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Reply on RC1

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Author comment on "Interactions of plutons and detachments: a comparison of Aegean and Tyrrhenian granitoids" by Laurent Jolivet et al., Solid Earth Discuss., https://doi.org/10.5194/se-2021-11-AC3, 2021

Antonio Castro's comment: This is an interesting paper that merits publication after some minor changes.
It is implicit in the proposed model that melting of lower crust and detachments are related each other. This is the classical model of MCC. Transitions from magmatic state structures to ductile (rock) and brittle shear zones and faults are in support of the conceptual model. Melting induced by mantle magmas agrees with petrological constraints and experiments. However, these processes are not restricted to heat input; the supply of water to the lower crust is a necessary condition according to experiments (Castro 2020). Water is likely supplied by mafic magmas formed in a hydrated mantle (Pargasite-bearing). The described mafic rocks that associate to plutons have the characteristics of vaugnerites (sanukitoids) and can be the water donors to the crust. Thus, the process must start in the mantle under extension and decompression (pargasite breakdown has a positive clapeyron slope). Mafic (hydrous melts) can be stored at the base of the crust and some pulses may reach the upper crust at late stages after the partially molten zone is exhausted. This seems to be compatible with the sequence of magmas.
The outcome from numerical simulations matches quite well the conceptual models built on the basis of the geological and structural study. In this way these models cannot be called conceptual but geological, as they are based on real data, and not on simple observations. The paper lacks of basic information on the chemistry of intrusive rocks. If available, it would be interesting to show basic geochemical diagrams (e.g. Peacock diagrams, aluminosity, etc.). These may reinforce the interpretations on lower crust melting and the arrival of mantle-derived magmas at the time of extension and dome formation. In my opinion the paper can be published after addressing these minor revisions.

Our answers:

We fundamentally agree with A. Castro’s approach although the goal of our paper is not to discuss the origin of water in the melting process producing the plutons we have studied. The focus is rather on the interaction between the pluton and the detachment once the magma has been produced. We however did our best to answer this remark and added a portion of text in the chapter describing the numerical model to make clear a number of points:

"Castro (2020) pointed out that melting of the lower crust is enhanced by both heat and water supplied by mantle derived mafic magmas. In particular, partial melting of granulitic

component triggered by adding water from a mafic, mantle-related, component (vaugnerites) can represent the potential origin of secondary I-type granites as demonstrated by the experimental approach of Castro (2020). Castro (2020) followed the concept of Chappell & Stephens (1988)whereby the possible dual origin of I-Type magma stems from primary I-type magmas issued from coeval subduction, while secondary I-Type magmas are more likely related to melting of old subduction-related rocks. In the Aegean and Tyrrhenian tectonic settings, there is no evidence so far for the presence in the outcropping migmatitized crust of mafic components such as sanukitoids issued from older subduction-related rocks in sufficient volume to be the main donors of water. In contrast, there are many evidences of mafic mantle-derived magmas, coeval with the I-Type granites s.l. described in our study. For example, at the root of the Serifos granodiorite (Aegean Sea), Rabillard et al. (2015) describe mafic dykes disrupted into enclave swarms scattered throughout the whole magmatic body. Injection of mafic hydrous component took place during the whole emplacement period of the pluton that was crosscut by basaltic dykes while the granite was at near-solidus conditions. Closely similar observations can be done in the Tyrrhenian granitoids. For example, the main facies of the Monte Capanne pluton exhibits a constant, peraluminous, monzogranitic composition (Poli and Tommasini, 1991; Dini et al., 2002; Gagnevin et al., 2004) while the mafic microgranular enclaves (MME) varies from tonalitic-granodioritic to monzogranitic. The leucogranitic dykes are syenogranitic in composition (Gagnevin et al., 2004). Gagnevin et al. (2004) proposed a multiphase magmatic emplacement from peraluminous magmas issued from melting of a metasedimentary basement and hybridized with mantle-derived mafic magmas whose heat supply possibly enhanced wall-rock assimilation. In addition, injection of mantle-derived magma in the San't andreas facies would have triggered extensive fractionation and mixing of the basic magma with the resident monzogranitic mush (Poli and Tommasini, 1991).

We thus fully agree with the assumption of Castro (2020) pointing out that the supply of water to the lower crust is a necessary condition to produce I-type granites, but we believe from the previous petrological studies combined with our field observations that the mafic magmas derived from the coeval mantle are the main donors of water during the partial melting of the lower crust. Distinguishing the two I-Type granites in both Aegean and Tyrrhenian granitoids can be completed by an extensive geochemical study of major and trace elements as illustrated by the synthesis made by Castro (2020) for I-type granites emplaced in different tectonic settings. This approach is not in the scope of our study as the origin of the mafic component has no significant direct impact on the interaction between plutons and detachments faults. Nevertheless, we agree that it may be worth showing basic geochemical diagrams to reinforce the interpretations on lower crust melting and the arrival of mantle-derived magmas at the time of extension and dome formation". In order to illustrate the chemical evolution of I-Type granites in the Aegean and Tyrrhenian settings, a complementary figure is proposed in appendix A (figure A1) issued from a compilation of geochemical analyses in. This MgO vs SiO2 Harker diagram clearly shows the classical negative correlation found in I-type hornblende-biotite-bearing granites. The microgranular enclaves represents the mafic hydrous melts that reached the upper crust while they mixed/mingled with differentiated melts either during ascent (Fernández and Castro, 2018) or at the base of the magmatic chambers (as well illustrated in Serifos granodiorite by Rabillard et al., 2015). Mixing/migling processes between mafic mantle-derived melts and acid magmas produce composite batholiths (Poli and Tommasini, 1991) as illustrated by the case of the Elba Island magmatic complex shown for comparison (see Dini et al., 2002 for explanation)."