STORIES IN STONE

THE CAPE TOWN TIN MINES

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Safety

Some locations can be dangerous because of opportunistic criminals. Preferably travel in a group when visiting geological outcrops. The abandoned mines described in this document are dangerous and not to be entered.

The text of this article is based largely on a previous publication: Miller, D. 2006. The tin mines of Cape Town. *South African Lapidary Magazine* 38(3): 12–20.

Amour Venter and Gregor Borg kindly gave permission to use their photographs.

Previous page: Quartz vein in Malmesbury hornfels at the Vredehoek tin mine, Devil’s Peak, Cape Town (photograph by Gregor Borg)

CAPE TOWN'S TIN MINES

In the vicinity of Cape Town there are some six tin-bearing deposits, associated with the Cape Granite Suite. The geology of the various tin occurrences in the Cape has been described most recently by Theron et al. (1992) and Cole (2003). Three of these occurrences were mined for cassiterite (SnO_2) in the early 20th century (Jones 2010). The deposit first mined at the turn of the century was on the farm Annex Langverwacht 245 near Kuils River. Most of the production was from alluvial deposits, producing over 700 tonnes of cassiterite concentrate until the working ceased in 1956. The visible remains of mining include various trenches and shafts, sunk into or near the ore bodies, as well as the remains of a boiler and hoisting machinery (Ingram 2003, Miller 2006).

Remains of a boiler and hoist at Zevenwacht (photograph by Amour Venter)

The abandoned hoist at Zevenwacht (photograph by Amour Venter)

The primary tin-bearing lodes, from which the alluvial cassiterite weathered, consist of quartz veins and fine-grained granite dykes, in a zone about 500 metres wide. The quartz veins reportedly contain molybdenite, wolframite, cassiterite, arsenopyrite, tourmaline, mica, and quartz. These veins are similar to others located in granites in the Helderberg area, and in metamorphosed sediments of the Malmesbury Group around Durbanville. The latter were prospected between 1904 and 1906, producing about 0,5 tonnes of concentrate. The tin mineralisation is related directly to the waning phases of the intrusion of the Cape Granites, dated to around 510 million years ago.

There are still several open horizontal adits at the former Zevenwacht tin mines (photograph by Amour Venter)

There are also some hazardous, partly-filled open shafts at Zevenwacht (photograph by Amour Venter)

Inspecting one of the abandoned adits at the Zevenwacht tin mine (photograph by Amour Venter)

At Kuils River black cassiterite (SnO_2) grains mostly 1 to 2 millimetres in diameter occur in quartz veins and fine-grained granitic (aplite) dykes in the granite host rock. These veins and dykes form ‘lodes’ between 1 and 3 metres wide, trending in a north-westerly direction across the boundary area of the farms Annex Langverwacht, Rosendal and Haasendal. On Annex Langverwacht and Rosendal various shafts and trenches were dug to intersect the ore bearing lodes. In addition to cassiterite the quartz veins also carry the tungsten mineral wolframite ($FeWO_4$), as well as molybdenite, pyrite, arsenopyrite, chalcopyrite, and tourmaline.

Erosion of the primary ore bodies produced alluvial deposits in the streams draining the hilly area. The stream bed on Annex Langverwacht was mined for its cassiterite-bearing quartz gravel. In fact, the alluvial deposits were the main source of the estimated 778 tonnes of cassiterite recovered during sporadic mining between 1902 and 1956. Only 28 tonnes of cassiterite concentrate and 5 tonnes of tungsten ore were mined from the hard rock lodes.

At Durbanville, cassiterite occurs along with small amounts of gold in quartz veins in the shales and impure quartzites of the Malmesbury Group rocks. This mineralisation has been identified geochemically as magmatic, that is, derived from a molten igneous source, presumably a nearby granitic intrusion. Various excavations exist on the farms Welbeloond, Hoogekraal 157 and Kuipers Kraal 133. A total production of 0,5 tonnes of concentrate at 70 percent tin has been reported from this area.

Cassiterite (SnO_2) crystals up to 2 cm across in vein white quartz from Zevenwacht, in the historical Wagner Collection, University of Cape Town

In 1909 cassiterite was discovered in a stream above Vredehoek on Devil's Peak (Nellmapius 1912). Mining here started in 1911 but had ceased by 1916 after producing an estimated total of about 4 tonnes of concentrate (Spargo 1991). The visible remains include the concrete flumes for concentrating the dense cassiterite, as well as beautifully constructed retaining walls, a blocked vertical shaft some 55 metres deep, and an accessible horizontal adit penetrating the Malmesbury Group rocks about 100 metres.

