

I. Serpentine Hill



Key facts about this geosite:

- The serpentine bearing complexes are a series of thrust-emplaced, dismembered **ophiolitic** bodies
- The rare purple mineral stichtite is found here
- Mining of Asbestos from ultramafic rocks at Serpentine Hill and "Argent Tunnel Prospect" occurred during the early 1940's

How to get there: From Zeehan, follow the Zeehan Highway (B27) east for 6 kilometres to the junction with the Murchison Highway (A10). Turn left and follow the Murchison Highway north for approximately 6 kilometres to a small quarry located on the western side on the road (Figure 1). Alternatively, if travelling south from Tullah or Rosebery on the Murchison Highway, the Geosite is 5.5 kilometres south of the Renison Bell Tin Mine. Be careful entering and exiting for traffic on the road. Watch out for bees in summer. The asbestos mines are on the eastern side of the road and best avoided. Be very careful with steep faces and loose rocks.

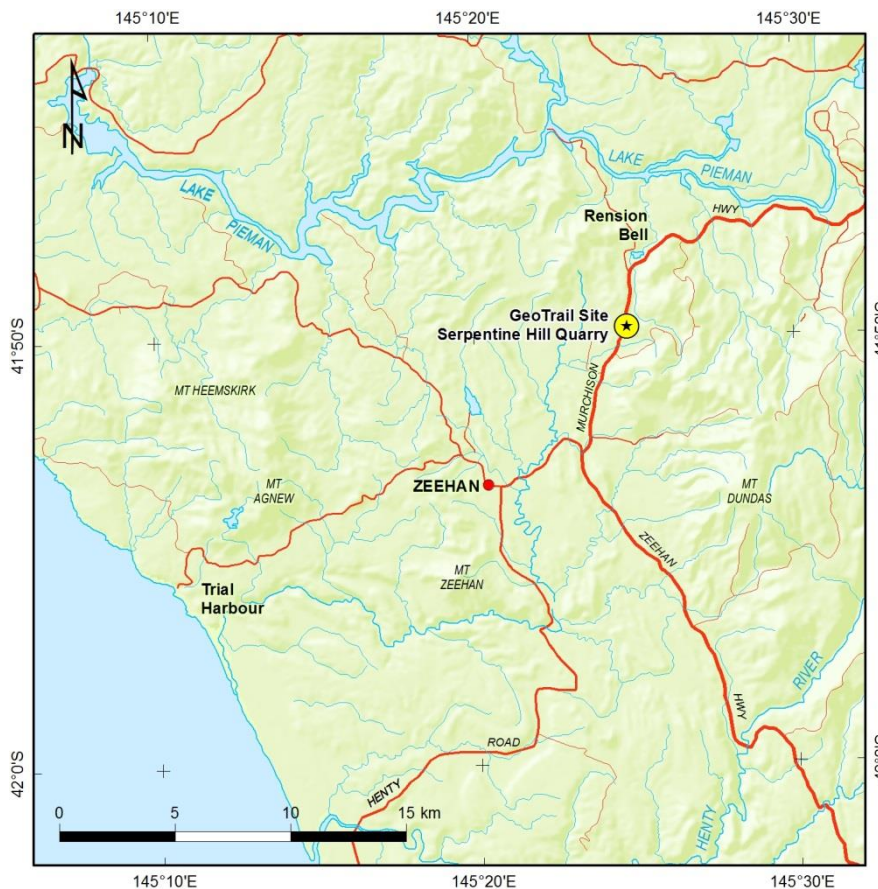


Figure 1. Location of the Serpentine Hill Geosite.

Geosite description: This site, is a good exposure of Early Cambrian [ultramafic](#) rocks, remnants of [thrust](#)-emplaced, dismembered [ophiolitic](#) sequences. They were originally mostly [peridotites](#) and [pyroxenites](#), rich in [olivine](#) and [enstatite](#), but are now largely altered to [serpentinite](#).

[Asbestos](#) was mined from these ultramafic rocks in workings at Serpentine Hill across the road and the nearby "Argent Tunnel Prospect" during the early 1940's. By the end of October 1945 approximately 360 tonnes of bagged fibre had been extracted. Sparse asbestos veins and fragments still occur in this area (Figures 2 and 3) and visitors should be careful not to break up any potentially asbestos bearing rocks, as the fibres are potentially carcinogenic if inhaled in large quantity.



