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Towards a 3-D structural model of the Oman Ophiolite and its underlying continental lithosphere

Christian Weidle (1), Lars Wiesenberg (1), Thomas Meier (1), Philippe Agard (2), Celine Ducassou (3), and Issa El-Hussain (4)

(1) Christian-Albrechts-Universität zu Kiel, Inst. for Geosciences, Kiel, Germany, (2) University Pierre et Marie Curie Paris 6, France, (3) German University of Technology, Muscat, Oman; now at: Université de Rennes, France, (4) Earthquake Monitoring Center, Sultan Qaboos University, Muscat, Oman

The deep structure of Oman ophiolite, often referred to as the world's reference example of obducted oceanic lithosphere, has thus far been imaged by few, local 2-D studies, some of them dating back to the 1980s. Moreover, very little is known about the physical properties of the underlying Arabian continental lithosphere that has been at least partly subjected to continental subduction during ophiolite obduction in late Cretaceous.

Between 2013 and 2016, we operated a temporary network of 40 broadband seismometers across the Oman Mountains to assemble a dataset capable of imaging the lithospheric structure from surface to the lithosphere-asthenosphere boundary below the northern Arabian margin. The network and project dataset is complemented by data from permanent stations in northern Oman, mostly operated by the local Earthquake Monitoring Center in Oman.

We use ambient seismic noise tomography to calculate phase velocity maps from 2 to 30s period, covering a depth range from approx. 3 to 50 km. Our preliminary results show at short periods (shallow depths) distinct signatures of the ophiolite and the metamorphosed continental sediments exposed in the Jebel Akhdar and Saih Hatat windows. These high-velocity anomalies are contrasted by very low velocities in the young, mostly unconsolidated sediments further south. The high-velocity anomalies below the Oman Mountains seem to reach deeper in the eastern part of the mountains, where the ophiolite cover is supposed to be thickest, than in the northwest. At periods above 10s, the pattern of anomalies changes away from following surface geological geometries towards a separation in an eastern and northwestern region. This is particularly indicative of a shallower continental Moho in the east. The current analysis will be complemented by earthquake based analysis cover the depth range from the continental Moho to approximately 300 km depth. Subsequent inversion will lead then to a three-dimensional, anisotropic seismic velocity model of the Oman ophiolite and its underlying continent, which can provide geodynamic constraints on reconstructions of ophiolite emplacement as well as the present state of the northern Arabian continental margin.