

Monaro Soils and Geology Tour

South East Local Land Services

5 December 2017

Background

Our visiting friends from Soil Knowledge Network (SKN) have come to the Monaro for their annual SKN meeting and knowledge sharing trip. SKN are a group of retired and semi-retired soil specialists who are passionate about soil and the land. They are an independent, not-for-profit group, which captures critical soil knowledge and experience.

Through field days, training events and their website, SKN's goal is "promoting the importance of soils through knowledge and expertise".

You can find more information about the group, their activities and several of their highly informative soil videos on their website: <http://www.nswskn.com/>

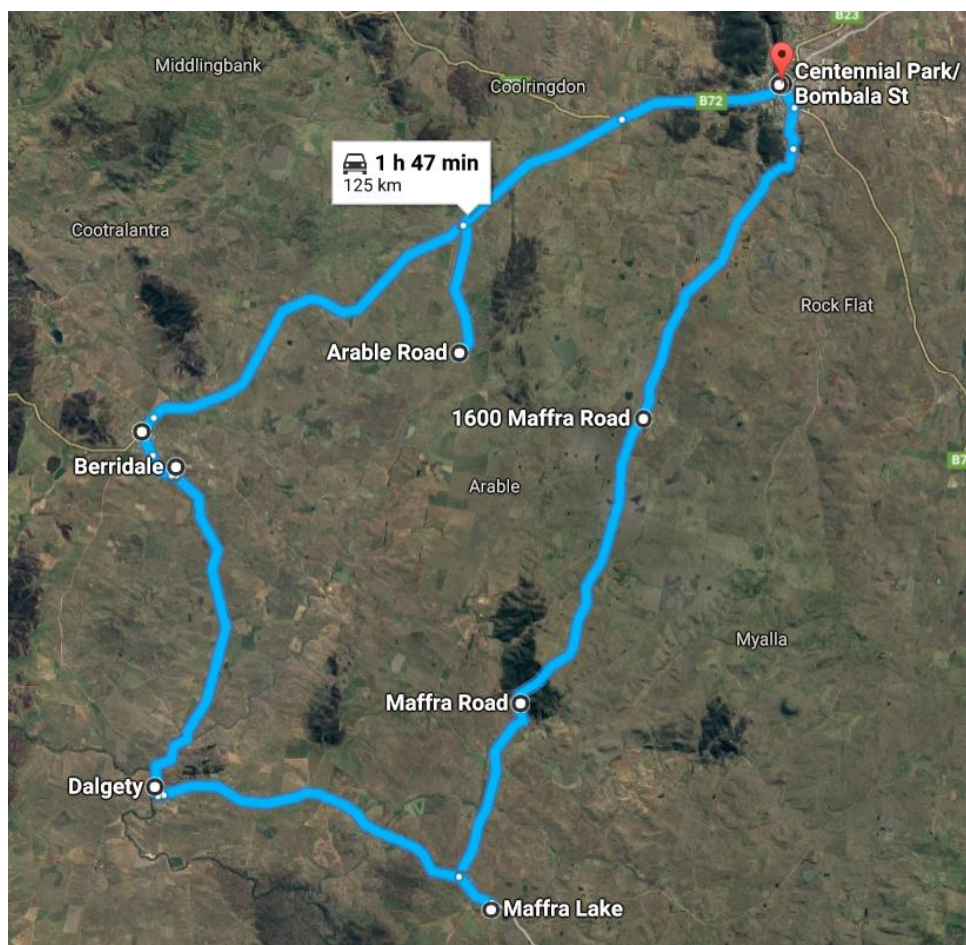


Figure 1. Tour Map (google maps)

The tour

Leaving from Centennial Park in Cooma, we travel south via Church Road and onto Maffra Road where we will be passing just west of “The Brothers”, then stopping at Ravensworth Travelling Stock Reserve (TSR). After this break we will briefly pause at Bobundara Nature Reserve and travel onto Maffra Lake. Afternoon tea will be at Dalgety by the Snowy River then we proceed back to Berridale, continue along Kosciuzsko Road (noting the Upper Snowy Landcare Dieback tree plantings) and onto our featured stop on Arable Road.

1) The Brothers

Australian Soil Classification: Rudosol and Tenosol (initially heading south of Cooma and up the first hill), **Dermosol** (coming down the southern side of the hill) and **Ferrosol** (majority of Maffra Road).

