GSA DATA REPOSITORY 2013142

Buatois, Almond and Germs– *Treptichnus pedum* - List of supplementary materials:

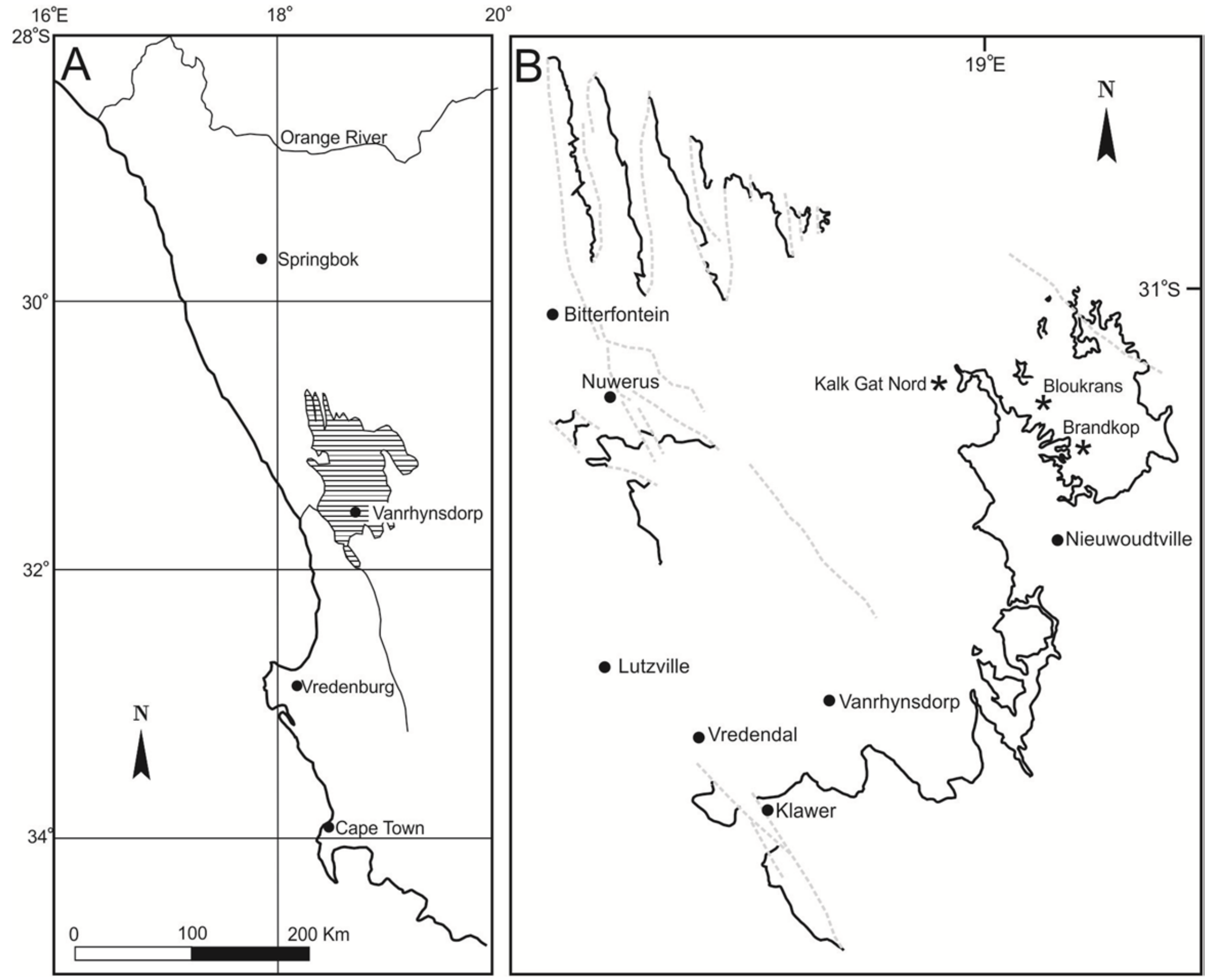


Figure DR1. Map showing the distribution of the Vanrhynsdorp Group. A. General distribution of outcrops (based on Gresse, 1992). B. Location of outcrops studied (asterisks).

