MUCKLEFORD LANDCARE

Field Day: The Geology of the Muckleford Valley. 14th November, 2015.

REGIONAL GEOLOGY

The ‘country’ rocks (or ‘basement rocks’) of the Maldon – Walmer- Newstead - Muckleford area were laid down in the Ordovician era (490 – 450 million years ago) as alternating layers or beds of sand, silt and mud sediments (‘turbidites’) in a deep sea setting. Over millions of years the marine sediments hardened into black shale, slate, siltstone and sandstone. The ‘turbidite’ sedimentary rocks are identical to the Ordovician ‘country’ rocks of Bendigo, Castlemaine and Ballarat. Major earth movements compressed and buckled the flat lying sedimentary layers or beds into north-south trending folds. Further compression resulted in formation of large fractures or faults, cross-cutting the folded sediments. The larger scale faults of this district, such as the Muckleford and Whitelaw Faults, are steep west-dipping faults which extend deep into the earth’s crust (up to 20km and more).

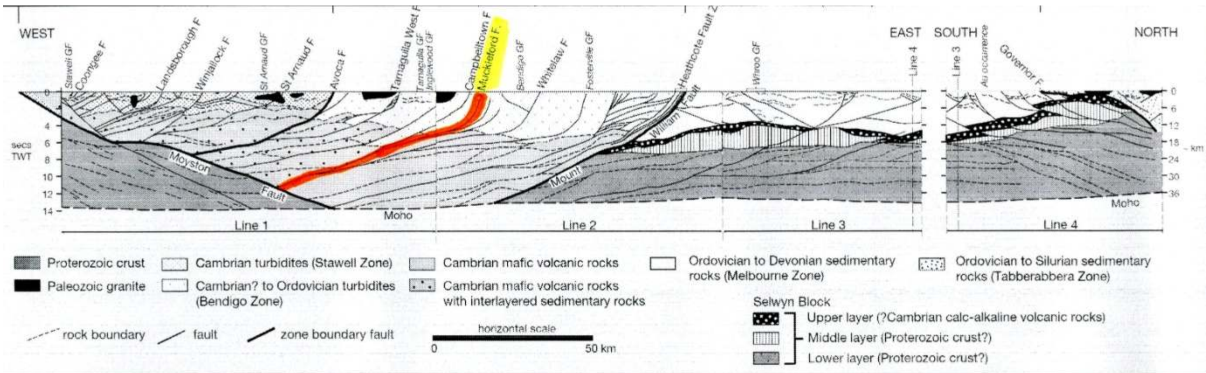


Figure 1. Cross-section of central Victoria, showing major faults. Muckleford Fault-red.
Ref: Willman et al, 2010. Economic Geology, v 105.

The Muckleford Fault formed 440 million years ago, but has been intermittently active until the present day. The total (reverse) displacement on the fault is around 2 km.

In the Devonian era (370 million years) a large mass of granite (Harcourt Granodiorite) was intruded into the folded sediments. The heat of the molten granite ‘baked’ the shale & siltstone into ‘hornfels’ (the dark, flint-like rock used in many Maldon buildings) and sandstone into quartzite, forming a rim of hard metamorphic rocks (metamorphic aureole).

The Muckleford Fault became active again and cut through the granite. This movement caused a fracture zone in the granite which later influenced the upper reaches of the Muckleford Creek.

Following uplift and erosion over many millions of years, the granodiorite was exposed and the hard rim of hornfels and quartzite formed a range surrounding the granite (Mt Tarrengower, the Nuggety Ranges, Mt Gaspard & Porcupine Hill). The granite to the north was deeply weathered and worn down below the metamorphic ranges (Baringhup, Lockwood lowlands). Other phases of the Harcourt Granodiorite were resistant to erosion and formed uplands (Mt Alexander).

