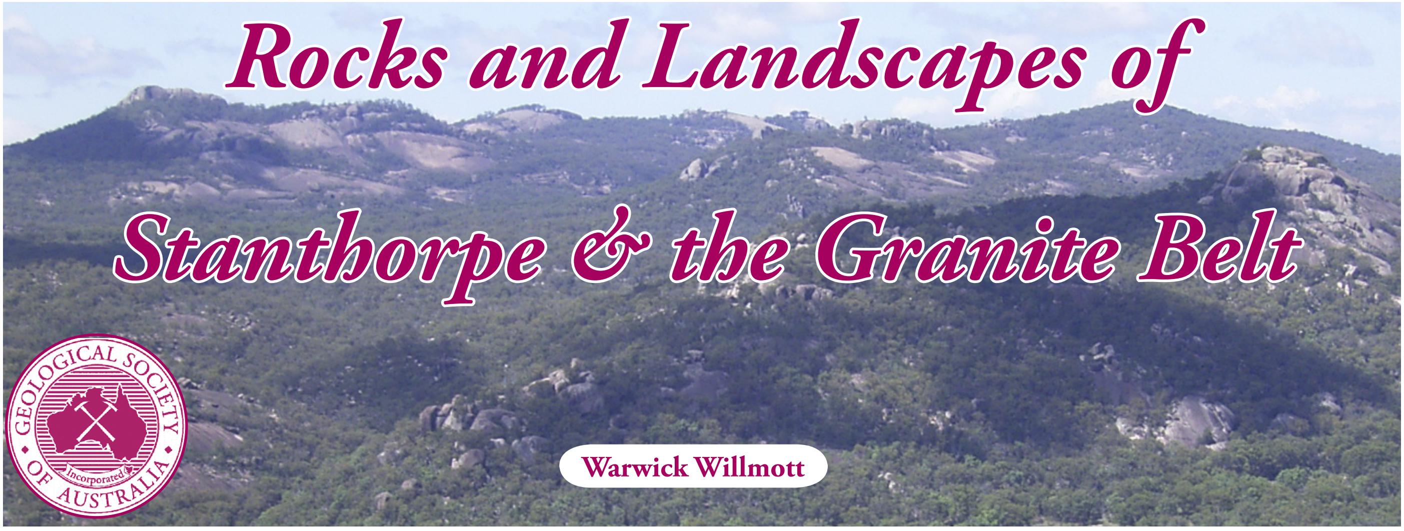
Rocks and Landscapes of Stanthorpe & the Granite Belt



Warwick Willmott

THE GRANITE BELT - QUEENSLAND'S COOL CLIMATE HIGHLANDS

The high country around Stanthorpe, with its characteristic rounded granite boulders and monoliths, is a distinctive part of Queensland. Originally settled by squatters pressing north from the New England tableland, later prospected by tin, metal and gold miners, then taken up for fruit growing by soldier settlers and Italian migrants, it is now well known for its fruit, vegetables, vineyards and winter tourism.

Geologically it is a northern extension of the New England Tableland of New South Wales. In summary, old hard sedimentary rocks ('traprock') of the *Texas Beds* make up the western part of the district, whilst farther east large bodies of molten granitic magma have invaded the older rocks and slowly cooled at great depths to form the *Stanthorpe Granite* and other granites. The granites have been later revealed at the surface by erosion of the overlying older rocks, and erosion of them has contributed sands and gravels to broad river plains to the north. These resulting sedimentary rocks are some of the first of the *Clarence-Moreton Basin.*

But how, when and why did all these distinctive rocks come about? To answer this we need to understand the geological setting of eastern Australia in ancient times. The Australian continent has grown 'eastwards' * over the last 550 million years by interaction of the Australian crustal plate with oceanic plates to the 'east'. We here are basically part of the youngest build-out, the New England Fold Belt, active from 380 to 210 my (million years) ago, but there are some older remnants left from earlier times.