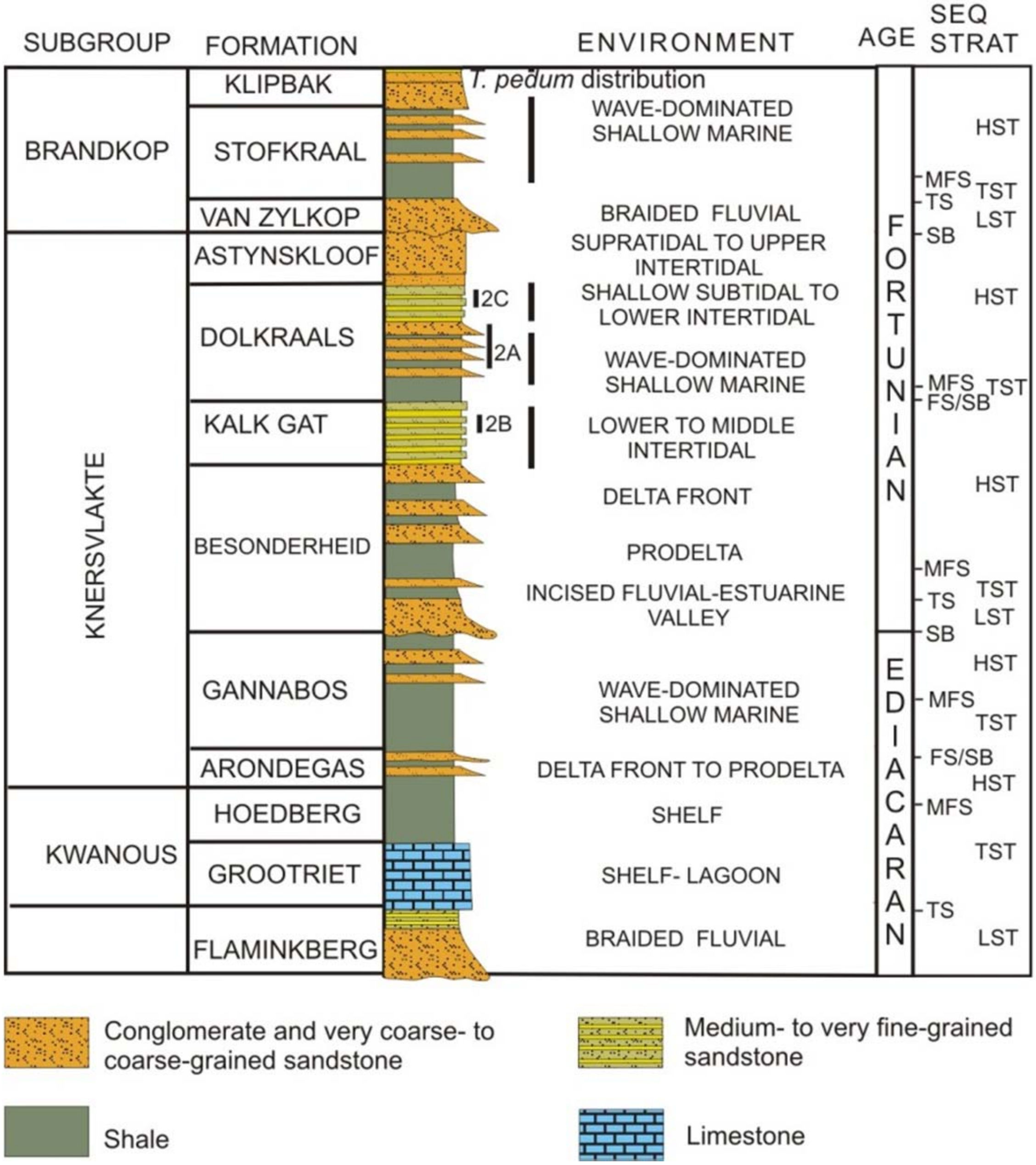


Figure DR2. Stratigraphy of the Vanrhynsdorp Group (based on Gresse, 1992), indicating vertical distribution of *Treptichnus pedum* and associated sedimentary environments. Short bars indicate approximate location of stratigraphic sections illustrated in Fig. 2