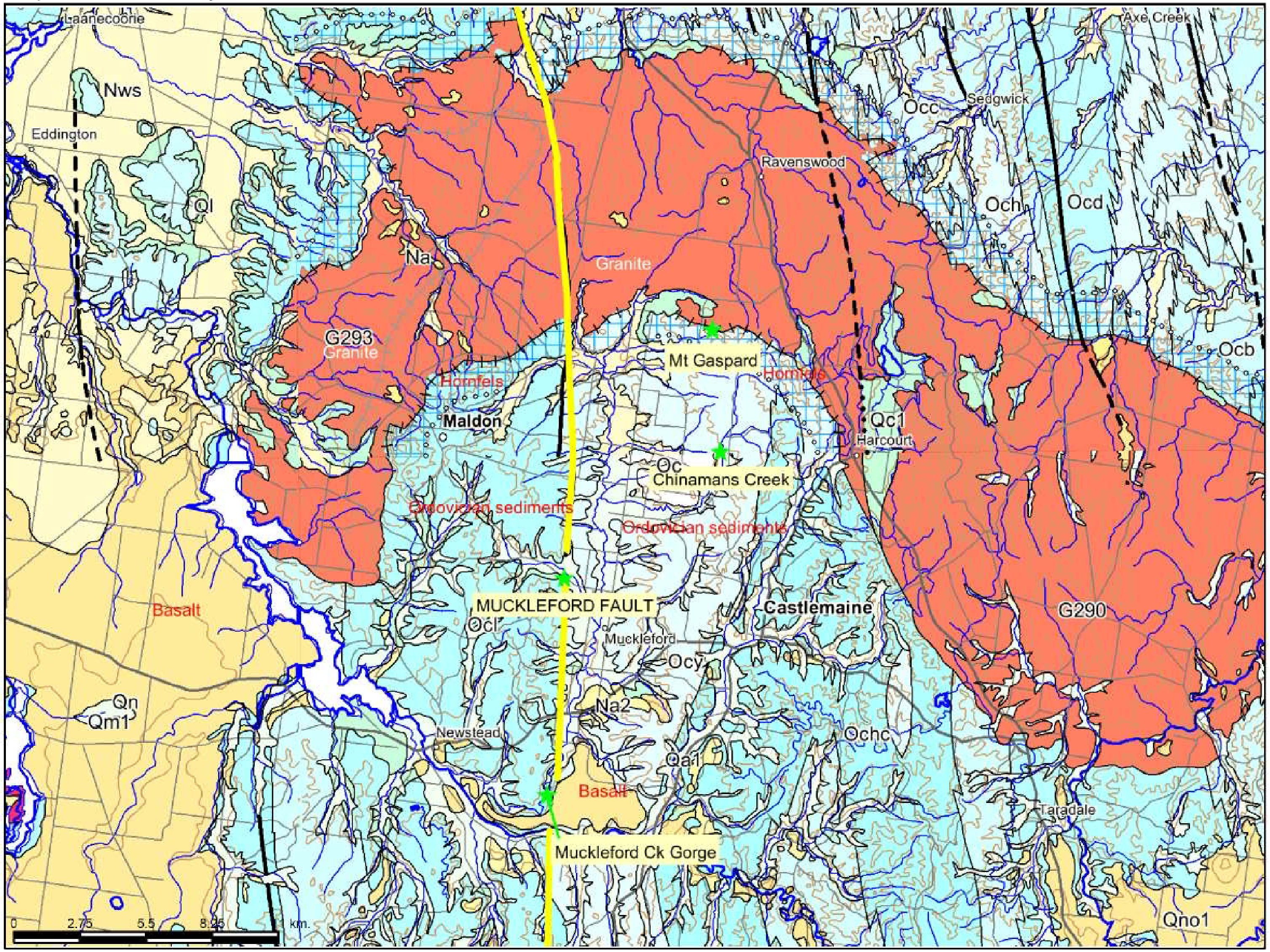


Figure 2. Geological Map of the MUCKLEFORD region. Blue: Ordovician sediments, Red: Devonian Granodiorite, Orange: Tertiary Basalt.

