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Research paper

Microfacies models and sequence stratigraphic architecture of the Oligocene–Miocene Qom Formation, south of Qom City, Iran

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ABSTRACT

The Oligocene–Miocene Qom Formation has different depositional models in the Central Iran, Sanandaj–Sirjan and Urumieh-Dokhtar magmatic arc provinces in Iran. The Kahak section of the Qom Formation in the Urumieh-Dokhtar magmatic arc has been studied, in order to determinate its microfacies, depositional model and sequence stratigraphy. The textural analysis and faunal assemblages reveal ten microfacies. These microfacies are indicative of five depositional settings of open marine, patch reef, lagoon, tidal flat and beach of the inner and middle ramp. On the basis of the vertical succession architecture of depositional system tracts, four third-order sequences have been recognized in the Oligocene–Miocene Kahak succession of Qom Formation. Based on the correlation charts, the transgression of the Qom Sea started from the southeast and continued gradually towards the north. This resulted in widespread northward development of the lagoon paleoenvironment in the Aquitanian-Burdigalian stages. Also, the sequence stratigraphic model of the Oligocene–Miocene Qom Formation has an architecture similar to those that have developed from Oligocene–Miocene global sea level changes.

1. Introduction

The Oligocene–Miocene Qom Formation includes marine marlstones and limestones with gypsum and siliciclastic rocks and is an important gas reservoir in Central Iran (Fig. 1). There is no particular section which has been specified as type section for the Qom Formation but generally its type area has been accepted to be the Qom plain in Central Iran (Aghanabati, 2011).

The first reports of the Qom Formation were published by Loftus (1855) and Von Abich (1878) in the Lake Rezayeh (Uromieh) region and by Tietze (1875) in Central Iran. Furrer and Soder (1955) subdivided the Oligocene–Miocene marine strata of the Qom Formation in the type locality of the formation near the town of Qom, into six members. These rock units are basal limestone, sandy marl, marl and limestone alternation, evaporites, green marls and top limestone. Bozorgnia (1965) expanded the subdivision into ten units using lithological and paleontological characteristics. He left the Rupelian strata unnamed and correlated it with the lower part of the Lower Asmari Formation in the Zagros Basin in south of Iran (Fig. 1).

Generally, the Qom Formation is unconformably underlain by red and green-gray shale and siltstones of the Oligocene Lower Red Formation and unconformably overlain by the Miocene Upper Red Formation. In the Tanbour and Bujan sections in the Sanandaj–Sirjan Province, the Qom Formation is unconformably underlain by Paleozoic metamorphic rocks and unconformably overlain by the Quaternary sediments (Anjomshoa, 2013; Anjomshoa and Amirshahkarami, 2014).

Biostratigraphic data on larger benthic foraminifera of the Qom Formation were established and dated as Oligocene–Miocene by Rahaghi (1973, 1976, 1980). A biostratigraphic revision of the Qom Formation was made by Naimi and Amirshahkarami (2011) and Yazdi-Moghaddam (2011).

Paleoecology and biostratigraphy of Qom Formation have been studied by Vaziri-Moghaddam and Torabi (2004), Daneshian and Ramezani Dana (2007), Reuter et al. (2009), Mohammadi et al. (2011), Anjomshoa (2013), Anjomshoa and Amirshahkarami (2014), Mohammadi et al. (2013, 2015) and Karavan et al. (2015). Karavan et al. (2015) have studied the sequence stratigraphy of the Qom Formation in the Bijegan section. Qom Formation with variable lithostratigraphic, biozonal and microfacies characteristics is

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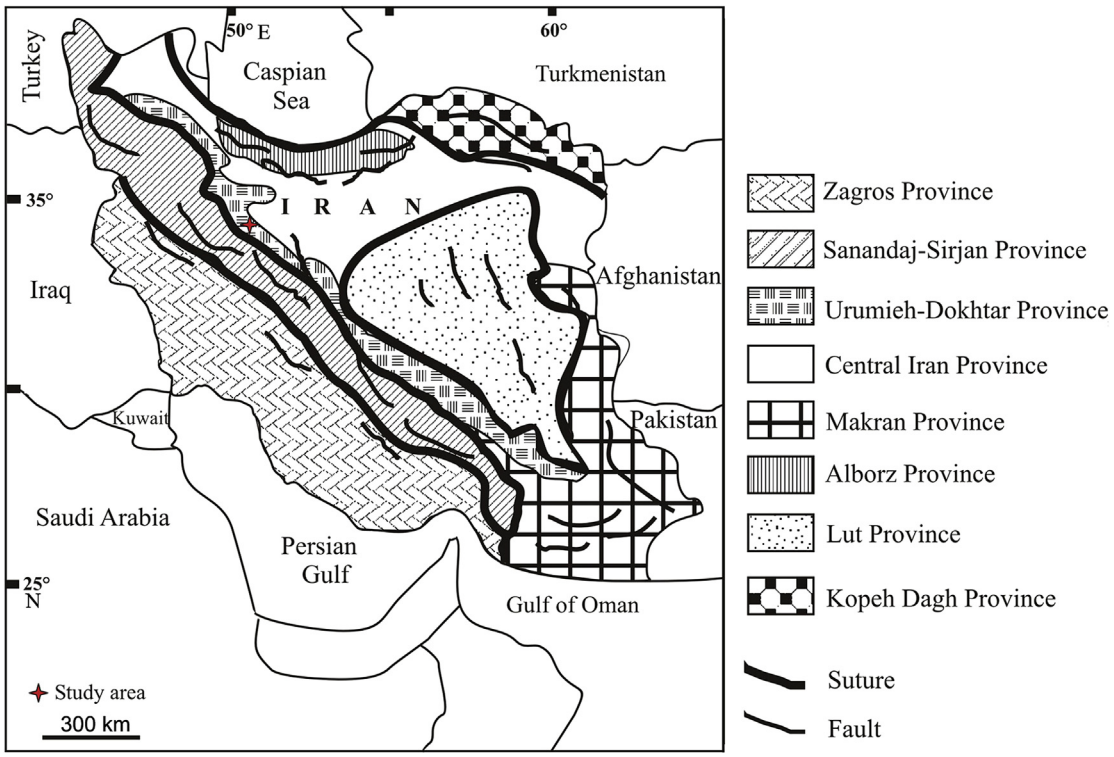