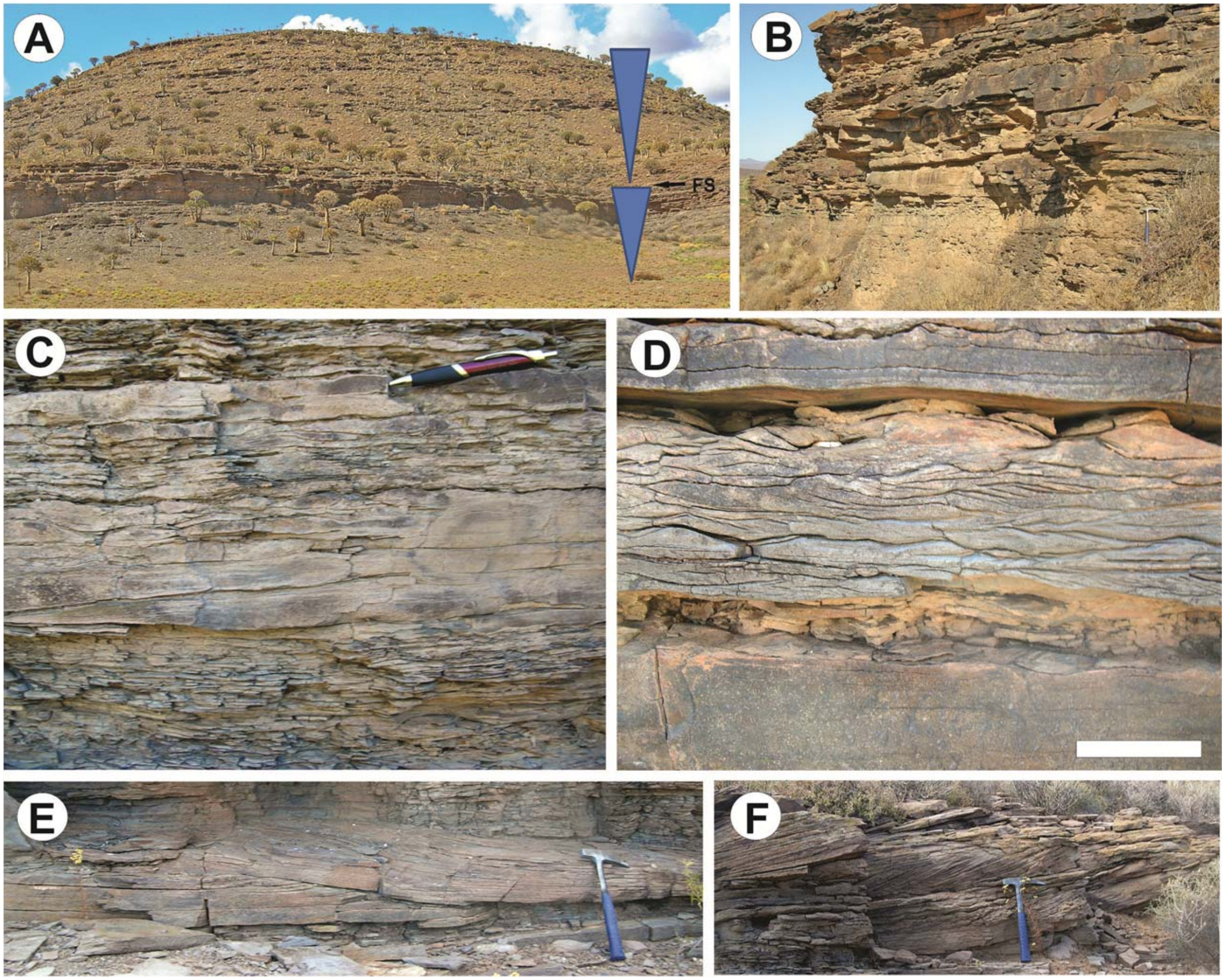


Figure DR3. Sedimentary facies of wave-dominated shallow-marine clastic successions in the Vanrhynsdorp Group. A. General view showing two coarsening-upward parasequence sets (triangles) in the Klipbak Formation near Brandkop. The first parasequence set includes lower- to upper-offshore deposits and culminates in the cliff-forming offshore-transition and lower- to upper-shoreface deposits. The second parasequence sequence set only includes lower- and upper-offshore deposits. Both parasequence sets are separated by a major flooding surface (FS). B. Coarsening-upward parasequence starting with upper-offshore deposits and culminating in the cliff-forming lower/middle-shoreface deposits. Lower interval of the Dolkraals Formation, roadcut outcrops near Bloukrans Farm. C. Upper-offshore deposits showing intercalation of suspension fallout siltstone and storm-emplaced very fine-grained sandstone displaying microhummocky cross-stratification and wave-ripple cross lamination. Klipbak Formation near Brandkop. D. Close-up of upper-offshore deposits showing wave-ripple cross-laminated very fine-grained sandstone. Klipbak Formation near Brandkop. Scale bar is 10 cm long. E. Lower/middle-shoreface deposits showing amalgamated hummocky cross-stratified very fine-grained sandstone. Klipbak Formation near Brandkop. F. Upper-shoreface deposits showing through cross-stratified fine- to medium-grained sandstone. Klipbak Formation near Brandkop.

