

Globally Synchronous Exposure of Tropical Carbonate Platforms at the Pennsylvanian-Permian Boundary Correlated with Onset of Major Gondwanan Glaciation: Implications for Petroleum Exploration

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Sedimentary systems deposited during global icehouse conditions are often very complex due to large-scale climatic and sea-level fluctuations. One icehouse period of particular interest is the late Paleozoic ice age (LPIA), which has been a topic of study for many years due to the importance of Pennsylvanian-Permian hydrocarbon systems to the petroleum industry. Recent evidence from Gondwana suggests that the acme of the LPIA was during the Early Permian rather than the Late Pennsylvanian, as traditionally viewed. Given this new evidence, Early Permian carbonate platform systems should have recorded this acme as widespread subaerial exposure events resulting from large-scale glacioeustatic sea-level falls. This study is a synthesis of global literature from eight tropical and subtropical carbonate platform systems spanning the Gzhelian-Kungurian. Tropical carbonate platforms are used because they are sensitive indicators of eustatic sea-level change during icehouse periods. The eight localities chosen for this investigation are: 1) Orogrande Basin, NM; 2) Permian Basin, TX; 3) U.S. Midcontinent; 4) South China; 5) Arctic North America; 6) Barents Shelf/Svalbard; 7) Russian Platform; 8) Bolivia. These locations were chosen because they contain well-constrained and stratigraphically complete sections of Upper Pennsylvanian-Lower Permian strata. In addition, most of these localities were free from major tectonic influences during carbonate deposition. Each stratigraphic record was analyzed in terms of: lithology/facies changes, variations in cyclicity patterns, and stratigraphic locations of unconformities/erosional hiatuses; the synthesized paleotropical records were correlated with the most recent reconstructions of Gondwanan glacial events during the Pennsylvanian-Permian transition. Results suggest that the majority of tropical and subtropical carbonate platforms from around the world underwent extensive subaerial exposure beginning in the earliest Permian due to glacioeustatic sea-level fall related to a major expansion in Gondwanan ice centers. These exposure events comprise a global sequence boundary. In most locations, exposure led to significant karstification, which increased the reservoir potential of carbonate strata across equatorial Pangea. Results highlight the potential of carbonate platforms deposited during glacial acmes as exploration targets.