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Interactive comment on "Evolution of a long-lived continental arc: a geochemical approach (Arequipa Batholith, Southern Peru)" *by* Sophie Demouy et al.

Anonymous Referee #1

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This manuscript describes the evolution of a part of the Arequipa batholith in S. Peru, using chemical and isotopic composition of bulk rocks. I don't think that this manuscript is meeting the standard of this journal and I suggest taht it goes back to the authors for s serious overhaul. My arguments are the following: 1.) The manuscript presents a lot of good geochemical data, but stays entirely descriptive. Data are used to make intrusive groups, to describe the geochemical characteristics of the different groups, but it dies not go much further. 2.) The authors stay with established and partly even outdated approaches, mention the Annen models, AFC processes. It is like they don't know the literature of the last 10 years. The community has gained a lot of insight in the the tempo of magmatism, about lulls and high-flux episodes, which goes significantly

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beyond St. Blanquat et al. (2011). Magmatism is also fractal in time ans space, this pulsed behaviour has been described, dated, and numerically modelled at very different temporal and spatial scale. It is like the authors have not read any literature on that topic since ca. 2010. Just to mention a few: Coleman et al., 2010; the Paterson & Ducea 2015 Elements issue, or the Schaltegger & Davies 2017 RiMG chapter. The discussion can therefore be improved significantly. 3.) The entire discussion is lengthy, unstructured and repetitive. It can be shortened and improved. There is a sign of a conceptual model towards the end, but the authors make no effort to put it into a shape that would underline its importance nor to make it attractive for a reader. The entire paper does not care about any of the virtually thousands geochemical analyses available form the Arequipa block, see some spectacular compilations in the Wörner Elements issue. 4.) The same concern as mentioned in 2) also applies to the knowledge of the local geology, and the understanding of Andean magmatism. There has been an Element issue edited by Wörner, right, also some more recent papers after Boekhout et al. (2012) on Andean geodynamics, geological evolution and magmatism that are directly relevant to this study (see, e.g., Spikings et al., 2016). 5.) The Conclusions are a Summary without any ideas that go beyond the points discussed in the text. What actually we have learnt from this work that enhances our knowledge or arc magmatism....?

I add some more detailed comments along with the concerning line numbers: 38: as mentioned above, magmatism is fractal in 1E5 to 1E7 years' timescales. Check out some of the recent high-precision dating papers going into more detail, such as Schoene et al., 2012; Samperton et al., 2015; Tapster et al., 2016; among many others. There is also literature on thermal-thermodynamic modeling, and probabilistic modeling of durations, fluxes and volumes available. 53-55: the depth of assimilation can be traced by the existence of absence of inherited zircon cores. Contaminated magmas can be free of inherited cores or xenocrystic zircons, because assimilation happened above saturation temperatures of zircon. 77-79: Is of no interest in this manuscript and can be omitted. 190: not really the best photos to illustrate this! 299: large scatter, not "scattered repartition" 451 and lines before and after: AFC is a model that described

fractional crystallization during assimilation. More modern models imply variable interaction between crystals and melt, between melts of different origin, and between melts and crust. The idea is that magma batches are small, ephemeral and are accreting a batholith over time. AFC is thus a relatively outdated model that does not apply due to kinetic reasons mainly. There are may examples published of magmatic systems that start with compositionnally diverse small magma volumes, that increase the overall heat budget of a certain crustal level, and finish with quite homogeneous, usually more crustal melt compositions. Oxygen isotopes would have been great in this context...
57: I think this started already in the Triassic, Spikings et al., 2016.

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