

- Some gold was found at the surface however, Oswald was convinced that there was rich gold at depth but was not rewarded until 1875
- by 1887 the mine was described as one of the world's richest mines, at that time processing ~100tonnes/week at average grade 2 oz/tonne and did so for 5 years
- The mine yielded a total of ~250,000oz of gold
- after Oswald's death in 1891 it became a public company

Calcining

- Calcining → roasting of quartz → burns off impurities → makes quartz more brittle for crushing
- process used in Maldon until about 1900
- five quartz kilns operated at the North British mine

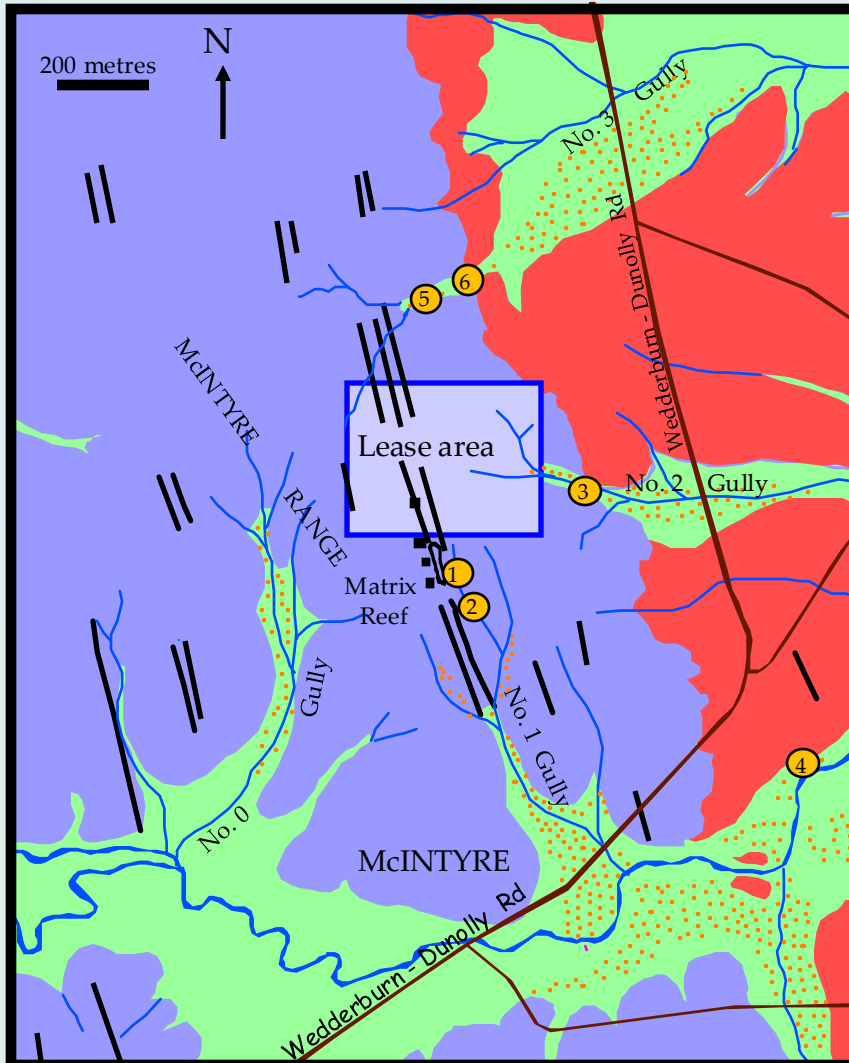


Quartz kilns,
North British mine

Matrix Reef, McIntyre

- Located at McIntyre, approximately 45km SW of Bendigo
- part of Berlin Goldfield, one of the richest Au producing areas in the world → produced 14 of 50 largest nuggets found in Victoria, all over 500z (15kg)
- four of these nuggets (782, 805, 810 and 860oz) were found in colluvium adjacent to the Matrix Reef
- Matrix Reef mine → one of two high-grade Au mines with average grade >140g/tonne

