δ^{11}B of post-collisional volcanic rocks in Armenia and the longevity of slab signatures

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1. Background

- Boron and its stable isotopes (^{11}B and ^{10}B) a key tracer of slab components under volcanic arcs:
  - ➛ Low mantle conc (<0.1 ppm)
  - ➛ Strong fluid partitioning, with concomitant isotope fractionation

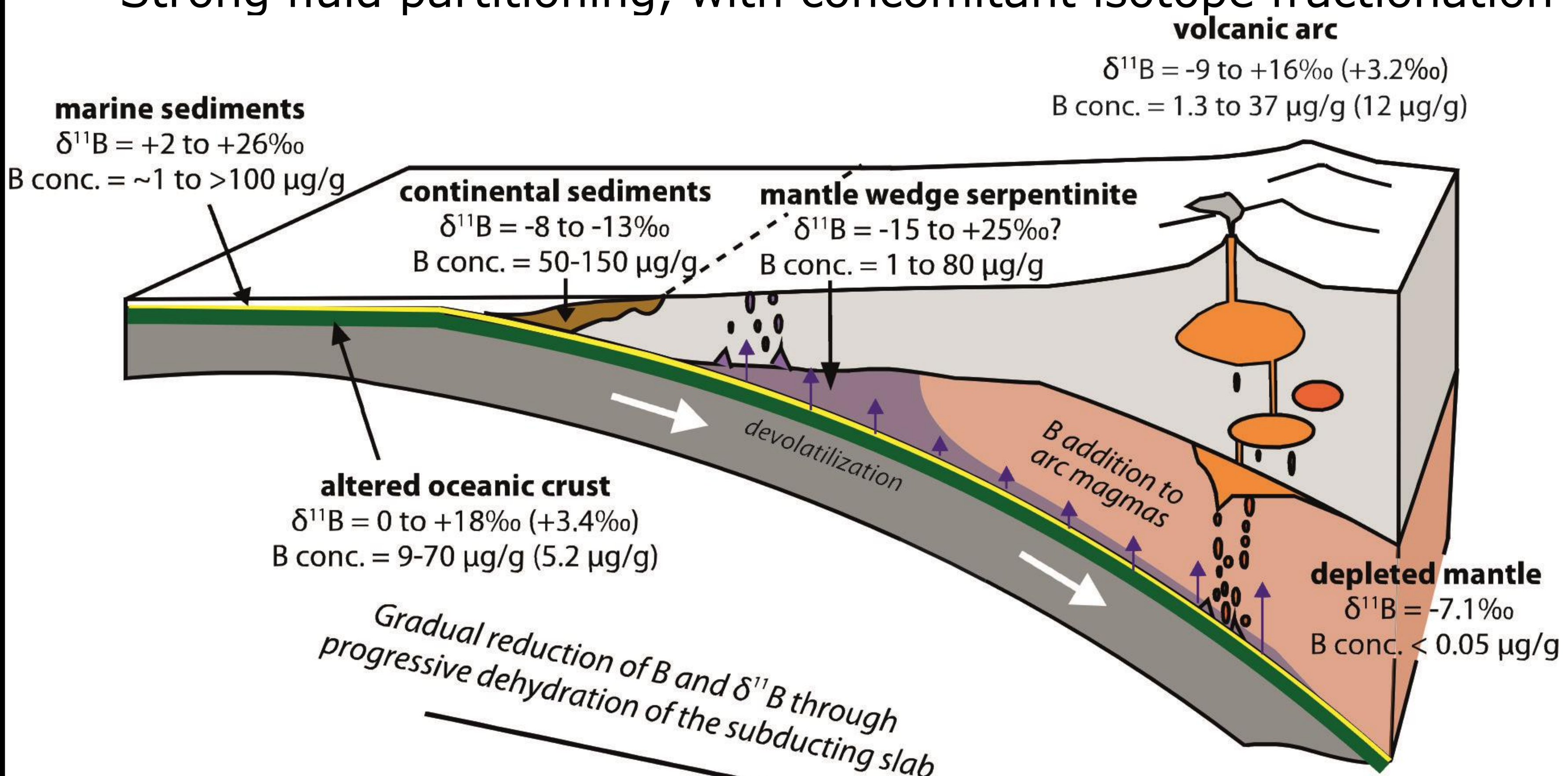


Figure 1: Modified[1] summary of slab components. Note the high B concentration in all slab components, and their highly variable δ^{11}B

