Geology of Tasmania

Despite its small size, Tasmania has a remarkable geological diversity and abundance of mineral deposits with the world's biggest exposure of dolerite. The rock record contains representatives of each period of the Neoproterozoic, Paleozoic, Mesozoic and Cainozoic eras. It is one of the few southern hemisphere areas glaciated during the Pleistocene with glacial landforms in the higher parts. Rocks from every period of the Earth's history from the Middle Proterozoic are present and there have been at least four major episodes of economic mineralisation. The west coast region hosts significant mineralisation and numerous active and historic mines. Significant mineral deposits include Proterozoic iron ore, silica, dolomite and magnesite; Cambrian base metal-gold and ultramafic-related platinum group minerals and chromite; Devonian slate-belt gold deposits; Devonian granite-related tin, tungsten, fluorite, magnetite, silver-lead-zinc and possibly nickel deposits; Triassic and Tertiary coal deposits; and Cainozoic alluvial gold, and residual iron oxide, silica and clay.

The earliest geological history is recorded in rocks from over 1,270 million years ago. These older rocks from western Tasmania were strongly folded and metamorphosed into rocks such as quartzite. After this there are many signs of glaciation from the Cryogenian, as well as the global warming that occurred at the start of the Ediacaran period. In the Permian period, conditions were again glacial and the Tasmania basin formed, with low sea levels in the Triassic. A giant intrusion of magma happened in the Jurassic forming dolerite which gives many of the Tasmanian mountains their characteristic appearance. Continental breakup happened in the Cretaceous and Tertiary Periods, splitting off undersea plateaus, forming Bass Strait and ultimately breaking Tasmania away from Antarctica. In the Tertiary, two basins extended inland from Macquarie Harbour and the northern Midlands. The higher mountains were glaciated during the Pleistocene.

Precambrian (pre 542 Mya)

On King Island in Bass Strait, the oldest Tasmanian rocks are found. In the Rocky Cape Block west of Wynyard and north of Granville Harbour, the Precambrian rocks of Siltstone and Quartzite are over 5700 meters thick. The Burnie Formation followed in the Tonian period with greywacke and slaty mudstone, and also some basic pillow lavas. The Precambrian basement that forms the central core of Tasmania contains turbidite with quartz sandstone interbedded with siltstone deposited by gravity flows aged 1,681 million years ago. Metamorphism happened 496 to 515 million years ago at the same time as the Cambrian ultramafic complexes were introduced. At the end of the Precambrian uplift there were several raised blocks forming land above the sea: the Tyennan Uplift in the central and south west Tasmania, the Rocky Cape uplift in the north west, and the Forth uplift, near Forth in the north.

Cambrian (542 – 488 Mya)

Next an oceanic arc collided with eastern Australia. This resulted in deep oceanic crust being thrust in a sheet over the top of the Precambrian rocks. The Mount Read Volcanics are a 250 km long belt that is 10 to 20 km wide in the west of Tasmania. Sulfides were formed by hot springs on the sea floor which have become ore deposits for copper, lead, zinc and silver. In the Dial Range Trough the middle Cambrian saw the deposition of conglomerate (of purple mudstone pebbles), sandstone with feldspar, mudstone and greywacke. The Murchison Granite intruded east of the Mount Read Volcanics. Major mineral deposits were formed at Mount Lyell, Roseberry and Henty. Cambrian sedimentary beds (Dundas group) interfinger with the Mount Read Volcanics and consist of sandstone, laminated mudstone and a pebble conglomerate in which the pebbles consist of quartzite, sandstone and green mudstone.

Ordovician (488 – 444 Mya)

During the Ordovician Tasmania was near the equator and was joined to Gondwana. In North east Tasmania the Mathinna Group starts in the Ordovician with a quartz sandstone formed in turbidity flows. Fossils are rare, and ages hard to determine.

Devonian (416 – 360 Mya)

In early to mid Devonian the Tabberabban Orogeny compressed Tasmania in an east-west direction. Tight folds were formed with axes in the north south direction at first. Later folding in the northwest to west-northwest direction was superimposed. In the north east of Tasmania the Mathinna Group received its last deposits in the form of turbidites. Granites were intruded in the east of Tasmania around 395 to 368 million years ago. Three large batholiths are in the north east: Scottsdale, Eddystone and Blue Tier. Gravity measurements show that granite underlies most of north east Tasmania at depth. The eastern Bass Strait Islands also show large exposures of granite, including Flinders, Cape Barren, and Clarke Island. Veins of gold were crystallised in the Mathinna-Alberton Gold Lineament. In the west of the state there were thirteen small granitic intrusions around 367 million years ago. The western plutons were associated with mineralization at Zeehan. On the eastern side of King Island small granite dykes were intruded around 350 million years ago.

