Accretionary processes and stratigraphic reconstruction of Neoproterozoic oceanic crust in North Wales, UK

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Extending across Anglesey and Llŷn Peninsula in North Wales, UK, the Mona Complex is a collection of Neoproterozoic-Cambrian units formed through the collision of the Iapetus oceanic plate with the Avalonian microcontinent [1]. One of these units, the Gwna Complex, represents accreted ocean floor material that is largely characterised as a regional-scale tectonic mélangé. Detrital zircon ages in terrigenous sediments suggest that subduction occurred around 600-540 Ma [2]. Accreted sequences of volcanics, pelagic sea floor sediments and turbidites can be used to reconstruct the history, stratigraphy and origin of the ancient ocean floor, whilst the presence of these different lithologies also have major influences on structural controls of accretion.

In Newborough, Anglesey, sub-greenschist (T < 300°C) Gwna Complex material has been accreted in the form of imbricated semi-coherent lenticular slices 5 – 200 m thick with a subvertical orientation. Large volumes of terrigenous sediment (turbidite-derived muds and fine sands) are present elsewhere in the Gwna Complex, acting as the mélange matrix, incorporating blocks of stronger, more brittle surrounding units. In Newborough, however, the Gwna Complex has experienced comparatively little terrigenous input, localising mélange formation to metre-scale layers towards the upper unit interfaces. This leads to the semi-coherent preservation of ocean floor stratigraphy. Highly foliated hyaloclastite layers within thick volcanic sequences were exploited as weak horizons during accretion, allowing relatively thick, coherent volcanic sequences to be preserved. Hyaloclastites typically make up to basal unit of lenticular slices.

Lenticular units record a stratigraphy consisting of relatively undeformed pillow basalts with intermittent hyaloclastite horizons, grading upwards into peperites and then carbonates as sea floor sedimentation becomes more prominent. Overlying layers of pelagic cherts and terrigenous turbiditic sediment are typically more dismembered and mélangé formation is localised within turbiditic sediment, and rarely within clast-poor hyaloclastites. The geochemistry of pillow basalts and associated volcanics from throughout the Gwna Complex is similar, albeit not identical, to typical modern MORB. This suggests that the volcanics originated from a mid-ocean ridge source, with overlying sediments accumulating on the sea floor representing different stages in the life
cycle of the oceanic crust leading up to subduction and accretion. A small series of accreted sills and related amygdalar hyaloclastites that occur in Newborough show a distinct OIB signature and are likely related to a later episode of minor intraplate magmatism.

References: