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Petrological evolution of the metamorphic sole of Oman

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Obduction corresponds to one of plate tectonics oddities, whereby fragments of dense, oceanic lithosphere (ophiolites) are presumably ‘thrust’ on top of light continental ones. Though reported from most convergent belts, the emplacement of ophiolites is still poorly understood.
The thin HT metamorphic soles (i.e. 800°C - 1 GPa, on average) frequently underlying such large ophiolite klippen may provide constraints on ophiolite emplacement. Metamorphic soles are indeed generally interpreted as oceanic shallow crustal material (basalts and sediments) heated against the warmer mantle at $\sim$ 30 km depths during initiation of underthrusting and subduction initiation. Tracing the PT evolution of these soles can thus in principle shed light on early obduction stages.
A number of major unknowns, however, still characterize metamorphic soles:
(1) their enigmatic origin (i.e. underthrust cover of the future "lower" plate, or sheared, folded and reversed cover of the "upper" plate?) (2) emplacement mechanisms that allow these soles to become tectonically and rheologically welded to the base of the ophiolite mantle (especially in the first case), (3) the mismatch in P between metamorphic conditions (i.e. 30 km equilibrium depths) and preserved ophiolite thickness ($\sim$10-15 km).
This contribution presents new data from various metamorphic sole locations across the Oman mountains, all dated at $\sim$95 Ma, using pseudosections modelling (testing a range of appropriate solution models for amphiboles) on both pristine metamorphic remnants (including melts) and less frozen-in samples. PT constraints, reappraised from north to south-east, suggest subtle PT variations with a trend of deeper metamorphic equilibration towards the north, where PT conditions reach 850°C and 1-1.2 GPa.
These thermobarometric data are complemented by multi-element geochemical constraints on the origin of metamorphic soles throughout Oman, which evidence very consistent E-MORB signatures and point to a protolith origin in a transitional oceanic domain located close to the continental margin. This result is in line with earlier findings (Ishikawara, 2005) and suggestions that these soles may derive from the Haybi complex (Searle and Cox, 1999).
These data are compared to the available structural and petrological data on both the ophiolite proper and the metamorphic HP-LT subducted continental material beneath.
We favour a scenario in which subduction initiates obliquely, in a transitional oceanic domain (close and to the north of Arabia), to a small and young marginal basin (c. 95 Ma; its spreading center is preserved in the south-east, near Maqsad). Limited calc-alkaline magmatic imprint (Lasail volcanism) and orthopyroxenite dykes on the south-western edge of the ophiolite could respectively correspond to limited arc magmatic inputs of the short-lived subduction and to the hydration-driven remelting of oceanic lithosphere. Our interpretation is finally set back in the frame of late Cretaceous Neotethyan geodynamics.