As we head south from Cooma the first hill we head up is part of the Dry Farm soil landscape. Not surprisingly, this rocky soil type that exists generally between Cooma and Pine Valley is low in fertility, often sodic and is very erodible. The tree and bush vegetation helps protect this fragile soil.



Once we clear this first hill the tour enters the more open and cleared farming country. This soil landscape is known as “Maneroo” and is characterised by basalt soils of varying depth, many with shrink-swell capabilities which makes the establishment of trees a challenging one. The Maneroo soil landscape can be identified in this area as undulating land with flat-topped hills and numerous lakes. The vegetation through this area was once all native grassland, with many areas sown to introduced pasture species as the Monaro region was settled and farming of these more fertile soils increased.

Not far from the Maneroo soil landscape lay one the most prominent features of the Monaro, The Brothers. These peaks are volcanic plugs, that is, they are the remains of the internal cores of the volcanoes that have since weathered/ eroded over time. The highest peak of the brothers is South Brother at 1120m.

Approximately 65 eruptive volcanic sites have been mapped in the Monaro region ranging in age from 54 to 34 million years old. The lava that flowed from around 35 eruptive events filled the surrounding valleys. The basalt plains visible today (Figure 2) are the remains of the valley floors as the slopes and peaks of the original volcanoes have been largely eroded.

