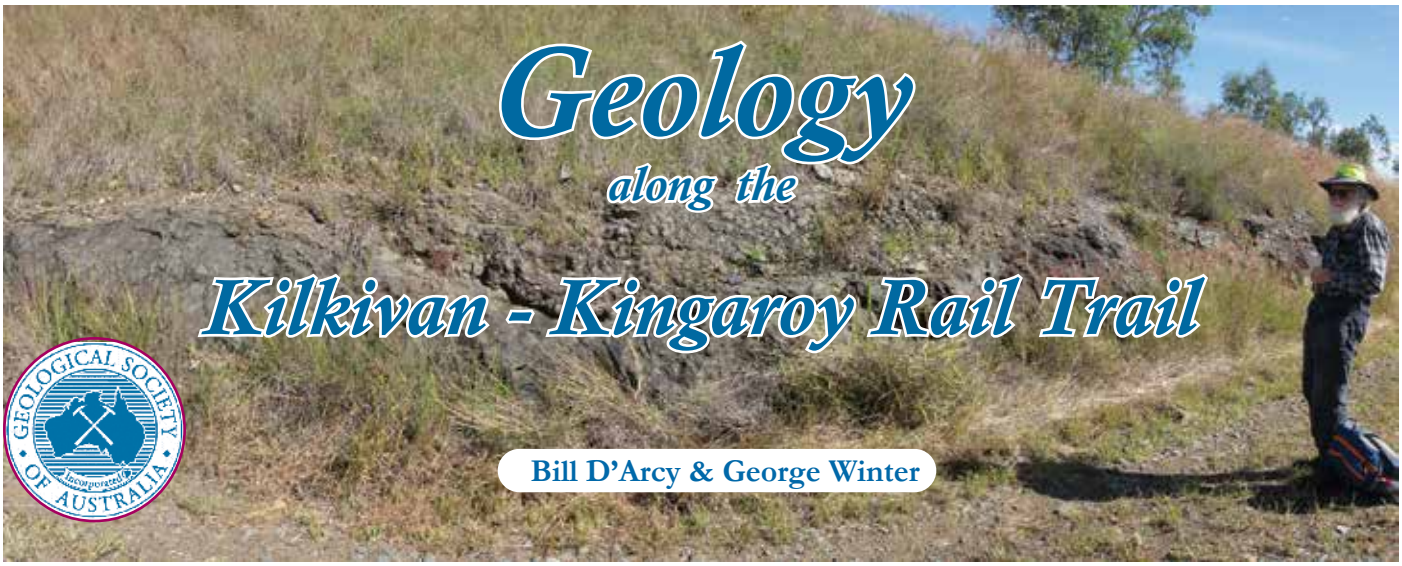

Geology along the Kilkivan - Kingaroy Rail Trail

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This leaflet highlights the geological outcrops and features you can see when walking, biking or riding along the Kilkivan to Kingaroy Rail Trial. We describe the features from east to west, starting at Kilkivan.

A complete Geological Log of the Trail with GPS references can be found on our website at gsa.org.au.

First, the geological setting

This is quite complex. The Trail starts on some of the oldest rocks of the region, which had their origin off the edge of the continent in Devonian to Carboniferous times, 370 to 300 million years ago. At that time an oceanic plate to the east (oceanic crust plus some of the underlying mantle) was being pushed westwards under the then continent of Australia. This phenomenon of subduction incorporates, interleaves, and deforms material from both plates (including erosional detritus from the continent), forming an assemblage called an accretionary or subduction complex. Sedimentary and volcanic rocks are compressed and deformed into meta-sediments and metamorphic rocks. Some of these, the *Amamoor beds,* are crossed west of Kilkivan and others, the *Maronghi Creek beds* and the *Bjelke Petersen beds* are encountered in a belt much farther to the west.

At times some of the mantle material beneath the crust, originally composed of a rock called peridotite, may be thrust upwards into overlying rocks, in the process being changed to a dark greenish black rock called serpentinite. There are some wide slices of this rare rock, the *Mount Mia Serpentinite,* around Kilkivan town.

The descending plate and wedge of mantle are a source of heat for the generation of granitic magma at depth to the west. This may rise and intrude the sedimentary and metamorphic rocks above, particularly in the later stages of the process. Near Kilkivan the *Claddagh Granodiorite* was one such granitic body that has given isotopic dates of 306 and 289 million years, i.e. late Carboniferous to early Permain.

