



Thermal consequences of syn-orogenic extension: example of the Sierra Nevada elongated dome (Western Mediterranean)

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Syn-orogenic extension contributes to the exhumation of HP-LT rocks early during orogenesis, producing structures that are mostly differentiated by dating and by their overprinting relationships with coeval contractive structures. But what characteristics are intrinsic to syn-orogenic extension? How can we differentiate syn- from post-orogenic extensional structures? Here we describe an example of the Betic cordilleras where syn-orogenic extension is particularly well recorded in the structure and P-T evolution of the mid-crustal rocks exhumed in the footwall of extensional detachments from the Sierra Nevada dome. Probably the most clear thermal indication of syn-orogenic extension is the discrepancy between metamorphic field gradients determined in the footwall of the extensional system compared with those obtained from P-T conditions of the end of the decompression P-T path. Whilst the metamorphic field gradients are typical of an orogenic wedge context (10-14 °C/km), those obtained from coeval conditions achieved at the end of the decompression P-T segment (480 °C at 4 kbar) indicate a thermal gradient of nearly 30 °C/km. Furthermore, the blastesis-deformation relationships in the footwall rocks indicate that structures like ductile contractive shear zones, folds and associated crenulation cleavage developed during decompression related with unloading produced by the overlying syn-orogenic extensional detachments. Additionally, P-T paths of the exhumed HP-LT rocks show a marked cooling event (approx. 150 °C) between the metamorphic peak and the development of the main foliation within the footwall thrust pile. We have related this cooling with underthrusting of cooler units just prior to the syn-orogenic extensional

exhumation. These results, added to the time overlap between HP-LT metamorphism (early-middle Miocene) and extensional basin development (middle Miocene) suggest extension related with the Sierra Nevada elongated dome was mostly syn-orogenic.