5351 million years ago, two 5km wide masses of granite intruded into King Island resulting in tungsten

Amongst the geological features of interest to be seen on King Island are:

- The oldest rocks of the southeast Australian region: sediments deposited on an ancient sea floor some 1.3 billion years ago;
- Glacial deposits from Earth's most severe ice age ('Snowball Earth') 636 million years ago;
- Lava flows and breccias from ancient volcanic eruptions, exceptionally well preserved in coastal exposures;
- Skarns – mineralogically interesting rocks that host Australia's largest tungsten deposit.

Cambrian earth movements (510 million years ago)

Some time after the late Ediacaran rifting and volcanic activity, in the middle Cambrian, about 510 million years ago, King Island was affected by another phase of compressional tectonic activity – a mountain-building event that also affected mainland Tasmania, where it is called the Tyennan Orogeny, and western Victoria and South Australia, where it is known as the Delamerian Orogeny.

King Island, together with the northwest corner of Tasmania, was not much affected by this event. On King Island there was some gentle folding and deformation of the Grassy Group and the older rocks. The main result that we see today is the easterly dip (tilt) of the layering in the Grassy Group, along the east coast.

The Sandblow Granite: a bonanza of tungsten from the Carboniferous (351 million years ago)

Two roughly circular masses of granite, each about 5 km wide, intruded into eastern King Island in the early Carboniferous period, about 351 million years ago.

One, the Mt Counsel Granite, just inland from Nine Mile Beach, is mostly covered by sand. The other, the Sandblow Granite, is well exposed along the coast at Grassy Harbour and south as far as Red Hut Point.

There is a third, much smaller area of granite inland of Bold Head, which appears to be part of the Sandblow Granite that has been split off the main body and moved north by the Grassy River Fault.

Granites of similar age, or a little older, are widespread in Tasmania and Victoria, where many of them are associated with important tin and gold deposits.

The Sandblow Granite was associated with

the formation of major scheelite (tungsten) orebodies at Grassy and Bold Head. Scheelite (calcium tungstate, $CaWO_4$) is one of the two main ore minerals for tungsten, a strong, dense metal with a high melting point, used for electric filaments and armour-piercing ammunition, as well as hard tungsten carbide machine tools. It is an inconspicuous translucent yellowish mineral, with the unusual property that it fluoresces bright blue under ultra-violet light, making it easy to spot in the host rock on a moonless night (or if you are down a mine).

Formation of the scheelite ore bodies at Grassy and Bold Head

In the final stages of the crystallisation of granite magma, superheated water is released, and percolates through microscopic pores or migrates along cracks, outward into the surrounding rocks.

At such high temperatures and pressures, the water carries a high concentration of dissolved minerals, often including many of the rarer elements such as tin, tungsten, molybdenum and gold.

The dissolved atoms of these elements do not readily fit into the crystal structure of the common granite minerals such as feldspar, so they become concentrated in the residual fluids in the late stages of granite solidification, through a kind of natural distillation process. Thus many of the world's orebodies of these rare elements are associated with granite margins. But a number of factors have to be just right for an economic mineral deposit to form.

One essential factor was that the Sandblow Granite was of a particular chemical type of granite that favoured tungsten, and to a much lesser extent, molybdenum, mineralisation.

Another factor was the presence of carbonate-rich beds (limestone, dolomite) in the rocks that the granite intruded near Grassy and Bold Head. These beds are none other than the carbonate-rich breccia and dolostone deposited during 'Snowball Earth' and its aftermath (including Cottons Breccia and cap carbonate). The hot fluids given off by the granite reacted with the carbonates, precipitating scheelite and other minerals.

Another important factor in the formation of the Grassy orebody was the presence of a number of fractures, or faults, which became pathways for the migration of the hot mineral-rich fluids out of the granite and into the carbonate-rich layers. These faults included the Grassy River Fault, and a number of north-west trending faults branching off it.

The hot fluids, laden with dissolved minerals, reacted with the carbonates and replaced most of the original calcite and dolomite with a new set of distinctive and unusual minerals, creating a type of metamorphic rock known as skarn.

The skarn at the Grassy mine is a colourful mix of grass-green epidote, reddish black garnet, and dark green diopside, while some of the calcite and dolomite transforms into sugary white marble. Less than 1% is the translucent yellowish scheelite.

All of these factors (the right type of granite, the presence of carbonate beds, the fractures) came together at Grassy to make one of Australia's largest tungsten deposits.

—An extract from Clive Calver's 'A guide to the Geology of King Island'