



Surface Karren of the Gregory Karst, Northern Territory



Ken G. Grimes, 2008

Karren in the Gregory Karst area.

Karst and karren are largely restricted to a thin (10-18 m) but extensive dolomite/limestone unit, the Supplejack member, within the flat-lying late Proterozoic Skull Creek Formation. The Skull Creek Formation is also dominantly carbonate, but has prominent shale beds, especially in the upper member. Outside the Supplejack member, the Skull Creek Formation has only poorly developed mesokarren, but it has well-developed microkarren, especially in the upper part. Extensive maze caves underlie the dissected surface, and these include Bullita Cave, Australia's longest with over 115 km of mapped passage.

The karrenfields show a zonation which results from progressively longer periods of exposure at the surface after removal by erosion of the overlying beds. This starts with incipient karren development on recently exposed surfaces and continues through progressively deeper dissected karren to a final stage of "ruined cities" of isolated blocks and pinnacles at the outer edge (Zones 1 to 4 on the diagram). The changes from one zone to the next are gradational.

Zone 1 has well-preserved stromatolite mounds (up to 12 m wide and 2 m high) exposed by stripping of the overlying rock. The surfaces are smooth or sculptured by incipient "rainpits" and rillenkarren with superimposed microkarren. Etching of joints and bedding

forms splitkarren. There are scattered kamenitza and small grikes.

Away from the contact, increasing dissection produces small spitzkarren up to 0.3 m high, and grades to zone 2.

In **Zone 2** the stromatolite domes are still recognisable locally, but are strongly dissected by a variety of mesokarren, including numerous kamenitza (up to 2 m wide and 0.4 m deep) and spitzkarren up to 1 m high. Grikes are wider and deeper; averaging 2 m deep, but with considerable variation, including occasional narrow connections to the cave passages below.

The transition to zone 3 is quite gradual.

Zone 3 has wider and deeper grikes, and connections to the cave become more common, though still narrow. Traversing the surface becomes difficult. Spitzkarren are dominant and up to 2 m high. Wandkarren appear on the grike walls and the sides of the larger spitzkarren.

In **Zone 4** the surface has become completely dissected. Giant grikes 1-5 m wide penetrate to the cave floors 10-15 m below and separate blocks of rock with strong spitzkarren on the tops and wandkarren, rillenkarren and cockles on the walls. As the grikes widen, one gets a "ruined city" topography of isolated blocks, many of which are tilted, and finally an abrupt change to a broad flat floored valley on the lower Skull Creek Formation with only scattered blocks and sculptured pinnacles.



← **Zone 1:**
Contact between the Supplejack and the overlying Skull Creek Formation. Man is standing on a big stromatolite mound.



Zone 1: →
Incipient rillenkarren (solution flutes)
10 cm scale

↓ **Zone 2-3:** Strongly sculptured karrenfield: spitzkarren & grikes.

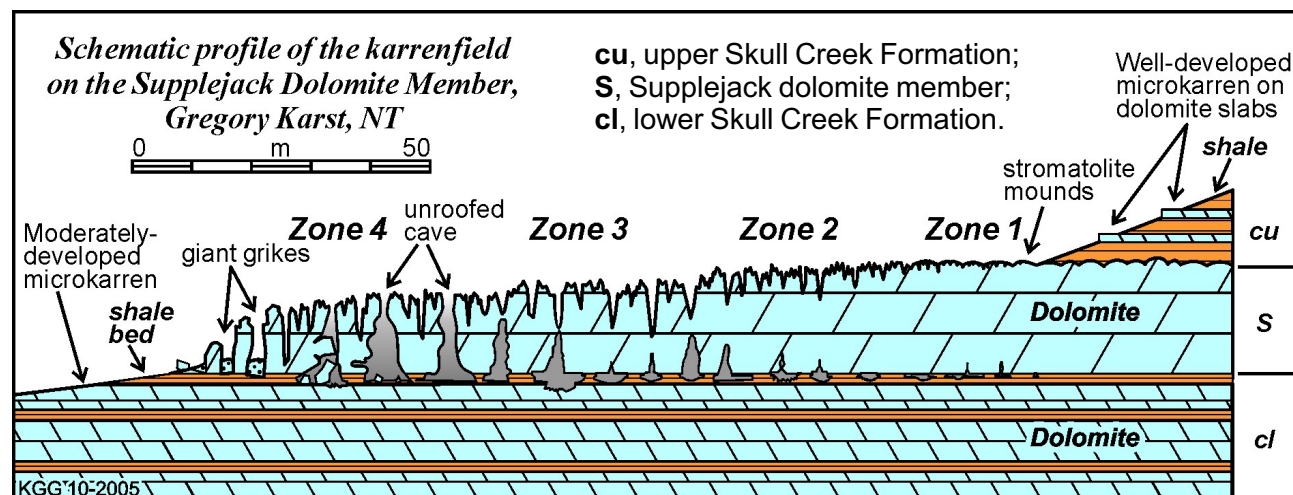


Zone 3-4: →
Deep grikes

← **Zone 4:**
Sculptured pinnacles



↓ **Zone 4:** Rotated blocks of a "stone city"





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Karren Types.

