
Permian and Triassic paleosols and paleoenvironments of the central Transantarctic Mountains, Antarctica

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We embarked upon our study of paleosols as guides to Permian and Triassic paleoenvironments around the Beardmore and Shackleton Glaciers of the central Transantarctic Mountains with some trepidation because few fossil soils had been reported there (Horner and Krissek 1991). It was pleasing to discover abundant paleosols (341 of 16 different kinds) in a stratigraphic section of 568 meters (m) spanning the Permian-Triassic boundary on a low northwestern spur of Graphite Peak (figures 1 and 2; 85°2.99'S 172°21.65'E) and also 34 of 6 kinds within 40 m measured in the natural amphitheater low on the northeast

face of Mount Rosenwald (figure 3; 85°3.09'S 178°29.52'E). Each pedotype was named after antarctic geologists: Alton Wade, Kerby LaPrade, James Morton Schopf, James Waller Collinson, David H. Elliot, William Roy Hammer, Julia Miller, and Molly Miller. Other names were carried through from paleosols in southern Victoria Land (Retallack, Krull, and Robinson 1996). Each pedotype represents a unique ancient ecosystem.

Coals are the most obvious paleosol horizons of the Late Permian, Buckley Formation. Two kinds of paleosols bear coal: the James pedotype has impure coal and subhori-

Reprinted from the *U.S. Antarctic Journal* v. 31, no 2.
This was the review issue for 1996, but was issued in 1998.