- Only handful of studies used B to invesigate impact of slab components where subduction has ceased

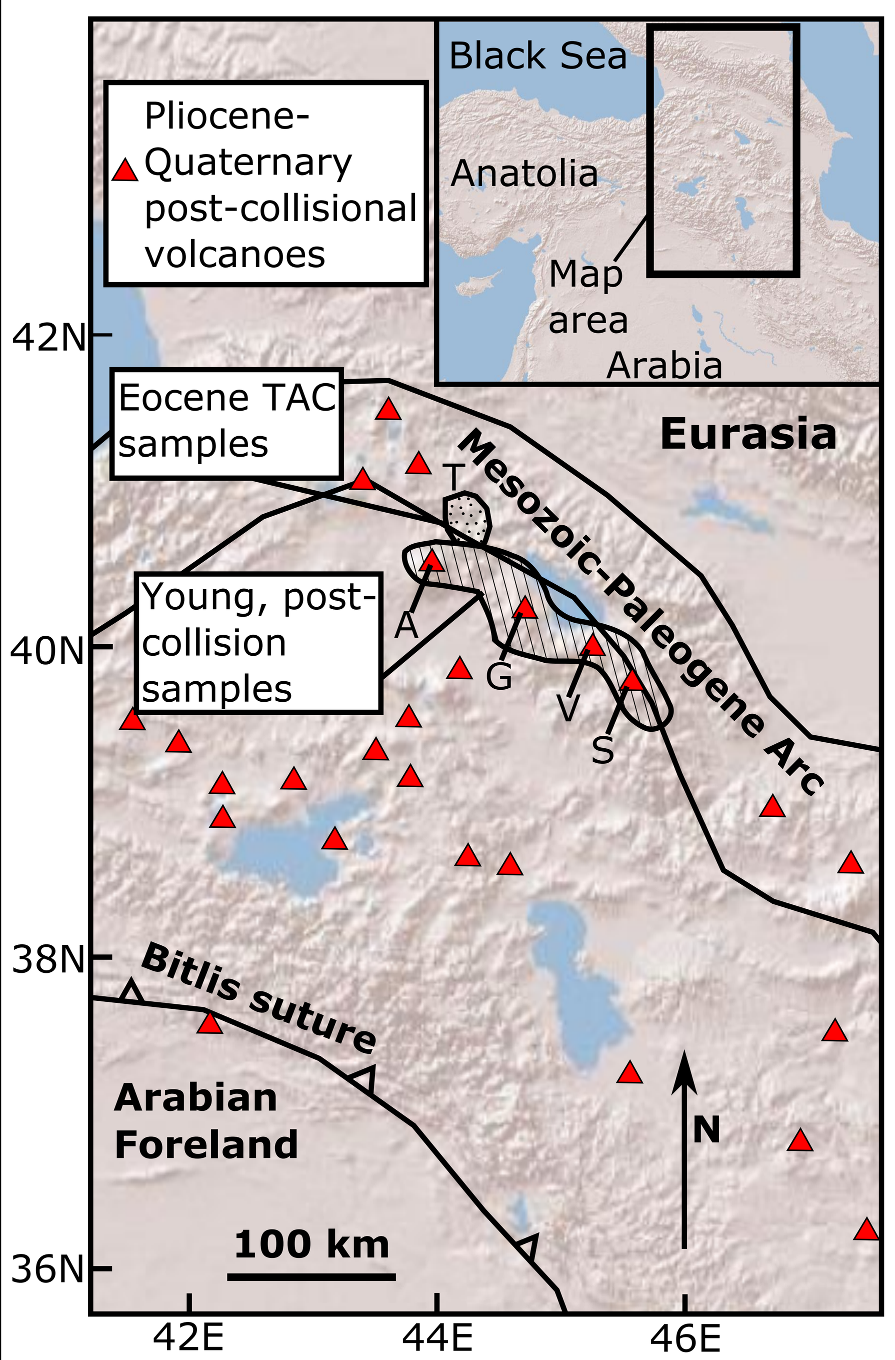


Figure 2 (left): map of Arabia-Eurasia collision zone and its widespread Quaternary volcanism. 1.5-0 Ma[2,3] post-collision samples from 3 volcanic highlands (labelled G, V and S) and Aragats volcano (A) in Armenia. Also shown is the location of the Eocene Tezhsar alkaline complex (TAC)

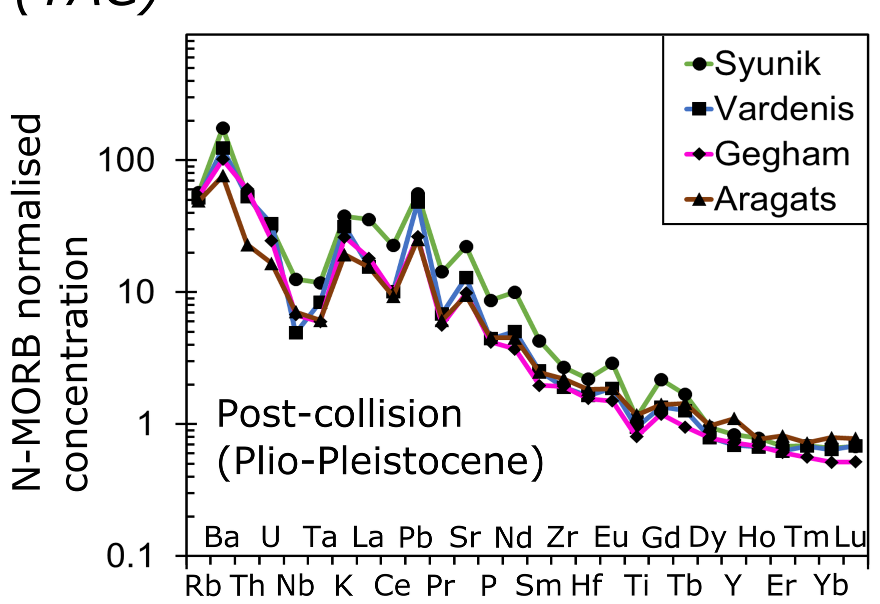


Figure 3 (above): post-collision volcanic rocks arc-type geochemistry

2. New Results

- First B isotope data for young volcanic rocks from modern continent-continent collision

