

## ***Interactive comment on “Alkali basalt from the Seifu seamount of the Japan Sea: post-spreading magmatism in the back-arc region” by Tomoaki Morishita et al.***

### **Anonymous Referee #1**

Received and published: 19 August 2019

The authors Tomoaki et al. focused the nature of post-backarc magmatism and provided a case study on the Seifu alkali basalt of the Japan Sea, using Ar-Ar geochronology and whole-rock major, trace element and Sr-Nd-Pb isotopic geochemistry. Their methods of direct fusion are interesting and ideal for the analysis of precious samples with a limited amount. The investigated SSM basalt provides a reference for studies on eastern Asian Cenozoic basalts and post-backarc magmatism and plays an important role to link the garnet-pyroxenite/peridotite sourced eastern China Cenozoic basalts and the spinel-peridotite sourced Japan Sea BABB. The primary issue is the organization of the language. The logic relationship of sentences is also weak, especially in the abstract, the 4.2 origin of the SSM basalt and its tectonic setting, and the conclu-

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sion part. Luckily, there are not many scientific problems. Thus, I suggest a moderate revision.

Major concerns:

(1) The language is not well organized. Some are not likely English. I rewrote an abstract. But I am also not a native speaker so the new abstract is just for authors' consideration. The main text should be carefully examined for language issues.

**Abstract** The spreading of the Japan Sea back-arc oceanic floor paused since 18-15 Ma. However, post-backarc magmatism continued. Here we report the geochronological and geochemical results of the Seifu Seamount basalt (SSM-basalt) in the southwest Japan Sea, to reveal its source lithology and heterogeneity. Our results show that the SSM-basalt occurred at  $8.33 \pm 0.15$  Ma ( $2\sigma$ ) that is an early stage of the Japan Sea post-backarc magmatism, based on the  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  plateau age. The SSM-basalt is highly alkaline and characterized by enrichment of light rare earth element (LREE) and Nb, similar to ocean island-type basalt (OIB). However, it has an elevated and approximately flat heavy rare earth element (HREE) pattern similar as mid-oceanic ridge basalts (MORB) and back-arc basin basalts (BABB), indicating an origin of low-degree partial melting of spinel peridotite mantle source. The Nd, Sr and Pb isotopic ratios suggest a depleted MORB mantle source that likely added by minor EM1-type enriched components. Here we concluded that the SSM-basalt formed shortly after the main back-arc spreading by low-degree partial melting of spinel peridotite marks a transitional product between the garnet-pyroxenite/peridotite sourced eastern China Cenozoic basalts and the spinel-peridotite sourced Japan Sea BABB.

**Keywords** Alkali basalt, Japan Sea, Post-backarc magmatism, source lithology, mantle heterogeneity

(2) The discussion 4.2 Origin of the SSM basalt and its tectonic setting is very confusing. Please split it into two sections, including "4.2 Source lithology and heterogeneity of the SSM basalt" and "4.3 Tectonic origin and implications". Rewrite all of

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them. In the new discussion 4.2, please use three paragraphs discuss the magma evolution (was there any AFC processes? How about the Ce/Pb ratio?); source lithology (peridotite/pyroxenite source? using FeO/MnO, CaO/Al<sub>2</sub>O<sub>3</sub> ratios, spinel or garnet facies? La/Yb, Sm/Yb ratios); and source heterogeneity (how to interpret the high Ba/Th ratio?). I am worried that the low <sup>87</sup>Sr/<sup>86</sup>Sr ratio was caused by weathering alteration and the source is isotopically same as the Yamato Basin BABB.

Minor corrections: (1) Rewrite the paragraph 1 in the introduction please. It is boring and not attractive, and not pointed out the scientific issue that the authors are going to solve. The second sentence tells that the post backarc magmatism is characterized by enriched basalts whereas the third sentence tells nothing.

(2) Use “seamounts” instead of the term “seamount chain” in the geological background. The latter makes readers link these seamounts with mantle plumes. However, the authors did not consider any possibility of plume at all in the whole paper.

(3) Please provide thin section photomicrograph images in the main text, showing the olivine, plagioclase, orthopyroxene, clinopyroxene, and spinel phenocrysts.

(4) Direct fusion method is not widely used. Please write the full procedures on major and minor element analysis using EPMA and LA-ICPMS in the main text methods, rather than just say “Details are shown in Tamura et al. (2015).”.

(5) Move the geochemical data in the supplementary Table S1 to the main text.

(6) Please provide the original measured EPMA and LA ICP-MS data in the supplementary table.

(7) Revise the “a few mm grains” to be accurate in 3.1. Replace “were done” with “were conducted”.

(8) delete the “and high-K to shoshonitic composition subdivided by Le Maitre (1989)” in 3.2. The SSM basalt is obviously sodic.

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(9) Please rewrite 3.2 Results. The current version is too short. The elements P, Ti, Al, Ca should be mentioned. Whether it is high-Ti or low-Ti basalt? How about the CaO/Al<sub>2</sub>O<sub>3</sub> and FeO/MnO ratios (pyroxenite/peridotite source lithology)? How about the Ba/Th ratio and its implication? In the discussion timing of the SSM basaltic magmatism is in the first. So please change the order in the methods and results that move the geochronology content in the first.

(10) The conclusion is too long and just repeats the words of the maintext. Shorten to two to three sentences please.

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Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2019-116>, 2019.

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