* *In those times Australia was part of the supercontinent Gondwanaland and was facing southwards. It has since been rotated to its present orientation by subsequent crustal plate movements.*

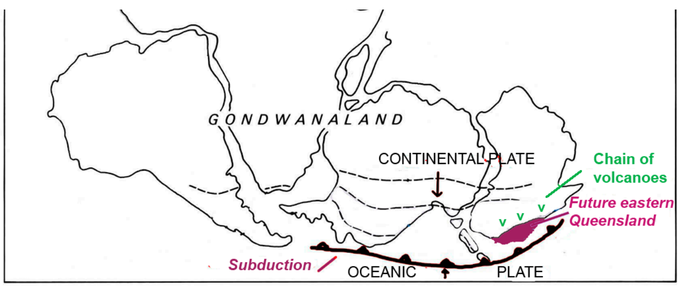
THE OLDER REMNANTS

Between Warwick and Dalveen a variety of volcanic rocks and volcanic-derived sediments deposited under marine conditions outcrop over a small area astride the railway line – the *Silverwood Group.* They are believed to have originated on an oceanic volcanic chain in late Silurian to early Devonian times (420 to 390 my ago) and to have been added to the edge of the continent during the later events described below. They are a complex series of rocks whose details are beyond the scope of this leaflet.

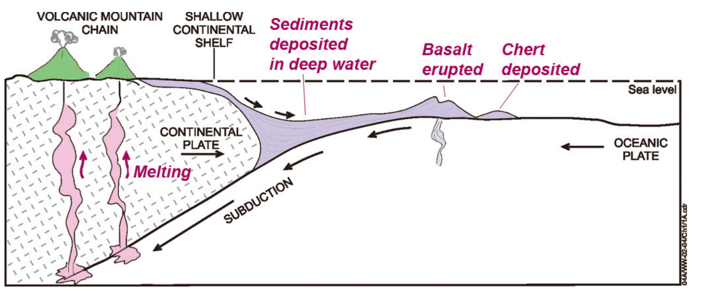
1. THE FIRST MAIN EVENT – FOUNDATIONS FOR THE DISTRICT.

In late Devonian to early Carboniferous times (360 to 320 my ago) a volcanic arc stretched along the 'eastern' side of the continent, caused by an oceanic crustal plate to the 'east' being subducted beneath the continental crust. A continental shelf and a deep water trench extended to the east. Sediments eroded from the chain avalanched down the edge of the shelf to form thick deposits in the deep water. The *Texas Beds* were deposited in this way about 340 to 330 my ago. They were mainly thick layers of fine-grained dirty sandstone and siltstone, but some basalt lavas were also included, possibly erupted on sea mounts, and these are associated with thin beds of limestone deposited on limy banks and reefs nearby. Some patches of chert accumulated from innumerable silica-rich skeletons of microscopic organisms called radiolaria.

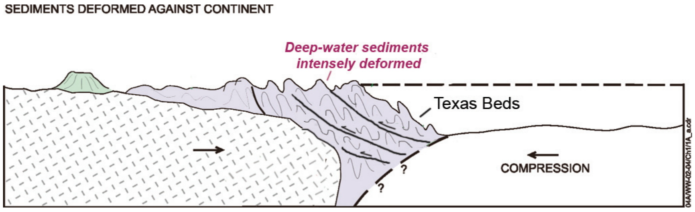
At the end of the Carboniferous (315 my ago), subduction ceased, and the sediments were compressed, hardened to '*meta-sediments*', and pushed upwards in numerous slices



Situation of eastern Australia 380 to 310 million years ago.



1a. Sediments deposited in deep water off the edge of continent.



1b. Compression of sediments to meta-sediments of Texas Beds.

probably into mountains. Around the same time, all similar strata in the New England Fold Belt were bent by major crustal forces into a 'Mega Fold' (see figure). This means that the Texas Beds are similar in origin to the meta-sediments of the Neranleigh-Fernvale Beds of the Gold Coast and Brisbane.