McIntyre area showing lease and historic workings



Legend

- Alluvium, colluvium
- Granite
- Hornfels, quartzite
- Quartz reef

Alluvial gold

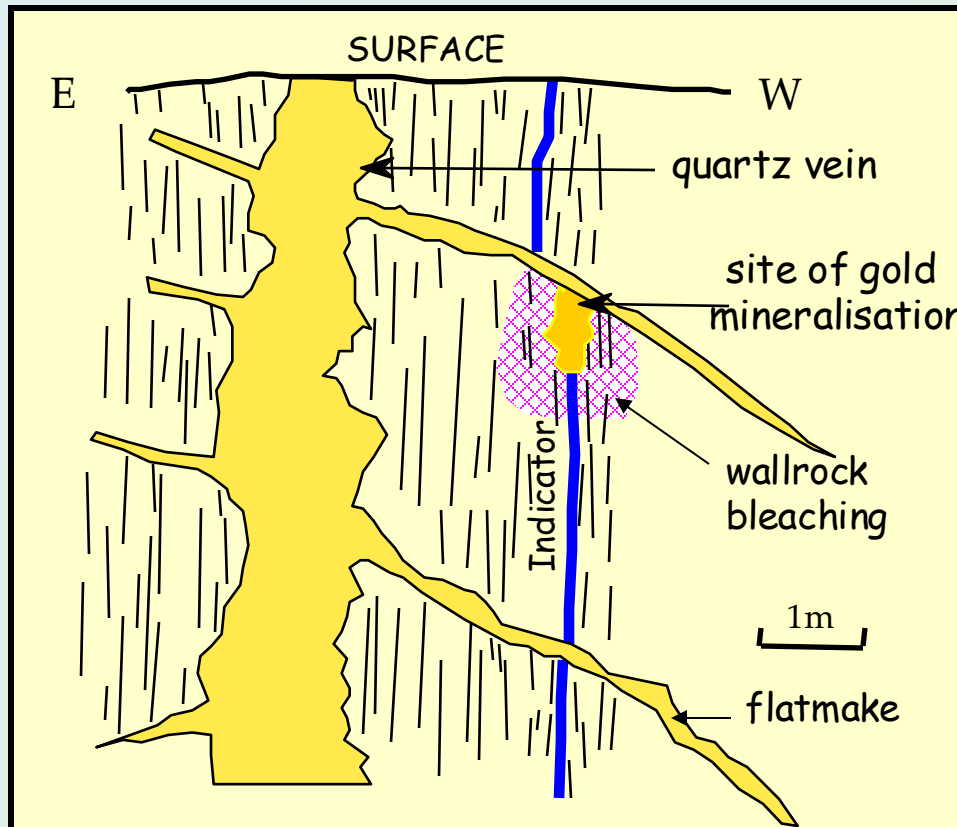
Shaft

Nugget locality

- 1 860 oz
- 2 805oz, 810oz , 782oz
- 3 320oz
- 4 75oz
- 5 160oz
- 6 189oz

Style of mineralisation

Nuggets and patches of coarse gold form along the intersection between vertical faults (indicators) and shallow to moderately dipping quartz spurs (flatmakes) after Bradford (1903).



Matrix Reef, McIntyre

- Rocks hosting the gold mineralisation are regionally deformed Ordovician turbidites, locally contact metamorphosed by the Tarnagulla granite
- contact metamorphosed rocks form a prominent ridge around edge of Tarnagulla pluton (cordierite spotted hornfels)
- quartz reefs and vertical faults occur within the contact aureole
- most of the gold was obtained along the intersection between an indicator and quartz spurs dipping west at $\sim 45^\circ$
- nuggets were shed from host structures as a consequence of erosion, also patches of coarse gold

Matrix Reef gold



Welcome Stranger nugget

- Welcome Stranger nugget comprising 2,260z (72kg) Au → largest alluvial nugget ever found
- discovered in Bulldog Gully, Moliagul in February 1869 by Cornish miner, John Deason who shared the lease with his friend Richard Oates
- top of the nugget was just 3cm below the surface
- gold value of nugget present day ~9.5 million dollars

