Solid Earth Discussions

Solid Earth Discuss., referee comment RC2
https://doi.org/10.5194/se-2021-11-RC2, 2021
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Comment on se-2021-11

Andrea Brogi (Referee)

Referee 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-RC2, 2021

The manuscript entitled "Interactions of plutons and detachments, comparison of Aegean and Tyrrhenian granitoids" by Jolivet et al. deals with the Neogene-Quaternary evolution of two areas in the Mediterranean that have been affected by magmatism strictly controlled by extensional tectonics. Authors mainly refer on the mechanism of emplacement and exhumation in relation with the Miocene – Pliocene tectonic evolution. Although the relationship between tectonics and magmatism is a "classical" topic, and several papers have focused on this precisely in the Tyrrhenian and Aegean areas, the authors offer a best opportunity to tackle a hot topic that in the last decade has been taking place overall on the evolution of the northern Tyrrhenian Sea and the Northern Apennines. In this view, Elba Island play a key role in the debate and has been object of different interpretations.

The manuscript sounds like a review paper as it has been constructed mostly integrating literature data apart from the last part which is dedicated to modeling. In this view, the manuscript is well organized and symmetrically divided for illustrating both northern Tyrrhenian (i.e. Elba) and Aegean areas. The last part illustrates and discuss the model designed for reconstructing mechanism of emplacement and exhumation of the magmatic bodies. Figures are clear, well done and well represent all data needed for the discussion. Nevertheless, in my opinion, a first figure comprehending both the northern Tyrrhenian Sea and the Aegean Sea, illustrating the tectonic scenario of the Mediterranean area is missed. A new figure in that line could be very useful for all readers not so familiar with this part of our Planet.

General conclusions of the paper are in line with what the authors are presenting and most of data presented in literature. However, a more accurate discussion should be dedicated to better highlight additional points as specified here below.

I agree with the authors that the Tyrrhenian Sea and Tuscany were affected by

extensional tectonics since Ealy Miocene and this can explain all the geological evidences that we can see and measure on the surface. However, the tectonic evolution of the Tyrrhenian Sea is object of an increasingly noisy debate on the geodynamic scenario that should be mentioned in the text. As authors probably known, some authors have recently published papers that are framing all the geological issues of the northern Tyrrhenian Sea and inner Apennines in an alternative view with respect to the extensional tectonics. Also, the emplacement and exhumation of magmatic bodies are framed in a compressional setting instead of related to extension (see for example Montanari et al., 2010, Tectonophysics). I agree that the alternative conclusions are difficult to share, but just for this reason authors should face the problem and at least mention the existence of the improbable conclusions of these papers. Discussion has been addressed in several papers that could be useful for the authors; I mention here the most representative ones that may help authors to get useful idea: Brogi et al., 2005 (JVGR); Brogi 2008 (Int.J.Earth.Sciences); Brogi and Liotta 2008 (Tectonics); Brogi 2011 (Tectonophysics); Liotta et al., 2015 (Tectonophysics); Brogi 2020 (J.Struct.Geol.); Brogi et al. 2021 (Geosciences Switzerland). In particular, I recommend the last paper for focusing on the different views on the emplacement and exhumation of the magmatic bodies in the Tyrrhenian area (i.e. views from the office-desk vs fieldwork and data collection).

At the same time, Authors refer the development of the Tyrrhenian Sea to a back-arc basin related to the roll-back and slab-pull, but it is not a common view; see for example the papers by Mantovani et al. 2001 (J. Virtual Explor), Viti et al. 2004 (Tectoncis); Mantovani et al., 2019 (Journal of the Geological Society) and others, which highlight a more complex geodynamic scenario compared to the classic model. Authors probably should add some lines also for highlighting these different points of view.

Magmatism (e.g. magma formation, emplacement and exhumation) has been modeled through numerical experiments and the results have been discussed in last part of the paper. In my opinion this is the most critical part of the manuscript. Authors set the model on parameters that I cannot understand: for example, the temperature, the depth and the volume of bodies seem to be not consistent with what it is known for the magmatic bodies described at least for the northern Tyrrhenian area. I suggest to better show in a table which are the parameters authors used for the numerical simulation. There is a wide literature from which authors should constrain the parameters to be fixed for the modelling (Caggianelli et al. 2014, Geol.Soc.Spec.Publ; Rochira et al. 2018, Geodynamica Acta; Spiess et al., 2021, J.Struct.Geol.). Evolution of the magmatic systems can be found in Dini et al., 2002, Dini et al. 2008; Westerman et al., 2004…

Additional information for the age of the Porto Azzurro pluton are in Gagnevin et al. (2011, EPSL) and Spiess et al. (2021, J.Struct.Geol).

Concerning the structural control on the magma emplacement, authors should also discuss the role of the transfer zones that accommodated the extensional tectonics since Early Miocene and which contributed to channel the magmatic intrusion (see Dini et al., 2008 – Terra Nova; Liotta et al., 2015 - Tectonophysics; Gola et al., 2017 – Energy Procedia; Liotta and Brogi, 2020 - Geothermics; Brogi et al., 2021 – Geosciences Switzerland). This part should be better introduced as authors, in their models, figure out the emplacement of the magmatic bodies “like balloons” without any explicit connection

with crustal structures. Of course, their geometry at melt and solid-state was modified by the activity of unroofing faults continuing to thin the tectonic pile, as clearly understandable from the surface analysis, but no indications are from the permeability development triggering the melt rise toward the upper crustal levels.

So in my opinion, this manuscript provides important inputs but additional work is necessary for refining at least the numerical modelling. The aim of the manuscript, addressed to resume and compare the tectonic setting which provided to the development of this part of Mediterranean as well as emplacement and exhumation of the magmatic bodies, is perfectly achieved.

Regards,

Andrea Brogi (University of Bari, Italy)