Between these two belts of old rocks the Trail crosses the northern end of the Esk Basin. This was an elongate depression that subsided and filled with sediments and volcanic rocks in the early to mid-Triassic period, about 240 to 230 million years ago. The trail crosses both the *Neara Volcanics* (mainly volcanic rocks and sediments derived from them) and the *Esk Formation* (mainly sedimentary rocks).

On the west the old rocks are covered in places by some basalt lavas of the *Main Range Volcanics,* probably erupted from the Bunya Mountain Volcano 24 to 23 million years ago. The Trail also crosses lower ground on alluvial sediments deposited from modern streams.

Kilkivan to Cinnabar ~ 7 km

Point 1. At the start of the Trail just west of the Kilkivan railway station, the right side of a cutting exposes purple-weathered serpentinite breccia to the east (*Mount Mia Serpentinite*) and pale grey mudstone to the west (*Amamoor beds*). There is a fault between the two where a vein of white nodular magnesite ($MgCO_3$) about 50 cm thick has been deposited. Magnesite is an alteration product of the serpentinite, a very magnesium-rich rock.

Pt. 2. Serpentinite is also exposed in the next cutting about 400 m from Kilkivan Station, again with a vein of magnesite 10 cm wide, which dips (slopes) steeply northwest. The soil above the serpentinite also is rich in white magnesite nodules a few centimetres across.

Pt. 3. At a culvert about 210 m beyond the KKRT-01 distance post, on the north side of the rail formation black nodular material forms a capping over the bedrock. This is derived from weathered serpentinite, and is mildly magnetic, suggesting the presence of the mineral magnetite (Fe_3O_4). This has probably persisted from the peridotite precursor of the serpentinite.

About 250 m beyond the culvert, the route is interpreted to cross onto poorly exposed Amamoor beds (mixed fine-grained meta-sedimentary rocks and meta-basalt).

Pt. 5. About 2.5 km from Kilkivan the Trail crosses Tansy Road and Coppermine Creek. About 10 m upstream from the creek crossing pale cream lumps of granitic rock about 0.5 m across are of the Late Carboniferous *Claddagh Granodiorite*. This contains the two ferromagnesian minerals (i.e. Fe- and Mg-bearing), biotite (a mica) and hornblende (an amphibole mineral). This rock is commonly foliated (showing fine layering) but these lumps are massive. Isotopic ages for this rock unit include 289 and 307 million years.

Claddagh Granodiorite bedrock starts near Coppermine Creek, and underlies the Trail for the next 2.5 km, but it is poorly exposed. It forms low ridges about 30 m high parallel to the Trail.

Granitic rocks commonly weather to a loose material called *grus*, which consists of sub-cm angular fragments of quartz and weathered feldspar, mixed with clay derived from complete weathering of some of the feldspar. Grus is visible in many ant nests, especially those on the top of the cuttings. An interesting example of a paleosol (or old soil) is visible about 600 m beyond KKRT-04 where the grus has been cemented into a hard surficial layer (**Pt. 6**). The age of the paleosol is undetermined.

Just west of KKRT-05 the Trail passes off the granodiorite onto the Middle Triassic volcanic and sedimentary rocks of the *Neara Volcanics* of the Esk Basin (254 to 235 million years old). Here the junction is not exposed and little can be seen of these rocks yet. After crossing Wide Bay Creek the Trail rises gently past KKRT-07 to Cinnabar Road and Cinnabar Siding.

The siding was named after the ore of mercury, cinnabar (HgS), which was mined on a very small scale around here from 1874 to 1892 and 1930 to 1945. The mineral occurred in veins of calcite deposited from mineralised fluids circulating in rocks of the Neara Volcanics.

Cinnabar to Kinbombi Siding ~ 14.7 km

The Trail continues west across poorly exposed Neara Volcanics, parallel to Sempf Road, passing markers KKRT-08 and KKRT-09 to cross Raguse Road.

Pt. 7. At the first left-hand bend about 600 m from Raguse Road, dark grey sandstone and cobble-conglomerate of the Neara Volcanics are exposed in a low cutting on the left. The cobbles are rounded to sub-rounded, and are mostly fragments of lava. Note the white grains of feldspar measuring typically 1 mm wide by about 4-5 mm long. These are set in a grey to purple groundmass with very fine grains (too small to identify individually without a microscope). This arrangement of components with larger crystals in a finer groundmass is called porphyritic texture.

The Trail rises gradually, with little exposure of rock past the markers KKRT-11 and KKRT-12.