Model of Welcome Stranger nugget



Welcome Nugget site, Moliagul



1 Examples of surface mining.

2 Site of John Deason's two-roomed house.

3 Site of Deason and Oates' Puddler. Deason built his house nearby as a deterrent to would-be thieves.

4 Site of Oates' house.

5 This wooden headstone dates from the 1860s. It is reputed to be a Chinese grave.

6 Chinese camp.

7 A former puddling machine.

8 This forest was cut down to fill the miners' needs.

9 Examples of new growth (coppice). Red and grey box trees.

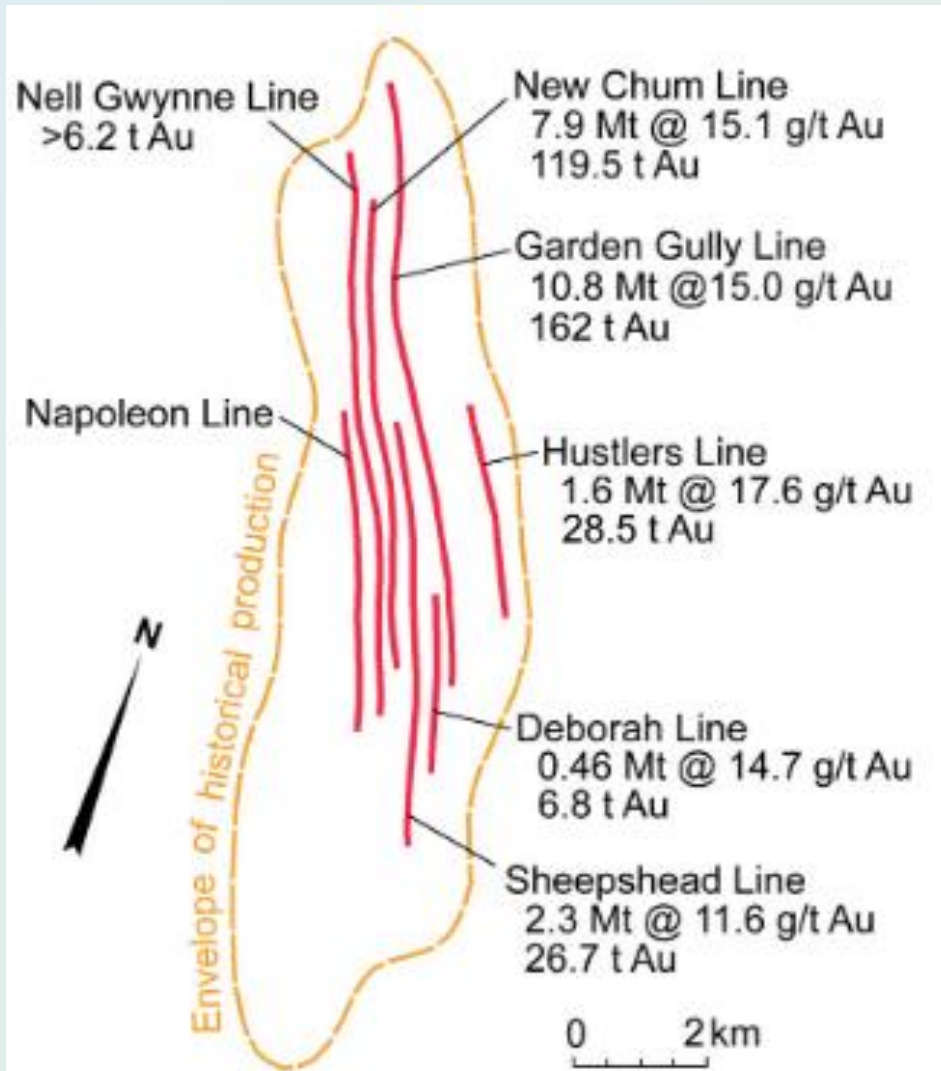
10 Black Gully. Miners worked upstream to here.