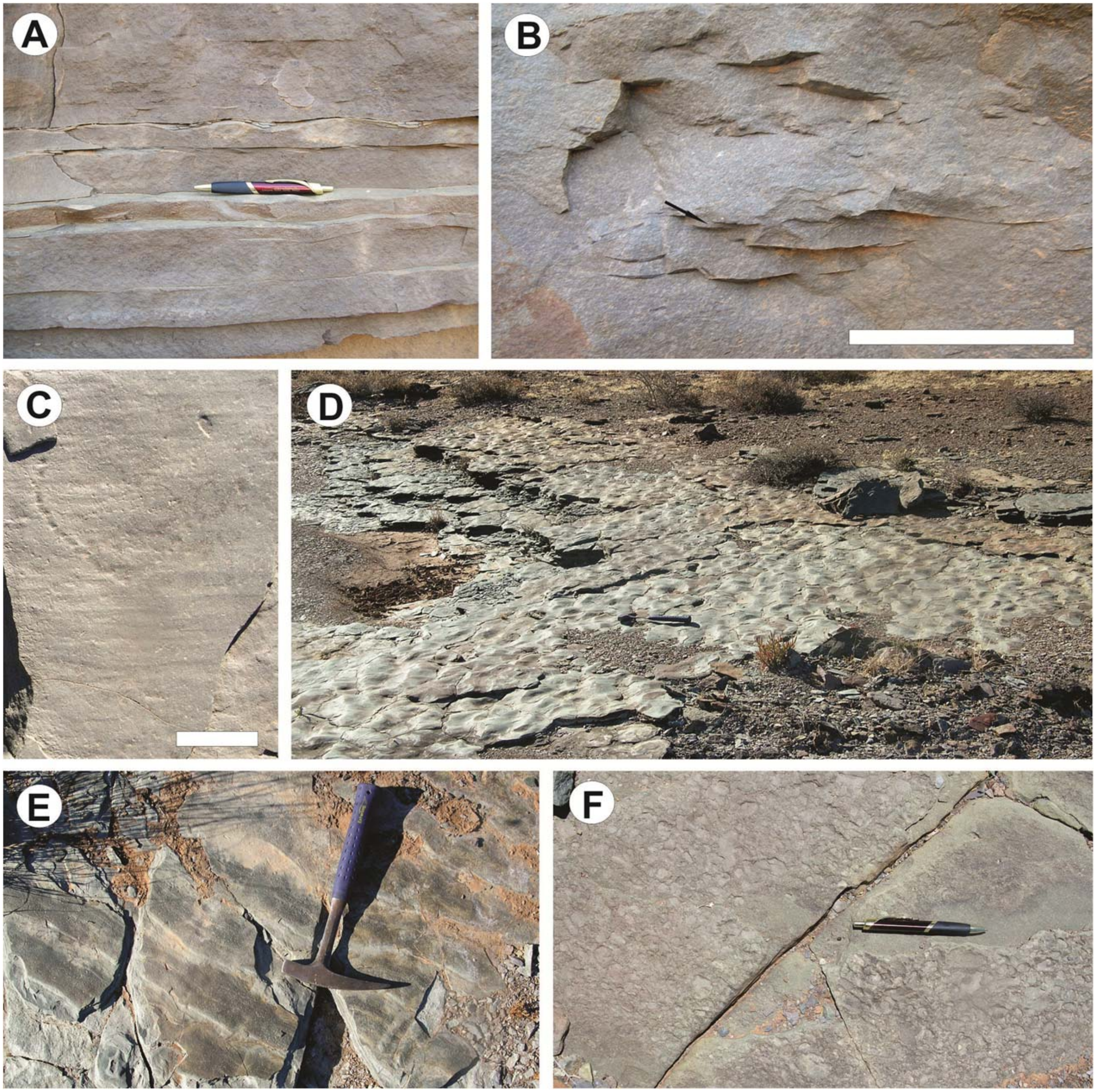