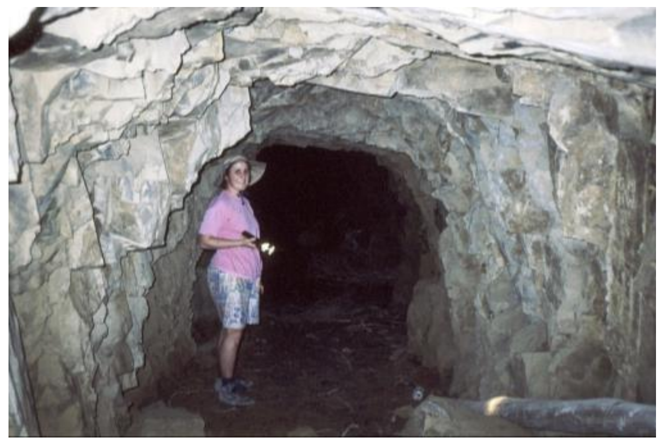
View towards Vredehoek from the former Devil's Peak tin mine, with the concrete washing flumes in the foreground

The Vredehoek tin mine on the slopes of Devil's Peak is some distance from the nearest granite-Malmesbury contact, but the style of mineralisation is very similar to that reported from Durbanville. No doubt the mineralisation also owes its existence to fluids expelled during the solidification of the intrusive Cape Granite.

The carefully constructed, abandoned walling at the Devil's Peak tin mine above Vredehoek

Adrian Frith at the obscure, collapsed entrance to the adit at the former Vredehoek tin mine on Devil's Peak. Subsequently it has been fenced off with a notice not to enter.

The cassiterite occurs in nearly horizontal quartz veinlets, in a zone about 8 metres wide with a north-south orientation, in Malmesbury Group shales. The veins consist of coarsely crystallised quartz with dark reddish-brown, cassiterite crystals, mostly near the margins of the veins. Accessory minerals are tourmaline, pyrite, arsenopyrite and rutile. No more than about 4 tonnes of tin concentrate were produced between 1911 and 1912. The short history of this mine has been documented in detail by Spargo (1991). Unfortunately, the visible remains are disintegrating rapidly, and despite being approached several times with plans to conserve them, the Cape Town City Council has remained indifferent to their preservation.



Vera Frith exploring the horizontal adit in the former Vredehoek tin mine on Devil's Peak

Dark brown cassiterite (SnO_2) crystal in white vein quartz, from the Vredehoek mine on Devil's Peak. The specimen is 8 cm wide.

To gain some insight into the origin of these tin deposits, one must turn to the history of the Malmesbury Group rocks and the Cape Granites which intruded them. Between about 1 000 and 600 million ago, an ocean lay to the west of present-day southern Africa. Regular alternations of muddy and sandy sediments accumulated on this ocean floor, probably as submarine fans on the deep ocean floor. Sometime around 600 million years ago this ocean closed up in a mountain building event (or orogeny). Wedges of metamorphosed sediments in the form of shale and impure quartzites were plastered onto the continental margin to make up the rocks of the so-called Tygerberg Terrane.

The dating of this event is uncertain but the older Cape Granites, intrusive into the rocks of the Tygerberg Terrane and associated with the collisional phase of the orogeny, have been dated to about 585 million years. The Tygerberg Terrane is the southernmost of three wedges of Malmesbury Group rocks (the other two are the Swartland Terrane and the Boland Terrane), separated from each other by major northwest trending faults.

Various episodes of granite intrusion took place into these rocks, extending over a long period of time from about 585 to 516 million years ago, and resulting in a large mountain chain.

So, how does all this happen? Why do oceans open and close? How do mountains and granite intrusions form? And what does this have to do with tin? Until about forty years ago geologists did not have good answers to these questions. Now we know that the semi-rigid crust of the Earth is covered with discrete plates, like the back of a tortoise. But unlike a tortoise, they are all different shapes and sizes, some carry continents and some carry only much thinner oceanic crust. These crustal plates are continuously on the move relative to one another, driven by heat convected through the mantle rocks below them.