Karren: Surface sculpturing features, formed by solution of limestone. Divisible into three size ranges, and a host of named forms within those.

Mesokarren: Normal-sized karren - recognisable within a 1m grid.

Macrokarren: Large-sized karren - recognisable within a 10m grid.

Microkarren: Small-sized rills & pits - recognisable within a 1cm grid.

Rainpits: Circular hemispherical pits, typically 1-2 cm across, mainly found on crests or flat surfaces. Not necessarily formed by rain!

Rillenkarren: (solution flutes) Linear, parallel or occasionally branching, grooves 1-3 cm wide and up to a metre or more long, running down slopes.

Kamenitza: (solution pans) Flat-floored basins, with steep to overhanging walls. A broad range of depths and widths.

Grikes: Linear trenches formed by enlargement of vertical joints. A large size range, up to "giant grikes" 5 or more metres wide and 10-20 m deep.

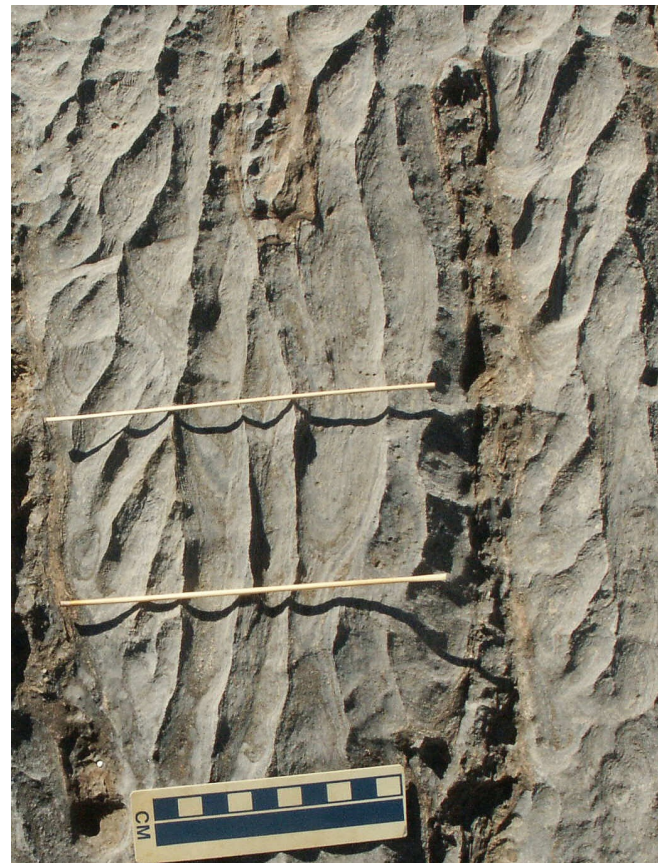
Wandkarren: (wall karren) Vertical gutters on a wall. Larger than rillenkarren. Up to a metre wide and deep and 10 or more metres long.

Splitkarren: V- or U-section notches following cracks. Size varies from mm up to several cm wide and deep. Larger ones would be called grikes if vertical.