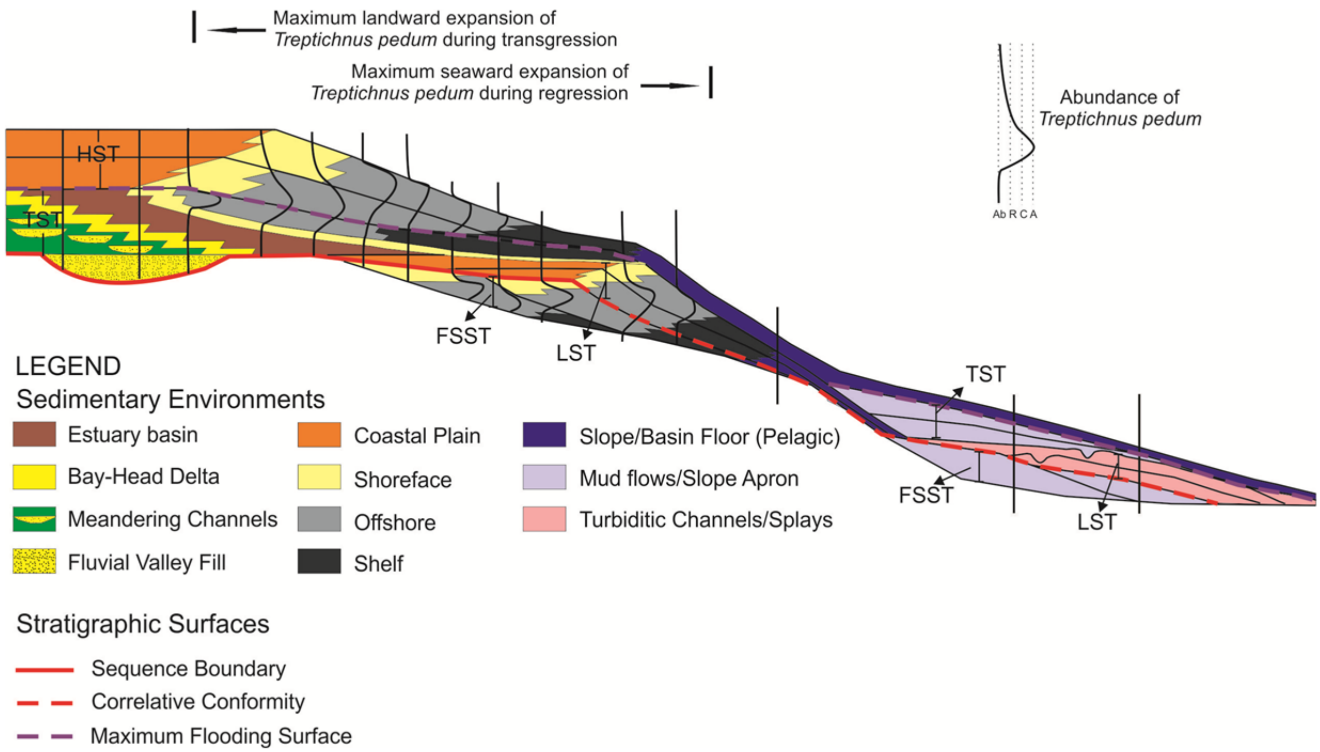