Pt. 8. At a high steel bridge over Kinbombi Creek the Trail descends to a splash crossing where sandstone of the Neara Volcanics is exposed on the western climb. Off-white carbonate veins up to 20 mm thick, most likely of calcite ($CaCO_3$), were precipitated from groundwater in the planar fractures (joints) of the rocks. Such veins are common in the Neara Volcanics sandstone (and conglomerate) elsewhere in the district. Loose cobbles farther up the climb are from the creek alluvium and are of rocks of the Neara Volcanics eroded from upstream.

Pt. 9. There is then little to see until past Coleman Siding Road, where cobbly sandstone of the Neara Volcanics is exposed in a deep cutting.

Pt. 10. About 100 m past the KKRT-16 marker a

Pt. 6. Hardened weathering debris from granitic rocks (grus).

Pt. 10. Typical cobble conglomerate of the Neara Volcanics.

cutting on the right shows cobble conglomerate (of dark grey porphyritic volcanic rocks – lava), with carbonate veins up to 5 mm thick. At the end of this straight stretch is a curved timber bridge.

The Trail continues to climb to the summit of the Coast Range through several cuttings exposing more sandstone and conglomerate of the Neara Volcanics. Sedimentary layering (called bedding) is visible in a cutting on the right-hand side about 150 m past a pair of old speed restriction signs (**Pt. 10a**).

Pt. 11. Opposite marker post KKRT-20 in the right-hand face is friable weathered shale.

Pt. 12. About 200 m beyond an old W whistle sign, a cutting exposes good examples of spheroidal or 'onion-skin' weathering in massive sandstone. Watermelon-sized blocks of sandstone are surrounded by rinds about 5 mm thick of crumbly, partially weathered sandstone. Typically, several rinds surround each corestone. The rock-mass weathers when groundwater in the joints corrodes the adjacent joint-block. The corners are attacked from three sides where joint faces meet, and the edges of the block are attacked from two sides; so progressive weathering is concentrated at the corners and edges of the joint blocks, rounding them. The weathering products are less-dense minerals than the primary minerals, so as weathering proceeds, successive layers of weathered rock about 5 mm thick spall off the joint blocks. Spheroidal weathering is common in many different rock types that have fairly homogeneous texture where joints are widely spaced. Igneous rocks are particularly prone to this form of weathering.

Kinbombi Siding is reached at the crest of the range, where there is a gate onto the Wide Bay Highway. Spectacular exposures of boulder beds of the Neara Volcanics can be seen at Kinbombi Falls Reserve on a side road about 4 km south of here.

Pt. 10a. Well bedded sandstone of the Neara Volcanics.

Kinbombi Siding to Goomeri ~5.2 km

Pt. 13. About 250 m past Kinbombi Siding a cutting exposes shale and mudstone (of the Neara Volcanics again), grading into cobbly sandstone. The beds dip gently north-westerly, and are centimetre-scale in thickness. In another cutting about 200 metres beyond marker KKRT-22 cobble conglomerate is exposed (**Pt. 14.**)

Pt. 15. In a cutting about 60 m northwest of marker KKRT-27 an old *palaeochannel* can be traced discontinuously in rocks of the Neara Volcanics for about 80 m. The sandstone in the lower half of the cutting may have been unconsolidated sand at the time of the erosion. The fill in the channel is cobble conglomerate (cobbly sand at the time of filling of the palaeochannel). The probable environment is an alluvial system that drained a volcanic terrain.

After another 600 m the Trail reaches the buildings of Goomeri Railway Station.

Goomeri to Manyung ~7.6 km

Pt. 16. West of Goomeri, cobbly sandstone dipping southeast is exposed in a cutting about 400 m beyond KKRT-28. This is the reverse of the northwesterly dip at Kinbombi Siding, indicating gentle regional-scale folding of the rocks, with a wavelength of several kilometres. Coarse-grained grey sandstone (still Neara Volcanics) can be seen in the inlet of a culvert under the Trail about 500 m beyond KKRT-29 (**Pt. 1 7**).

Pt. 18. About 100 m beyond marker KKRT-30, a steeply dipping band of strongly weathered off-white rock about 20 cm wide has a rough banding sub-parallel to the margins. This is a fault zone that cuts

Pt. 12. Onion-skin weathering in thick sandstone bed.