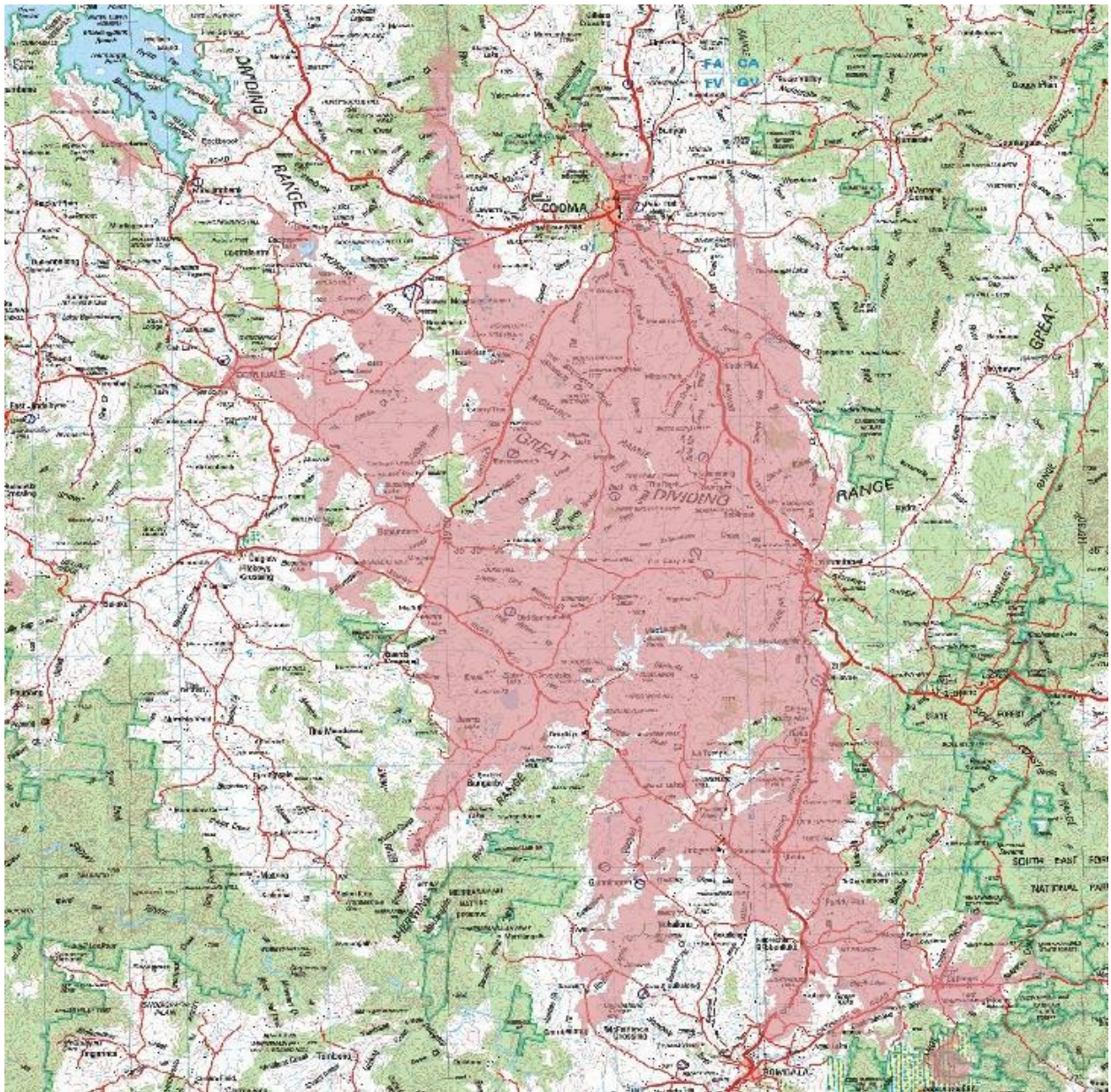


Figure 2. The volcanic basalt soils of the Monaro (red) spread from north west of Cooma to north east of Bombala.

In the central Monaro the aggregate thickness of the layered lava flows, interbasaltic sediments, duricrusts and paleosols is up to 400m. In addition there are multiple intrusive plugs that form resistant features in the landscape, commonly at points of intersection of regional faults. These plugs were once magma conduits beneath volcanoes now eroded from the landscape.

The Brothers are remnant plugs that preserve a slightly coarser (porphyritic) textured rock compared with surrounding the lava-forming basalt (fine texture; cooled rapidly). The conical shape of the hills forms when blocks of eroded rock tumble from the resistant plugs to form aprons around the central cores. Weathering and development of soil on this colluvial pile results in the modern low hill landscape observed.

2) Ravensworth Travelling Stock Reserve

Australian Soil Classification: Ferrosol

Ravensworth TSR is located on the Maffra Road within the Maneroo soil landscape region. The 45 hectare TSR is an example of the nationally protected Natural Temperate Grassland and is a good example of a kangaroo grass dominant grassland.

The roadside cutting shows an excellent example of a physical and chemical breakdown of the basalt which is the parent rock for the ferrosol soil.

When basalt lavas first cool and contract, the rock becomes internally jointed, forming cooling columns that have a hexagonal prism shape. When these weather they form an arrangement of stacked corestones (Figure 3; 4; 5). At this sloping site the soil profile is stony and relatively shallow while on flatter sites the profile depth is generally deeper.



Figure 3. Basalt rock columns, Ravensworth TSR



Figure 4 (left). As the basalt corestones weather they are replaced by secondary clay minerals, typically smectite and kaolinite clays, with yellow brown or red brown coloration due to minor amounts of hematite and/or goethite, Ravensworth TSR. Figure 5 (right). Concentric weathering of a basaltic corestone shows the 'onion skin' texture that results from hydrolysis of rock to form secondary clays and sesquioxides, Ravensworth TSR.

3) Bobundara Reserve

Australian Soil Classification: Kurosol

The Bobundara Nature Reserve is part of the Bobundara soil landscape which briefly intersects the Manaroo landscape. The underlying geology here is the Ordovician Adaminaby beds comprising mostly of shales, slates and fine grained sandstones that are tightly folded and commonly vertically to sub vertically bedded.



At this site the shales are strongly weathered and the soil is a moderately deep kandosol (red earth). Discrete gravelly layers and stone lines are common, indicating the role that downslope movement of sediment has played in soil development. These soils are easily compacted when grazed, increasing runoff and erosion risk, particularly on the steeper slopes.

The Ordovician metasedimentary rocks have typically weathered through to a kaolinite and quartz dominant secondary assemblage, with minor hematite/goethite producing a relatively chemically inert rocky saprolite and overlying soil with low cation exchange capacity (low inherent soil fertility).

Vegetation in this area mainly consists of cleared snow gum, broad-leaved peppermint and silver wattles with the site recently rehabilitated by the National Parks and Wildlife Service.

4) Maffra Lake

Australian Soil Classification: Ferrosol

Maffra Lake is a nationally-listed important wetland that sits within the 58 hectare Maffra Lake TSR. The lake lies at the contact (junction) of the basalt and granite derived soils with outcrops of granite visible on southern side of the lake.



The Monaro lakes and their surrounding environment are often home to threatened species such as the striped legless lizard, earless dragon, booroolong frog, southern bell frog and migratory bird species such as common sandpiper, cattle egret, red-necked stint, latham's snipe and white-bellied sea-eagle.

The vegetation at this site is mainly native grassland with an increasing occurrence of african lovegrass and serrated tussock.