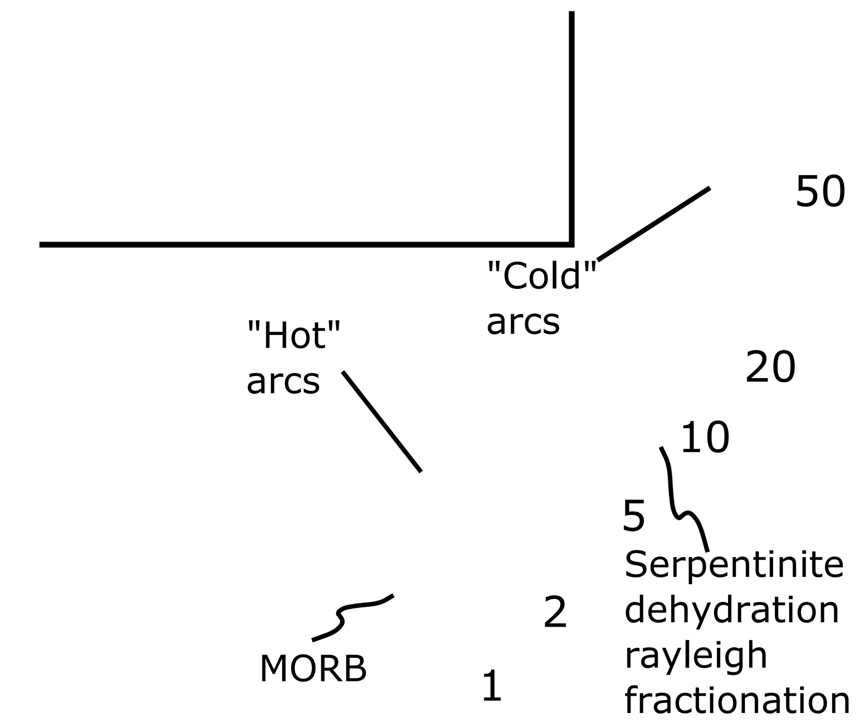


Figure 4 (left): arc rocks[1] and post-collision samples have higher δ^{11}B than MORB[4] due to the addition of a slab component. The post-collision rocks have very low B/Nb suggesting the slab component is fluid depleted.

