

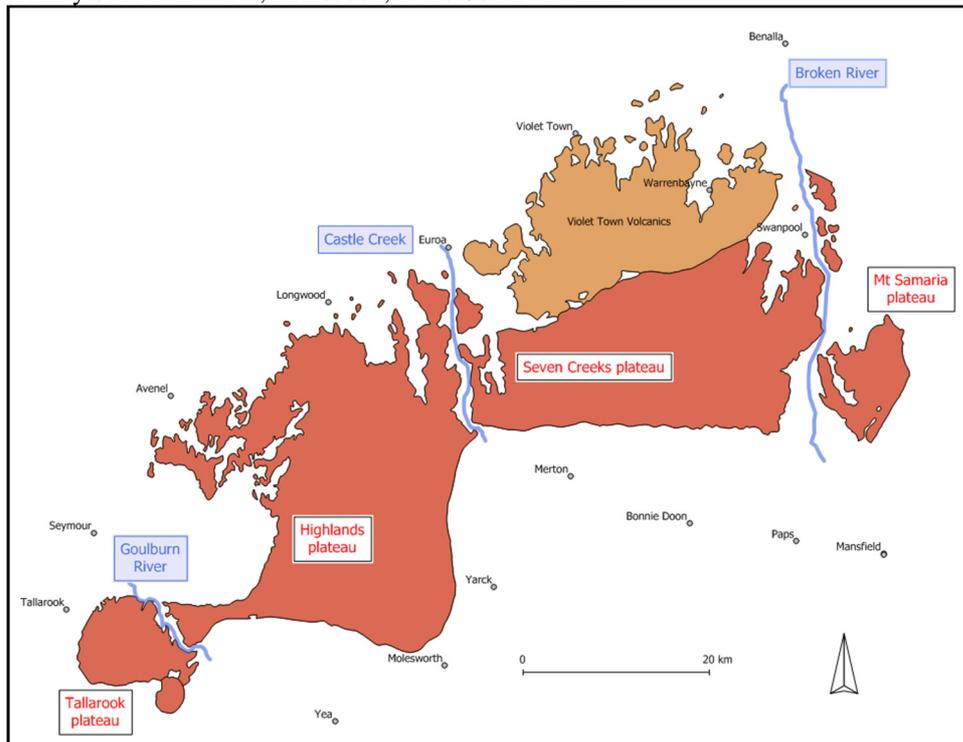
Strathbogie granite: a platform for local science *Under the microscope conference*, Euroa Victoria, June 2019.

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The Strathbogie Granite extends for 2000 km² in north-east Victoria and is divided into four distinct plateau areas by the Goulburn River, Castle Creek and the Broken River. From west to east these plateaus are Tallarook, Highlands, Seven Creeks and Mt Samaria. The Violet Town Volcanics are a separate but less extensive unit geologically from this granite. The volcanic rocks and granite are geographically close to one another in the vicinity of Kelvin View, Kithbrook, Boho South and Lima.



Strathbogie Granite (red), Violet Town Volcanics (brown), various plateaus with subdividing waterways, and locations.

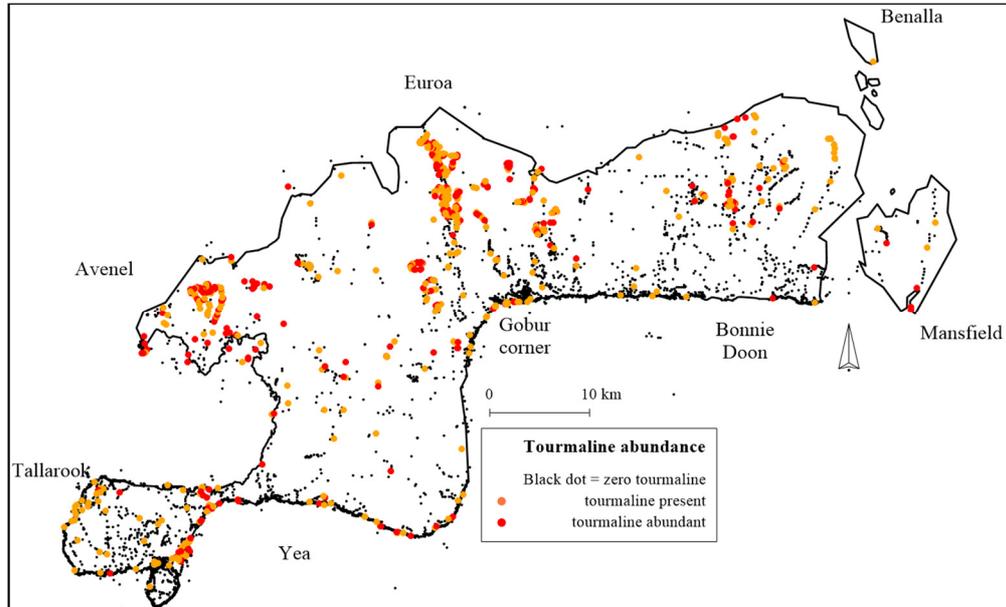
There is a significant contrast in the mode of formation of the volcanic rocks (i.e. those that come out at the surface as lava, ash falls and ash flows) compared to the dominant plutonic rocks (i.e. Strathbogie Granite magma that never reached the surface but solidified slowly underground giving generally coarse-grained crystals). Distinguishing the Violet Town Volcanics (VTV) and Strathbogie Granite is not easy in the field even to the trained eye. Features of the VTV include microscopic glass shards, flattened pumice and broken crystals.