The meta-sediments themselves

The Texas Beds now comprise:

argillite (hardened siltstone)

greywacke (hard, dirty sandstone)

chert (silica)

greenstone (originally submarine basalt)

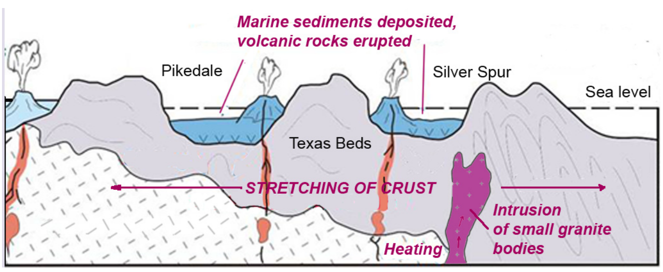
and some *limestone* and *marble.*

The term traprock used locally for these meta-sediments is actually incorrect. It is an old English word meaning basalt lavas or dykes. Early settlers saw the rocks' black colour and assumed they were basalt as in England or India (the Decan Traps) but this is not the case.

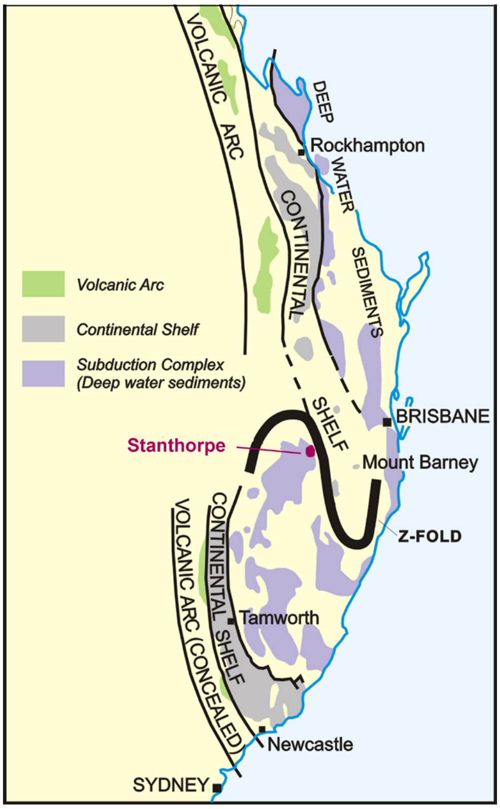
The meta-sediments are hard and resistant to weathering and erosion, so they give hilly country with shallow rocky soils, but where these are more deeply developed they are of moderate fertility.

2. THE SECOND EVENT

In the early Permian (~290-280 my ago), the continental crust relaxed after the previous compression, then stretched and subsided, allowing some areas to be inundated by shallow seas. Sediments with marine fossils were deposited in them. Remaining high heat flow in the crust saw some melting to produce volcanic rocks and small bodies of granite. Only small slices of these rocks are preserved amongst the Texas Beds, such as near Pikedale and Silver Spur near Texas, and they are difficult to distinguish as they also have been hardened and compressed by later events. They were probably much more extensive, and some remnants of marine sediments can be seen on top of Mount Donaldson in Sundown National Park. Granites of this age and origin include the Ballandean Granite south of the town, the Jibbinbar Granite, the Mount You You Granite at Pikedale and the Greymare Granite west of Warwick.



2. 290 to 280 my ago. Small basins sink, marine sediments deposited, volcanics erupted, granites intruded.



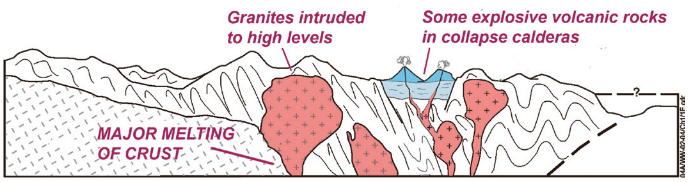
The large crustal mega-fold or Z fold that affected eastern Australia about 310 to 300 my ago.