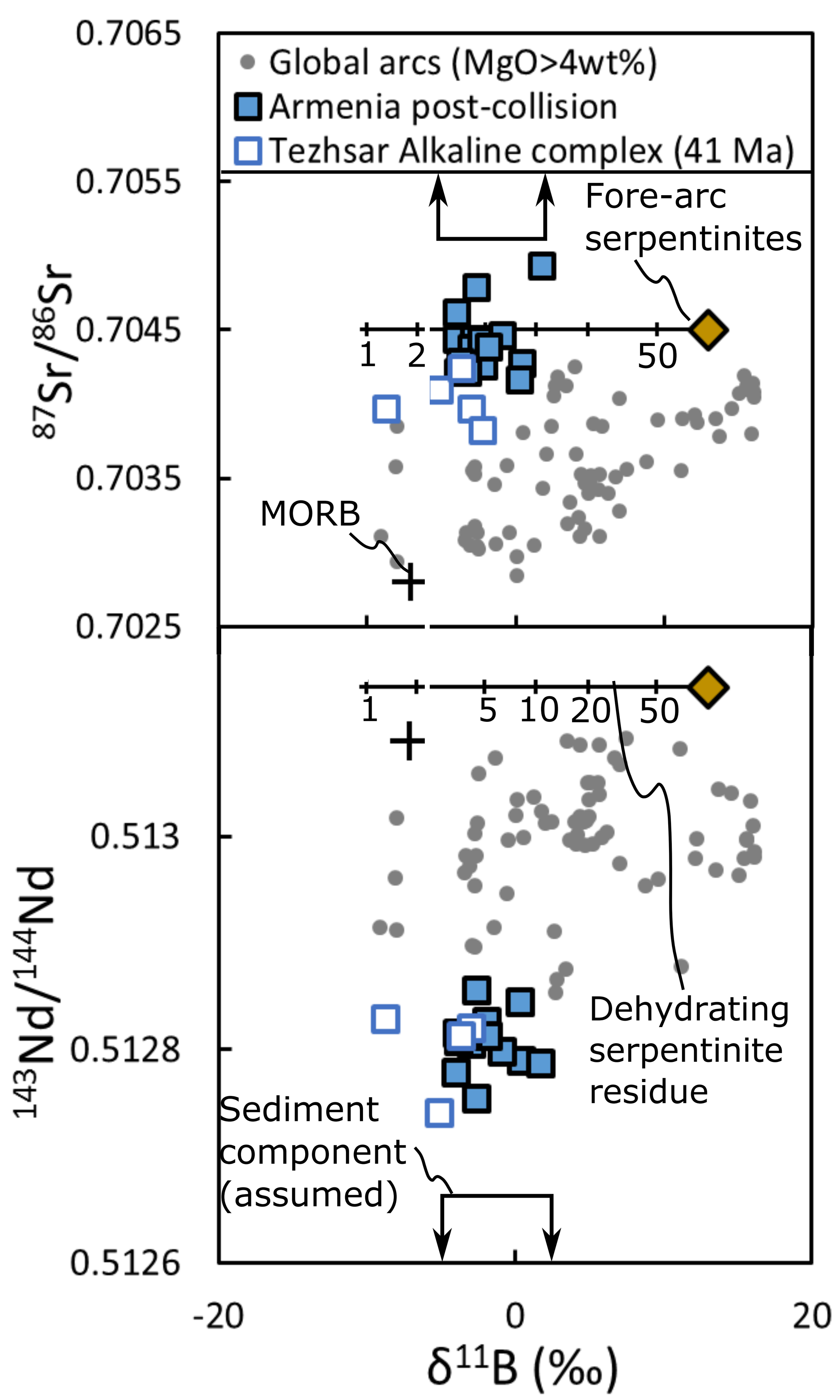


Figure 5 (left): tight cluster in Sr-Nd-B isotope space similar to 41 Ma[5] TAC samples means this is a long lived reservoir

3. Inherited slab signature: amphibole sponge

- Consistent isotope composition over time (Fig. 