Bendigo Goldfield

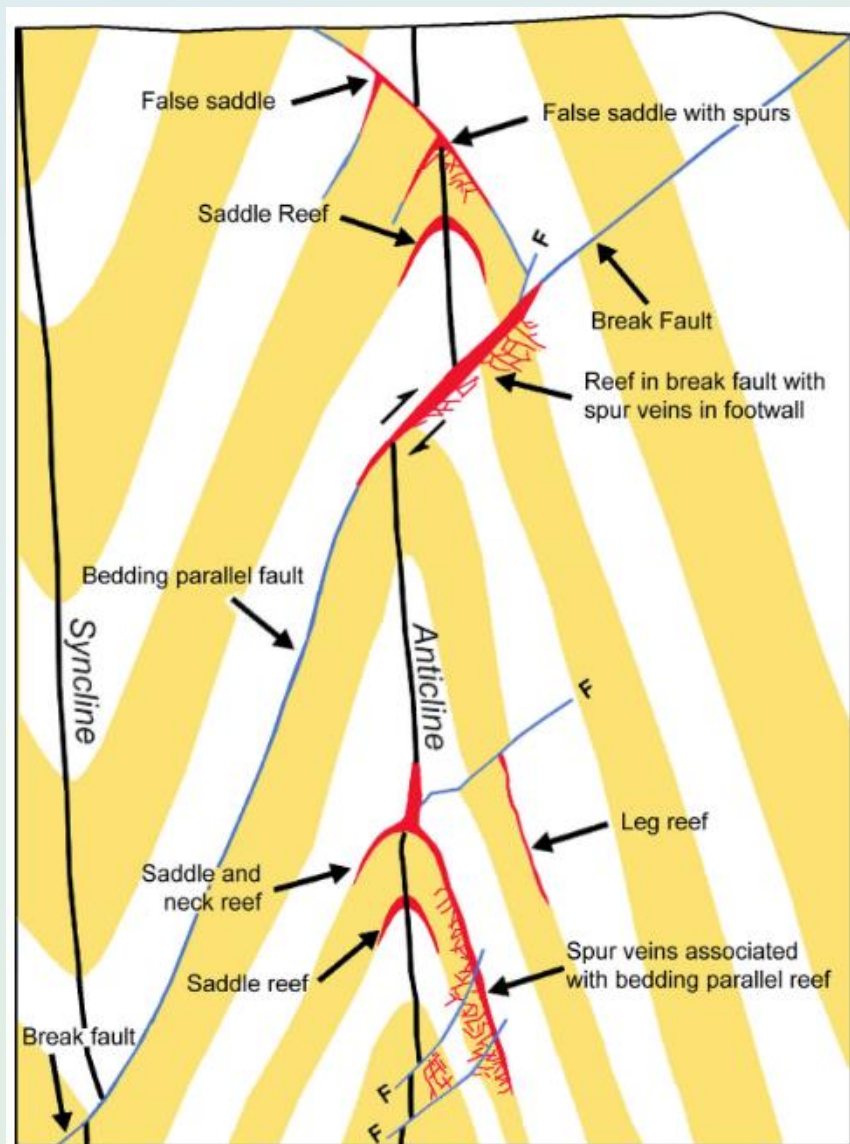
- Bendigo goldfield lies in a 9km wide, NNW trending block of Lower Ordovician, lower greenschist facies turbidites, bounded by regional steeply west dipping Whitelaw and Sebastian faults
- second largest gold producer in Australia after the Golden Mile in Kalgoorlie
- alluvial gold was first discovered in Bendigo in 1851
- productive portion of goldfield is contained within a 15 x 5 km zone
- >20 near parallel anticlines have been mineralised within this zone
- 80% of the production being from quartz bodies in anticlinal crests

Bendigo lines of lode



The main Bendigo Goldfield lines of lode showing production 1851 to 1954; after Kay, 2019

Quartz reef structures in Bendigo Goldfields (after Dominy et al. 2003)



Central Deborah Mine, Bendigo

- Central Deborah → one of more than 5,500 registered gold mines in Bendigo goldfields
- mine opened in 1939 by Central Deborah Gold Mining company
- one of the last mines to open in the Bendigo goldfields
- mine was expanded 1945-46 but closed in November 1954 having produced 29,865oz Au
- mine reopened in 1986 as a tourist attraction

Central Deborah mine



Victoria Hill, Bendigo

- Victoria Hill was one of the richest areas of the Bendigo goldfield
- gold was discovered on Victoria Hill in 1854, by 1861 1.2Moz of gold had been extracted from the site
- it contained many successful mines including Ballerstedt's open cut, Lansell's '180' and the Victoria Quartz mine
- between 1853 and 1861, sixteen claims were established on Victoria Hill
- Victoria Hill contains mullock heaps, poppet heap and the foundations of massive winding engines

Victoria Hill



Ballerstedt's open-cut mine (1854 - 1871)

- In 1854, Prussian immigrant Christopher Ballerstedt bought the claim that hosted the Ballerstedt open cut mine
- Ballerstedt was the first person to prove that the gold reef extended underground
- Ballerstedt sank a shaft and struck it rich at 90m
- by 1860, Ballerstedt had found gold worth \$486,000
- Ballerstedt died in 1869 and the mine ceased operation in 1871

Lansell's '180' mine 1861-1907

- George Lansell purchased a mine from Theodore Ballerstedt for \$60,000 in 1871
- he called the mine '180' because it occupied 180 yards on the rich New Chum reef
- in 1895 the shaft was down to 968m, the deepest mine in Australia
- when it closed in 1907, the mine had yielded 77,000oz of Au worth \$308,000,000 at modern day prices

Victoria Quartz Co. mine (1877-1913)

- In 1857 eight small claims in the area merged to form the Victoria Quartz Co.
- in 1908 it boasted the world's deepest shaft (1,365m). It reached a depth of 1,406m in 1910
- in 1910, water burst into the claim flooding the shaft and halting operations
- the company baled water for 6 months then handed the mine over to tributers that worked the upper levels
- the mine closed in 1913 having produced 48,000oz Au

Chewton town map



Chewton

