GSA Data Repository Item 2009056 The terrestrial Permian-Triassic boundary event bed is a non-event

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METHODOLOGIES

Stratigraphic columns were characterized on a submeter scale using standard field methods and a Jacob staff with leveling eyepiece. Architectural elements and lateral facies relationships were identified in the field by walking prominent outcropping sandstone bodies that overlie the "laminite" intervals on the Bethel and Heldenmoed farms. Photomosaics were created to trace sandstone bodies from the Heldenmoed to Bethel farms where these thinned and pinched out into massive siltstone (e.g., Fig. DR1F).

LITHOFACIES

Lithofacies are identified based on field characterization, thin-section analysis, and XRD bulk compositional data obtained using a Rigaku D-Max B two-axis x-ray diffractometer and Jade MDI 7 software. The stratigraphic and lateral relationships of these are illustrated in the accompanying Figure.

Fine Grained Feldspathic Arenitic Sandstone

This lithofacies comprises of a yellowish-grey (5Y 8/2) to very pale orange (10YR 8/2), fine-grained, silica cemented, feldspathic arenite. Clasts are sub-angular to sub-rounded and well sorted. XRD bulk composition data indicate an even mix of quartz (44.7 % by volume) and albite (42.0% by volume), whereas laumontite comprises

13.3% by volume. Point count data confirm the feldspathic nature (54% Q, 44% F, 1% L). SEM investigation confirms the presence of laumontite, but not whether it is present as clasts or cement.

Primary structures include ripple and planar cross beds, and mm-scale mudclasts. Ripples range from 10-30 cm in wavelength and are ~ 7 cm in amplitude. Millimeter-scale lenticular micro-cross bedding occurs in the troughs of some ripples, planar micro-cross bedding occurs in the troughs of others, whereas centimeter-scale planar beds also occur. Rounded mudclasts, 1 cm in diameter, also occur. The contact with the overlying lithofacies is sharp.

Greenish-Grey Carbonate Cemented Feldspathic Wacke

Greenish grey (5GY 4/1), very-fine grained, carbonate cemented, well sorted, feldspathic wacke exhibits a mineralogical composition of 51% quartz, 37% feldspar, and 11.8% lithic fragments (point count data). A thick (30 cm) massive bed horizontally fines to a coarse siltstone and eventually pinches out. This lithofacies , resistant to weathering and standing in relief from the outcrop, is rooted and also contains millimeter-scale mudclasts.

Fine to Very Fine Feldspathic Wacke and Coarse Siltstone

This dark greenish-grey (5G 6/1), light greenish-gray (5GY 8/1) to light bluish grey (5B 7/1), coarse to fine, silica cemented sandstone and siltstone is comprised of 62% albite, 35% quartz, 3.1% laumontite by volume (XRD bulk compositional data). Point counts confirm these data (56% Q, 31% F, 12% L). SEM investigation using EDAX reveals that laumonite, which is a zeolite feldspar replacement, is part of the lithofacies cement. This lithofacies is composed of alternating coarse to fine beds

organized into fining upwards sequences. Sandstone and siltstone color correlates with grain size, with coarser beds generally greenish grey (5G 6/1) overlain by fine grained, light greenish grey (5GY 8/1) sandstone or siltstone. Coarser beds fine upwards into fine siltstone laminae and the couplets range in thickness from 0.8 cm to 5 cm. Although this lithofacies is separated into distinct beds, lenticular geometries and gradational contacts make it difficult to trace individual beds across an exposure.

Ripple and low angle cross bedding occur throughout the lithofacies. Asymmetrical ripples are found within beds and as isolated laminae with wavelengths ranging from 7-21 cm and an amplitude of ~ 2 cm. Micro-trough cross lamination occurs locally and planar cross beds are distinct throughout the horizon.

Trace fossils include burrows and crinkled surfaces. Two distinct invertebrate burrows occur. The larger burrow *Katbergia carltonichnus* (Gastaldo and Rolerson, 2008) is more frequent and averages 1-2 cm in diameter, is greater than 15 cm in length, and often inclined. Scratch marks ornament the surface of the burrow, and these may be infilled by the surrounding or overlying lithofacies. The smaller is a thin, "straw like" vertically oriented burrow that is 2-3 mm in diameter, 6 cm in length, filled exclusively with dark greenish grey siltstone, and characterized by horizontal scratch-like ornamentation along the exterior. These small vertical burrows can occur independently of, or in conjunction with, *Katbergia*. Burrows commonly cross-cut beds and laminae.

Coarse to Fine "Maroon" Siltstone

A maroon (brownish grey – 5YR 4/1) coarse to fine grained, silica cemented, massive siltstone is distinguished easily from other lithofacies. The maroon beds vary

in thickness from 0.02-2 m. The thickest bed beneath the "laminite" interval has been referred to as the End Permian Paleosol (EPP; Retallack et al., 2003). One 8 cm high slickenside appears in close proximity to a calcareous nodule in this horizon.

The maroon interval is bioturbated by both invertebrate and vertebrate activity. Invertebrate burrows occur sparingly, with a density of 1-2 burrows/m². Both *Katbergia* and thin vertical "straw like" burrows appear and generally are filled with the maroon siltstone. Neither burrow type occurs within the nodule horizons. Vertebrate burrows are oriented 5-15° from horizontal and are filled with either maroon or mottled siltstone. Burrow scratches, oriented parallel along the sides of the burrow, are rarely preserved.

Calcareous nodules are common and concentrated within the EPP, with a majority occurring within 1 m of the lower contact. EPP Nodule density is approximately 3-4/m². They range in shape from well rounded ellipses to knobby and amorphous, and vary in diameter from 10 to 40 cm. All are reactive to dilute HCL. Compositionally, nodules are typically cemented by micritic calcite, although sparite cemented nodules also are present. Nodule thin-sections show a range of internal structures from preserved bedding to radiaxial calcite. Typically they reveal significant mineral alternation and recrystallization. Starburst carbonate structures are visible in several samples and may represent the precipitation of calcite after gypsum (Tabor, pers. comm., 1/2008). Some nodules contain dark quadrilateral opaques up to 0.02 mm in diameter and 0.08 mm in length that tend to be concentrated within the darker zones. Some domains of red matrix show well distinguished rims of carbonate or sparite growing into them. Nodules with intact bedding structures are rare and indicate bioturbation prior to the precipitation of carbonate.

Greenish Grey Very-Fine Feldspathic Siltstone

This is a green-grey (5G 6/1) to light grey (N7), coarse-fine grained, silica cemented, feldspathic siltstone. X-ray diffraction bulk compositional data indicate a mineralogical composition of quartz (39.7% by volume), albite (44.9%), muscovite (7.3%), and clinoclore (8.2%). Mudclasts also are present in these massive beds and are cm-scale in size. This lithofacies, which appears throughout the Bethulie area, fines upward and forms a gradational contact with the overlying lithofacies.

Coarse Mottled Siltstone

Greenish grey (4GY 4/1) to Brownish grey (5YR 4/1), coarse-grained, silica cemented, massive siltstone. The mottled siltstone is a dark grey color, but upon closer inspection has intermixed bands of greenish and brownish grey. The thickness of mottled siltstone beds vary from 3-9 cm; however in some sites it increases to 17 cm. The mottled siltstone occurs in beds within the maroon siltstone below the EPP, and is common as fill in vertebrate burrows.