Permian (300 – 250 Mya)

In the Permian, glacial conditions predominated with, icecaps on the land, and ice floating on the sea, as a result of which tillite is found at the base of the Permian deposits. Mudstone with dropstones was formed in the sea areas, particularly in the eastern half of Tasmania. The rocks are undeformed and cover the central part of the state, most of the east coast, down to the south coast, and with extensions to the north coast near Launceston and Devonport. What is now visible has been reduced by erosion.
The Permian and Triassic deposits together are known as the Parmeener Super Group. The lowest levels are a discontinuous dark grey pebbly tillite up to several hundreds of meters thick which is found in many southern areas, at Wynyard in the north and in the west at Zeehan. The ice that brought the till flowed from the west of Tasmania in an easterly direction. Siltstone, mudstone and sandstone were deposited with frequent dropstones and fossils. Deposits include oil shale known as tasmanite, freshwater deposits that include coal, and more marine units including limestone, up to 60 m thick, siltstone and sandstone, and the very top layers are coloured black, probably from an estuary.

Triassic (250 - 200 Mya)

Continental conditions resulted in sandstone deposits, which contain small dinosaur remains. The Triassic sediments are also part of the Parmeener Super Group. The lowest levels are a sparkling clean quartz sandstone free of coal. The uppermost parts have sandstone and beds of coal. The sandstone has also been heavily used as building stone which is notable in Hobart and towns such as Oatlands and Ross.

Jurassic (200 – 145 Mya)

A major intrusion of dolerite occurred in the Jurassic. This was a widespread phenomena covering over one third of Tasmania, and possibly more in the past. This intrusion also affected Antarctica, Argentina and South Africa at 183 million years ago. Three to five million cubic kilometers of magma were intruded overall, being the planet's fourth largest known magma intrusion.
Tasmania has the largest exposure of dolerite in the world of 30000 km^2 and a volume of 15000 km^3. In Tasmania the rock is characteristic of many mountains with its columnar joining and dark blue grey colour. Most of the intrusions are in the form of sills up to 500 m thick. Dolerite is crushed to use as road metal, and aggregate.

Cretaceous (145 – 65 Mya)

In the Cretaceous, continental breakup of Gondwana started near Tasmania. Bass Strait was stretched and thinned and became filled with water. Flowering plants moved into Tasmania about 90 million years ago. At these times Tasmania was still connected to Antarctica. South from Tasmania is an extension of continental crust called the South Tasman Rise. This extension created a number of sedimentary basins which contain several kilometers of sediment from the late Mesozoic to Cainoozoic time periods.

Tertiary (65 – 2.6 Mya)

Tasmania finally disconnected from Antarctica 45 million years ago. Several basins were formed by faulting. Faulting was connected with continental breakup. Tertiary age deposits are found in the northern midlands (Tamar Graben), and south of Macquarie Harbour in the Macquarie Harbour Graben. Thick layers of Tertiary rocks are found in the estuaries of southern rivers.

The Tamar Graben was an extension to the south of the Bass Basin onto the Tasmanian island. Sediments started to be laid down in the graben at the very end of the Cretaceous, and the Longford sub-basin is filled with 800 m of clay, sand and gravel. The Devonport-Port Sorell Sub-Basin was formed in the Paleocene with deposits of carbonaceous mudstone and sandstone. The Thirlstane Basalt (38My) rests on these sediments, then the Wesley Vale Sand follows, and the Moriarty Basalt at the surface which is 50 meters thick and 29.5 million years old.

Volcanic vents opened up 58 to 8 million years ago. Some volcanoes were explosive with bombs, and pyroclastic tuff. In the north west, there was so much lava that valleys filled and overflowed. A plain resulted with up to 750 meters thickness, and maximum extent south of Wynyard and Burnie. Table Cape has basanite from 13.3 million years ago and Stanley at 12.5 million years ago. Lava flows ran south down tributaries of the Derwent River 24.3 to 22.4 million years ago and in the western Midlands there is basalt from 36.3 million years ago.

Quaternary (2.6 Mya to present)

Valley glaciers and a 1000 km^2 ice cap from 41-44 000 years ago and 18-10 000 years ago. The ice cap on the Central Plateau was around 65 km in diameter. Significant areas of till are found in the central highlands arranged roughly in a circle around the former ice cap. Glaciers flowed out into the Franklin River, the Canning Valley, and north into Forth and Mersey Rivers. Glaciers were in a number of locations on the west coast and flowed into many modern day river valleys. Several caves have developed in dolomite and limestone. Well known are King Solomons Cave and Marakoopa Cave at Mole Creek, and the Newdgate Cave at Hastings. Gravels are also left from rivers in Quaternary times with pebbles of quartzite, dolerite and agate.