Permian-Triassic Boundary in the Central Transantarctic Mountains, Antarctica by James W. Collinson, William R. Hammer, Rosemary A. Askin and David H. Elliot

Photos of localities, people, outcrops, sedimentary features, plant fossils, vertebrate fossils, and palynomorphs

Trace fossils in the lower Fremouw Formation on Thrinaxodon Col



Coalsack Bluff field camp in 1969-1970. Coalsack Bluff is in back. Located on the margin of the polar plateau, this campsite was cold and windy. The proximity of the camp to the fossil locality was fortuitous.



West face of Coalsack Bluff. Extensive glacial moraine in foreground.



Fossil finders: (left) Jim Jensen, Ned Colbert, and David Elliot.



Permian-Triassic boundary and bone localities on west side of Coalsack Bluff. Locality to left dips vertically.



E. H. (Ned) Colbertin 1969 by lower Fremouw channel-form sandstone containing abundant disarticulated bones on west side of Coalsack Bluff.



The tent designed and used by Jim Jensen for excavating bones. The bone-bearing beds here dip vertically.



Vertebrate paleontologist excavating a bone. The weather was clear most of the time, but katabatic winds made Coalsack Bluff an uncomfortable place to work.



Isolated bone fragment typical of occurrences in channel-form sandstone beds.



Thrinaxodon Col in the center of the photo (taken from the slope of Mount Kenyon facing north).





Phil Colbert standing on the bedding plane (avulsion surface) in the lower Fremouw where several *Thrinaxodon* skeletons were found at Thrinaxodon Col.



James W. Kitching excavating and plastering a specimen of *Thrinaxodon* for transport and eventual preparation during the 1970-1971 field season. When he saw the first specimen in the rock, he exclaimed "That's my baby!" He recognized it immediately from his extensive work in the Karoo Basin of South Africa.



Field camp on the McGregor Glacier near the Shackleton Glacier in 1977-1978. The remains of a Jamesway Hut from the 1970 camp is on the right edge of the photo. Mount Kenyon, the peak in the background, represents the margin of the polar plateau. An almost complete section of the Fremouw Formation is exposed on the face of the mountain.



Field party in 1977-1978. From left: Kenneth O. Stanley, Charles L. Vavra, James W. Collinson, Noel R. Kemp, William R. Hammer, John W. Cosgriff, and John M. Zawiskie.



Photo of Collinson Ridge taken from a helicopter during 1995-1996 field season. All of the Fremouw Formation was thought to be Triassic until the fossil peat yielded *Glossopteris* (McManus et al., 2002). The Permian-Triassic boundary lies within a 10-m-thick unfossiliferous fine-grained sandstone and siltstone sequence between the highest plant and the lowest vertebrate fossils.





Erosional remnant of floodplain deposits overlying cross-bedded sandstone in the Triassic part of the Fremouw Formation on Collinson Ridge.

Green-gray floodplain deposits in the Triassic part of the Fremouw Formation on Collinson Ridge.



Channel-form sandstone deposits with large scours and intraformational conglomerate near the base of the Fremouw Formation on the lower slope of Mount Kenyon. These rocks could be either Permian or Triassic.



Crevasse-splay sandstones within mudstone of the middle Fremouw Formation on Shenk Peak.



Shenk Peak section. The Permian-Triassic boundary is in the vicinity of the arrow.



Charles Vavra pointing to base of crevasse splay in the middle Fremouw of the Shenk Peak section.



Mudcracks and burrows on the underside of a crevasse splay bed in the above photo.



A possible tuff bed (21 m above the base of our section) just below the Permian-Triassic boundary on Collinson Ridge. This bed was traced eastward for about a kilometer before it was cut off by the dolerite sill. This bed is overlain by a cross-bedded, medium-grained, green-gray sandstone and underlain by fine-grained sandstone. Load structures occur at the base along with deformed plant material.



Rob Andress by permineralized (silica) peat in the lower Fremouw Formation on Collinson Ridge. The peat exposure is about 0.6 m thick and 2 m across. When collected in 1995-1996, the outcrop was thought to be Triassic, but later studies of samples suggested a Permian age (McManus et al., 2002). The photos to the right were provided by H. A. McManus.



Venation in a Glossopteris leaf.



Cross-section of a *Glossopteris* root (Vertebraria).



Permineralized (silica) wood in the lower Fremouw on Collinson Ridge. The stumps (upper left and lower) are in situ with thin roots extending outward into fine-grained sandstone. Upper middle and right are logs. Scales are Estwing hammer (28 cm), Swiss Army Knife (9 cm), and bamboo staff in 10 cm increments.



