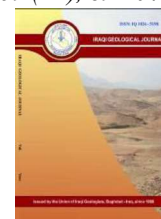




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Mineralogical and Petrographical Analysis of Zubair Formation Rock Member in the Zubair Oilfield, Basrah Governorate, Southern Iraq

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Abstract

The Zubair Formation is a major hydrocarbon-bearing unit in southern Iraq, composed of five distinct members. This study focuses on the mineralogical analysis of three members of the Zubair Oilfield—the upper shale (Z/1), upper sand (Z/2), and lower sand (Z/5). The objective is to determine the mineralogical composition of these units, with particular attention to distinguishing between clay and non-clay minerals and identifying the specific clay mineral types that may influence reservoir quality. Five wells were selected, each one is located in a different structural dome within the Oilfield, for analysis to capture spatial variability across the Oilfield. Mineralogical characterization was conducted using integrated analytical techniques, including scanning electron microscopy coupled with energy dispersive X-ray spectroscopy (SEM-EDX), bulk and oriented X-ray diffraction, and petrographic thin-section analysis. Through a thin-section study, two main sandstone lithologies were identified based on the sandstone classification: quartz arenite and quartz wacke. The samples were analyzed and consist mainly of sandstone, shale, and siltstone. Results indicate a diverse mineralogical composition, comprising non-clay minerals such as quartz, gypsum, calcite and dolomite, as well as clay minerals including smectite, illite, chlorite, kaolinite and illite-smectite mixed layers. While the principal aim of the study is descriptive mineralogy, the occurrence of these clay minerals carries implications for reservoir properties: swelling clays such as smectite may reduce permeability, whereas kaolinite and chlorite can either preserve porosity or hinder fluid flow depending on their occurrence. Overall, the findings highlight the mineralogical heterogeneity of the Zubair Formation and provide a framework for better understanding the relationship between mineral composition and reservoir quality in this key hydrocarbon unit.

Keywords: Zubair Formation; Zubair Oilfield; XRD; SEM-EDX; Thin Section; Southern Iraq

1. Introduction

The Zubair Formation is one of the most significant Lower Cretaceous hydrocarbon reservoirs in Iraq, particularly within the Zubair and Rumaila oilfields, which rank among the country's largest petroleum-producing regions (Jassim and Goff, 2006). It consists primarily of sandstones deposited in deltaic, fluvio-deltaic, shallow marine environments and its distribution extends across southern and central Iraq into northern Kuwait and Saudi Arabia (Powers et al., 1966). Stratigraphically, the Formation is subdivided into five members: the Upper Shale Member (Z/1), the Upper Sand Member (Z/2), the middle shale member (Z/4), the lower sand member (Z/5) and the lower shale member (Z/6),