Figure 2. Asbestiform chrysotile veins, 1-2cm wide, in serpentinite.



Figure 3. Fibrous chrysotile vein, 15mm wide, in serpentine.

At the Tunnel Hill quarry west of the highway, the rare purple to lilac mineral stichtite was found in an unusually rich vein-like deposit (Figure 4). This is a popular mineral for lapidarists and mineral collectors, and polishes well (Figure 5). The main lode has been worked out, but small specimens can still be found by diligent collectors.

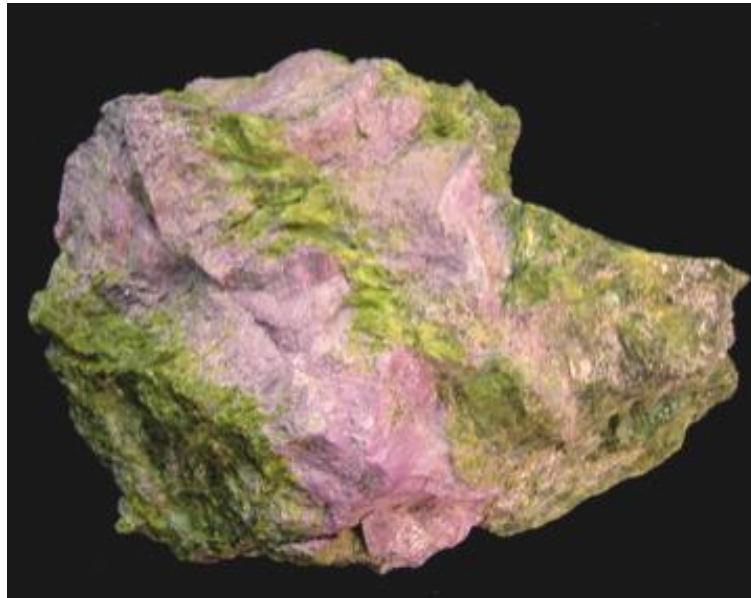


Figure 4. Stichtite (pink mineral) and serpentine from Serpentine Hill, 200mm across.
Photograph courtesy of Ralph Bottrill.



Figure 5. Polished sphere of purple stichtite and green serpentine, plus black chromite, from Dundas.

[Stichtite](#) ($\text{Mg}_6\text{Cr}_2(\text{CO}_3)(\text{OH})_{16.4}\cdot\text{H}_2\text{O}$) is an uncommon [magnesium hydroxycarbonate](#) which belongs to the [rhombohedral hydrotalcite](#) group and forms a series with hydrotalcite, [pyroaurite](#) and [woodallite](#). [Barbertonite](#) is a less common hexagonal polytype that was identified as intergrowths with stichtite from Dundas by Bottrill and Brown (2000).

There are five main stichtite deposits in Tasmania (Figure 6). These include Serpentine Hill, Nevada Creek, West Comet, Stichtite Hill (the type locality) and Birchs Inlet. The Stichtite Hill area is presently being mined for stichtite and [serpentine](#) (mostly for carving and polishing: Bottrill and Brown, 2000) and is one of the principal sources of stichtite specimens in the world. The lilac to purple stichtite in a green or black serpentine matrix makes attractive specimens.

