

From ridge to trench: The sedimentary record of a Neoproterozoic Ocean Plate Stratigraphy, Mona Complex, Wales

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Ocean Plate Stratigraphy (OPS) consists of a sequence of volcanic and sedimentary rocks forming the uppermost part of an oceanic plate, typically preserved within the tectonic stacks of an accretionary wedge. While the characteristics of Phanerozoic OPS are well-documented, those of Neoproterozoic OPS—particularly their sedimentary components—remain relatively unexplored. In this study, we integrate field observations with petrography and geochemical analyses (major and trace elements, Sr–Nd isotopes) of sedimentary rocks from the Gwna Group (Mona Complex, Wales, UK), an exceptionally well-preserved and exposed example of Neoproterozoic OPS, recognized within a UNESCO Global Geopark.

The studied lithologies include chemogenic (red chert/jasper and carbonate rock, predominantly dolostone) and clastic (fine-grained black, red, and green mudstone, as well as coarse-grained volcanoclastic turbidites) rocks. Unlike Phanerozoic OPS, the Gwna Group does not contain a thick bedded chert sequence formed by the accumulation of planktonic remains. Instead, carbonate rock and red chert fill interpillow spaces or occur as layers less than 2 meters thick above the basaltic basement. These lithologies are interpreted as chemical precipitates from hydrothermal fluids associated with seafloor magmatic activity ($\epsilon\text{Nd} = -2.4$ to -1.2) or from seawater ($\epsilon\text{Nd} = -8.3$ to -7.4).

The red, green, and black mudstones, deposited in a pelagic to hemipelagic setting, record varying redox conditions. Their low ϵNd values (-11.3 to -3.5) suggest a detrital input from a mature continental crust. In contrast, the turbiditic and volcanoclastic rocks, which constitute the majority of the Gwna Group, exhibit ϵNd values ranging from -1.9 to $+0.8$ and are interpreted as being derived from an adjacent volcanic arc and deposited in a trench. We show that the chemical composition of sedimentary rocks on an oceanic plate changes significantly during its journey from ridge to trench, which may serve as a valuable paleoceanographic and paleogeographic indicator.