Controls on depositional facies in Upper Cretaceous carbonate reservoirs in the Zagros area and the Persian Gulf, Iran

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Abstract In the Zagros area and the Persian Gulf, Upper Cretaceous carbonate sequences are among the most important hydrocarbon reservoirs. In this study, facies analysis and stratigraphic interpretation of these sequences, Cenomanian-Santonian in age, have been carried out in subsurface sections from various parts of the Zagros area (including the Dezful Embayment and Fars Province) and the Persian Gulf. To have a better understanding about the facies variations at the regional scale, depositional facies of these formations have been determined and grouped as facies associations. Frequency analyses of depositional facies and their characteristics reveal considerable variations in the study area. These are interpreted to have resulted from the combined effects of paleoenvironmental conditions and platform configuration. The overall depositional model of these formations is that of a carbonate ramp, which was likely homoclinal for the Sarvak and distally-steepened for the Ilam Formation. The isopach maps of the studied intervals are depicted based on the available data from hundreds of drilled wells, surface sections and seismic interpretations. Large scale variations in facies and thicknesses of the studied formations are interpreted to be controlled by regional tectonic evolution and sea-level fluctuations during the Upper Cretaceous.

Keywords Upper Cretaceous · Regional depositional model · Tectonic setting · Zagros area · Persian Gulf · Iran

Introduction

The Upper Cretaceous depositional sequences in the Middle East are characterized by extensive shallow-water carbonate platforms within which locally, and at different times, intra-shelf basins developed hundreds of kilometers across and with water depths of 50–100 m (Murris 1980; Razin et al. 2010; van Buchem et al. 2010; Fig. 1). In the Zagros area and the Persian Gulf (Fig. 2), the sequences are characterized by considerable variations in facies and thicknesses (Motiei 1993). These changes are related to the sedimentation in a foreland basin along the NE margin of the Arabian Plate, which are substantially controlled by the combined effects of tectonic activities, eustatic sea-level fluctuations and palaeoclimatic conditions (Fig. 1; Alsharhan and Nairn 1997; Sharland et al. 2001; Mehrabi and Rahimpour-Bonab 2014).

This study focuses on the Cenomanian–Santonian intervals, which are well-known in the Middle East by different lithostratigraphic nomenclatures in different countries (Fig. 3). The general stratigraphy and paleogeography of these formations have been studied in detail in various areas of the Arabian Plate, notably in Iran, United Arab Emirates and Oman (e.g., James and Wynd 1965; Murris 1980; Burchette 1993; van Buchem et al. 2006). A regional sequence-stratigraphic model for this interval was provided by Sharland et al. (2001) and high resolution sequence-stratigraphic studies on the outcrops of the Sarvak Formation were published by Razin et al. (2010) in the High Zagros (SW Iran). These studies documented the detailed stratigraphic architecture of the shallow water platform and intra-shelf basinal deposits, and discussed the relative influence of tectonics, eustasy and climate on their formation and evolution. Seismic interpretation and seismic stratigraphic modeling confirmed and refined these sequence-stratigraphic models (van....
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