Figure DR4. Sedimentary facies of tide-dominated shallow-marine clastic successions in the Vanrhynsdorp Group. A. Shallow-subtidal deposits showing flaser- to wavy-bedded very fine-grained sandstone and mudstone. Upper interval of the Dolkraals Formation, roadcut outcrops near Bloukrans Farm. B. Close-up of shallow-subtidal deposits showing flaser-bedding and local presence of doubles mudstone drapes (arrow). Upper interval of the Dolkraals Formation, roadcut outcrops near Bloukrans Farm. Scale bar is 10 cm long. C. Lower-intertidal deposits showing parting lineation and epichnial preservation of *T. pedum* on very fine-grained sandstone. Kalk Gat Formation, creek near Kalk Gat Noord Farm. Scale bar is 5 cm long. D. Interference ripples in lower-intertidal very fine-grained sandstone. Kalk Gat Formation, creek near Kalk Gat Noord Farm. E. Lower-intertidal deposits showing flat-topped ripples. Kalk Gat Formation, creek near Kalk Gat Noord Farm. F. Flat-pebble mudstone conglomerate layer interbedded within lower-intertidal very fine-grained sandstone deposits. Kalk Gat Formation, creek near Kalk Gat Noord Farm.



Sup. Mat. 5. Figure DR5. Sequence-stratigraphic architecture, and environmental tolerance and range offset of *Treptichnus pedum*. For the sake of simplicity, a single valley incision is illustrated, and a wave-dominated regime is depicted for the fully marine segment. A similar diagram can be produced for a tide-dominated regime by changing the facies belt of the shallow-marine segment. The maximum landward range of *T. pedum* in wave-dominated systems is most likely controlled by frequency and intensity of storms. Under high intensity and frequency of storms, amalgamated hummocky cross-stratified sandstone tends to occur, precluding colonization by the *T. pedum* producer. Under moderate or low intensity and frequency of storms, formation of *T. pedum* is favored by longer colonization windows during fairweather. The sequence-stratigraphic context of the South Australia succession (Uratanna and Parachilna formations) consists of valley incision and subsequent transgression (Gehling, 2000). A similar situation is expressed by the Nama and Vanrhynsdorp groups. However, multiple valley incisions occur in the Nama Group (Wilson et al., 2012), representing a departure of the single valley-fill model adopted in our reconstruction. The earliest Fortunian regressive event in the Vanrhynsdorp Group (upper interval of the Besonderheid Formation) took place essentially due to deltaic progradation rather than the establishment of a shoreface-offshore complex, which may have been detrimental for colonization by the *T. pedum* producer. The Fortune Head succession (Chapel Island Formation) lacks valley incision and records a transgression in a tide-dominated shoreline (Myrow and Hiscott, 1993).

Table DR1. Summary of the main characteristics of the studied facies, interpretation in terms of depositional processes and sedimentary environments and stratigraphic distribution.

FACIES ASSOCIATION	FACIES	LITHOLOGY & SEDIMENTARY STRUCTURES	SEDIMENTARY PROCESSES	SEDIMENTARY ENVIRONMENT	DISTRIBUTION
Tide-dominated Shallow Marine	Flaser-bedded, ripple cross-laminated very fine-grained sandstone	Medium-bedded very fine-grained sandstone displaying flaser-bedding and, less commonly, wavy bedding. Sandstone beds are 1.5-15 cm thick, but are stacked forming up to 10 m thick laterally persistent units. Mudstone partings are up to 1 cm thick. Double mudstone drapes are locally present. Although superficially of massive aspect, sandstone beds contain wave-ripple cross-lamination and locally parallel lamination. Quasi-symmetrical ripples are preserved on sandstone bed tops.	Sand deposition from tidal currents, mud fall-out during slack-water intervals, and subsequent reactivation and tractive sand deposition.	Shallow-subtidal sandbody	Upper interval of the Dolkraals Formation
	Flaser- and wavy-bedded ripple and parallel-laminated very fine-grained silty sandstone and mudstone	Flaser- and wavy-bedded very fine-grained silty sandstone intercalated with mudstone. Sandstone beds are 1.5-15 cm thick and mudstone intervals are 0.1-13 cm thick. Sandstone beds display wave and current ripple cross-lamination, parallel lamination, parting lineation, and mudstone drapes. Double mudstone drapes are locally present. Symmetrical, quasi-symmetrical, asymmetrical, interference, linguoid and flat-topped ripples are the bedforms preserved on sandstone tops. Some of the ripples show bifurcated straight crests. Ripple wave	Sand deposition from tidal currents, mud fall-out during slack-water intervals, and subsequent reactivation and tractive sand deposition. Erosion of underlying mudstone layers and formation of mudstone intraclasts. Strong ebb outflow flattening the original flood-generated ripple. Parallel lamination formed under upper-flow regime conditions.	Lower intertidal sand flat	Kalk Gat Formation