Figure 1. General map of Iran showing the eight geologic provinces (adapted from Heidari et al., 2003).

widespread in the Sanandaj–Sirjan, Urumieh-Dokhtar magmatic arc and Central Iran provinces. Most of the researches on the Qom Formation involve the characterization of biostratigraphy and microfacies. Also, there is no exact correlation among the Qom Formation successions. The Qom sequence stratigraphy explains the depositional model and transgression of the Tethyan Seaway in Central Iran.

The Kahak is one of the most important sections of the Qom Formation in the eastern margins of the Urumieh-Dokhtar magmatic arc in Iran.

Qom Formation contains numerous benthic foraminifera species which provided useful data for reconstruction of the depositional paleoenvironments (Anjomshoa and Amirshahkarami, 2014).

Biostratigraphy of Qom Formation has been studied by Naimi and Amirshahkarami (2011) in Kahak area (Table 1). The assemblage biozones of the study area are explained by the late Oligocene–early Miocene biostratigraphy (Laursen et al., 2009).

The current paper has three purposes: (1) the explanation of the depositional settings of the Qom Formation in the Kahak section using the microfacies analysis; (2) the sequence stratigraphy and microfacies correlation of Qom Formation in the study section with Oligocene–Miocene Asmari succession in the Zagros Basin; (3) study of the sedimentary basin transgression of Qom Formation in the Tethyan Seaway in Iran.

2. Geological and geographical position of the study area

The microplate of Central Iran originated during final collision of the African/Arabian Plate with the Iranian Plate, the process of which has already started in the Mesozoic (Coleman-Sadd, 1982).

An important effect of the collision of these plates was the closure of the Tethyan Seaway during the Miocene (Harzhauser and Piller, 2007; Reuter et al., 2009).

The termination of migration of marine biota and exchange of tropical waters between the eastern Mediterranean and the western Indo-Pacific Tethys has been called the Terminal Tethyan Event (TTE) by Harzhauser et al. (2007). Accordance to Adams et al. (1983) the timing of TTE is of Aquitanian age, while Harzhauser et al. (2002) proposed a Burdigalian age. Amirshahkarami (2013b) discussed a disconnection seaway between the shallow marine limestone of the Oligocene–Miocene Asmari Formation in Zagros Basin (Southwest Iran) and the western Indo-West Pacific region in the Aquitanian and Burdigalian times.

Another effect of the plate collision was the formation of a fore-arc basin (Sanandaj–Sirjan Basin) and a back-arc basin (Qom Basin) on the Iranian Plate at the northeastern margin of the Tethyan Seaway (Fig. 2A). These basins are separated by a volcanic arc system which developed during Eocene times (Stöcklin and Setudehina, 1991).

According to Mohammadi et al. (2013, 2015) deposition of the Qom Formation (Rupelian–Burdigalian in age) took place in three NW–SE-trending basins: Sanandaj–Sirjan (fore-arc basin),

Table 1
Larger benthic foraminifera biozonation in the Kahak section of the Qom Formation (Naimi and Amirshahkarami, 2011).

Stage	Biozone no.	Assemblage biozone
Burdigalian	IV	*Borelis melo, Borelis curdica*
Aquitanian	III	*Pseudolituonella reicheli, Peneroplis* sp.,0 *Dendritina ranji, Triloculina trigonula, Rotalia* sp., *Pyrgo* sp.
Chattian	II	*Eulepidina* sp., *Eulepidina dilitata, Nephrolepidina* sp., *Amphistegina* sp., *Operculina* sp., *Bozorginella qumiensis, Miogypsina sp., Pseudolituonella reicheli, Rotalia* sp. *Triloculina trigonula, Triloculina tricarinata*
Rupelian	I	*Nummulites fichteli, Nummulites vasc, Eulepidina dilitata, Nephrolepidina* sp., *Neprolepidina tournoueri, Eulepidina* sp., *Pseudolituonella reicheli, Miogypsina irregularis, Amphistegina* sp., *Operculina* sp.