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Over the past thirty years, intense research has been devoted to interrelations of plutons emplacement and shear zones localization and development in various tectonic settings, from strike-slip, extensional to compressional. Within deforming continental regions, especially regions where Metamorphic Core Complexes (MCC) developed, emplacement of plutons interacts with processes of shear localization in the crust, and shear zones nucleation and their subsequent propagation are often coeval with the crystallization of magmas in plutonic bodies. Despite existing interest, the question of how and why plutons interact with extensional shear zones is still poorly understood. It is thus essential to recognize localizing events during emplacement and cooling of magmatic bodies, measure their kinematic and temporal indicators and evaluate their ability to localize deformation at the local and regional-scale.

The Cyclades (Aegean Sea, Greece) form a well-suited area to study this relationship as the development of crustal-scale structures, metamorphism and emplacement of magmatic bodies are shown to be synchronous. The Cycladic granitoids (17-8Ma) intruded the middle/upper crust during thinning of the Aegean domain. They were all emplaced in close interaction with Miocene high-temperature metamorphic domes and associated crustal-scale detachments. Integrating existing data and our new observations performed on Serifos, Mykonos, Naxos and Ikaria Islands, we describe (1) the geometrical relationships between the granitoids, the host rocks and the crustal-scale detachments (2) kinematic indicators inside and outside the granitoids (3) distribution, localization and evolution of deformation within each pluton during emplacement and cooling.

Intrusion, cooling and internal deformation of all granitoids were coeval and kinematically compatible with the development of detachments. One can indeed recognize a continuum of deformation from late-magmatic to brittle conditions within magmatic bodies during their emplacement and cooling, consistent with shearing recorded within host rocks. Plutons have an influence on the activity of detachments: in several examples the intrusion of a plutonic body makes the detachment migrate upward in the crust, progressively inactivating the deep branches of detachments (Mykonos, Tinos and Serifos). On the other hand the distribution and evolution of deformation in plutons show that their emplacements were largely tectonically controlled by active detachments and that the deformation tends to localize through time at the contact between granitoids and host rocks during their cooling. While the system of detachments exerts a control on the shape and final location of intrusions, the Serifos pluton recorded within a short time span strain localization resulting in shear zone nucleation and growth during its cooling. This study emphasizes once more the importance of regional tectonics and particularly that of detachments system in the control of granitic plutons emplacement, and introduces some additional constraints on the relationship between MCC formation, detachments and pluton emplacement in the Aegean Sea.