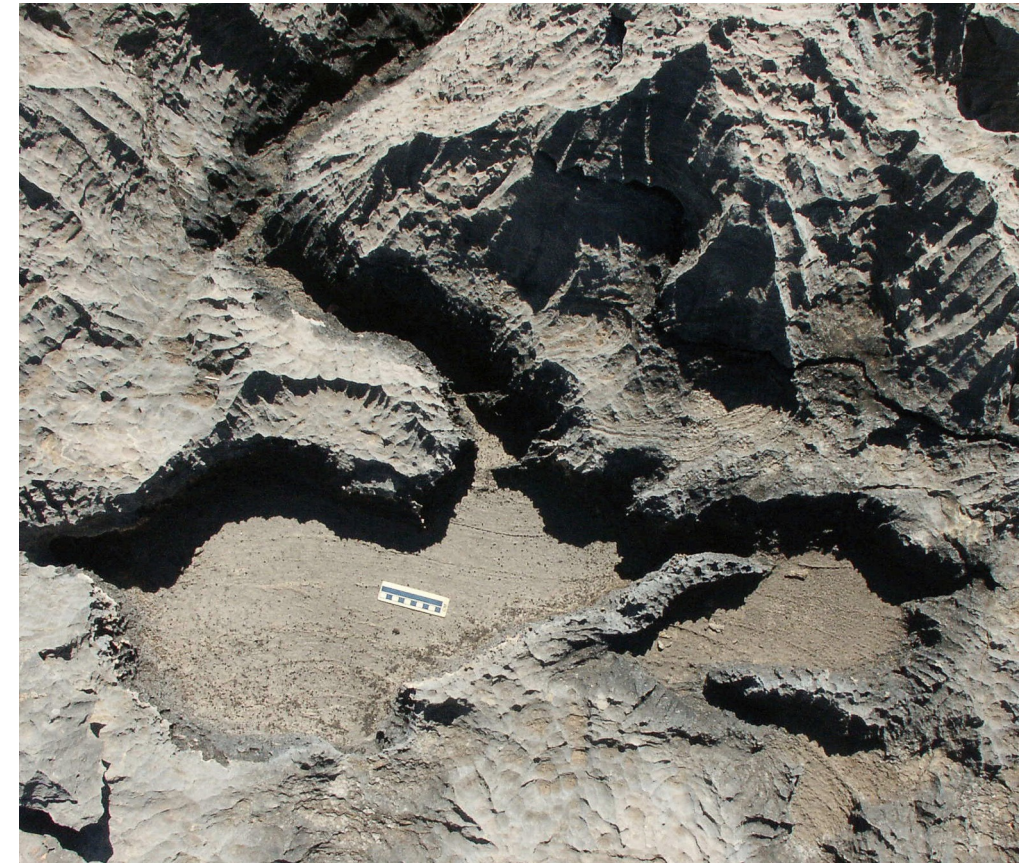
Cockles: Hemispherical pits, similar to rainpits (q.v.), but found on steep to vertical walls and have a larger range of sizes. May be quite deep and sharp-edged.

Runnels: Small meandering to straight solution gutters that drain water from the surface into grikes.

Spitzkarren: Sculptured beehive-shaped pinnacles ranging from a few decimetres up to several metres high and wide. Composite forms with rainpits on the crest grading down to rillenkarren and then to wandkarren. Form in fields separated by grikes or runnels.



↑ Rillenkarren (solution flutes)



↑ Kamenitza (solution pans) feeding to a runnel.

← Rainpits & splitkarren (V-notches)

↓ Small spitzkarren above a grike wall that has cockles and horizontal solution ripples.

↓ Wandkarren on a vertical face. Spitzkarren on crest

↓ Microkarren superimposed on a v-notch (splitkarren)





Microkarren of the Gregory Karst, Northern Territory

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Microkarren are finely-sculptured forms, typically recognisable within a one cm grid, that appear to occur mainly in arid climates. In Australia they have been found in the monsoon (seasonally dry) and arid areas. However, these cryptic forms are poorly recorded and it is too early to make definite statements about their distribution. Solution by thin films of water, dew or light rain, with surface-tension effects, may be their most likely origin.

In the Gregory Karst the best development of microkarren is on the flaggy to slabby outcrops of fine-grained dolomitic limestone in the upper Skull Creek Formation, where there is little competition from mesokarren. However, microkarren do occur within the main karrenfield of the Supplejack member. They are common in zone 1, but also occur in the other zones, usually at the tops of spitzkarren and associated with rillenkarren and rainpits on gentle slopes.

Microkarren Types.

Note that, apart from *microrills*, these terms are my own unofficial ones invented to assist in my study.

Microrills: Narrow grooves, running down gentle slopes. Typically 1 mm wide, and less than 1 mm deep, but can be up to a metre long. They vary from straight, to sinuous to tightly meandering.

Micro-networks: Are similar to microrills, but form an irregular network rather than long linear runs. They grade to...

Micro-teeth: Which are sharp, conical or faceted teeth about 1 mm wide and <1 mm high.

