Foredeep Development along the Late Cretaceous Obduction Orogen in North Oman

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Abstract

The Oman Mountains are well-known as having a large intact thrust sheet of Late Cretaceous oceanic crust and mantle (Semail Ophiolite) emplaced from NE to SW onto the previously passive continental margin of Arabia. The emplacement history of the ophiolite and underlying thrust sheets is well constrained by structural and geochronological data. However, the stratigraphy and development of the foreland basin in front of the advancing nappes is still poorly understood. This study aims to unravel the tectonostratigraphy of the foreland basin and link this to different stages of ophiolite emplacement.

Obduction is associated with a regional mid-Turonian (92Ma) unconformity that ended middle Cretaceous shallow water carbonate deposition. It caused collapse and erosional recession along the platform margin. Re- deposited platform sediments and blocks form a sedimentary mélange which was later incorporated into the thrust complex. On the platform this unconformity is related to the development of a foreland bulge in front of the southward advancing nappes. It was subaerially exposed and incised by extensive fluvial valley systems some 150 m deep. The subaerial unconformity was onlapped during the initial phase of foredeep development by a thin (150 m) transgressive carbonate ramp (Muti Formation) as it subsided into a starved foredeep. Further forebulge onlap was by fine-grained coastal clastics that were sourced laterally from local uplift of the Huqf Basement along the eastern plate margin.

As the drowned platform entered the foredeep it was affected by major faulting related to bending of the plate. Major fault scarp erosion and retreat resulted in deposition of thick debrite deposits which are composed of clasts from the transgressive Muti deposits as well as the underlying mid-Cretaceous platform carbonates.

Transgression ended in the Santonian (85Ma) and is followed by some 250 km northward progradation of a more than 1 km thick mud-prone delta complex into the southeastern part of the foredeep. This deltaic wedge has been incised by deep canyons and slump scars suggesting slope collapse and sediment by-pass during the Early Campanian (83Ma). The eroded slope is onlapped by a sequence of laterally-derived siliciclastic turbidite siltstones and sands which onlap the nappes to the north demonstrating that nappe emplacement ended in the early Campanian. The clastics are sourced from exposed Paleozoic clastics in the Huqf area. There is very little detritus from the orogen.

In the western part of the foredeep clastic influx was much reduced. Here, the main foredeep infill consists of Late Campanian to Maastrichtian hemipelagic chalks and marls which can be more than 1300 m thick. Influx of detrital sediments from the orogen is restricted to a strip just a few kilometers wide along the thrust front.

This sequence is affected by a late Campanian uplift associated with incisions up to 150 m deep filled with redeposited hemipelagic carbonates. This may be related to inversion in eastern Oman coinciding with slab break-off (ca 75Ma) and exhumation of eclogites in the northeast.

The foredeep along the ophiolite obduction complex was a persistently underfilled basin: filled by hemipelagic carbonates and local clastic detritus from the forebulge. Lack of sediment input from the orogen suggest that this was mostly subaqueous. Limited uplift may be related the high density of the ophiolite slab and could be a general feature of obduction orogens.