an OCT zone, through polyphase subductive processes to the juxtaposition of fragments during collision or exhumation.

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Geodynamic and structural controls on the exhumation of Cenozoic metamorphic core complexes: Application to the Alpine-Carpathian-Hellenic orogenic belt

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Metamorphic core complexes (MCCs), particularly Cordilleran-type MCCs, represent typical the thick ductile/viscous material within the middle to lower crust and the mechanically strong upper crust within highly extensional tectonic setting. In the extensional setting, the rheological stratification is particularly the presence of a thick layer of highly ductile material, which results in an upward motion of the viscous material during progressive exhumation. Extensive studies of metamorphic core complexes have highlighted a fundamental problem that the relationship between the mylonitic rocks in the footwall of the ductile low-angle detachment fault at its top, and the brittle-deformed to undeformed hangingwall unit. The exhumed metamorphic rocks typically record a progressive change from ductile to brittle behaviors during decompression. As such, MCCs also reflect highly localized extensional strain on the scale.

As exemplified in the Alpine-Carpathian-Hellenic (ACH) orogenic belt, the exhumations of such MCCs are controlled by several processes including: (1) the retreat of the subduction zone, (2) extensional gravitational collapse of previously shortened lithosphere, (3) continental strike-slip component of tectonic plate movement, and (4) rheological stratification of the extending crust in post-orogenic settings. Our examples mainly include the Naxos MCC in the Aegean Sea, and Rechnitz and Tauern MCCs in the Eastern Alps, which represent Cordilleran-type MCCs. Cordilleran-type MCCs are exhumed virtually parallel to the regional extension direction. Such cases are common in post-collisional settings with extension of previously over-thickened lithosphere, or as in the case of the Aegean Sea, in a back-arc basin setting, which formed due to the retreat of a subduction zone.

Here, we propose a scheme between several possible end-member type cases of exhumation mechanisms of MCCs, e.g., classification of different detachment modes (e.g., rolling hinges, initial low-angle detachment) and contribution of pure-shear vs. simple-shear modes of exhumation. In these cases, upward motion along a detachment (ductile low-angle normal fault) and internal ductile thinning imply gradual exhumation with the youngest exhumation along a rolling hinge at the trailing edge of the MCCs.

Deformational styles at all scales are dominated by extensional structures similar to those documented in numerous MCCs. In all cases investigated by us, the level of the ductile low-angle normal fault is controlled by the presence of thick successions of calcite-dominated lithologies (e.g., calcite marble, calcareous phyllite), which are rheologically weak at low temperatures. These lithologies are overlain by quartz- and feldspar-rich lithologies in the upper hangingwall unit, which remains brittle during deformation. One of the most important meanings to occur in these low grade metamorphism rocks is the new recrystallized assemblage formed the lower the strength of the rock, active representing a matrix-controlled interconnected weak layer rheology. Strain partitioning results in preservation of high-temperature microfabrics, minerals and textures with low-grade mylonitic shear zones. As a result, grain size reduction associated by fluids circulating within shear zones leads to rock softening, which results in strain localization, weak rock rheology and the overall thermal structure of the crust.

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Differential compaction and early rock fracturing in the Triassic Esino Limestone high-relief carbonate platform (Central Southern Alps): field evidence and numerical modeling

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Syndepositional fractures are important features in high-relief, steep-slope carbonate systems as they control the occurrence of platform-margin collapse events, drive the generation of early diagenetic fluid flow systems and development of karst networks and may enhance permeability. Studies on modern and fossil carbonate systems recognized the importance of early (syndepositional) fractures, which can be generated by different processes (gravitationally controlled fractures, antecedent-topography controlled fractures, and tectonically controlled fractures).

In this study we focus on the generation of margin-parallel, gravitationally-induced early fractures driven by compaction of basinal sediments prograded by early-cemented high-relief carbonate platforms with steep slopes. Compaction is most effective when brittle early-lithified sediments prograde over unconsolidated basinal deposits.

Numerical models were used to investigate the effects of differential compaction on strain development and early fracturing in early-cemented high-relief carbonate platform, prograding onto basinal sediments, whose thickness increases basinward. Results show that basinal sediment compaction induces stretching of internal platform and slope strata in prograding platforms. When sediments are early cemented, such extensional strain is accommodated by the generation of syndepositional fractures. The amount of stretching is predicted to increase from the oldest to the youngest layers, due to the thickening of the compactable basinal sequences towards the external parts of the platform. Stretching is also controlled by the characteristics of the basin: the thicker and the more compactable the basinal sediments, the larger will be the stretching.

To test this model on a real case, ad hoc computations were dedicated to the Ladinian-Early Carnian carbonate platform of the Esino Limestone (Central Southern Alps, Italy), up to 800 m thick and with a top to basin relief of more than 500 m. This platform, after a prevailing initial aggradational stage, rapidly progrades on thinly-bedded fine-grained resedimented limestones. This case study is favorable for numerical modelling, as it is well exposed and both its internal geometry (inner platform, reef and prograding steep clinostratified slope deposits, consisting of reef-derived breccias) and the relationship with the adjacent basin can be fully reconstructed, as the Alpine tectonic overprint is weak in the study area. Furthermore, rapid early cementation processes affect the carbonate platform facies, so that conditions for creation and preservation of early fractures occurred. Evidence for early fracturing (fractures filled by fibrous cements coeval with the platform development) is