The formation of permanent, semi-permanent and ephemeral lakes in the Monaro occurs as a result of the presence of Ca(Mg,Fe)-smectite clays that have the capacity to shrink and swell. Once the clays are saturated they 'seal' the surface allowing any additional water to pond. When the lakes dry out, the clays crack and water is no longer retained. In this location there is sufficient clay veneer to allow a semi-permanent lake to form despite the location at the contact between rock types. Ephemeral lakes formed in a similar setting can also be seen on the main road between Cooma and Berridale.

5) Dalgety & Snowy River

Australian Soil Classification: Dermosol

Our afternoon tea stop is by the banks of the Snowy River at Dalgety. The township was once a transit point on the stock route from Victoria up to the high country grazing reserves. Passed over as the nation's capital in the early 1900's, Dalgety, the Snowy River and the Buckley's Crossing Hotel all remain a popular meeting places for locals!

The river is home to many platypus which can often be found upstream of the heritage listed iron lattice Dalgety Bridge which was constructed back in 1889.



The low rainfall, large sections of granite subcrop (rock in the shallow subsurface) and light granitic soils of this area significantly restricts potential agricultural production.

6) Berridale Boulders

Australian Soil Classification: Dermosol (Dalgety Road), **Rudosol** and **Tenosol** (Kosciuzsko Road).

The Berridale Boulders are granitic tors formed due to spheroidal weathering of biotite granodiorite of the Berridale Batholith. Corestones form below ground when water enters fractures in the jointed rock (~1.5-3m joint spacing). Weathering occurs at the corners of the joint blocks more rapidly than the edges, and the edges more rapidly than the faces. The resultant spheroidal corestones are then exhumed to form rounded stacks and tors (boulders) at the lands surface.



The other, far less obvious feature of the Berridale region is the Berridale Wrench Fault. The fault which is thought to have occurred approximately 400 million years ago, resulted in a large geological split running around 11 kilometres long between 2 granitic intrusions (Lambert & White 2007). The fault runs north-west from Bobundara Creek (Maffra Road), passing just to the north of the Berridale township and up to the western reaches of Lake Eucumbene (Figure 6). It is believed that movement on this fault is responsible for several recent seismic events in the local area.



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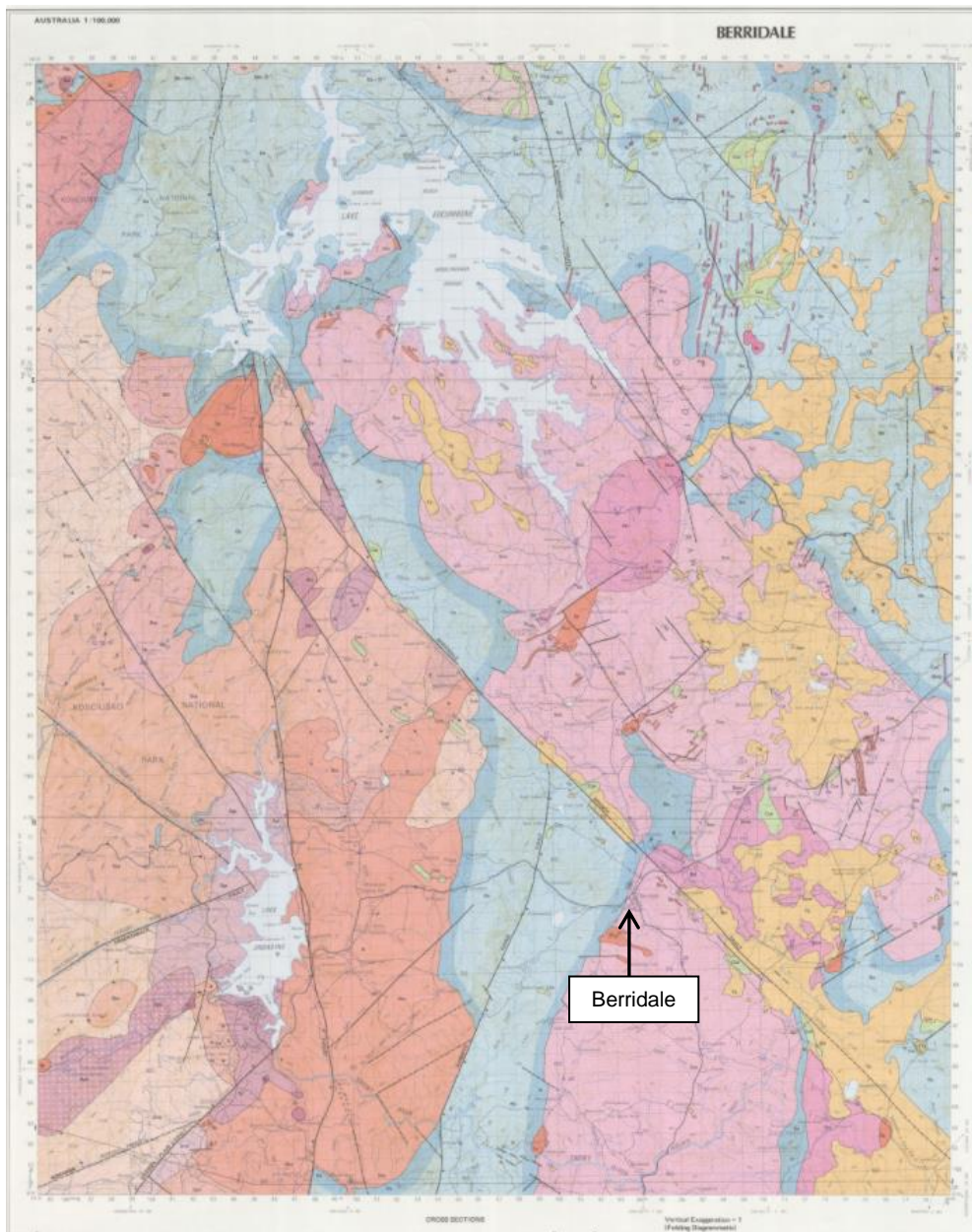