LOCAL GEOLOGY

In the road cutting, at the corner of the Maldon – Castlemaine Road / Butchers Road junction, the Ordovician siltstones and sandstones have been tightly folded ('kink folds') near the Muckleford Fault. Exposures of the fault are rare because the sediments have been deeply weathered. However, the topographic expression of the fault is obvious on aerial photographs / satellite images and maps. West of the fault, low undulating hills have formed on Ordovician sediments. East of the fault Ordovician sediments have been down-thrown forming a north-south valley now filled with recent alluvial gravels, sands and clays transported by Muckleford Creek, overlying the Ordovician bedrock.

In the larger river and creek valleys (Loddon River, Muckleford Creek, Porcupine Creek etc) coarse (gold-bearing) quartz gravel, sands and clays were deposited 20 - 30 million years ago. The older gravels now form remnant terraces along the west side of the Muckleford Creek valley, on the up-thrown block of the Muckleford Fault.

The Muckleford Fault displaced the gold-bearing gravel ('wash') 30 metres in the Muckleford Gorge area, east of Newstead. This proves that the fault was active as recently as 15 - 20 million years ago. Around 3 million years ago, basalt lava flowed from volcanic vents in the area and filled river and creek valleys (Moolort Plains, Guildford Plateau). The fault moved once again displacing the basalt 15 metres (see Figure 3). Subsequent erosion has 'reversed' the topography, leaving the old basalt filled streams as elevated ridges (e.g. Guildford Plateau).

The drainage pattern of Muckleford Creek and its tributaries is influenced principally by the Muckleford Fault but also the alternating, north-south striking Ordovician sandstone ridges, such as the ridge separating Muckleford Creek from Chinamans Creek ('Ottreys Scrub'- Mt Gaspard). Chinamans Creek cuts across the sandstone ridge along Creasys Road (sandstone bluffs occur in the Chinamans Creek valley in this area).

