

## **Lithofacies and Depositional Environmental Analysis of the Upper Ordovician Ra'an Shale, Northwest Saudi Arabia**

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### **ABSTRACT**

The Middle Ordovician Ra'an Member of Qasim Formation exposed along a curved belt bordering the Arabian Shield located in the western part of the Kingdom, and dip gently to northeast, east and southeast. It is organic rich, particularly in the lower part. This paper present outcrop-based detailed sedimentological analysis in order to better understand the depositional processes and settings, which control the vertical and lateral heterogeneity of Ra'an Shale and organic richness as well. Five outcrop sections with cumulative thickness up to 37.9 m have been selected for this study. Ra'an shale is mainly dominated by silica and k-feldspars (50 and 33 % in average respectively) while the clay minerals exist with 10 % in average with particular increase in the lower part to 20 %. Based on field observation, petrographic analysis, mineralogy and sedimentology, four lithofacies have been identified in the Ra'an shale. The studied sections expose numerous examples of soft sediment and primary structures, such as bioturbation, slump, dewatering, ripples, cross-bedding, sharp contacts, lag deposits, internal erosion and traction structures, composite grains, lamination blending and general loss of layering. These structures as well as the lithofacies analysis suggest energetic depositional conditions to which the sediments delivered either by suspension settling, turbidity currents, and/or by bottom currents. The distribution of lithofacies in the studied shale shows an overall trend from relatively deep water to shallow water depositional environments. However, the topmost part of the Ra'an Shale exhibits significant decreasing in water depth as indicated by the wide occurrence of tiggillite burrows at the upper boundary between Ra'an and Quwarah Member of Qasim Fm. Organic content is primarily occurred in the lower part. Detailed sedimentological and lithofacies analysis connected with strict geochemical parameters as presented in this study are very important for the understanding of the organic potential and distribution of Ra'an Shale.