Cobble-conglomerate filling an old channnel at Point 15. The substrate of sandstone was probably unconsolidated sand at the time of erosion of the channel.

the cobbly sandstone. The pale colour is probably a by-product of alteration by hydrothermal fluids or groundwater in the fault zone, which is also susceptible to strong weathering.

Mapping by the Geological Survey of Queensland postulates a fault about 150 m west of this exposure, obscured by alluvium, with Neara Volcanics to the east, and Esk Formation to the west. The fault in the cutting is either the real location of the fault, or is a subsidiary member of a system of related faults. Elsewhere in the district, the Esk Formation seems to dip beneath the Neara Volcanics, so the fault is probably an east-block-down normal fault (i.e. the east block probably moved down the easterly-dipping fault zone). The amount of movement is unknown.

Pt. 19. The cutting just before the creek crossing after KKRT-32 exposes Esk Formation, which here is a pebbly sandstone with a green matrix.

Fault zone in cobble conglomerate at Point 18.

Manyung to Murgon ~10.8 km

Pt. 20. About 250 m after the second creek crossing just out of town, a cutting shows pebbly to cobbly sandstone of the Neara Volcanics overlain by a ferruginous duricrust, which is a type of ancient soil (a palaeosol). In the same cutting 60 m further west there is vague bedding in the sandstone, dipping about 75° easterly, which is surprisingly steep. More pebbly sandstone and conglomerate (with chert pebbles) are seen about 350 m beyond KKRT-35. Here too, vague bedding dips about 75° to the east.

Pt. 21. About 750 m beyond marker KKRT-36 there are finer-grained mixed sedimentary rocks (shale, mudstone and fine-grained pebbly sandstone) of the Neara Volcanics. Bedding is more distinct in these rocks, and dips about 25° south-east. The rocks appear to be bleached from their usual grey, and may be part of a palaeosol, which formed just below an old ground surface, possibly before the next rock unit was deposited.

Pt. 22. About 370 m past KKRT-37 a bench seat faces a low cutting which exposes the *Oakdale Sandstone*, a poorly-consolidated rock unit deposited locally in rivers and lakes between 56 and 34 million years ago (Eocene). The Neara Volcanics at the previous exposure may have been weathered just below the old ground surface on which the sandstone was deposited. Shale beds within the Oakdale Sandstone close to nearby Boat Mountain contain fossils of a diverse vertebrate fauna (the famous Tingamarra Local Fauna) of ancestors of a number of creatures including frogs, crocodiles and turtles.

Denser vegetation is seen on the Oakdale Sandstone than is typical on the Neara Volcanics. Oakdale Sandstone is interpreted to underlie the Trail from near KKRT-37, to Annings Road, a distance of about 1.5 km, but exposures are poor.

After the Barambah Road turnoff from the adjacent

Bunya Highway, about 900 m from marker KKRT-40 the Trail passes onto a slice of the *Bjelke Petersen beds* (named after the dam nearby). These are much older marine rocks from the accretionary complex consisting of mudstone, shale, chert and limestone. Fossils extracted from the limestone are Late Carboniferous in age (between 330 and 300 million years old).The beds are exposed in a south-trending strip about 1 km wide, and are faulted against the adjacent rock units, forming a ridge about 100 m tall. This ridge may have been an exposed island, possibly elevated along the bounding faults, during deposition of the Neara Volcanics.

Pt. 23. An exposure of the Bjelke Petersen beds 10 metres east of marker KKRT-41 displays steeply dipping sandstone beds in slate. About 800 m beyond KKRT-41 the trail is interpreted to leave these beds and pass again onto Neara Volcanics, possibly at a faulted contact. Unfortunately exposure is poor.

Pt. 24. Beyond the crossing of Sawpit Creek the rock type is interpreted to be of the Esk Formation. An exposure of pebbly sandstone (sub-rounded pebbles) with rare cobbles is visible about 600 m beyond the crossing. Strongly weathered sandstone is also visible about 200 m further on.

The Trail then climbs towards the outskirts of Murgon.

Murgon to Wondai ~13.2 km

At the edge of town the trail begins to descend steeply, and the underlying material is ferricrete, which developed several millions ago in a deeply weathered paleosol near the then ground surface.

Pt. 25. On the left-hand curve about 400 m beyond marker KKRT-46, near the top of a descent to a creek, there is pebble and cobble conglomerate (with andesite pebbles), and weathered porphyritic andesite (probably a lava flow) both of the Neara Volcanics on the left-hand side.