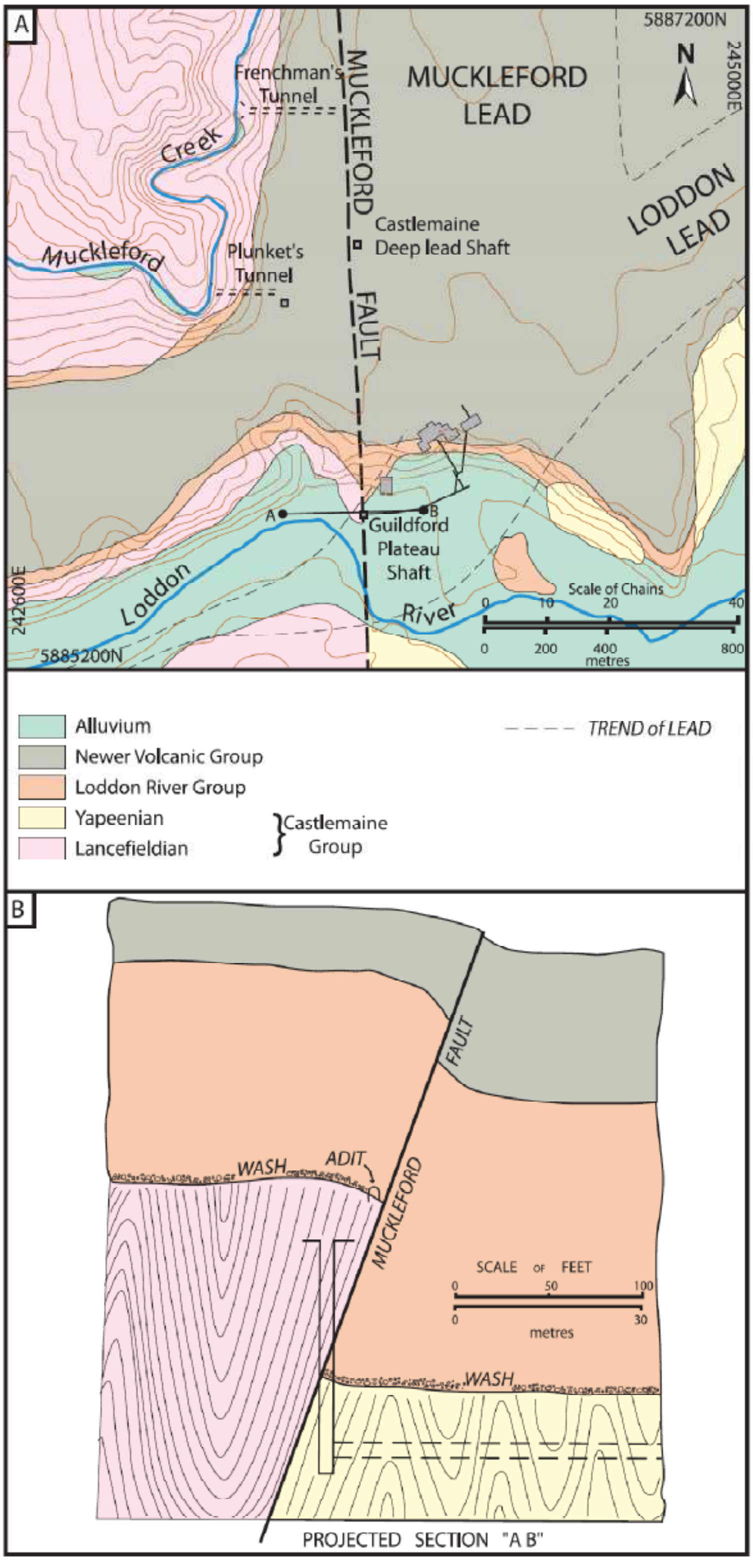
SOILS

Soil types vary according to the parent rock type and position in the landscape. On the Harcourt Granodiorite soils are typically sandy clay loams. Where granodiorite outcrops, along the northern slopes of the contact metamorphic ranges, rounded granite tors occur in thin sandy soils. Further down slope, in the Baringhup, Bradford Hills, Ravenswood area, sandy clay loams occur.

Along the contact metamorphic ranges (Nuggetty Ranges, Mt Gaspard ranges, Porcupine Hill) the alternating, hard, hornfels and quartzite has only thin skeletal clay loam soils, which have eroded to bedrock, especially where tree-cover has been cleared. Further down slope, on undulating hills of Ordovician sandstone and siltstone alternating with slate clay loam soils occur. Such soils are usually low-fertility types (see Figure 4).

The better soils occur on alluvial deposits along the Muckleford Creek valley.

To the south, in the Guildford Plateau area, fertile, red – black swelling clay soils occur on the basalt.



Willman et al, 2002. Geological Survey Report 121.

Figure 3. Muckleford Fault cross-section, Muckleford Creek gorge area, east of Newstead.

The Muckleford Fault has been active from 430 million years ago until the present.

The Fault moved 30 metres around 15 million years ago and then a further 15 metres around 3 million years ago.

Since then numerous small, intermittent movements have occurred.

Over the last 50 years 727 seismic events (tremors), of various magnitudes, related to the Muckleford Fault, have been recorded.
(Gary Gibson, 2015)

A 2.7 magnitude tremor associated with the Muckleford Fault was recorded near Lockwood on 25th June 2015.

DRYLAND SALINITY

Dryland salinity is prevalent in Central Victoria where the Ordovician sediments and Devonian granites are deeply weathered and the water balance has been changed due to extensive clearing of ridgelines. Salinity discharges are common at the break-of-slope, at the foot of contact metamorphic ranges. The hard and brittle hornfels and quartzite is extensively fractured, thus creating a permeable, high capacity saline groundwater store. The saline water was originally held in check by tree cover, however, when the trees were removed the infiltration rates of the thin skeletal soils increased, changing the water balance and causing saline discharges at the break-of-slope below the ridges and rising saline water tables in the valleys.
In many areas, re-vegetation programs of ridgelines have started to reverse the saline water imbalance.