5) ➛ long-lived reservoir, inherited from previous subduction
- Stored in lithosphere ➛ lower T ➛ Stable metasomatic phases: amphibole

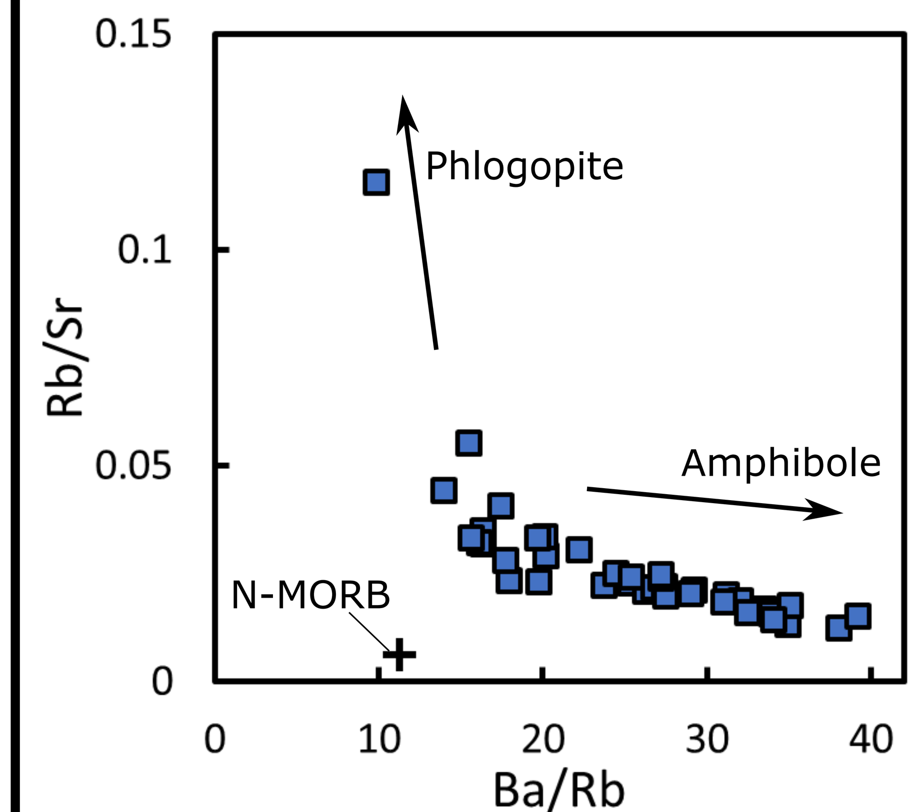


Figure 6 (above): in this and subsequent figures samples are primitive and post-collision