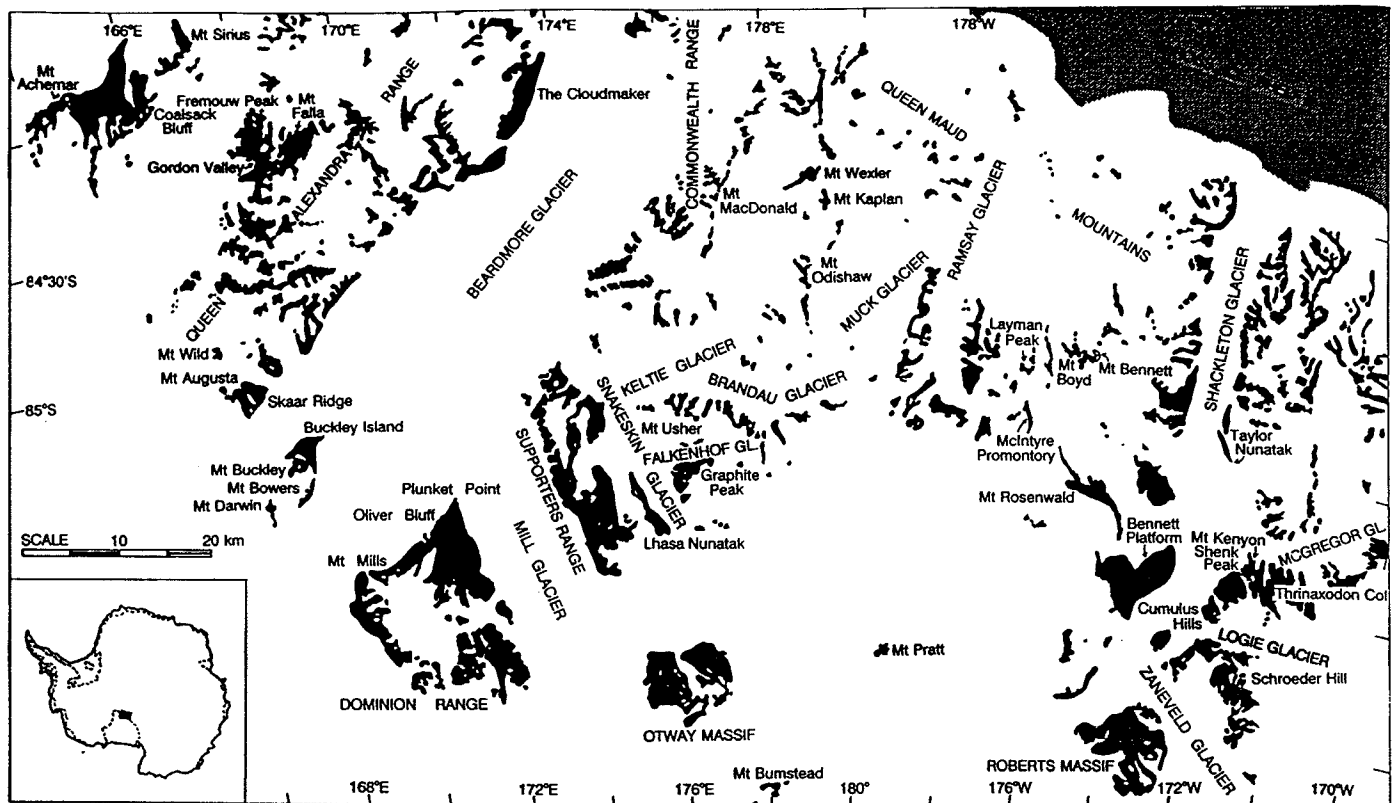


Figure 1. Rock and soil (black) and locations of Graphite Peak and Mount Rosenwald in the central Transantarctic Mountains, Antarctica. (km denotes kilometer.)

zonal *Vertebraria* roots in the underclay, but the Evelyn pedotype has bright coal and *Vertebraria* penetrating deeply [more than 5 centimeters (cm) and up to 92 cm]. Chambered roots as well as fossil stumps and leaves of *Glossopteris* are evidence that James and Evelyn pedotypes supported swamp woodlands. Their differences reflect reduced sediment supply and an initially deeper water table in Evelyn compared with James paleosols. Cherty tuffaceous siltstones and claystones include two kinds of very weakly developed paleosols. Morton pedotypes have blue hue, *Glossopteris*, thin *Vertebraria*, and rare burrows, but Molly pedotypes have green hue, *Paracalamites*, thin unchambered roots, and locally common burrows. Both represent communities early in ecological succession from disturbance. Other colonizing communities are represented by sandstones with relict bedding and root traces, such as the Sandy (gray with carbonaceous root traces) and Kerby pedotypes (greenish gray with clayey root traces). Finally, the Waller pedotype is siltstone with abundant burrows and nonchambered, gymnospermous root traces. Sandy, Kerby, and Waller pedotypes supported woody gymnospermous vegetation but lacked identifiable fossil plants. The abundance of cherty and coaly pedotypes in the Buckley Formation at Graphite Peak is remarkably similar to paleosols of the Late Permian, Newcastle Coal Measures in southeastern Australia.

Paleosols of the Early to Middle Triassic Fremouw Formation are of entirely different pedotypes. They also are

more even in their development and distribution than Permian paleosols (figure 2), indicating a marked paleoenvironmental change across the Permian-Triassic boundary. Some Early Triassic paleosols of the lower Fremouw Formation are identical to those in the Feather Conglomerate and Lashly Formation of southern Victoria Land. These include John (gray and thick with subsurface accumulation of clay), Dolores (gray and thin with subsurface nodules of berthierine), Michael (lithic sandstone with stout white root traces), and Edwin (quartz sandstone with burrows and root traces) pedotypes. These can be interpreted, respectively, as soils of lowland forest, swale woodland, streamside colonizing woodland, and channel bar herbaceous vegetation (Retalack et al. 1996). Also found were William (carbonaceous shaley weakly bedded surface) and Alton pedotypes (densely rooted carbonaceous surface horizon over light-colored subsurface). Both supported lowland seasonally waterlogged woodlands that were colonizing and well established, respectively. These noncalcareous paleosols indicate humid climate persisting into the early Triassic, like similar paleosols of the lower Narrabeen Group of the Sydney Basin, Australia.

Red paleosols are a distinctive feature of the Fremouw Formation in the Shackleton and Beardmore Glacier area. At Graphite Peak (figures 1 and 2), they are 50–112 m above the base of the formation. Red paleosols were also found at a comparable stratigraphic level at Mount Rosenwald (figure 3), on the 2,870-m peak near Mount Layman (84°48.70'S

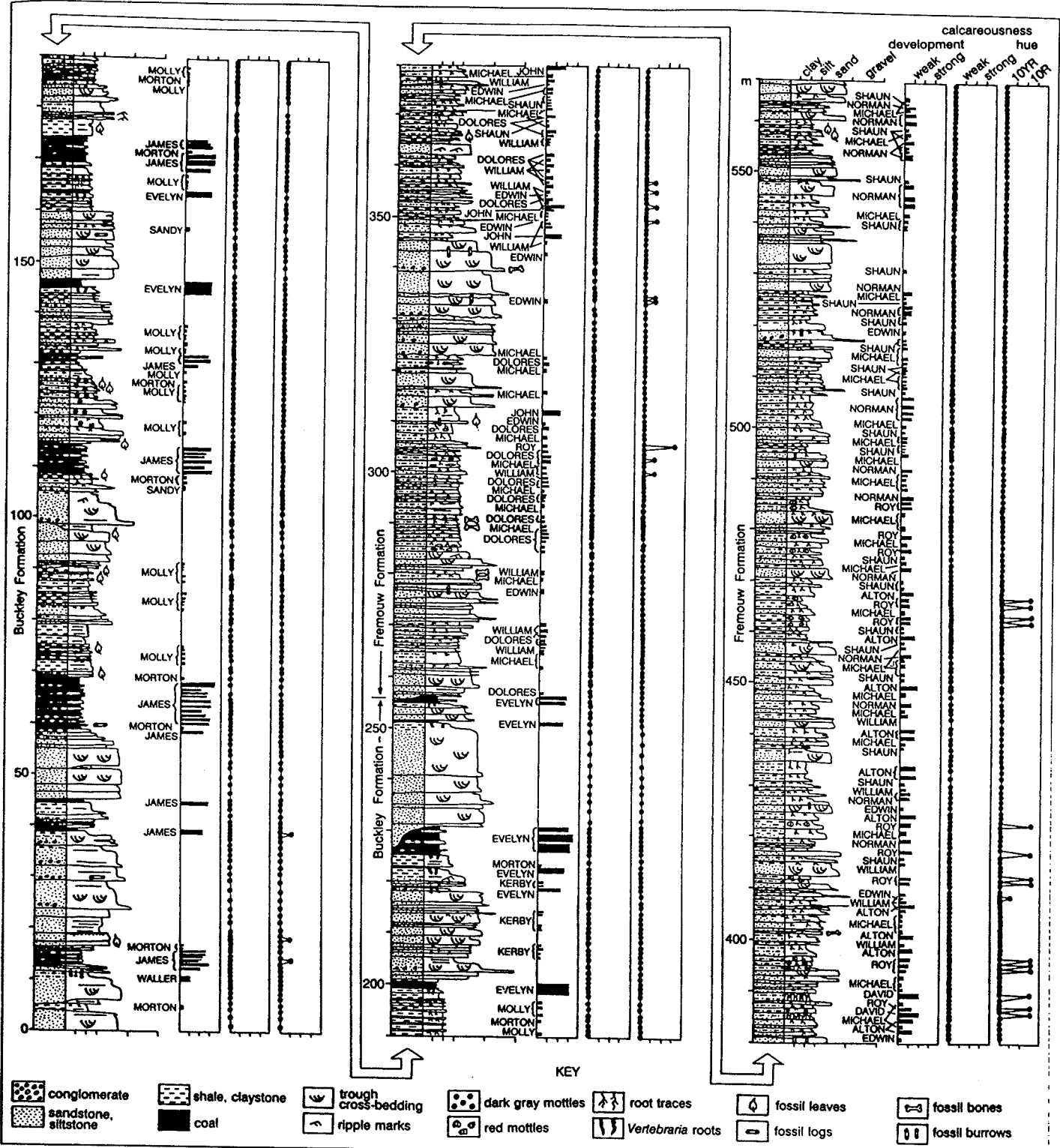


Figure 2. A measured section of paleosols on Graphite Peak. Hue is from a Munsell color chart. Calcareousness is by reaction with acid. Degree of development is from relative destruction of bedding.

179°78.18'W) and on Mount Boyd (84°48.83'S 179°68'W). The red paleosols included Roy (shaley with scattered red mottles), Julia (sandy with red subsurface), and David pedotypes (with red clayey subsurface). All have abundant stout drab-haloed root traces and are comparable to humid, cool-temperate, forested paleosols of the middle to upper

Narrabeen Group of the Sydney Basin, Australia (Retallack 1977a).