Within the Strathbogie Granite there are several variants including the finer-grained Kerrisdale and Lightning Ridge microgranites near Strath Creek, and Lima East, respectively. Most of the granite though is a mix of a coarse-grained variant with 4-5 cm feldspar phenocrysts and, separately a microgranite (aplite) which has a sugary-texture and feldspar and quartz grains about 1-2 mm in diameter.

As for all granites, the Strathbogie Granite contains feldspars, quartz and a mica (in this case the black biotite). What makes the Strathbogie Granite scientifically important globally is the abundance of the mineral cordierite ($(\text{Mg Fe})_2\text{Al}_4\text{Si}_5\text{O}_{18}$). Other granites in Europe, Nova Scotia and South Africa have cordierite but none appear to have common cordierite throughout 2000 km² of outcrop.

The VTV and Strathbogie Granite formed 374 and 373.5 million years ago, respectively. The Earth's crust under central Victoria was especially hot and beyond 15 km depth rocks melted. Temperatures of 850 – 900°C are inferred. Some of the magma, or liquid rock, rose to the surface and formed ash clouds and particularly ash flows (VTV). Different magmas formed slightly later and rose but failed to reach the surface instead spreading out laterally and cooling slowly to form granite. Some of the granite reached within 1 km of the surface (i.e. the surface of the time), and so was covered with the pre-existing sedimentary rocks. These very high temperatures (for granitic rocks) and shallow depth of emplacement are two reasons for the widespread cordierite.

An example of the influence of the granite geology on agriculture might be the distribution of boron. This element is important for the full development of plants, their reproduction, their roots and early growth; for example, boron is important for successful cultivation of olives. In many rocks, tourmaline is the only mineral in which boron is found. By chance, tourmaline in the Strathbogie granite is particularly easy to recognise in hand specimen, and the field mapping equates to 8000 qualitative boron analyses (see figure). However, the abundance of tourmaline in granite may not directly equate to the concentration of boron available in soils for plants. The pattern though is rather interesting with much more tourmaline to the north and a general absence to the south except at the granite margins. The north with tourmaline coincides with what is inferred to be the top of the granite sheet(s). Unlike boron, many of the other elements important for agriculture have low concentration in most granites.



Top: Tourmaline distribution reflecting abundance of boron in the fresh granite.

Left: Large white feldspar in coarse grained granite. Right: Large crystals in pegmatite vein in fine grained aplitic granite.

Baker G 1940. Cordierite granite from Terip Terip, Victoria. *American Mineralogist*, 25 543-548.

Clemens J C and Phillips G N 2014. Inferring a deep-crustal source terrane from a high-level granitic pluton: the Strathbogie Batholith, Australia. *Contributions to Mineralogy and Petrology* 168 1070-1091 with electronic appendices E1 1-16, E2 1-10, E3 1-6, E4 1-5.

Clemens J D, Wall V J 1981. Origin and crystallization of some peraluminous (S-type) granitic magmas. *Canadian Mineralogist* 19 111-131

Edwards J, Olshina A, Slater K R 1997. Nagambie and part of Yea 1:100 000 Map and report, Geological Survey Victoria Report 109, 142p.

Hergt J M, Phillips G N and Ely K S, 2002. Strathbogie Igneous Complex, central Victoria. *Victoria Undercover: Benalla 2002 Conference proceedings and field guide: collaborative geoscience in northern Victoria*. CSIRO Publishing, Melbourne 43-49.

Jay C 2017. The Kerrisdale pluton of the Strathbogie batholith: investigating textural and chemical variations. *Granites2017@Benalla symposium, Victoria, Australia*. *Australian Institute of Geoscientists Bulletin* 65 67-68.

Phillips G N 2017. Determining the shape of an intrusion: the Tallarook granite. *Applied Earth Science*, 126 11-30.

Phillips G N 2017 Strathbogie granite: a summary. *Granites2017@Benalla symposium, Victoria, Australia*. *AIG Bulletin* 65 88-92.

Phillips G N and Clemens J D 2013. Strathbogie batholith: field-based subdivision of a large granitic intrusion in central Victoria, Australia. *Applied Earth Science (Trans. Inst. Min. Metall. B)* 122 36-55.

Phillips N and Clemens J 2017. *Geology of the Tallarook plateau*. Excursion guide 58pp, *Outdoor Recreation In Victoria*.

Phillips G N, Ely K S, Hergt J M, Cownley D G, Paul B, Dickins C, 2002. 3D geometry of the Strathbogie batholith. *Victoria Undercover: Benalla 2002 Conference proceedings: collaborative geoscience in northern Victoria*. CSIRO Publishing, Melbourne 55-60.

Phillips G N, Wall V J, Clemens J D 1981. Petrology of the Strathbogie batholith: a cordierite bearing granite. *Canadian Mineral*. 19 47-64.