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The Permian–Triassic succession in the southern Sydney Basin, southeastern Australia: a unique and complete stratigraphic record of global changes during the Palaeozoic–Mesozoic transition

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The Permian–Triassic transition is widely regarded as representing an epic chapter in earth history. It is mostly notably characterized by a sequence of global-change events, including: the final collapse of the great Late Paleozoic Ice Age in the Middle Permian, the end-Permian mass extinction, and the rapid global warming at the dawn of the Triassic. Despite this rapidly emerging knowledge, well-preserved continuous stratigraphic sections that contain detailed records of these global changes are very rare in a global context. In this paper, I will report a nearly continuous stratigraphic succession in the southern Sydney Basin exposed along the south coast of New South Wales in southeastern Australia, spanning from the earliest Permian (Asselian-Sakmarian) to the Lower Triassic, with exceptionally preserved sedimentary and paleontological records that show profound changes in paleoclimate, depositional environment, biotas and ecosystems over this period.

The Permian–Triassic succession of the southern Sydney Basin in southeastern Australia comprises both marine and non-marine sedimentary sequences, as well as extensive outcrops of volcanic rocks. The marine component, of Early–Middle Permian age, is composed of a number of formations; they are, from the base to the top: the Wasp Head Formation, Snapper Point Formation, Pebbly Beach Formation, Wandrawandian Siltstone (Formation), Nowra Sandstone (Formation), Berry Siltstone (Formation), and Broughton Formation. This Lower–Middle Permian marine succession contains excellent field evidence in support of four stratigraphic intervals of glaciation, indicated by dropstones, glendonites, cold-water faunas, as well as evidence from oxygen stable isotopes. The Upper Permian (Lopingian) of the costal succession, locally known as the Illawarra Coal Measures, is predominantly a sequence of estuarine to alluvial plain facies, intercalated with multiple intervals of coal seams, unequivocally suggesting a climatic transition towards a benign climate state.

Although the precise Permian–Triassic boundary is still a matter of debate for eastern Australia, in the southern Sydney Basin, it is well constrained within a relatively narrow stratigraphic interval (20-50m) between the last Permian coal seam (the Bulli Coal) and the top of the Scarborough Sandstone. This interval also coincides with profound changes in depositional systems and terrestrial ecosystems and a drastic turnover (mass extinction) in plant species composition. The Lower Triassic in the study area is represented by the Narrabeen Group, a succession of claystones, sandstones and conglomerates, believed to have been deposited in a variety of non-marine settings ranging from lacustrine, braided fluvial channel to inter-channel floodplain environments. Horizons of paleosols are common especially in the middle and upper parts of the Narrabeen Group (e.g., Bald Hill Claystone), suggesting a strong degree of oxidation and chemical weathering under the influence of global warming.

