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Subduction initiation close to the continental margin? Implications from U-Pb zircon geochronology of the Pınarbaşı metamorphic sole, central Turkey

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Metamorphic soles below ophiolites record high (up to ∼850°C) metamorphic temperatures at pressures up to 10-15 kbar uncommon in normal subduction zones. They are therefore interpreted to form during intra-oceanic subduction initiation at locations within ocean basins where high temperatures exist at relatively shallow depths, i.e. in the vicinity of mid-ocean ridges. The Pınarbaşı metamorphic sole in Turkey is a particularly well-preserved example and consists of a sequence a few hundred meters thick of strongly foliated metabasites and pelagic sediments. The sole structurally overlies a serpentinite-hosted tectonic mélange, and underlies the mantle section of the supra-subduction zone Pınarbaşı ophiolite. The sole rocks preserve an inverted metamorphic field gradient with garnet-clinopyroxene-amphibolites at the top and greenschists at the contact with the underlying tectonic mélange. The Pınarbaşı sole thus fits well in the general tectonostratigraphy and metamorphic facies of soles worldwide, generally interpreted to represent the top of a nascent intra-oceanic subducting slab that accreted to the base of the hot overriding oceanic plate. This implies that the metamorphic sole could yield constraints on the initiation of subduction in an oceanic domain, something that is not yet well understood. One of the remaining questions is: did subduction start at, close to or further away from the mid oceanic ridge?
The age of metamorphic soles has commonly been dated by 40Ar/39Ar chronology. Across Turkey, soles consistently provide Ar-Ar ages of 94-91 Ma, interpreted as cooling of the soles during exhumation and subduction zone maturation. In the top of the metamorphic sole of the Pınarbaşı ophiolite we found zircon which indicate a preliminary U-Pb ID-TIMS age in the comparable range of 94 – 91 Ma, which we interpreted as the age of peak metamorphism in the garnet-clinopyroxene amphibolites. Surprisingly, the zircon grains also include inherited cores pointing to a derivation from Precambrian crust. These zircon cores are likely a detrital component in the Pınarbaşı sole derived from the continental margin. The Central Anatolian ophiolites were underthrusted by continental rocks of the Anatolide-Taurides less than 10 m.y. after subduction initiation. From this we infer, that subduction initiation in Turkey occurred so close to the continental margin that clastic continent-derived sediments were incorporated in the sole upon subduction initiation. The Anatolide-Tauride passive margin is Middle Triassic in age, and it is quite unlikely that a mid-oceanic ridge existed in the Cretaceous so close to a Triassic continental margin. We therefore tentatively conclude that subduction initiation close to continental margins, within ancient oceanic crust is possible, and even leads to high-temperature conditions in the nascent subduction zones. How these high-temperature conditions were reached is open for debate, but may relate to the subduction initiation process.