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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Insights into the recurrent energetic eruptions on Awu, one of the deadliest volcano on earth" *by* Philipson Bani et al.

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We greatly acknowledge Dr. Caroline Bouvet de Maisonneuve (RC 2) for carefully reviewing our manuscript. Here we provide our responses to the main remarks, comments, and suggestions.

Main Questions (MQ)

MQ 1: In the introduction, please provide more information about the purpose of this study and the focal point of the manuscript.

Response: The objective of this manuscript is to highlight the intense eruptive charac-

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Discussion paper

ter of Awu volcano and provide insights into the possible mechanisms that fueled the deadly energetic eruptions. We thus adjust the title to better reflect the objective of this work. The title is changed to “Insights into the recurrent energetic eruptions that drive Awu among the deadliest volcanoes on earth”.

Did you compile all the info in Table 1? If so, it would be worth highlighting explicitly.

Response: Yes we did and now mention it in the text.

MQ 2: Why did you obtain whole-rock analyses? Was it just to know the average composition of Awu lavas (assuming that the current dome is representative), or was it needed to compute gas ratios?

Response: The bulk rock analyses are intend to provide an idea about the lava dome composition and also to provide readers with as much information as possible about this little know volcano.

MQ 3: Why did you analyse the volatile flux and gas ratios, i.e. how does it fit with the rest of the data presented here and why report it here rather than in Bani et al., submitted (what is the title and where was it submitted?)? You have to tie in these types of information a bit better to strengthen this contribution.

Response: Gas composition and emission rates provide important information about the magma source behind the observed activity. As mentioned in the text, the prevalence of H2S of SO2 and the low SO2 emission rate indicate a predominant of hydrothermal processes on Awu in the present time. The limited magmatic fluids are thus likely sustained by a degassed magma source, in accord with the low equilibrium temperature of circa 380°C. The above information indicate a continuous cooling tendency in Awu’s crater, since 2004. As for the other manuscript (Bani et al. submitted), it was submitted to GRL and focuses more specifically on the CO2-rich gas from Awu and the possible source mechanisms. In contrast, this NHESS manuscript focuses on the Awu volcano and its intense eruptive activities. We prefer to develop fully these two topics

in separate manuscripts. We now provide a full reference to the manuscript submitted to GRL.

MQ 4: The interpretation of the geochemical data is overstretched. From your 2 whole-rock analyses, you cannot conclude that the peculiar tectonic setting of Sangihe is at the origin of the recurring strong activities at Awu. There are recurring violent eruptions at other volcanoes in Indonesia or the rest of the world, which are in very different tectonic settings, and Kelud (cited in this paper as an analogue of Awu's alternating dome – explosive activity) is a good example. Please revise the interpretation, and provide more information regarding the sampling location, sample descriptions, and analytical methods.

Response: We collected only one fresh (less altered) sample directly on the lava dome, but it was analyzed in two separate laboratories, including Laboratoire Magmas et Volcans (Clermont-Ferrand) and Pôle de Spectrométrie Océan (Brest). We now mention it in the text. We agree that it is not reasonable to trace the magma source from one sample. However, here our result provides for the first time the composition for the current lava dome on Awu. Data from Morrice et al. (1983) and Hanyu et al. (2012), included in Table 2, are obtained from samples collected in 1978-80 and 1998. The locations of the samples are provided in Hanyu et al. (2012). The current lava dome was formed in 2004. It rapidly reached its current size then completely stopped from growing. We believe it was from the same lava body thus our result may be representative of the lava dome composition. The triggering mechanism of the 2014 eruption of kelud was the second crystal nucleation event (Cassidy et al., 2019). The subsequent rapid crystallization that followed, has led to over-saturation of the source melt with intense diffusion of volatiles and growth of bubbles. Unfortunately investigating the triggering mechanism is beyond the scope of our work. Thus we simply quote the common process – the injection of a new magma – as the triggering event. We now include in the manuscript other mechanisms that can trigger the eruptive activity on Awu, including the second crystal nucleation and the acidic-sulfate alteration processes. We agree

that the following sentence is not justified in this manuscript: “This particular double subduction and arc-arc collision have rendered the slab prone to melting that subsequently produces the magmatic source behind the recurrent strong eruptive activities on Awu. The mechanism also contributes to unusual slab carbon delivery into the mantle as highlighted by the extremely elevated CO2 (Bani et al. submitted).” However we still believe the geodynamic context has its role in Awu activity. The above sentence is now replaced by the following sentence: “This particular double subduction and arc-arc collision have rendered the slab prone to melting (Clor et al., 2005)that subsequently supply the magmatic source beneath Awu volcano.

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