An integrated study of the UAE-Oman mountain belt: Implications for collision tectonics and ophiolite emplacement

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The United Arab Emirates (UAE)-Oman mountains constitute a 700 km long, 50-150 km wide orogenic belt composed of a series of Tethyan thrust sheets overlying a passive continental margin. It contains the world’s largest and best-exposed thrust sheet of oceanic crust and upper mantle (Semail Ophiolite), which was obducted onto the Arabian rifted continental margin during the Late Cretaceous. Although the shallow structure of the UAE-Oman mountain belt is reasonably well known, the deeper structures remain poorly constrained. The mechanisms by which dense oceanic crustal and mantle rocks are emplaced onto less dense and more buoyant continental crust are still controversial and remain poorly understood. In this study, we have carried out the first integrated geological mapping, seismic reflection, refraction, passive seismic and potential field experiments in the UAE, from the Arabian Gulf to the Gulf of Oman, to provide new constraints on the nature of continental and oceanic crust beneath both the Semail Ophiolite and the offshore UAE-Oman margin. Reflection data were acquired along 925 km line in the Arabian Gulf and Gulf of Oman using a large-volume airgun source (7060 cubic inches) and up to 5 km long streamer. Refraction data were acquired along selected reflection lines using 25 land recording stations in the UAE. In addition, gravity and magnetic anomaly data were acquired along all the seismic lines as well as two onshore profiles. The results obtained provide constraints on crustal structure, hydrocarbon potential and seismic hazard of the northern UAE. Geological mapping combined with seismic constraints have revealed the geometry of the ophiolite thrust sheet and sub-ophiolite structure at depth. Seismic reflection data in the Gulf of Oman show clearly the contact between the ophiolite and overlying sediments and evidence for thick Cenozoic sediments, tilted fault blocks and re-activated faults that appear to have offset the seafloor. The seismic refraction data suggest ophiolite seismic velocities of about 5.5 km/s, which is underlain by a thick layer of faster material, where velocities vary between 6.0 and 6.4 km/s. The velocity and gravity models reveal a Moho depth that rises from c.a. 40 km in the west to ca. 20 km in the east towards the Gulf of Oman. We interpret the NE margin of the ophiolite to be a low-angle normal fault with up to 8 km of Cenozoic sediments in localized depocentres. In addition, passive seismic data, recorded on a temporary deployment as part of the project and UAE seismic network, has been used to calculate receiver functions across the mountain range and foreland basin to constrain the deeper crustal structure.

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