3. THE THIRD EVENT

From the mid Permian to mid Triassic (265-235 my ago) the eastern side of continent was subjected to renewed compression– *the Hunter-Bowen Orogeny.* It is unclear why this occurred, but it might have been related to a renewed subduction zone in areas far to the east. In any case it was accompanied by widespread heating deep within the crust which generated vast bodies of molten magma which then rose upwards through the crust.

Some reached the surface to be erupted from violent volcanoes as rhyolite lavas or 'welded tuffs' consolidated from hot debris. These now outcrop as black, fine-grained hard rocks such as the *Wallangarra Volcanics* and *Dundee Rhyodacite* between Wyberba and Wallangarra.

However most of the magma bodies cooled slowly while still deep beneath the surface where they eventually solidified. In this district several small bodies were intruded north of Braeside in the late Permian, and then the huge *Stanthorpe Granite* was intruded 247 my ago in the early Triassic. Small bodies of the Ruby Creek Granite were intruded slightly later north of Stanthorpe and at Sundown. Erosion gradually removed the meta-sediments above the granites to expose them at the surface. Thicknesses in the order of kilometres were stripped off but some granite bodies are still buried.



3. 260 to 240 my ago. Large-scale melting of crust, eruption of volcanics, intrusion of large bodies of granite.

Dark welded tuff of Wallangarra Volcanics between Wallangarra and Wyberba.

Detail of the minerals of the Stanthorpe Granite.

The granites themselves

As magma cools it solidifies to a mush of mineral crystals, then rock. The larger and deeper the body, the slower the cooling, and the slower the cooling, the larger the crystals of minerals that form.

Granitic rocks crystalise to varying proportions of -

Quartz (clear)

Potassium feldspar (pink)

Sodium/calcium feldspar (white)

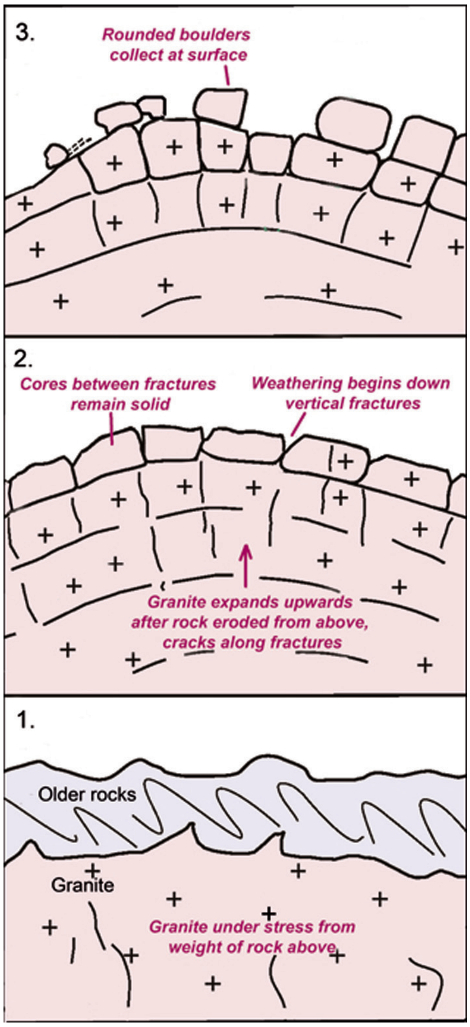
Biotite mica & *hornblende* (black).

It may contain fragments of surrounding rocks or other granites called *xenoliths*. The last dregs of magma may be squeezed along fractures to crystalise as *aplite* - essentially a quartz-feldspar rock - in cross-cutting dykes or sills.