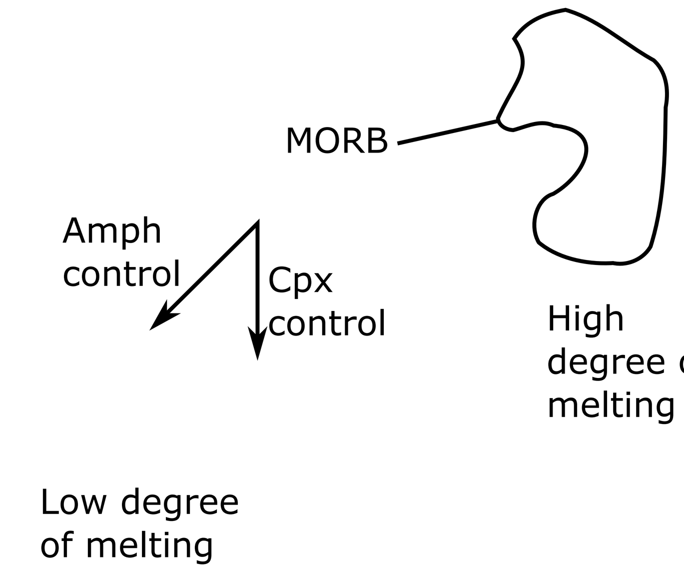
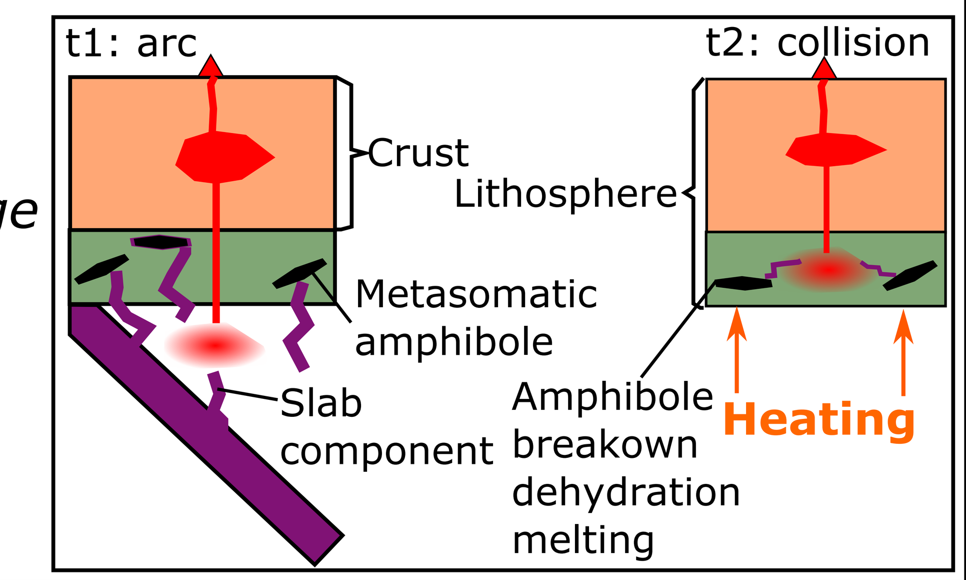


Figure 7: Dy/Dy measure of curvature of REE profile[6], Ti/Ti* size Ti anomoly, Fig. 3*

Figure 8 (left): amphibole sponge model analogous to that of Jon Davidson[7], but in the mantle lithosphere, not the crust. See Sugden et al. (2019)[8] for more detail



4. Long live the sediment melt!

- Light δ^{11}B, low B/Nb + ^{143}Nd/^{144}Nd (Figs 4, 5) ➛ **NOT** serpentinite aqueous fluid
- Lack of aqueous fluid not inherited from hot subduction zone (Fig. 10) ➛ fluids transitory, sediment melts long-lived