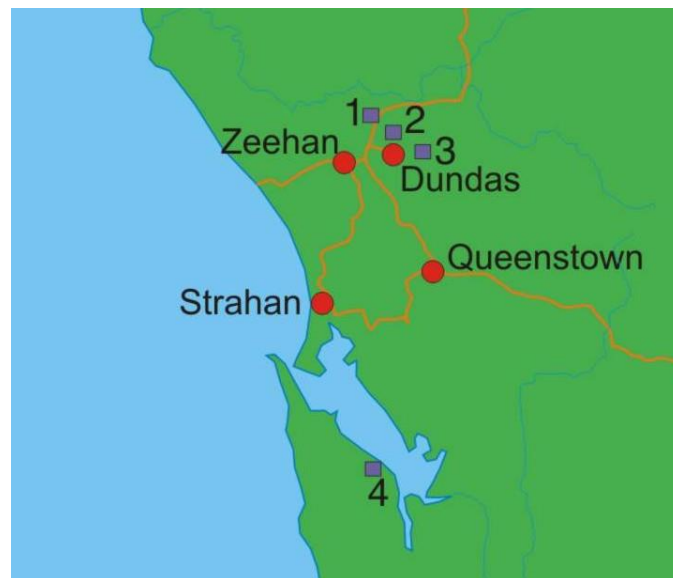


Figure 6: Locations of the main stichtite occurrences in Tasmania. 1: Serpentine Hill; 2: Nevada Creek, 3: Stichtite Hill, 4: Birches Inlet.

The Stichtite is hosted in serpentinised [dunites](#) within [Early Cambrian ultramafic complexes](#), particularly the Dundas ultramafic complex (Brown, 1986; Burrett and Martin, 1989). These complexes are a series of thrust-emplaced, dismembered ophiolite sheets found along the Dundas Trough, which bisects western Tasmania. During the Devonian era they were deformed and intruded by mineralised [granites](#) (Brown, 1986) (Figure 7).



Figure 7. Looking southwest from near Serpentine Hill towards outcropping Devonian Granite in the Mt Heemskrik and Mt Agnew area. (Photo courtesy of David Gatehouse.)

Interesting facts about stichtite in Tasmania: The stichtite deposits at Dundas are all hosted by generally massive serpentinite bodies, probably derived from altered [chromite](#)-rich dunites (Brown, 1986). The occurrences of stichtite are erratic, both in size and distribution within the serpentinites, and some appear to be related to shearing and brecciation of the host serpentinite. The occurrences include zones ranging from small spots of stichtite forming coronas nucleated around chromite, through to zones with stichtite remobilised during deformation into coarser patches and irregular vein-like bodies (up to 20 cm across; Figure 2), cutting serpentinite. The latter style of occurrence is the best source of stichtite specimens for collectors and lapidarists, but is very uncommon.

Stichtite occurs as opaque to translucent, pale pink to lilac, orange (weathered), crimson, mauve or deep purple, fine-grained, massive to finely foliated material with a dull to waxy and pearly lustre. It commonly contains disseminated chromite-[magnesiochromite](#) grains (up to 1 cm diameter), which may be [octahedral](#) or occur in irregular to highly angular fragments. The stichtite is hosted in massive to schistose, pale to yellowish green, dark green or black serpentinite. The serpentinite contains mostly serpentine minerals and minor chlorite, [talc](#), [magnetite](#) and [hematite](#). The black serpentinite contains abundant fine-grained disseminated magnetite. The serpentines mostly comprise [lizardite](#) and/or

[clinocrysotile](#), but [antigorite](#) occurs in some schistose serpentinites. [Asbestiform chrysotile](#) is a rare associate of stichtite, but occurs in some nearby serpentinites.

Discrete macroscopic stichtite crystals are unknown, but in thin section it consists of fine-grained platy or [micaceous](#) to radiating fibrous aggregates of [crystallites](#) to 2 mm or more in size. It forms radiating aggregates around, and largely replacing, chromite and also part of the surrounding serpentine minerals. In some samples, stichtite is partly altered to a chromian [clinocllore](#), but this is only observed microscopically. Stichtite may also occur in association with [aragonite](#), talc, clinocllore, haematite and magnetite.

Some stichtite is partly weathered to soft pink aggregates that can include [hydromagnesite](#), [kaolinite](#) or [magnesite](#), in admixture with relict stichtite. One partially weathered specimen from the Petterd collection in the Tasmanian Museum, Hobart, contains the rare mineral [mountkeithite](#), a hydrotalcite-type phase with an expanded interlayer containing MgSO₄ (Hudson and Bussell 1981). The mountkeithite occurs as very fine-grained (sub-mm) masses of very pale pink platy resinous interlocking schistose grains. It's presence was confirmed using [X-ray](#) diffraction and [EDS](#) techniques.

