A New Sequence Stratigraphic Framework for the Neogene Sediments based on Exposed Outcrops in the Northern Red Sea

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Abstract

The well-exposed Neogene outcrops of the Midyan Peninsula, Northwestern Saudi Arabia have been studied by numerous authors. When compared, many of these studies appear to be contradictory, which has led to an inherent ambiguity regarding the stratigraphic relationships between these sections. Recently, in 2021, field studies were conducted, in order to produce a comprehensive sedimentological and stratigraphic analysis and comparison, to consolidate and refine the Neogene stratigraphy in this area. These Neogene successions contain a great lithological diversity, and are structurally complex due to the effects of the early Miocene Red Sea rifting. Detailed sedimentary logging of approximately 300 meters of section was integrated with subsurface datasets from the different adjacent Red Sea sub-basins, from Midyan Basin in the north to Jizan Basin in the south. Previous studies concluded that the Al Wajh Formation is of late Oligocene (Chattian) to early Miocene (Aquitanian) age (part of the Tayran Group) and constitute an entirely continental deposit within the Red Sea rift with no recognized corresponding marine sequence. However, the present study shows that, in outcrop, the Al Wajh Formation comprises a series of marginal and shallow marine facies, primarily the younger sections, informally named as the Upper Al Wajh Formation. This newly defined section represents the first marine incursion identified within the Neogene of Saudi Arabia. Facies within this section are predominantly composed of carbonate and had previously been defined as the Musayr Formation (Hughes *et al*., 2005). Evaporite facies are also exposed in the Midyan Peninsula with penetrated subsurface equivalent. The central Yanbu Basin equivalent halite facies, previously defined as the Yanbu Formation, identified in the subsurface and now represents the third lithological unit of the Upper Al Wajh Member. Accordingly, we propose herein that the use of the Tayran Group, comprising the the Al Wajh, Yanbu and Musayr formations (Hughes and Johnson, 2005) should be discontinued, and the entire section should be simply defined as the Al Wajh Formation. In addition, this study also concludes that the Al Wajh Formation appears to be limited to a basin located between the Midyan and Yanbu sub-basins. The southern Red Sea sub-basins from Ghawwas to Jizan do not appear to show any evidence of marine deposits during the late Oligocene (Chattian) to early Miocene (Aquitanian). This newly developed stratigraphic framework is supported by extensive integration of subsurface data, outcrop dating and regional correlation. This framework will contribute to a refined understanding of the early syn-rift tectonostratigraphy of the Red Sea, however additional studies are required in order to better constrain the precise ages of these sections.