Bill Hammer's vertebrate paleontology field party at work collecting vertebrate fossils on a major avulsion surface in the lower Fremouw on Collinson Ridge in 1995.



Size-comparison of skulls of *Lystrosaurus maccaigi* (left) and *L. murrayi* (right). This skull of *L. maccaigi* (WSU 0974 in Cosgriff et al., 1982) was found in the lower Fremouw on Shenk Peak, 10 m above the highest Permian plant fossils. The skull of *L. murrayi* was collected by J. W. Cosgriff in South Africa and is presently in the Fryxell Museum at Augustana College.



Longitudinal and cross-sectional views of a large tusk collected by James Kitching in the lower Fremouw on Thrinaxodon Col in 1970. This specimen (AMNH 9505) was first discussed by Colbert (1974). Cosgriff and Hammer (1982) suggested that it may be *Lystrosaurus maccaigi* because of its large size.





In situ specimens (above) of *Thrinaxodon liorhinus* in the lower Fremouw on Thrinaxodon Col. These and other specimens were described by Colbert and Kitching (1977).

Cast (left) of prepared specimen (AMNH 9500) in upper left.





Vertebra centrum from a thecodont in the lower Fremouw on Collinson Ridge.

Left humerus, ventral view, from a thecodont in the lower Fremouw on Shenk Peak.





Dorsal (left) and ventral (right) views of *Myosaurus gracilis* (WSU 0975) collected in the lower Fremouw on Collinson Ridge (Hammer and Cosgriff, 1981).



Lower Fremouw Formation section on the east side of Kitching Ridge.



Partial skeleton of *Lystrosaurus* from lower Fremouw on east side of Kitching Ridge.



Lower Fremouw vertebrate locality on west side of Kitching Ridge. Beds are dipping gently west.



James Kitching in 1970 at outcrop in photo above. This is part of the outcrop where he collected an extensive fauna.



Trace fossils on bedding surface in lower Fremouw on Kitching Ridge. These were described from other localities by Miller and Collinson (1994b).



Root casts in mudstone in lower Fremouw on Kitching Ridge.



Burrows (see arrows) in lower Fremouw on Kitching Ridge identified as possible crayfish burrows (Babcock et al., 1998).



Possible vertebrate burrows in lower Fremouw on Kitching Ridge described in Miller et al. (2001).



Graphite Peak section where the first Triassic tetrapod fossil was found by Peter Barrett in 1967. More vertebrates were collected here by Kitching in 1970 and Hammer in 1985-1986. Retallack, Krull and colleagues studied the paleosols in 1995-1996. Askin collected samples containing the palynomorphs illustrated here from just below the Permian-Triassic boundary in 1995.

Permian-Triassic Boundary at Graphite Peak (from Fig. 9)



¹Basu et al, 2003; ²Krull and Retallack, 2003; ³Poreda and Becker, 2003; ⁴Retallack and Krull, 1969.



Abundant, corroded, very poorly preserved bisaccate pollen from 150 m below the top of the Buckley Formation, microslide GP-33/2. It cannot be determined what proportion of these might have been taeniate.



Protohaploxypinus limpidus (Balme & Hennelly) Balme & Playford 1967, GP-94/1, length 61 microns



Protohaploxypinus sp., GP-94/2, length 88 microns



Bascanisporites undosus Balme & Hennelly 1956, GP-94/2, diameter 74 microns



Praecolpatites sinuosus (Balme & Hennelly) Bharadwaj & Srivastava 1969, GP-94/1, length 93 microns



Scheuringipollenites ovatus (Balme & Hennelly) Foster 1975, GP-94/1, length 49 microns



Praecolpatites sinuosus, GP-94/1, length 98 microns







1979, GP-97/1, diameter 102 microns

Playfordiaspora crenulata (Wilson) Foster Playfordiaspora crenulata, GP-97/3, diameter 90 microns

Playfordiaspora crenulata, GP-97/3, diameter 107 microns



View demonstrating common Playfordiaspora crenulata, GP-97/3



Protohaploxypinus microcorpus (Schaarschmidt) Clarke 1965, GP-98/pre-ox/1, length 82 microns. NB. This specimen fits within the description discussed by de Jersey (1979, *Geol. Surv.Queensland, Publ.374, Pal.Paper 46*) which incorporates the smaller Australian specimens previously described as *P. reticulatus.*



Lunatisporites sp., GP-98/1 length 69 microns





?Lunatisporites sp. GP-97/1, length 82 microns. Possibly four taeniae with longtitudnal splitting

Lunatisporites sp., GP-97/4, length 65 microns



Plicatipollenites gondwanaensis (Balme & Hennelly) Lele 1964, GP-97/3, diameter 110 microns