Historical information about Stichtite in Tasmania: Stichtite was known from Dundas since 1891 and was first recorded (albeit described incorrectly as "[kammererite](#)", a chromian clinocllore) by Petterd (1896) after a specimen from there was exhibited at the Tasmanian Exhibition in Launceston in 1891 (Twelvetrees, 1914). It was later recognised as a new mineral by Petterd (1910), after chemical analysis by A.S. Wesley at the Mt Lyell mine, but Petterd died in 1910 before describing the mineral properly. It was formally described by Twelvetrees (1914) who sent material to Europe for more detailed analysis by several mineralogists and collated the various mineralogical data from Petterd (1914, description), Ward (1914, optics), Hezner (1914, chemistry) and Himmelbauer (1914, structure). It was named stichtite after Mr Robert Sticht, general manager of the Mt Lyell mines, and a world-renowned pioneering metallurgist and sponsor of Petterd's first catalogue of minerals.

The original find and type locality was described by Twelvetrees (1914) as "the razorback crest of a ridge above the Adelaide silver-lead mine, Dundas". This description corresponds well with the present workings on Stichtite Hill. A co-type sample is stored in the ENSM (School of Mines) Paris, France (Sutherland et al., 2000).

Other Minerals at Serpentine Hill: Fibrous magnetite occurs in interesting specimens (Figure 8). Pyroaurite (and/or [sjogrenite](#)) occurs sparsely as earthy orange to pale yellow material, commonly with fibrous magnetite in fine joints and shear-related veinlets, mostly in relatively chromite-poor serpentine, but also with stichtite. Some "[osmiridium](#)" (a mixture of several Os-Ir-Ru alloys and other platinum group elements) is reported to occur in small amounts in alluvial deposits derived from the serpentinites at Dundas (Reid 1921).

Primary occurrences of this material are usually hosted by chromite grains and chromitites, and may thus potentially occur within some stichtite specimens. Some small, altered [pegmatitic](#) pyroxenite and [gabbro](#) bodies (now mostly altered to serpentine minerals and “hydrogrossular”) also occur within the serpentinite.



Figure 8. Black fibrous magnetite in green serpentine, with minor yellow pyroaurite.

Interesting Facts about ultramafic rocks in Tasmania: Low-titanium tholeiites and related gabbros form a major part of the Serpentine Hill Ultramafic Complex. These ultramafic rocks are important host rocks for Platinum Group Elements and associated mineralisation. The arcuate belt of Neoproterozoic–Cambrian rocks in western Tasmania contains a number of different volcano-sedimentary successions, with the volcanic rocks ranging from mafic to felsic in composition. A number of ultramafic-mafic rock complexes are exposed along the deformed western margin of this zone. The main features of Tasmanian ultramafic rocks are that they are high-magnesium, well layered and, prior to serpentinisation, were dominated by olivine and [orthopyroxene](#) (enstatite). [Clinopyroxene](#) and [plagioclase](#) are subsidiary mineral phases and only occur as post-[cumulate](#) minerals in one of three different successions. These features separate the Tasmanian rocks from the dominantly clinopyroxene-rich ultramafic rocks which are usually associated with mid-ocean ridge and back-arc tectonic environments.

The closest correlates (or similar rock types) to the Tasmanian rocks occur within the Marum ‘ophiolite’ of Papua New Guinea (England and Davies, 1973; Jaques and Chappell, 1980; Jaques, 1981) and the Betts Cove area in Newfoundland (Church, 1977). The ultramafic rocks of western Tasmania have been subdivided into three different successions

using a combination of field and constituent mineral chemistry (Brown, 1986). These three sequences are;

- a high-magnesium layered dunite-[harzburgite](#) (Figures 9 and 10) succession (LDH), which contains a tectonic [fabric](#) formed by plastic [deformation](#) of cumulate layers;
- a layered pyroxenite-dunite succession (LPD), which is dominated by orthopyroxene; and
- a multiply-intrusive ultramafic-gabbro succession (LPG).
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Figure 9. Layered dunite-harzburgite at Serpentine Hill.
Photograph courtesy of Tony Brown.

The largest volume of ultramafic rocks belongs to the olivine-rich LDH succession. This succession consists of well-layered dunite, orthopyroxene-bearing dunite and minor harzburgite. Layering is defined by primary mineral alignment of cumulate olivine, orthopyroxene and chromite grains, though now mostly serpentinised. A tectonic fabric, parallel to layering, pervades the succession. This fabric is defined by a flattening and elongation of the primary cumulate minerals. This succession is considered to have been formed as the magma chamber component of boninitic magmatism (Brown and Jenner, 1989).

