Solid Earth Discussions

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Reply on RC2

Laurent Jolivet et al.

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-AC2, 2021

Thanks a lot for the king general appreciation of our paper. We also thank you for the numerous suggestions of improvements that we will for sure implement in the revised version. As a first answer to your comment let us first point out that our study is not so much about the specific case of Elba and the Monte Capanne, but more on the geometry and kinematics of plutons intruding the crust in an extensional context where low-angle detachment form. Our observations in the Aegean have revealed a common scheme for all the plutons we examined and we find some striking similarities in the case of Elba. The modelling procedure we use is entirely different from that adopted in the various papers you cite. Instead of pure thermal and theological models we have here a thermo-mechanical model where we do not prescribe the position of the detachment. This detachment instead forms in a self-consistent way with the density contrasts and imposed rheology of the host rock and magma. The magma is a bit resistant probably compared to a true pluton, but its resistance is negligible compared to that of the host rock like we expect for a magma. In our models, we also take into account the lateral thermal diffusion, which is not the case in most of the cited models. All parameters use for the modelling are in a table in the supplementary materials.

These models are shown for comparison with the conceptual model we derived previously from the field observations of the Aegean plutons and the overall geometry and kinematics are very similar, suggesting that our model is viable. The emplacement of granites in the model is controlled by structures that form in a way consistent with the rheology, dictated to the first order by the thermal evolution and the rheological contrasts introduced in the stratification of the initial setup. The fact that the plutons start as balloons is similar to the models you cite but the cause for melting is different. Melting is not caused by decompression but by heating from below because the upper lithospheric mantle thins and is boudinaged because of extension.

Our models do not consider a two-phase flow with a magma percolating in a permeable medium. Such models do not exist yet, at least for long-term models running on geological time scales, unfortunately. Tectonics involved in our models lasts for millions of years while porosity waves would last only a few hundred years, which correspond to only one time step of our model. We thus cannot consider the successive batches of magmas involved in the formation of plutons. The balloons that form at the beginning of extension

are a good approximation of several successive episodes of magma extraction along the channels formed in the imposed stress field. This is the best we can do at the moment.