Tropical westerlies over Pangaean sand seas

DAVID B. LOOPE*, MAUREEN B. STEINER†, CLINTON M. ROWE* and NICHOLAS LANCASTER‡
*Department of Geosciences, University of Nebraska, Lincoln, NE 68588, USA
†Department of Geology and Geophysics, University of Wyoming, Laramie, WY 82071, USA
‡Desert Research Institute, University of Nevada, Reno, NV 89512, USA

ABSTRACT

Cross-equatorial, westerly winds are key features of tropical circulation in monsoonal regions. Although prominent in numerical climate models of Pangaea (the supercontinent straddling earth’s equator, Late Palaeozoic to Early Mesozoic), such flow has not been confirmed previously by migration directions of ancient dunes. Wind-blown sandstones that span 100 million years of earth history are widely exposed in south-western USA. If recent palaeomagnetic data from the Colorado Plateau are used to correct Mesozoic palaeogeographic maps, the Plateau is placed about 10° further south than previously assumed, and the prevailing north-westerly surface winds recorded by dune-deposited sandstones are explicable as cross-equatorial westerlies – the hallmark of modern monsoon circulation. Permian to Early Jurassic dunes were driven by north-westerlies produced by a steep pressure gradient spanning the supercontinent during December–January–February. Although winds are light in most modern, near-equatorial settings, the East African Jet accounts for more than half the cross-equatorial flow in June–July–August. The thicknesses of annual depositional cycles within the Navajo Sandstone indicate that the near-equatorial, north-westerly winds that drove these particular dunes were stronger than the modern East African Jet. The Early Jurassic dunes that deposited the thick cycles were positioned west of the dominant (southern hemisphere) thermal low and against highlands to the west – a setting very similar to the East African Jet. The mountains along the western coast of Pangaea not only enhanced wind strength, but also cast a rain shadow that allowed active dunes to extend very close to the palaeoequator.

Keywords Dunes, Jurassic palaeogeography, monsoon, palaeowinds, Pangaea.