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Rapid recycling of Gondwana-derived sedimentary rocks in western South China during the Artinskian warming

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Climatic conditions are important factors controlling landscape erosion and weathering. Distinguishing climate forced landscape erosion is critical to understand the interactions between climate change and landscape evolution, but it is usually complicated by other influences. Artinskian warming is an important climate event during the Permian icehouse demise and characterized by a high atmospheric pCO_2, a major eustatic sea-level rise, a sudden biotic replacement and hydroclimatic change in low latitude regions. During this climate warming period, South China evolved as a stable continental block and has preserved a unique siliciclastic sedimentary succession of the Liangshan Formation. We conducted a sedimentary provenance analysis on the Liangshan Formation to understand the response of landscape erosion to the Artinskian warming event. Four sections of Liangshan Formation in western South China were selected for comprehensive analysis. Detrital zircon and rutile U-Pb ages were analyzed for provenance in combination with sedimentary facies, sandstone petrography, mudstone mineral and chemical compositions. Detrital zircon U-Pb age spectra show two major age groups of 1100−900 Ma and 700−500 Ma with subordinate ones of 2600−2400 Ma and 850−700 Ma. Detrital rutile U-Pb age spectra only show one dominant age group of 700−500 Ma. These detrital zircon and rutile U-Pb age patterns present a remarkable Gondwana affinity as comparing with the corresponding records in northeast margin of Gondwana. However, during the early Permian South China block was isolated from Gondwana by the wide Tethys Ocean and unlikely to have direct sedimentary influx from the far-away Gondwana continents. In this paleogeography, the Liangshan Formation could only derive from a provenance in South China itself. In western South China, the Liangshan Formation is disconformably overlying the Carboniferous-earliest Permian carbonates, Devonian quartzose sandstones, Silurian quartzose sandstones and mudstones, and Cambrian-Ordovician carbonate and mudstones, of which the sandstones and mudstones have been suggested to have a possible Gondwana derivation when South China located close to the northern Gondwana margin during the early Paleozoic to Devonian. The Liangshan Formation mainly composed of massive mudrocks and quartzose fine sandstones with high maturity showing strong weathering and forming multiple cycles. Detrital zircon U-Pb age data were collected from the Cambrian-Ordovician, Silurian, Devonian and Carboniferous successions in western South China. They were used for quantitatively fitting the provenance of the Liangshan Formation by Dzmix method. The Dzmix fitting analysis shows that the relative contribution of Cambrian-Ordovician, Silurian, Devonian and Carboniferous are 23.6%, 24.6%, 50.3% and 1.5%, respectively.

This result indicates that the siliciclastic sediments of Artinskian Liangshan Formation were mainly recycled from the Devonian, Silurian and Cambrian-Ordovician sedimentary rocks. Considering the carbonate dominated successions in the Carboniferous to earliest Permian, the deposition of the Liangshan Formation would indicate a sudden input of terrigenous materials and thus a rapid recycling of Gondwana-derived pre-Carboniferous sediments. Therefore, during the Artinskian warming, the climate became more humid with increased precipitation in South China to drive intense erosion and promote river transportation of sediments into the coastal areas, forming the Liangshan Formation.