The metamorphosed Malmesbury Group rocks in the foreground were deposited originally on the sea floor, then were subducted, deformed, and eventually exposed by erosion.

At volcanic mid-ocean ridges new crust is created, and the ocean floor widens, in places plunging back into the mantle below continental margins or shunting continents along until they collide. In both cases associated mountains form by a combination of mechanisms. Simplistically, continental collision may form mountains by crumpling, plastering any intervening ocean floor rocks onto the join, and by thickening the crust. The formation of the Himalayas through the collision of India with Asia is a modern example.

When ocean floor plunges under a continental margin (the process known as subduction), wet ocean sediments are driven into the hot mantle and may partially melt. This molten mass is buoyant and can rise, intruding, metamorphosing, and often partly melting the crustal rocks above it, and forming volcanoes where any molten rock reaches the surface. Much of the melt cools and solidifies at depths of 10 kilometres or more, to form coarse-grained igneous rocks like granite. The Andes are a good modern example of such mountains, associated with the subduction of Pacific Ocean crust. These mountain-building processes are known as ‘orogeny’.

Obviously, both orogenic mechanisms can be involved in building any particular mountain chain. An ocean floor can be subducted until the ocean closes completely and the continental masses on each side collide, creating a complex geological record consisting of a variety of rocks – volcanic lavas, metamorphosed sediments, and intrusive igneous rocks of various kinds including granites. Erosion of the mountain chain will expose these various rocks, eventually revealing the originally very deep roots of the mountain chain.

These granite domes on Paarl Mountain originally crystallised from molten magma tens of kilometres below the surface of the Earth. They have been exposed by subsequent erosion of the rocks above them. (photograph by Amour Venter)

Typically, these exposed roots will include metamorphosed sediments, altered chemically and physically by the intense heat and pressure of their burial and deformation. Depending on the level of erosional exposure, they may also include masses of intrusive igneous rocks, originally formed in the roots of developing mountains by partial or total melting of deeply buried rocks. This is precisely the situation we have with the Malmesbury Group rocks and the intrusive Cape Granite.

A world-famous example of the contact between the metamorphosed, partly digested, Malmesbury slate and the intrusive, formerly molten Cape Granite is exposed at the southern end of the Sea Point beach front.

Dark Malmesbury Group rocks intruded by lighter Cape Granite at the Sea Point beach front.

These are the exposed remnants of the roots of a former mountain chain the size of the Alps, subsequently eroded down to modern sea-level. The rocks now exposed on the surface were buried at least 10 kilometres deep when the Cape Granite actually solidified more than 500 million years ago. This formed part of the early assembly of the Gondwana supercontinent and preceded the deposition of the Table Mountain sandstones and formation of the Cape Fold Belt.

A molten body of granitic composition, intruding into metamorphosed sedimentary rocks at a depth of many kilometres in the roots of a growing mountain chain has a profound effect on the surrounding rocks. Apart from the thermal metamorphism caused by the heat conducted away from the cooling molten mass as it crystallises and solidifies, it expels fluids. These hot, water-based fluids under pressure (so-called hydrothermal fluids), penetrate the surrounding rocks, including the metamorphosed sediments and any pre-existing granite that may have intruded in an earlier episode. Hydrothermal fluids carry with them various dissolved elements, including some that can precipitate on cooling to form metallic ores, depending on the composition of the source rocks and those they travel through.

