Forum Comment

https://doi.org/10.1130/G54507C.1

Paleohydraulics of cyclonic storm deposits suggest that the equatorial climate of Earth in the Pennsylvanian was not cold

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Myrow et al. (2026) presented a paleohydraulic analysis of prodeltaic units containing hummocky cross-stratification (HCS) from the middle Atokan–upper Desmoinesian Fountain Formation and lower Desmoinesian Minturn Formation (Colorado, USA). These units record marine fan-delta deposition proximal to uplifts of the Ancestral Rocky Mountains (ARM). Their analysis suggests the need for large waves and winds of up to hurricane strength. Paleolatitudinal reconstructions place both units at <5°N, and Myrow et al. acknowledged this is problematic because it eliminates the possibility of extra-tropical cyclonic storms for producing the HCS, and minimizes the possibility of cyclonic storms, which are exceptionally rare at such latitudes. To explain the discrepancy, they proposed a higher paleolatitude and warm sea surface temperatures (SSTs) sufficient for hurricanes. They concluded this implies a warm equatorial climate during the entire Pennsylvanian—at odds with the hypothesis of episodic relatively low-elevation upland glaciation in equatorial Pangaea during the late Paleozoic ice age (LPIA).

We applaud Myrow et al. for a creative approach to this problem. In contrast to universal acceptance of LPIA glaciation at high paleolatitudes, upland glaciation in equatorial Pangaea strikes some as an outrageous hypothesis, thus meriting rigorous and repeated testing, but is challenging because uplands are rarely preserved, precluding discovery of ice-contact indicators (e.g., Soreghan et al., 2022). Here, we address what we perceive as gaps in their presentation and offer alternative food for thought.

Although Myrow et al. acknowledged the difficulty of calling upon cyclonic storms at the Equator, they nevertheless resort to this explanation, dispensing swiftly with two alternative explanations: trade winds and monsoons. Close proximity of ARM uplifts to the seas recorded by the Minturn and Fountain units (<30 km) suggests the possibility of coastal-gap wind jets. In the present climate, strong high pressure associated with outbreaks of polar continental airmasses can channel air through mountain passes at lower latitudes, resulting in high winds and high wave heights across wide fetches in coastal waters. The best-known example affects the Gulf of Tehuantepec (GT) in the Pacific off Central America. An average of 6.4 events/yr with winds exceeding 24.5 m/s were observed in GT by satellite scatterometry at 12.5 km resolution (Brennan et al., 2010). The fetch of winds exceeding 60 knots (30.9 m/s) in a November 2006 event was ~200 km (Brennan et al., 2010). Simulation of a 2013 event by a mesoscale model with resolution as fine as 444 m suggests the strongest wind speeds reach 35 m/s (Prósper et al., 2019). Event durations average ~36 h, allowing ocean waves to develop to heights of 3–6 m over 400 km fetches and somewhat deeper bathymetry than inferred for the Central Colorado Basin (Melville et al., 2005).

Myrow et al. dismissed a form of upland-generated winds (katabatic winds) as incapable of producing the required fetch for HCS due to inferred offshore-directed flow (see Myrow et al.'s supplemental material). However, their figure 1A shows mountainous regions on both sides of the seaways, making wind direction uncertain. Wind gaps through canyon systems therefore could have produced winds of 35 m/s along fetches of 100–200 km across the seaways, meeting the criteria for HCS demonstrated by Myrow et al.. A colder global climate, proximity to an even larger continent, and the likelihood of semipermanent high pressure north and south of a glaciated Central Pangaean Mountains (Soreghan et al., 2022) would only increase the likelihood of coastal gap wind jets, even near the Equator.

The record of inferred SSTs is aliased. Estimated SSTs from isotopic analyses on marine units capture warm (interglacial/transitional) intervals of the LPIA, as do the studied HCS deposits. Last Glacial Maximum (LGM) equatorial SSTs were ~2–8 °C cooler than today (e.g., Paul et al., 2021), and Macarewich and Poulsen (2022) suggested 3–6 °C cooling for the equatorial Panthalassic Ocean during the LPIA. No analog exists for the Midcontinent sea, and glacials caused exposure across much of it, so assessing the extent of SST cooling is difficult.

Fundamental forcings during the LPIA, notably lowered (by ~3%) solar luminosity and remarkably low $p\mathrm{CO_2}$, should have primed Earth for cold conditions (Feulner, 2017). Also the HCS beds discussed in Myrow et al. represent two isolated points in time within the ~25 m.y. duration of the Pennsylvanian. Pronounced $p\mathrm{CO_2}$ fluctuations on orbital time scales (Montañez et al., 2016) and volcanic aerosol cooling (Soreghan et al., 2019) suggest a highly dynamic climate with alternations between colder and warmer states.

We look forward to further testing of the upland glaciation hypothesis, as such tests advance our science and expand our collective concepts of the possible bounds of the Earth system.

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