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Structural and tectonostratigraphic evolution of the Upper Cretaceous–Eocene sequence in Malaqet–Mundassah–El Saah Range, Oman Mountains, United Arab Emirates and Oman

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ABSTRACT

The Malaqet–Mundassah area lies on the western flank of the Northern Oman Mountains in the UAE and Oman. This area is a well-exposed example of Alpine thrusted and folded Ophiolitic assemblage and post-obduction autochthonous sequences. The hinge zones of the thrust propagation folds accommodated stronger deformation compared with the weaker deformation that occurred in the other parts of these folds. In this area, there have been three main tectonic shortening events, two associated with the formation of unconformities (pre-Late Campanian and Cretaceous/Tertiary) and one during the deposition of megabreccia and conglomerates units (Early–Middle Eocene). Each event continued mildly during the deposition of sediments above. Tectonism was accompanied by sea level changes so that the Malaqet–Mundassah area experienced two marine regressions and two transgressions between the Late Cretaceous and the Oligocene times. Activity of northwest striking (NE-dipping) thrust faults and similarly trending thrust-propagation folds is responsible for the formation of a local basin, the Malaqet–El Saah basin in which the Simsima, Muthaymimah, Saah, and Tawi Uwayyir formations of the area were deposited. The syn-sedimentary activity of thrusts, folds and strike-slip faults is documented in thickness variations, stratigraphic onlapping of formations towards the fold hinges, and the presence of megabreccia and conglomerate deposits not found elsewhere in the foreland basin.

1. Introduction

The emplacement of the Semail Ophiolite onto the eastern margin of the Arabian plate occurred during the first phase of the Alpine orogeny that began with the closure of Neotethys. The Upper Cretaceous emplaced nappes can be divided into two units; the lower one consisting of shelf carbonates, continental slope carbonate debris flows, deepwater calciturbidites, cherts and marine volcanics of the Hajar Supergroup, Sumeini Group, Hawasina and Haybi groups (Fig. 1). The upper unit is the Semail Ophiolite, representing young hot suprasubduction zone oceanic crust (e.g. Glennie et al., 1974; Searle, 1988). Obduction occurred during Turonian to Campanian times (e.g. Glennie, 1992).

The deformation history of the Oman Mountains and surrounding regions involved two west to west-southwest directed tectonic shortening events. The older event is represented by emplacement of the thrusted nappes (allochthonous rocks) in the Late Cretaceous. The younger event began during the deposition of the Miocene Fars Formation (neoautochthonous rocks) and was associated with the final closure of the Neotethys (Glennie et al., 1974). This event culminated in the Zagros continent–continent collision that continues to the present day (Searle, 1985, 1988).

The mainly shallow-marine neoautochthonous sediments were deposited unconformably upon the Semail Ophiolite that formed the floor of a foreland basin (Glennie et al., 1990; Searle et al., 1983, 1990, 2004; Nolan et al., 1986, 1990; Searle 1988, 2007; Robertson et al., 1990; Nicolas et al., 2000; Dunne et al., 1990). These neoautochthonous rocks were deformed during the second Alpine event by intense thrusting and related folding (Warrak, 1996; Abd-Allah, 2001; Abd-Allah et al., 2009; and others). The foreland basin extends between the western boundary of the Oman Mountains and the foredeep thrust front (Fig. 1).

The Malaqet–Mundassah–El Saah region is a representative part of the deformed eastern extensions of the foreland basin sequence that was deposited on top of the Ophiolitic basement in the Northern Oman Mountains (Fig. 1). This region occupies the southeastern corner of the United Arab Emirates (UAE), near its border with the Sultanate of Oman. The geological structures of the Malaqet and Mundassah areas were reported by Warrak (1987), Noweir and Eloutefi (1997), Boukhary et al. (2003), and