Weathering and erosion of granite terrains

Erosion reduces the downward weight or pressure on the granite and allows the rock to expand upwards, creating large horizontal fractures that separate large slabs. These slabs crack down vertical fractures, and weathering down these results in rounded boulders. Where fracturing is closely spaced, the rocks decompose to form valleys and low country, but where sparse, resistant slabs and domes of rock can remain, such as in Girraween National Park. Fascinating weathering features can develop on these outcrops - more details of these are given on the excellent website www.rymich.com/girraween/ .

Because the granites are composed of coarse grains, on weathering they separate to a coarse sandy soil composed mainly of quartz and feldspar grains. Few of their minerals contain the nutrients calcium, iron and magnesium so the soils are relatively infertile. The coarse texture also gives a poor water holding capacity. However these coarse sands can wash down slopes and can build up deep soils on lower slopes which are quite suitable for agriculture.



Fracturing following un-roofing of granite.

Large monolith of The Pyramids, Girraween National Park.

4. THE FOURTH EVENT

Once the granite bodies were exposed by erosion, quartz sands and gravels began to be eroded from them. Eventually vast quantities were transported by broad streams to build up great beds of sand and gravel in a gradually sinking area to the north – the *Clarence -Moreton Basin*, which began to subside in the latest Triassic to early Jurassic (210-185 my ago). The sand eventually hardened to sandstone and conglomerate of the Marburg Subgroup which now outcrop around the eastern Darling Downs. These rocks can be seen in road cuttings between Warwick and The Glen rest area, and there are some at a higher level near Dalveen. Later the streams became more sluggish, and silts, shales, muds and coal were deposited as the Walloon Coal Measures, but that is a separate story.

MINERALS OF THE DISTRICT

The well known minerals of the district are related to some of the geological events described above.

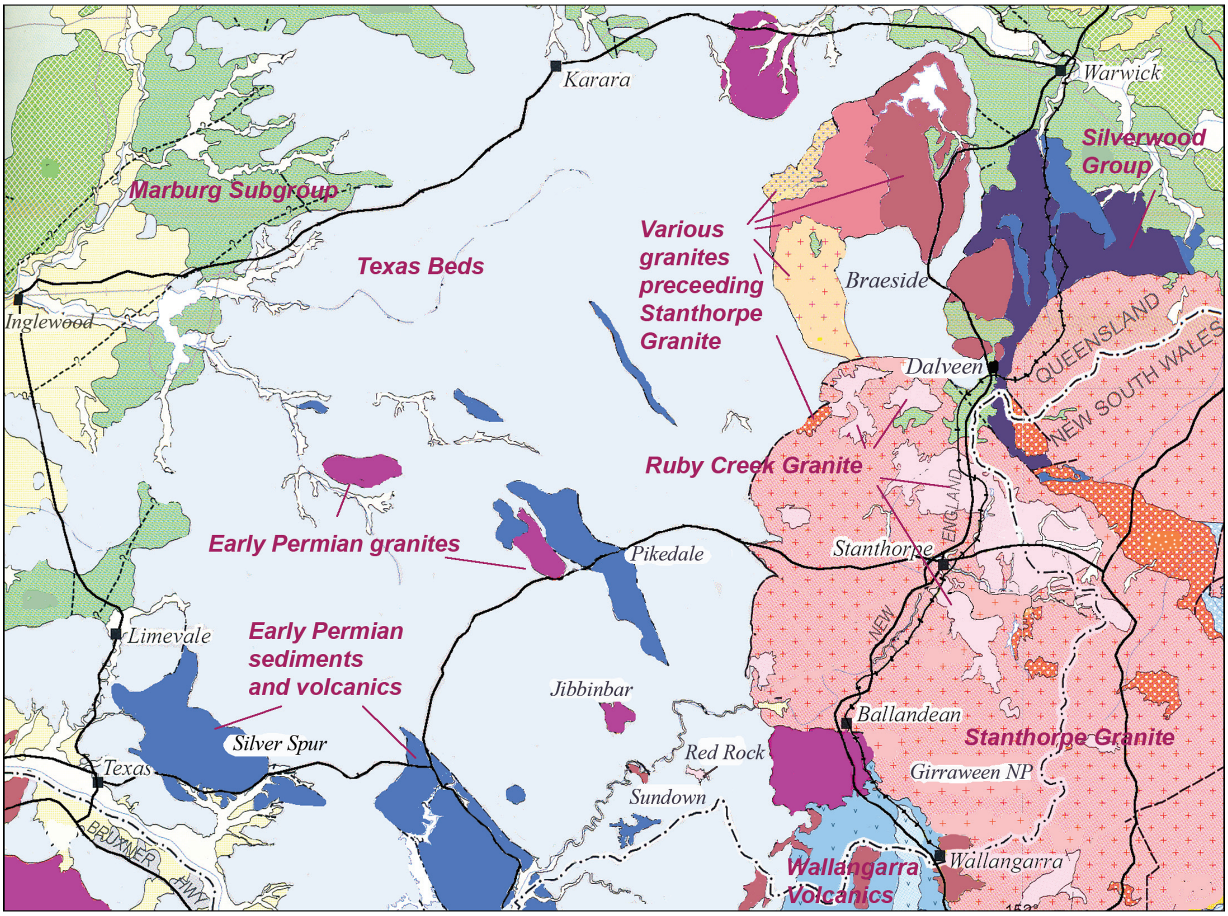
Small gold deposits resulted when fluids containing gold in solution were squeezed out of meta- sediments of *Texas Beds* when they were compressed, hardened and uplifted. The gold was deposited in veins and shear zones impregnated with silica, silver, copper and gold minerals. These deposits were small and only economic near the surface where the minerals were concentrated by weathering processes. Examples are the old Waroo mine northwest of Pikedale and numerous small mines southwest of Warwick. Limestone bands within the Texas Beds have been mined at Limevale (marble chips) and at Riverton (agricultural lime and glass-grade limestone).