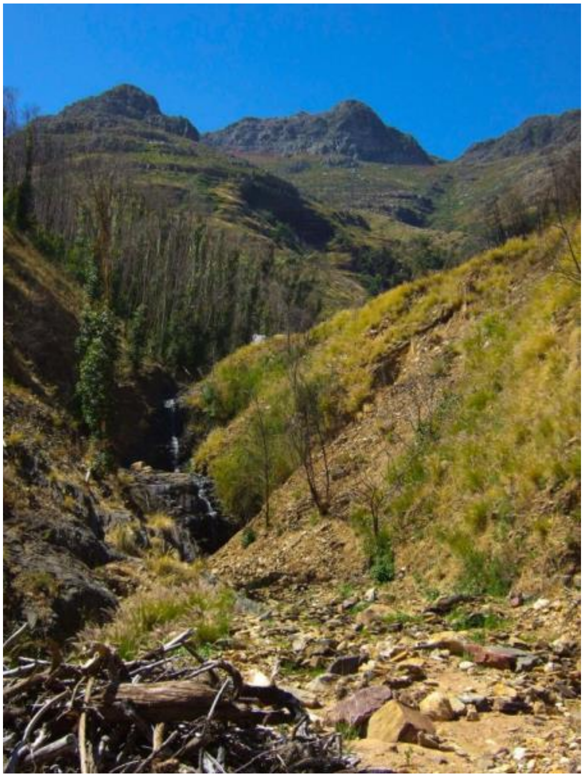
These dissolved elements may crystallise in cracks in the cooler surrounding rocks, forming veins or more dispersed impregnations at sufficient concentrations to be of potential interest to us. One of the mobile elements that can be transported in hydrothermal fluids is tin. In the case of the Cape tin mines, ore bodies are found in both the metamorphic Malmesbury Group rocks and in late stage veins in the Cape Granite. In a recent review, ‘The Metallotects of Southwestern Gondwana’, this occurrence is described as ‘classical granitic-intrusion-related origin of the cassiterite-bearing quartz veins’ (Borg & Gauert 2018: 658).

These colourful intrusive igneous rocks at Yzerfontein have veins of iron sulphides containing small amounts of copper and gold. (photograph by Amour Venter)

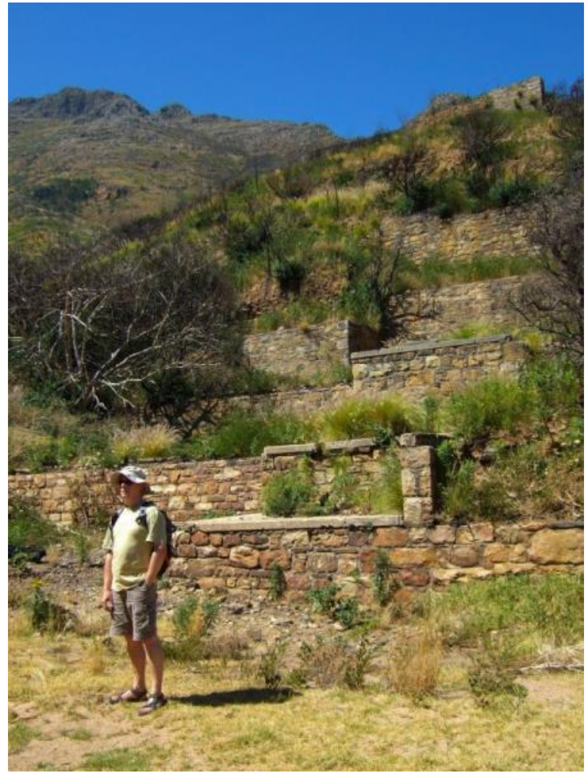
The three historic tin mines described here exploited ores forming a subset of about 20 distinct reported deposits of hydrothermal mineralisation associated with emplacement of the Cape Granites. These are described in detail by Rozendaal & Scheepers (1995). Other examples include the relatively well-known gold-bearing copper/iron sulphide veins on the coast at Yzerfontein; veinlets containing pyrite, chalcopyrite, magnetite, molybdenite; arsenopyrite in the Boterberg Granodiorite southwest of Philadelphia near Malmesbury; and other less well-known occurrences of tin, tungsten, copper, gold, and molybdenum mineralisation (Cole 2003, Jones 2010).

VIRTUAL TOUR OF THE DEVIL'S PEAK TIN MINE

PHOTOGRAPHS BY GREGOR BORG



Tin Mine Stream runs down the northern slopes of Devil's Peak to the Cape Town suburb of Vredehoek.



The only externally visible remains of the mine are some disintegrating concrete washing flumes and this rather elaborate walling on the southern side of Tin Mine Stream.

The interior of the mine is wet. The horizontal adit is ankle deep in water, even in summer. There are unprotected, water-filled vertical shafts in the floor of the main mining chamber.

Some of the rubble-filled shafts are timbered, with the original timbers preventing collapse.

The tin ore, cassiterite, occurs in nearly horizontal quartz veins, some of which are still visible in the mine. The width of the field of view is 1,6 metres.

It is quartz veins like these cutting the Malmesbury hornfels outside the mine that must have lead prospectors in the early 1900s to explore here for exploitable tin ore.

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