Geochemistry, Geophysics, Geosystems

REPLY

10.1029/2018GC008034

This article is a reply to a comment by Uslular and Gençalioğlu-Kuşçu (2018), https://doi.org/10.1029/2018GC007533.

Key Points:
- Revised compilation of Anatolian mafic igneous rocks does not alter our results
- Geochemical modeling is not contingent upon exact silica content
- Detailed geographic subdivision does not change our conclusions

Correspondence to:
F. McNab and N. J. White,
fm430@esc.cam.ac.uk;
njw10@cam.ac.uk

Citation:
McNab, F., Ball, P. W., Hoggard, M. J., & White, N. (2019). Reply to "Geochemical characteristics of Anatolian basalts: Comment on 'Neogene uplift and magmatism of Anatolia: Insights from drainage analysis and basaltic geochemistry' by McNab et al.". *Geochemistry, Geophysics, Geosystems*, *20*, 542–544. https://doi.org/10.1029/2018GC008034

Received 24 OCT 2018
Accepted 20 DEC 2018
Accepted article online 19 JAN 2019
Published online 23 JAN 2019

Reply to "Geochemical Characteristics of Anatolian Basalts: Comment on 'Neogene Uplift and Magmatism of Anatolia: Insights from Drainage Analysis and Basaltic Geochemistry' by McNab et al."

F. McNab[1], P.W. Ball[1], M. J. Hoggard[2], and N. J. White[1]

[1]Bullard Laboratories, Department of Earth Sciences, University of Cambridge, Cambridge, UK, [2]Department of Earth and Planetary Sciences, Harvard University, Cambridge, MA, USA

Abstract Uslular and Gençalioğlu-Kuşçu (2018) have written a lengthy, and highly critical, comment about McNab et al. (2018, https://doi.org/10.1002/2017GC007251) which states that our data compilation for Neogene (and Quaternary) volcanic rocks from Anatolia is selective, inconsistent, and not fit for purpose. We state for the record that our compilation is not based on analyses from the published GEOROC database. Uslular and Gençalioğlu-Kuşçu (2018) also state that our subdivision of this database into three broad longitudinal categories is unrealistic since it does not consider the full range of different tectonic units. They conclude that our interpretation of the link between Neogene-Quaternary volcanism and uplift of Anatolia is erroneous. We refute this rather strongly worded comment by carefully addressing the five substantive issues raised.

We tackle the five substantive issues raised by Uslular and Gençalioğlu-Kuşçu (2018) as follows. First, we have revised the data compilation shown in our original Figure 11 by including analyses from the publications referred to by Uslular and Gençalioğlu-Kuşçu (2018), and 190 additional analyses to which they do not refer. We have included a suite of publications that postdate the original submission of McNab et al. (2018). Note that we deliberately excluded the analyses of Parlak et al. (2001) since these authors state that the relevant samples are crustally contaminated. Our revised data compilation is substantially the same as that shown in our original Figure 11 (Figure 1). However, it does differ in important ways from that presented by Uslular and Gençalioğlu-Kuşçu (2018). Notably, we necessarily continue to screen analyses in order to exclude those with MgO < 5 wt%, which cannot easily be modeled. The compilation of Uslular and Gençalioğlu-Kuşçu (2018) also contains several numerical transcription errors. The similarity between our revised and original compilations is unsurprising since the transition of subduction-influenced to ocean island basalt (OIB) magmatism within western Anatolia is well known (Figure 1a–1e). A small number of newly included analyses from the Konya province of Central Anatolia have significantly elevated ratios of K/Nb and Ba/Nb. (Figures 1f–1g) These lamprophyres probably represent small melt fractions from an enriched source (Asan & Ertürk, 2013). Note that their low Pb/Ce ratios as well as a lack of isotopic measurements mean that it is difficult to determine whether they are the products of arc volcanism or lithospheric contamination (Figures 1h–1j). Our revised data compilation and the associated reference list are available on request.

Second, Uslular and Gençalioğlu-Kuşçu (2018) repeatedly state that we have made a critical mistake by including samples that lie outside the typical silica range for basalts (i.e., 45–52 wt%) and by neglecting samples with <5 wt% MgO that lie within this range. This inference is incorrect since SiO_2 content of mafic igneous rock is not strongly dependent upon fractionation of the olivine phase and can vary greatly with both source composition and equilibration depth. MgO content, however, is a more reliable proxy for fractionation of the early crystallizing phases. Thus, MgO content is known to be the most appropriate and widely used tool for sample screening. Third, we acknowledge that we have used the chronologic term "Neogene" rather loosely and that we mislocated the Erciyes and Hasandağ stratovolcanoes. These minor errors do not affect the results and conclusions of McNab et al. (2018). Fourth, we did consider and test a more detailed geographic subdivision of Anatolian magmatism, along the lines of that proposed by Uslular