Also as in the Sydney Basin, paleosols higher in the Fremouw Formation associated with Middle Triassic floras (Retallack 1977b) are gray and green. These Middle Triassic paleosols include Shaun (shale with root traces), Michael

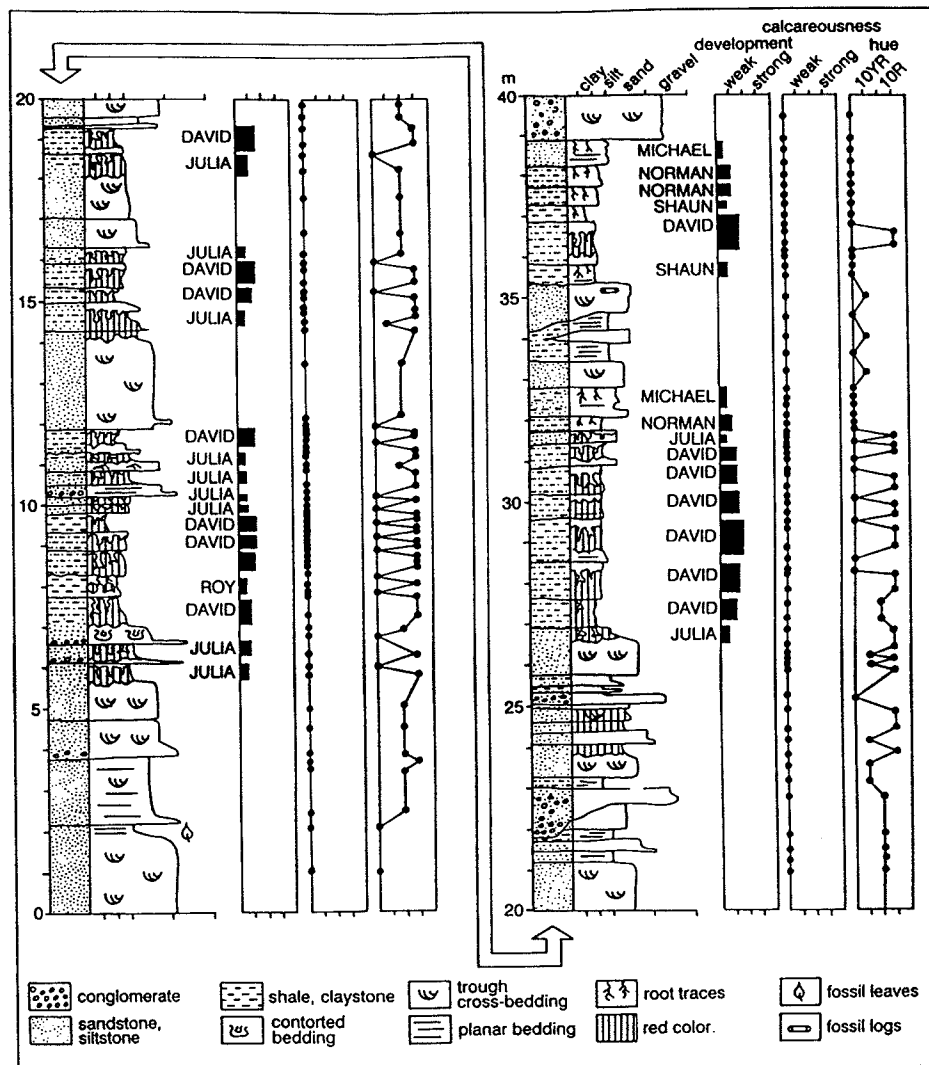


Figure 3. A measured section of paleosols on Mount Rosenwald. Hue is from a Munsell color chart. Calcaresousness is by reaction with acid. Degree of development is from relative destruction of bedding.

(sandstone with root traces), and Norman pedotypes (green claystone with white root traces), identical to paleosols of the Lashly Formation in southern Victoria Land. They represent seasonally waterlogged, subhumid, cold-temperate woodlands and early successional streamside vegetation (Retallack et al. 1996).

We thank Shaun Norman for field assistance, and in Shackleton base camp of 1995–1996, we appreciated the organization of David Elliot, Kevin Killilea, and the pilots of Helicopters New Zealand. Work was funded by National Science Foundation grant OPP 93-15228.

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