		length is 4.5-12 cm and amplitude is 0.2-0.5 cm. Up to 3 cm-thick layers with mudstone flat pebbles are locally present			
	Lenticular-bedded mudstone and very fine-grained silty sandstone	Massive to parallel laminated mudstone interbedded with very thin, very fine-grained silty sandstone, displaying lenticular bedding and, more rarely, wavy bedding. Sandstone beds display wave and current ripple cross-lamination.	Suspension fall-out under low-energy conditions punctuated by higher-energy tractive sand deposition due to tidal currents.	Mixed flat	Kalk Gat Formation
Wave-dominated shallow marine	Siltstone with thinly bedded very fine-grained sandstone	Massive or thinly parallel-laminated, tabular siltstone units intercalated with sharp-based and tabular sandstone beds. Sandstone is 0.1-4 cm thick and siltstone is 5-15 cm thick. Thinly bedded very fine-grained sandstone shows combined-flow ripple cross-lamination and symmetric to quasi-symmetric ripple tops and, very rarely, micro hummocky cross-stratification. Ball and pillows are present locally.	Low energy, suspension fall-out deposition during fair-weather times punctuated by rare, distal storm events.	Lower offshore	Lower interval of the Dolkraals Formation and Klipbak Formation
	Siltstone with interbedded wave-rippled and hummocky cross-stratified very fine-grained sandstone	Massive or parallel-laminated siltstone with, tabular, erosive-based, thinly bedded very fine-grained sandstone beds. Sandstone is 4-15 cm thick and siltstone is 4-10 cm thick. Sandstone beds exhibit combined-flow and wave ripple-cross and, less commonly, parallel lamination, and microhummocky and hummocky cross-stratification. Ripple	Alternating background suspension fall-out during fair-weather times and relatively distal storm deposition. Closer proximity to the fair-weather wave base.	Upper offshore	Lower interval of the Dolkraals Formation, Stofkraal Formation and Klipbak Formation

		wave length is 5-12 cm and amplitude is 0.2-1 cm. Preserved sandstone bedforms include straight to slightly sinuous-crested symmetric to quasi-symmetric ripples. A wide variety of soft-sediment deformation structures, including convolute lamination, balls and pillows and pseudonodules. Sandstone bases locally show flute and tool marks.			
	Regularly interbedded hummocky cross-stratified very fine- to fine-grained sandstone and mudstone	Regular intercalations of parallel-laminated mudstone and medium to thickly bedded, erosive-based, tabular hummocky cross-stratified fine- to very fine-grained sandstone forming discrete layers. Sandstone is 10-70 cm thick and siltstone is 1-5 cm thick. Hummocky includes both isotropic and anisotropic varieties. Combined-flow ripple cross-lamination and/or symmetrical to quasi-symmetrical ripples and interference ripples are present.	Alternation of sediment fall-out during fair-weather times and high-intensity oscillatory flows during frequent storms right below fair-weather wave base.	Offshore transition	Lower interval of the Dolkraals Formation, Stofkraal Formation and Klipbak Formation
	Amalgamated hummocky very fine- to fine-grained cross-stratified sandstone	Hummocky cross-stratified, very fine- to fine-grained sandstone forming amalgamated units up to 1 m thick. Bedsets laterally persistent, but individual beds may pinch out. Internal second-order erosion surfaces separating hummocky cross-stratified laminasets.	Frequent storm wave activity and wave-generated surges above fair-weather wave base.	Lower/middle shoreface	Lower interval of the Dolkraals Formation and Klipbak Formation
	Trough cross-bedded fine-	Trough cross-bedded, erosive-based, fine- to	Strong erosive events and	Upper shoreface	Klipbak Formation

	to medium-grained sandstone	medium-grained sandstone forming sets up to 80 cm thick. Laterally extensive units, although individual beds may show lateral thickness variations.	multidirectional current flows leading to migration of 3D dunes in the build-up and surf zones.		

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