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Extended Abstract

Sedimentological, Diagenetic, and Well-Logging characteristics of Dashtak Formation in Coastal Fars and the Persian Gulf

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Abstract

The Middle-Late Triassic sequence in the Zagros and Persian Gulf, known as the Dashtak Formation, holds significant importance as the cap rock for the reservoir formations of the Dehram Group. Additionally, the lower sections of this formation serve as a gas reservoir in certain fields. However, due to the lack of sufficient data on this formation, limited studies have been conducted. This research investigates the facies (and microfacies), depositional conditions, and diagenesis of this formation in an onshore field (Field Y) and an offshore field (Field X) in the coastal Fars region. The data includes petrographic analysis of 548 thin sections prepared from drill cuttings from 15 wells in Field Y, along with well-logging data from 2 wells in Field X. The study results identify 15 microfacies within 5 facies belts. The findings indicate that diagenetic processes such as mechanical and chemical compaction, dissolution, dolomitization, and anhydritization, cementation (including calcite cements of syntaxial, mosaic, pervasive, and coarse-crystalline twin forms), and occasionally fracturing, significantly influence the distribution of pore systems within the various microfacies based on their primary textural characteristics. Comparison of gamma logs from the wells in Field Y and Field X reveals that shale volume in different zones is lower in Field Y compared to the wells studied in Field X. Additionally, carbonate minerals (limestone and dolomite) are more abundant in the wells of Field X. The results also show that Well Y has a higher volume of anhydrite compared to the wells in the offshore field. Overall, the results suggest that the Dashtak Formation in the studied onshore well was deposited at a shallower depth. In other words, the water depth during deposition decreased from the current south to north in the central Persian Gulf region.

1. Introduction

A cap rock is one of the main components of an economic hydrocarbon accumulation. These layers, with very low porosity and permeability, prevent fluid from moving upward [1]. Direct core data from these formations are rarely obtained, resulting in many of their characteristics being unknown. The geological properties and integrity of these formations are often not precisely examined [2], leading to unanswered questions regarding their presence or absence, thickness, facies characteristics, depositional environment, geometric shape, and diagenetic and geomechanical processes in hydrocarbon system studies [3].

Researchers focus on the geological properties at sample to basin scales, including density, absolute and relative permeability, fluid flow, pore pressure, wettability, leakage, geomechanical properties, and fracturing in these rocks. Examining facies characteristics helps understand the conditions at the time of deposition of these rocks [4]. This understanding not only forms the basis of depositional environment and

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geometric shape studies of cap rocks but also plays a crucial role in determining petrophysical properties. Diagenetic processes after deposition affect these rocks and alter their characteristics [5].

In Iran, few studies have been conducted on the properties of cap rocks. The Dashtak Formation, as the cap rock for large Permian-Triassic reservoirs, is one of the main formations in the Zagros and Persian Gulf regions [6]. This Middle to Late Triassic formation lies above the Kangan Formation and shows significant variations in the basin. Given the lack of core samples from this formation in many wells, combining drill cuttings and well-logging data can play an important role in accurately understanding the properties of this formation and the distribution of these properties from onshore to offshore in the Zagros and Persian Gulf basin. Therefore, this study examines the facies characteristics, diagenesis, depositional environment, and petrophysical properties of this formation in two fields in southern Iran. One field is onshore, and the other is offshore, thus correlating this formation in these two fields can illustrate the lateral changes of the Dashtak Formation in the Zagros basin along a north-south section in the study area. Combining drill cuttings data and well-logging data in this study will provide more data and analyses for correlating it in the Zagros basin.

2. Methodology

The study of microfacies and depositional environment of the Middle-Upper Triassic from fifteen wells in the onshore field (Field Y) located in coastal Fars was conducted. Petrographic analysis of 548 thin sections prepared from well cuttings was performed. Sedimentology, paleontology, microfacies, facies changes, and integration of well-log data led to the identification of facies, depositional environment, the proposal of a depositional model, and well comparisons. A transmitted light and polarizing microscope was used for the petrographic study of the thin sections. One-third of the thin sections were stained with Alizarin Red to distinguish dolomite from calcite. The drilling samples were named using the methods of Dunham and Embry and Klovan, and microfacies were described following Wilson's method. By comparing the identified microfacies with the models introduced by Flügel and Burchette and Wright, the proposed depositional environment was introduced.

The studies in the wells of Field X were based on well-log data from two wells (X1, X2) (gamma, neutron porosity, sonic, and density logs). The deterministic method for formation evaluation, due to the shortage of logs and the unavailability of most drilling mud data, was used in Geolog software version 7. Since the analyses in this study will be based on the members of the Dashtak Formation, these members and their characteristics are shown in Table 1.

3. Results and Conclusions

- Petrographic studies of thin sections from cuttings of fifteen wells for the Middle-Late Triassic sequences led to the identification of fifteen microfacies in the Dashtak Formation.

- The analysis and examination of microfacies confirm the deposition of these sediments in a shallow basin with a carbonate-evaporite platform and ramp system. The presence of significant thicknesses of evaporites indicates deposition under warm and dry climatic conditions. These depositional environments are characterized by gentle slopes with no abrupt changes in gradient from the shoreline to the deeper parts of the basin, including gypsum sediments, mudstones, microbial zones, and then grainstones (including ooids and intraclasts), wackestones and packstones (peloidal and bioclastic). Tidal deposits include carbonates and evaporites. Intertidal sediments consist of algal and foraminiferal mudstones with hyaline shells and low diversity.

- Calcite and anhydrite cements filled the porosities and fractures during the mesogenetic stage due to burial diagenesis. Fracturing or replacement by saddle dolomite and calcite crystals with twin forms occurred during deep burial or uplift and exposure to meteoric diagenesis in the telogenetic stage, resulting in the loss of porosity.

- Comparing the characteristics of onshore and offshore wells showed that offshore wells were deposited in a deeper environment than the onshore well. Higher shale content in offshore wells, greater anhydrite content in the onshore well, and the presence of carbonate and even bioclastic facies in the onshore well are evidence of this conclusion.

5. References

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