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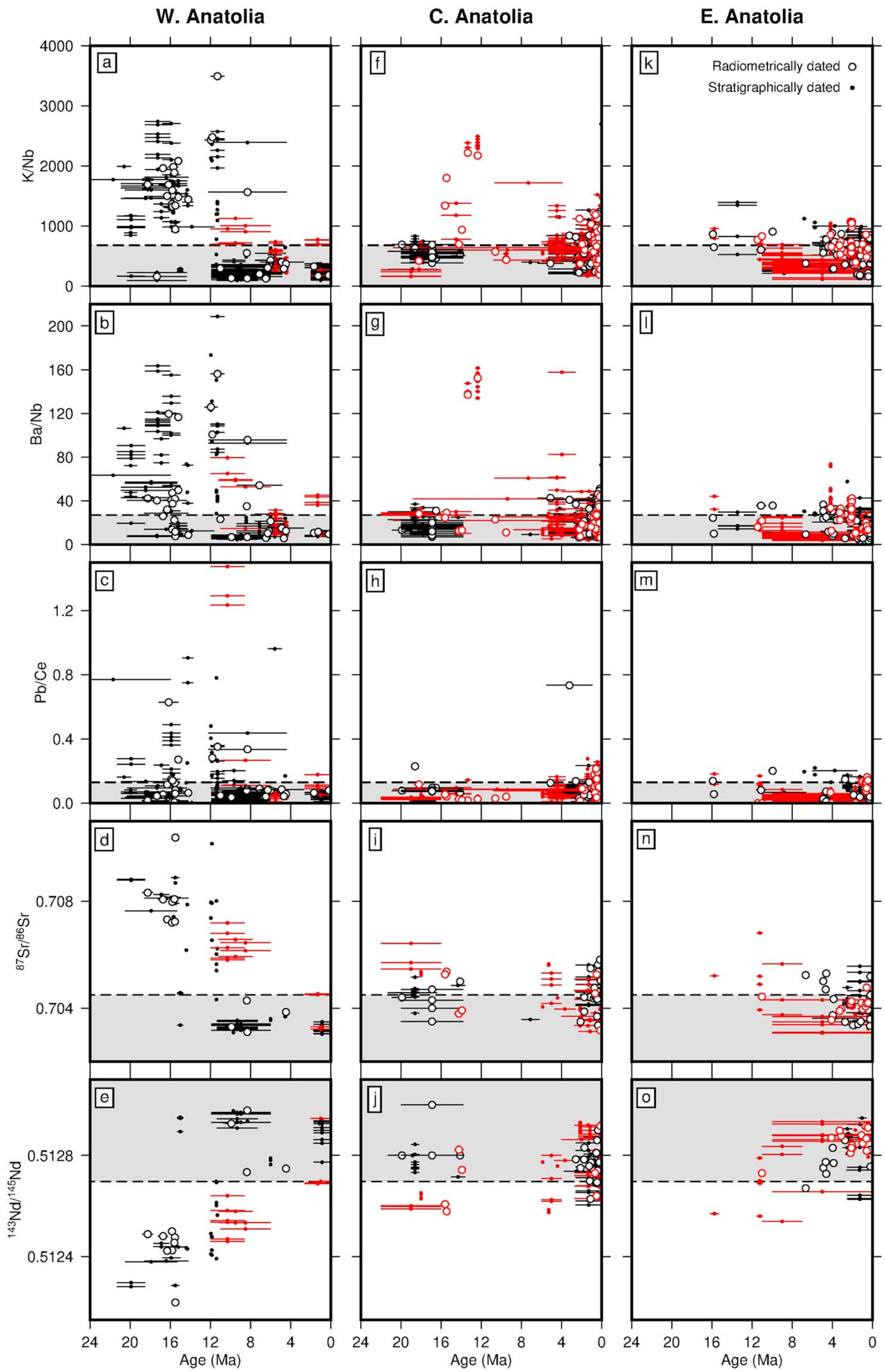

Figure 1. Revised version of our original Figure 11 (McNab et al., 2018). Geochemical analyses of mafic volcanism from Western (a–e), Central (f–j), and Eastern (k–o) Anatolia as function of age. Open circles with horizontal bars = radiometrically dated samples ±1σ; closed circles with horizontal bars = chronostratigraphically dated samples ±1σ; black = samples from original compilation of McNab et al. (2018); red = additional samples; gray boxes with dashed lines = mean and standard deviation of ocean island basalts from GEOROC database (http://www.georoc.edu).

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and Gençalioğlu-Kuşcu (2018), during preparation of McNab et al. (2018). This detailed subdivision does not affect the results and conclusions presented by McNab et al. (2018), notably an increase in asthenospheric temperature from west to east that accords with regional topography and with fluvial landscape analysis. Fifth, we reject the assertion that generalization of an OIB-like affinity within the last 10 Ma is misleading. When appropriate sample screening is applied, compositions of mafic rocks from this time interval are close to those of OIBs with the exception of some more enriched samples, the origin of which we carefully discuss in McNab et al. (2018).

References

Asan, K., & Ertürk, M. A. (2013). First evidence of lamprophyric magmatism from the Konya region, Turkey: A genetic link to high-K volcanism. *Acta Geologica Sinica*, *87*(6), 1617–1629.

McNab, F., Ball, P. W., Hoggard, M. J., & White, N. J. (2018). Neogene uplift and magmatism of Anatolia: Insights from drainage analysis and basaltic geochemistry. *Geochemistry, Geophysics, Geosystems*, *19*, 175–213. https://doi.org/10.1002/2017GC007251

Parlak, O., Delaloye, M., Demirkol, C., & Ünlügenç, U. C. (2001). Geochemistry of Pliocene/Pleistocene basalts along the Central Anatolian Fault Zone (CAFZ), Turkey. *Geodinamic Acta*, *14*, 159–167.

Uslular, G., & Gençalioğlu-Kuşcu, G. (2018). Geochemical characteristics of Anatolian basalts: Comment on "Neogene uplift and magmatism of Anatolia: Insights from drainage analysis and basaltic geochemistry" by McNab et al. *Geochemistry, Geophysics, Geosystems*, *19*. https://doi.org/10.1029/2018GC007533