Pt. 26. About 150 m beyond the concrete causeway crossing the creek, on the right-hand side, a cutting shows siliceous sandstone with quartz veins. The sandstone contains cobbles of jasper (microcrystalline silica – SiO_2– coloured crimson by hematite – Fe_2O_3), and probable andesite.

About 400 m past marker KKRT-47 the Trail is interpreted to leave the rocks of the Esk Basin (the Neara Volcanics and Esk Formation) and pass onto the much older *Maronghi Creek beds*, but the junction unfortunately is not exposed.

The Maronghi Creek beds are strongly-deformed sedimentary and low-grade metamorphic rocks of the accretionary complex and of Late Devonian to Early Carboniferous age (i.e. probably between 380 and 330 million years old). The Trail crosses the Maronghi Creek beds, or modern alluvium, from here to Wondai.

Pt. 27. About 1 kilometre beyond the concrete causeway, and about 5 m to the right of the Trail, a pile of tangled iron appears to be wreckage of a railway wagon. Red-brown siliceous argillite (silicified mudstone) of the Maronghi Creek beds is exposed in a cutting about 100 m beyond the wrecked wagon. The Maronghi Creek beds consist of many different rock types and examples are exposed over the next few hundred metres to the crossing over Barambah Creek.

Pt. 28. About 50 m beyond marker KKRT-48 jasper (red chert, or microcrystalline silica) is exposed in the right-hand cutting face. This rock is interpreted to have originated in the deep ocean from the accumulation of innumerable siliceous skeletons of microscopic animals called radiolaria.

Pt. 28a. About 50 m further along the left side of the cutting is in massive manganese oxide impregnated in red jasper. Manganese deposits are common in these rocks, and are interpreted as having been deposited on the deep ocean floor. A fault cuts the rocks another 50 m to the south (**Pt. 28b).** Bedding in the southern block is distinct but the rocks in the northern block are fairly massive.

The Trail crosses Barambah Creek by a low-level footbridge, after which three alluvial terraces are obvious on the opposite bank. The route then follows Yellow Waterhole Creek upstream to the south, but outcrop of hard rock is sparse for about 2 km, as it traverses mainly alluvium.

Pt. 29. Cream-coloured banded chert is exposed in a cutting on the right side about 600 m past marker KKRT-50.

Pt. 30. On the steep slopes above the narrow alluvial plain a blanket of angular rock fragments mixed with soil is called colluvium, which has been shed from the

Pt. 28a. Manganese-oxide impregnated jasper of the Maronghi Creek beds.

Fault defining the edge of jasper in the Maraonghi Creek beds, Point 28b.

hills above. In some places minerals precipitated from groundwater (especially iron oxides) have cemented the colluvium into a duricrust. A typical example is about 650 m beyond maker KKRT-51.

Pt. 31. About 40 m beyond the colluvium exposures, a cutting is in slate, which is another rock type of the Maronghi Creek beds. The precursor sedimentary rock was clay-rich, such as shale or mudstone. After deformation of the rock a new layering, or slaty cleavage, developed perpendicular to the compressive shortening. The cleavage is generally (but not necessarily) oblique to the original bedding.

Pt. 32. Another rock type of the Maronghi Creek beds is exposed in a cutting about 70 m beyond marker KKRT-52. This is metamorphosed basalt, coloured dark olive-green by the metamorphic mineral chlorite. Sometimes this rock is called greenstone.

Pt. 33. About 550 metres beyond KKRT-53 is yet another metamorphic rock of the Maronghi Creek beds - silver-green phyllite. The bright sheen is due to the presence of minute white-mica crystals, with flat surfaces that cause mirror-like reflections. Phyllite is like slate, but with newly grown mica grains larger than those in slate.

Pt. 34. About 450 m beyond the phyllite exposure, cream siliceous argillite is revealled in the cutting near marker KKRT-54. Then a prominent ridge of chert crosses the Trail about 200 m beyond KKRT-54 (**Pt. 35**).

Pt. 36. Cream and white siliceous argillite is exposed in cuttings about 350 m beyond KKRT-55, and is cut by a manganese-oxide vein about 100 mm thick. After marker KKRT-57 the Trail passes a deserted building on the right, which was the old Wondai dairy factory, before entering the outskirts of Wondai.