The LPD succession is also well layered but is dominated by orthopyroxene. The main rock types are orthopyroxenite and olivine orthopyroxenite, with a lesser amount of dunite. Harzburgite layers have not been found within this succession. The mineral chemistry has a wider compositional range but is also very consistent from area to area. Plagioclase has not been observed in rock from either of the LDH or LPD successions.

The third ultramafic succession is characterised by multiple intrusions of various ultramafic and mafic rocks (Brown et al., 1988). This succession consists of an early, well-layered sequence of orthopyroxenite with subsidiary olivine pyroxenite and dunite. This sequence varies from the LPD succession in that dunite layers usually contain an upper, mineral-graded zone, and numerous sedimentary-like structures occur within and across the layering.



Figure 10. Banded dunite/pyroxenite at Serpentine Hill.

[Basaltic](#) rocks associated with these ultramafic complexes: Two basaltic [lava](#) types have been recognised within the ultramafic rock complexes. Both types contain [pillow lava](#) and [tabular lava flows](#) with intercalated breccia units, consisting of volcanic flow detritus, and minor interbedded sedimentary rocks. One of the varieties is chemically and petrographically similar to some of the Western Pacific [boninite](#) lavas (Kuroda and Shiraki, 1975; Shiraki and Kuroda, 1977; Hickey and Frey, 1982). The second lava variety is a low-Ti [tholeiitic basalt](#).

These lavas are especially unusual. They consist of chrome spinel and [pseudomorphed clinoenstatite](#) and [orthoestatite phenocrysts](#) in a fine-grained to quenched groundmass of pyroxene [microlites](#). The lavas have unusual chemistry with anhydrous SiO₂ contents of 53–

59 wt % with an average of 56 wt %. TiO_2 is less than 0.2 wt %, MgO is between 18 and 24 wt %, Zr and Y have average values of ~6 ppm, Nd is less than 3 ppm, and the lavas have concave chondrite-normalised REE patterns with $(\text{La}/\text{Yb})_n \sim 1$ (Brown and Jenner, 1989). The boninitic lavas occur mainly in the southern part of the Heazlewood River area but fault-bounded blocks also occur to the south of Mclvor Hill and in the Moores Pimple area to the northeast of Dundas.

The second lava variety (the low-Ti tholeiitic basalt) are [aphyric](#) but contain a large grain size variation down through a flow. The flows usually have pillow-structured tops, then progress down through fine (1–2mm), medium (3–5mm) to coarse-grained (>5 mm) basalt, the coarser grained varieties resembling gabbro in hand specimen, to a chilled base. In places, thin, intercalated, sedimentary rocks occur between flows. Lavas belonging to this group occur on the eastern side of the Heazlewood and Serpentine Hill area and at Mclvor Hill.

Summary: The ultramafic rocks in western Tasmania are considered to have formed as magma chamber cumulates from parent liquids which produced boninitic and low-titanium basalt lavas and associated gabbroic rocks. The Western Pacific island arc system between New Guinea and Japan is a Tertiary to Recent setting for the production of similar lavas and associated rocks. The present juxtaposition of rock successions in western Tasmania is considered to be the result of an island arc being [obducted](#) onto a continental terrane during the early Cambrian, followed by further deformation during a mid-Devonian orogeny.

Additional Information: Further information on PGE and their host rocks in Tasmania can be found in a number of background reports, including:

- Report on the osmiridium 'lode' at the head of Main Creek, Adamsfield (Nye, 1930);
- Geological Survey Bulletins Osmiridium in Tasmania (Reid, 1921) and The osmiridium deposits of the Adamsfield district (Nye, 1929), both of which were reprinted as a single volume in 1991;
- Notes on the history of mining and exploration at Adamsfield (Bacon, 1992);
- Platinum Group Metals. Supply, uses and future (Stait, 1987);
- Geology and economics of platinum-group metals in Australia (Hoatson and Glaser, 1989);
- Bibliography on mineralogy, geochemistry, metallogeny, analytical procedures and exploration of the Platinum-Group Elements (de Oliveria et al., 1991);
- International strategic minerals inventory summary report — Platinum-Group metals (Sutphin and Page, 1986).