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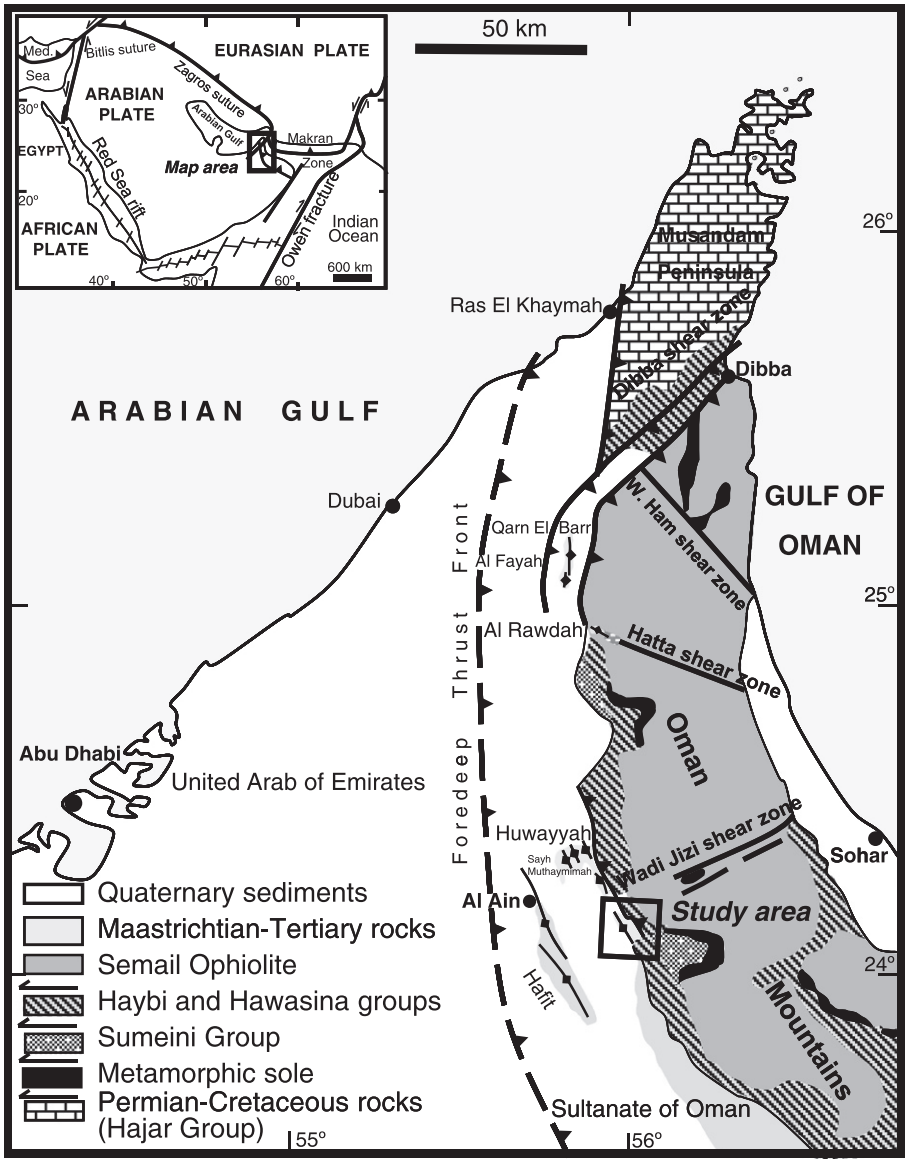

Fig. 1. Tectonic map of the Northern Oman Mountains (modified after Abd-Allah et al., 2009) shows the location of the Malaqet–Mundassah–El Saah study area.

Abdeen and Boukhary (2004). The present contribution critically evaluates the structural models suggested by these authors, and aims to provide details of the structural characteristics, folding processes, strain distribution, and tectonic effects on depositional history of the area. The study also presents an accurate geological map of the Malaqet–Mundassah area, and for the first time a detailed geological map of the El Saah area. Geological mapping incorporated detailed stratigraphic measurements, and collection of bedding and fracture orientation data. Two seismic sections (without analysis) were kindly provided by the National Drilling Company. The depths to the seismic reflectors apparent on these sections were estimated using data from the drilled wells, in consultation with the geophysicists of the National Drilling Company.

2. Stratigraphy

The neoautochthonous sediments were deposited on a regional unconformity above the Upper Cretaceous Semail Ophiolite (Fig. 2). The sediments are the fill of a foreland basin located at the present-day western flank of the Northern Oman Mountains. The Ophiolitic rocks consist mainly of serpentinites, talc carbonates, whereas the Hawasina beds include quartz sandstone, conglomerate, carbonate turbidite and silicified limestone.

Paleocene–Oligocene formation names used in the present study represent established regional formal units, whenever correlation with the regional units is feasible (e.g. Simsima, Muthaymimah, Dammam, and Asmari formations). Other stratigraphic formal units that have not previously been correlated with regional units (e.g. Saah and Tawi Uwayyir formations) follow the terminology set up by Boukhary et al. (2003).

2.1. Simsima Formation

The Simsima Formation (Glennie et al., 1974; Nolan et al., 1990) consists of thick-bedded dark grayish yellow limestone, locally calcareous sandstone. Boukhary et al. (2003) assigned a Maastrichtian age to this formation in the Malaqet area, while Abdelghany (2003) proposed a late Campanian–late Maastrichtian age. The present