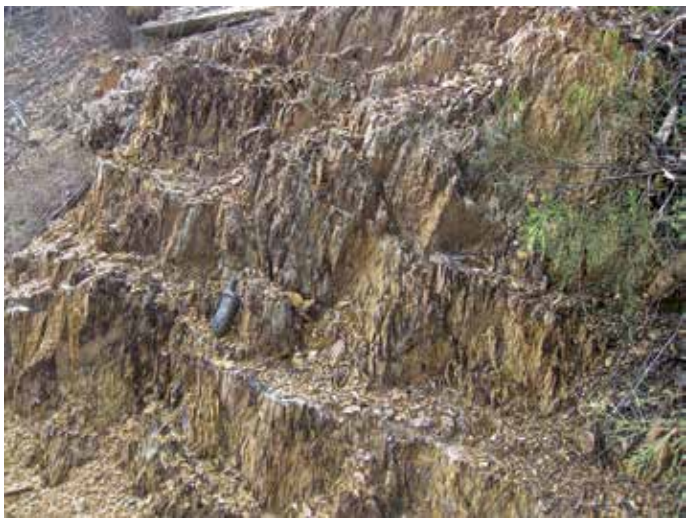
Wondai to Tingoora ~8 km

Exposures of bedrock are scarce in Wondai town until the outskirts are reached.

Pt. 37. At the Dingo Creek bridge past the KKRT-59 marker, cream-coloured slate and chert (of the Maronghi Creek beds) are exposed on the north bank of the creek to the left of the Trail. Beyond Dingo Creek the Trail passes onto colluvial and alluvial deposits to almost Tingoora.

Pt. 38. However yellow-brown weathered basalt is exposed in a right-hand bend in the cutting, about 500 m beyond KKRT-64. This basalt is of the *Main Range Volcanics* of Miocene age (isotpoic ages elsewhere suggest an age between 25 and 19

Consolidated and cemented gravel in colluvium at Point 30.



Slate of the Maronghi Creek beds at Point 31.

million years), and it was possibly erupted from the Bunya Mountains Volcano. There are a few 5 mm-wide quartz veins cutting through the basalt. More weathered basalt is about 250 m beyond marker KKRT-65.

Tingoora is situated on an east-facing slope with the ground rising towards a basalt plateau to the west.

Tingoora to Wooroolin ~5.7 km

There is a shortage of outcrop on this leg, but the scenery has a geological background.

Pt. 39. After the Trail crosses Dingo Creek a low cutting exposes strongly weathered basalt, which shows vague spheroidal weathering.

Higher ground to the west and south is the edge of a plateau at an elevation of 450 to 460 m, about 40 to 50 m higher than Tingoora Station. The various levels in the topography reflect the outcrop of individual horizontal lava flows stacked up as the Main Range Volcanics. There are often layers of sediments (including basalt-derived soils) between individual flows. Erosion of the plateau has resulted in numerous flat-topped hills, typically 100 m to 300 m wide, and tens of metres above the surrounding land. These are often too stony to be used for agriculture, but are attractive locations for farm homesteads. This staircase-like sequence of treads and risers in basalt terrain has been called *traps* in some countries; famous examples include the Siberian Traps and the Deccan Traps in western India.

The Trail climbs onto the plateau, and winds between low hills (remnants of a higher level in the topography), to reach Wooroolin.

Wooroolin to Kingaroy ~16.5 km

There is essentially no outcrop or exposure of rocks along most of this section, but mapping in the district suggests that the underlying bedrock most of the way to Kingaroy is the Main Range Volcanics. Younger surficial materials (soils, alluvium etc) hide the bedrock. The stepped topography caused by horizonal basalt flows mentioned in the last section is also obvious here.

Pt. 40. About 2 km south of Wooroolin, just before marker KKRT-74, a low cutting on the left exposes red-brown stony soil over cream-coloured, strongly weathered rock which was probably basalt. About 200 m further south there is a similar exposure of soil over extensively weathered basalt. Colour mottling in this is suggestive of the mottled zone of a lateritic (palaeo) soil profile. The white mottles are composed of the clay mineral kaolinite. Such weathering profiles are common in the district and commercial quantities of kaolin clay from thicker profiles (on granites) are mined around Kingaroy.

After crossing the Memerambi-Gordonbrook Road the Trail descends about 1 km to a minor intermittent stream, and then the next rise southward is interpreted to be underlain by Maronghi Creek beds for a further 2 km, but there is no exposure along the Trail. This rise was apparently a ridge around which the subsequent basalt lavas flowed.

There are no further exposures until Kingaroy is reached.

Deeply weathered basalt at Point 40.

Edited by Warwick Willmott