A geological map of the Serpentine Hill area is presented below (Figure 11).

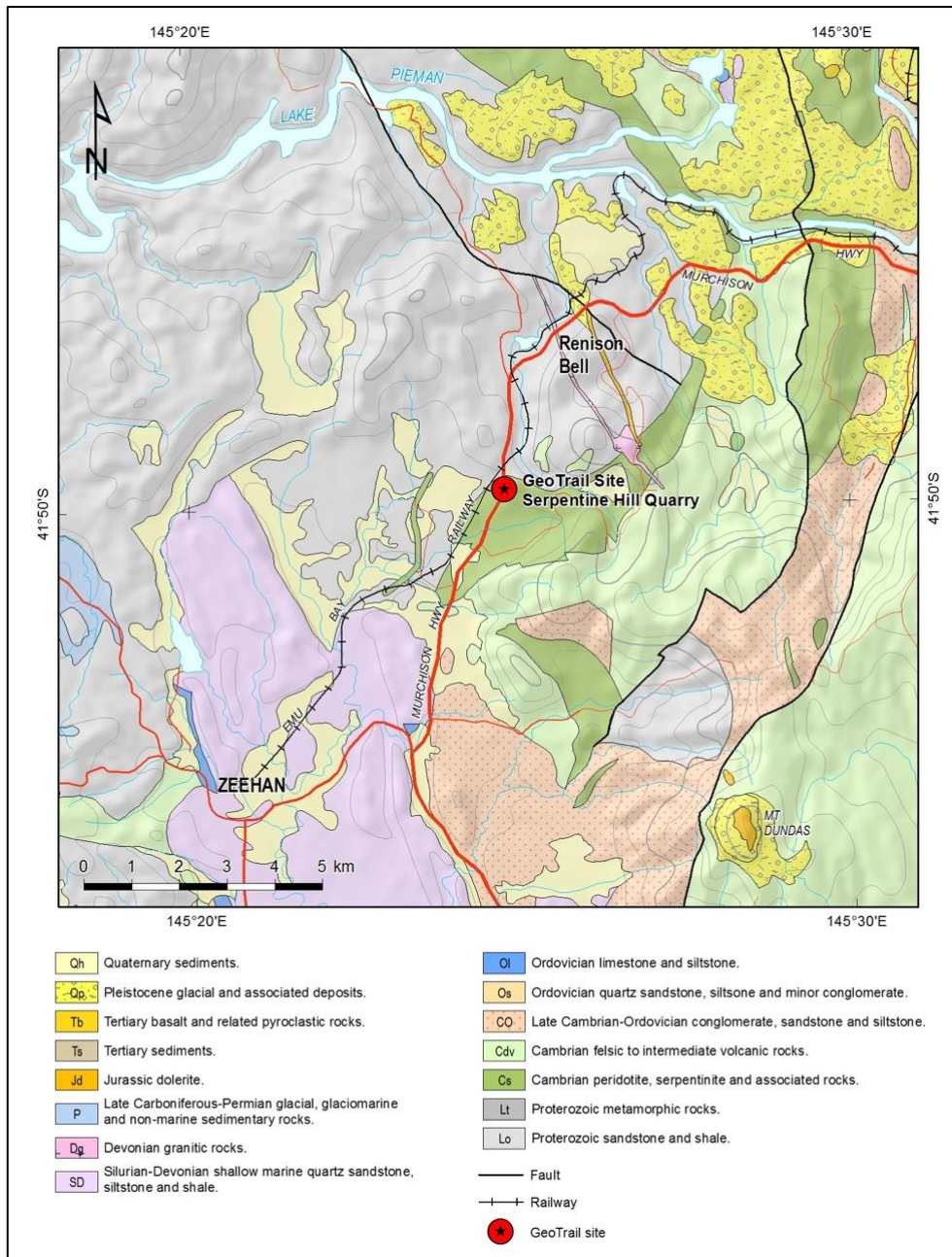


Figure 11. Geological map of the area showing the location of the Serpentine Hill Geosite

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