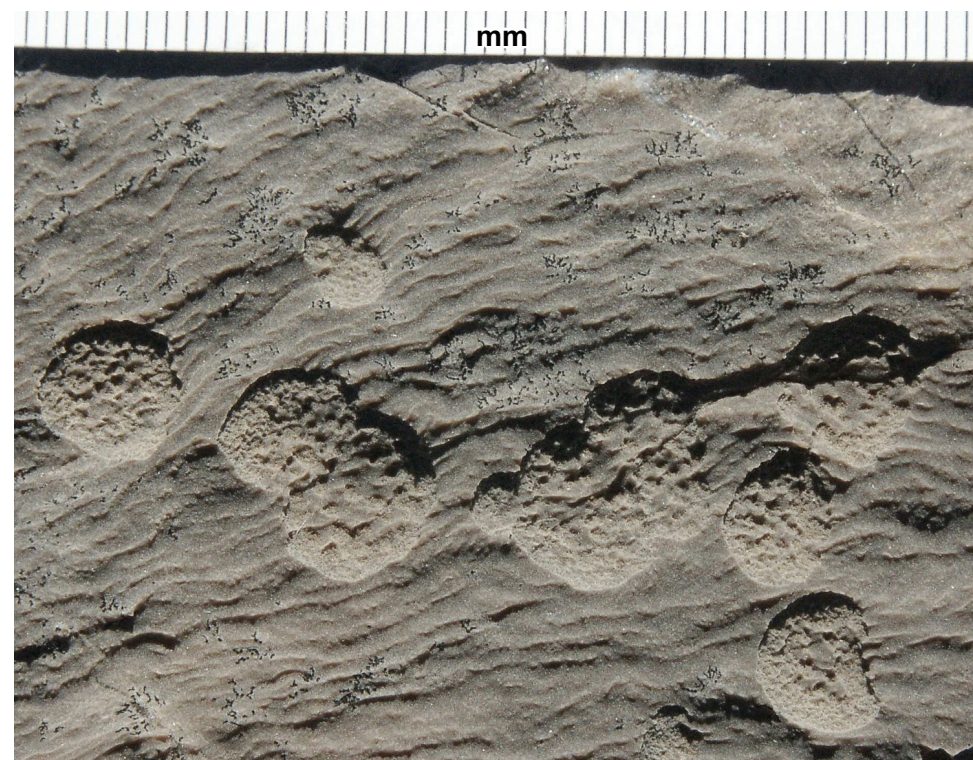
Micro-pits: Hemispherical to conical pits occur in a wide range of sizes from 1 mm up to 2 cm (i.e. to normal *rainpits*)

Micro-pans: Shallow pits, 5-10 mm wide, but only 1-2 mm deep. They have flat floors with fine micro-pits or teeth. They are commonly superimposed on other microkarren.

Micro-notches: Irregular v-section notches that follow cracks in the rock (a micro-version of *splitkarren*).

Micro-tessellations: U-section notches in lines or networks. They commonly disrupt other microkarren.

Etched rock structures: Various structures of fossils, crystals or bedding may be etched out.



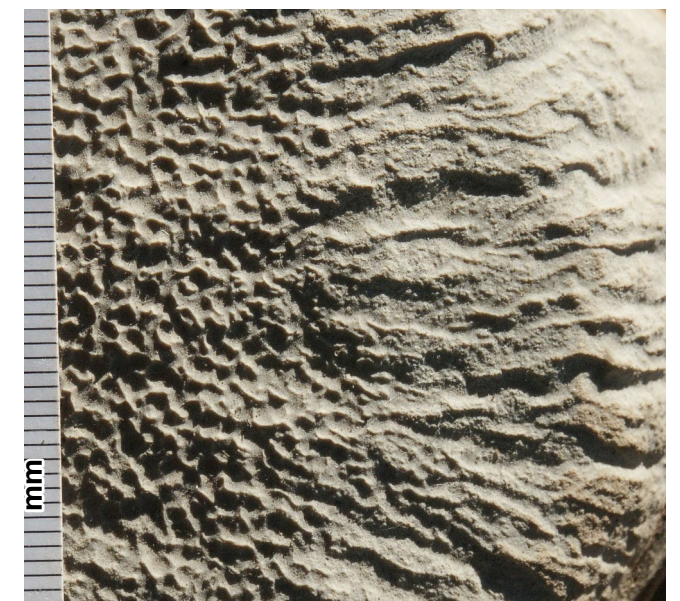
↑ Microrills superimposed on shallow rillenkarren.

← Radiating, and variable-width, microrills on cobbles of a dolomitic limestone tessellated pavement.

Sharp, tightly meandering microrills. →

Shallow micro-pans with pitted floors, superimposed on microrills. ↓

Micro-tessellations in a network disrupting prior micro-teeth. ↓



↑ Micro-pits (left) grade to broad microrills



↓ Micro-teeth