Figure 6. The Berridale 1:100 000 Geological Map showing the distinct Berridale Wrench Fault running through the centre (NSW Government, Planning & Environment, 1976).

7) Arable Road

Australian Soil Classification: Kurosol

The Arable Road field site is located adjacent to the Hazeldean Plug (Figure 6d) a conical hill formed due to erosion and weathering of a resistant intrusive plug, in the same manner as The Brothers.

The site occurs at the contact between Monaro basalt lavas and the underlying Silurian Cootralantra granodiorite (granite derived soil) (Figure 6a). The granodiorite has cross-cutting aplite and pegmatite dykes and large quartz veins (Figure 6b, 6c) that now form resistant ridges in the landscape.

The basalt lava pile is somewhat eroded allowing us to look at a section through the basalt lava stratigraphy. Ancient soils (paleosols), hard mineral crusts that formed at or near the surface of soil by the evaporation of groundwater (duricrusts) and contact metamorphosed soils have all been preserved between lava flows here.



Figure 6: (a) View to the east down the flanks of a hill comprised of layered basalt lava flows to Cootralantra granodiorite tors on the valley floor; (b) view to the north showing a N-S trending resistant aplite dyke outcropping through basalt alluvium, with a flat-topped basalt low hill in the background;



Figure 6:(c) outcrop and float of quartz vein material that forms a NW-SE trending low ridge in the north-west of the field site; (d) view to the west from the crest of Hazeldean Plug showing the colluvial apron that comprises the flanks of the conical hill in the foreground, Cootralantra granodiorite tors on the near middle ground and to the north, flat-topped hills with smooth flanks formed on layered basalt lava flows in far middle ground and the Snowy Mountains on the skyline.

More information

Soils Knowledge Network - <http://www.nswskn.com/>

eSPADE - <http://www.environment.nsw.gov.au/eSpade2WebApp#>

eSPADE is the go-to website for local soil landscape information. Much of the information provided in this handout including Australian Soil Classifications, Soil Landscape and geological information was all sourced from this site.

Australian Soil Club – Soil classifications and their characteristics: <http://www.soil.org.au/soil-types.htm>

Geological sites of NSW – The Monaro Plain -
<http://www.geomaps.com.au/scripts/monaroplain.php>

Lambert & White (2007) The Berridale Wrench fault: A major structure in the Snowy Mountains of New South Wales, Journal of the Geological Society of Australia, Vol. 12:1. Retrieved from: <http://www.tandfonline.com/doi/abs/10.1080/00167616508728583>

NSW Government, Planning & Environment (1976). Berridale 1:100 000 Geological Map: <https://www.resourcesandenergy.nsw.gov.au/miners-and-explorers/geoscience-information/products-and-data/maps/geological-maps/1-100-000/berridale-1100-000-geological-map>

Deakin University – Soil and Rocks. <https://blogs.deakin.edu.au/sci-enviro-ed/wp-content/uploads/sites/40/2014/04/rocks-soil.pdf>

Acknowledgments:

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National
Landcare
Program



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For updates go to www.lls.nsw.gov.au

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