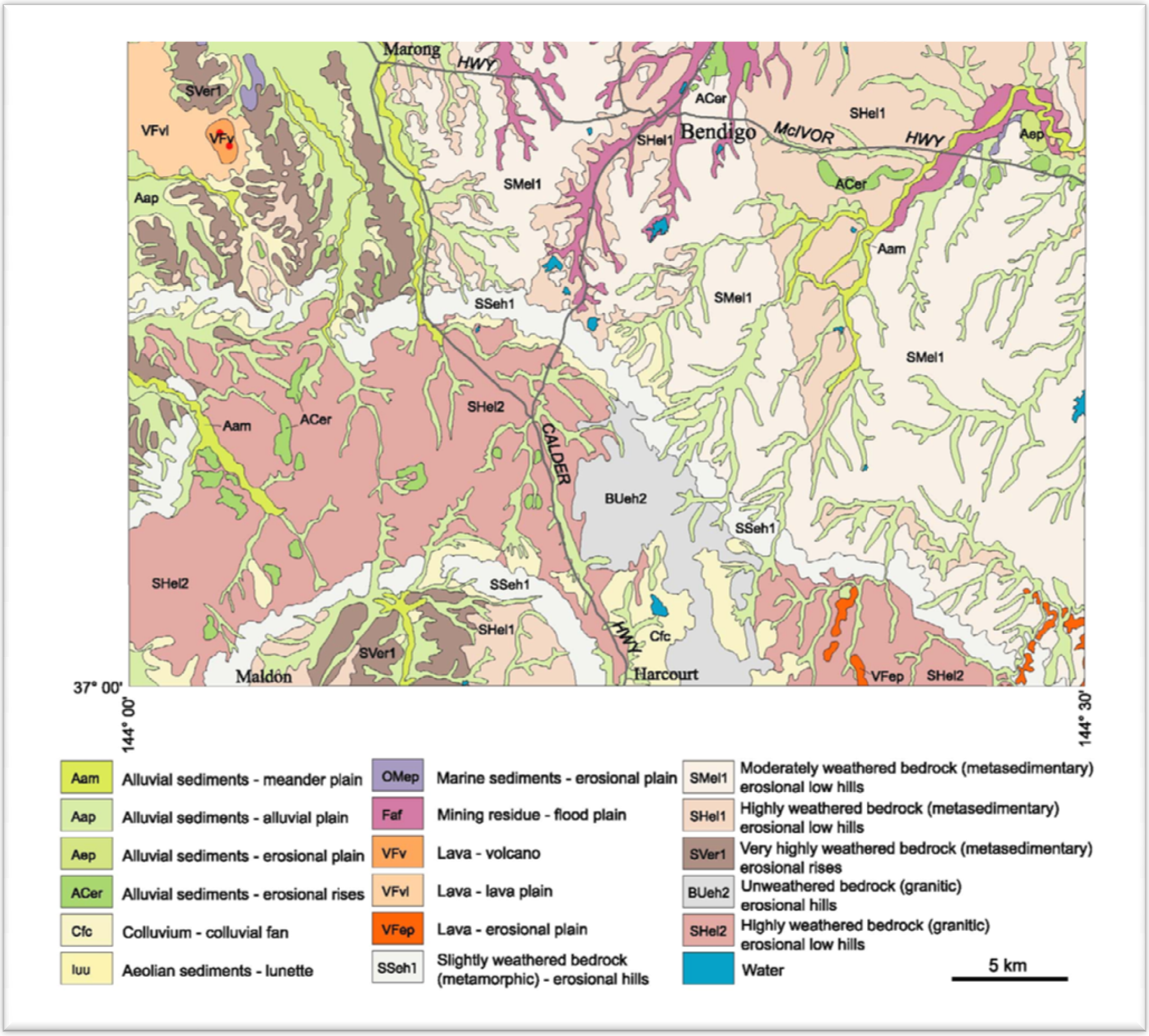


Figure 4. *Kotsanis & Joyce, 2002. Regolith mapping in the Bendigo region.*

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