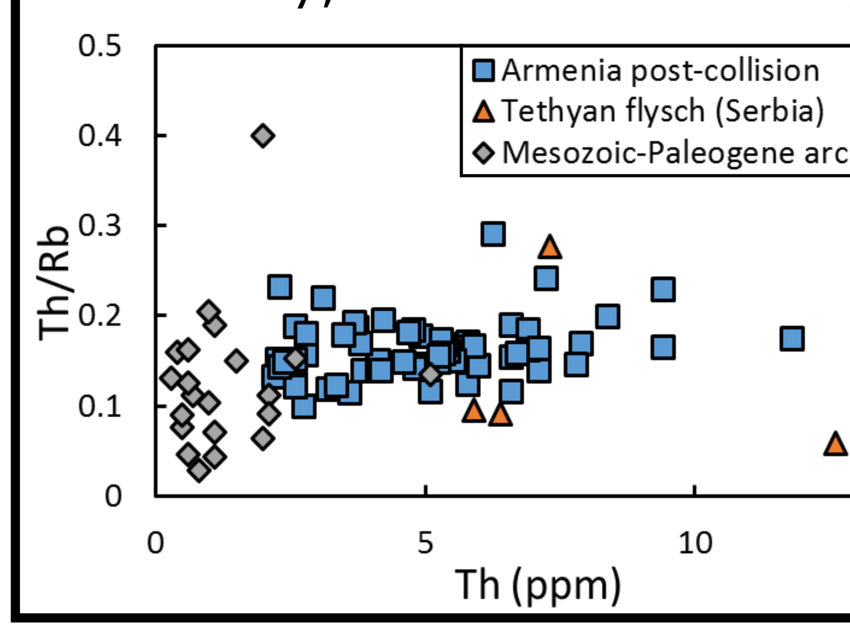
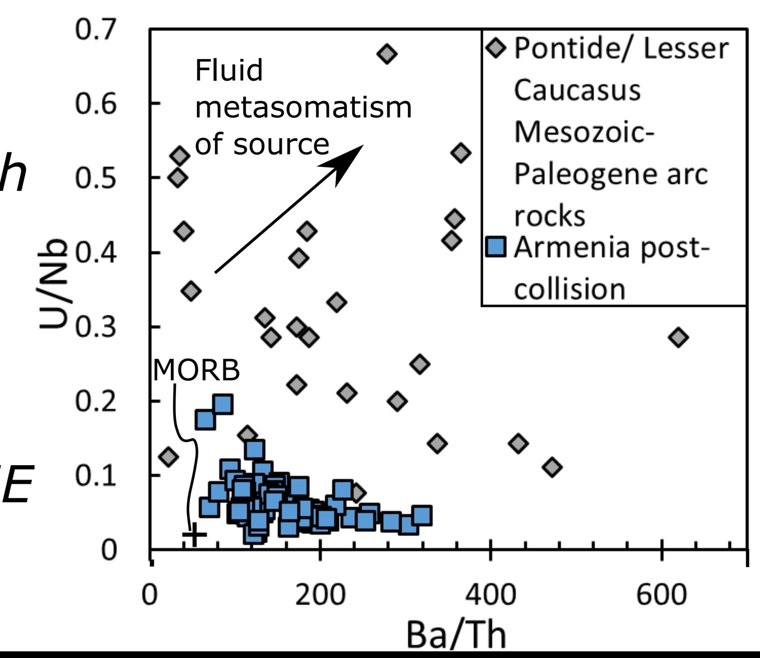


Figure 9 (left): Th/Rb similar to Tethyan Flysch ➛ mobile phase must have been a melt[10]

Figure 10 (right): FME more enriched in Mesozoic arc [11,12]



5. Conclusions

- **Post-collisional B + δ^{11}B distinct from both MORB and arcs**
- **B signature inherited from previous subduction and stored in an amphibole sponge in the lithosphere**
- **Slab component dominated by sediment melts**

References: [1] **De Hoog & Savov**, (2018). *Boron isotopes: the fifth element.* [2] **Joannin**, et al. (2010). *Earth & Plan. Sci. Lett.* 291. [3] **Karakhanian**, et al. (2002). *J. Volcanol. & Geotherm. Res.* 113(1-2). [4] **Marschall**, et al. (2017). *Geochim. Cosmochim. Acta.* 207. [5] **Sokół**, et al. (2018). *Lithos.* 321. [6] **Davidson**, et al. (2013). *J.Petrology.* 54(3). [7] **Davidson**, et al. (2007). *Geology.* 35. [8] **Sugden**, et al. (2019). J. Petrology. 60(2). [9] **Elliott**, et al. (1997). *J. Geophys. Res.* 102(B7). [10] **Johnson & Plank**, (2000). *Geochem. Geophys. Geosys.* 1(12). [11] **Aydinçakir & Sen**, (2013). *Lithos.* 172. [12] **Mederer**, et al. (2013). *Lithos.* 177.