Minerals were also associated with the *volcanic rocks erupted in the small basins* formed in early Permian times. They were probably erupted on the sea floor – from 'black smokers'- and incorporated in surrounding sediments. Sulphide minerals of zinc, lead, silver, copper, and some gold were deposited in deposits such as those at the Silver Spur, Silver King, Pikedale and Tooliambi mines. Arsenic sulphides were apparently introduced by the Jibbinbar Granite of this age and these were mined for prickly pear poison at the old Jibbinbar State Mine from 1919 to 1927.

Metallic minerals (of tin, arsenic, copper, gold etc) become concentrated in the very last fluids of granites, as they can't be incorporated in the crystals of the other minerals formed earlier. They tend to concentrate in the roofs of the granite intrusions or in veins and fractures in the meta-sediments above the roofs. The final fluids of *Stanthorpe Granite* were apparently largely barren of such minerals, or the granite has been eroded to levels far beneath the original roof, as few mineral deposits are associated with this large intrusion.

However the last fluids of the *Ruby Creek Granite* were much richer in metallic elements, and the roofs of the various intrusions have only been exposed 'recently'. The body of the granite to the north and east of Stanthorpe was responsible for introducing minerals such as cassiterite (tin oxide), wolframite, molybdenite, and some sulphides of arsenic, zinc and lead. Cassiterite (SnO_2), is heavy and resistant and accumulates in stream alluvium. The alluvial tin mined in the old days around Stanthorpe came from erosion of veins and fractures in this body. Production from hard rock mines was minor. In Red Rock Gorge in Sundown National Park a small body of Ruby Creek Granite is just beginning to be exposed beneath meta-sediments of Texas Beds. Small tin, arsenic, copper and molybdenite mines were worked around the roof of this intrusion, and other small mines were worked just to the south at Sundown itself, above a still- buried bodied of the granite. More on the history of these mines is included in the Society's book *Rocks and Landscapes of the National Parks of Southern Queensland.*

Amplified from a talk to the Stanthorpe Field Naturalists Club 2013



Geological map, simplified from illustration on page 455 of volume '*Geology of Queensland*' (2013).