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# Detachment structures in the Bernina domain (SE Switzerland): can they explain the extreme thinning of the continental crust prior to mantle exhumation in the Alpine Tethys ocean?

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It is generally accepted that subcontinental mantle is exhumed at magma-poor rifted margins. However, much less attention has been paid to the processes that predate mantle exhumation. An increasing number of observations from magma-poor rifted margins world-wide show evidence for extreme crustal thinning to less than 10km without seismic evidence for significant normal faulting. This leads to the question of what structures/processes can explain such major crustal thinning and where and when are they active? In order to find answers to these questions, we initiated a research project in the Bernina domain in SE Switzerland, which was located between the proximal and the distal/deep Adriatic margin exposed today in the overlying Upper and underlying Lower Austroalpine Ortler/Campo and Err nappes respectively.

The Bernina domain is formed by rocks derived from the pre-rift middle crust (Sondalo gabbro), the upper crust and local occurrences of Permo-Mesozoic cover sequences. In addition to well-identified Alpine structures dated as Late Cretaceous thrust and normal faults that are folded by large-scale Tertiary folds, older structures can be mapped as well. These structures are mylonitic shear zones separating the Permian Sondalo gabbros (middle crustal) from the gneiss and granites (upper crust) and top-basement detachment faults that are associated by characteristic black fault rocks

that are locally overlain by Triassic to Lower Jurassic pre-rift sediments or Lower to Mid-Jurassic calcareous turbidites. Because these structures are cut by Alpine thrust faults, sealed by Jurassic sediments and overprint Permian gabbros, we conclude that the mylonites are younger than Permian and presumably formed during Jurassic rifting, an interpretation that will be tested by absolute age determinations. These preliminary field observations show that the Bernina domain, located between the proximal and distal/deep Adriatic margins in a transitional position comparable with the necking zone in present-day magma-poor rifted margins, preserves a crustal section formed by middle crustal rocks, upper crustal rocks and remnants of pre-rift sediments that are separated by detachment structures and sealed by Lower to Mid Jurassic sediments. This overall situation recalls that of the Canavese/Ivrea/Baldisero zones in Southern Alps where it has previously been shown that Jurassic tectonics juxtaposed these units, during major thinning of the crust.

In conclusion, we suggest that the detachment faults observed in the Bernina domain formed during Jurassic rifting and were responsible for the major thinning of the crust prior to mantle exhumation in the adjacent Platta and Malenco units. These preliminary results need to be confirmed by further investigations (cooling ages, field work) and together with the study of the evolution of the conjugate margin (Briançonnais/ European margins) will provide a better understanding of the relationship between deep crustal and mantle processes and surface processes occurring during final rifting (180 to 160 Ma) during the formation of the Alpine Tethys. The results will be used to test and benchmark rifted margin formation models.