

Dear Editor Andrea Di Muro

Manuscript **Lahar events in the last 2,000 years from Vesuvius eruptions. Part 1: Distribution and impact on densely-inhabited territory estimated from field data analysis**

Many thank for your revision which improved and clarified some points of the the manuscript. In red our answer

It follows the reply to the comments one-by-one:

I'm happy to join the reviewers in stressing the importance of the work your team has performed and the high quality of the dataset you have integrated to build a very exhaustive study of lahar processes in the Vesuvius area. The review process has permitted to effectively integrate the suggestions and remarks of the three reviewers and I consider the paper can be accepted for publication. In order to produce a final version best conveying the important messages of your paper to a broad audience, I would like to suggest you to consider here below some minor modifications and suggestions.

A rapid submission of a final version integrating these suggestions will thus permit the review process of the three companion papers to be finalized basically synchronously.

Many thanks for your consideration. We have followed the suggestions below.

Line 100: "Mobility" would imply long range transport capability, but in the sentence here it is unclear whether you are instead stressing that lahar triggering can occur also in distal areas (xx km from the summit Vesuvius crater); if this is correct, this term should be modified to express you are showing a large trigger area can be affected and not that flows have a large transport distance.

Thanks. We have clarified this point (LINES 98-102).

Line 108: unclear sentence; what does that mean "repeated lahar..episodes...stroke..its human settlements...evidencing attempts of resettlement"?

Thanks. We have clarified this sentence (LINE 110).

Line 640 “Both Acerra and Nola localities”; this is one of the many examples scattered in the whole paper and already pointed by the reviewers, where the sites are quoted but with no reference to a map, or (most important) explicit quotation of distance with respect to the volcano summit or to the location with respect to the primary deposits etc etc are reported; Reference sites are also described in detail in the appendix, but no distance is reported with respect to Vesuvius or other information able to help the reader to quickly locate the sites. This kind of sentences implies the reader has a good knowledge of the study area, but make the reading difficult for researchers knowing little about the Vesuvius area and related eruptions and request a frequent check in maps to locate the quoted sites; in order to improve the readability of the whole text, please integrate these basic information throughout the whole paper, in order to help the reader to immediately locate the quoted areas/cities (“how far from Vesuvius is a given distal area”?) and thus better follow the line of reasoning presented in the text.

Thanks. We have specified the distance between Acerra and Nola from their source areas (Somma-Vesuvius and Apennines, respectively) throughout the text.

Also, we have slightly modified all maps throughout the text in order to show the main toponyms, in particular the recurrent ones that we use for results presentation and discussion.

Fig. 17 Do the velocity values reported in the figure correspond to syn-eruptives or post-eruptive units? Do you find a correlation between deposit thickness and calculated velocity?

Thanks. The velocity and pressure values correspond both to the syn- and post-eruptive lahar units, which we have specified immediately after Fig. 16 and also before Fig. 17. This is specified now also in Fig. A1 caption (LINE 739, LINES 1025-1026).

There is no correlation between deposit thickness and calculated velocity; the correlation is between clast dimension and calculated velocity (Eq. A3).

Line 861 : please delete the brackets enclosing the temperature value.

Thanks. We have done it (LINE 885).

>>Both Pollena and 1631 distribution maps suggest that for a given location, the thickness of post eruptive lahars is larger than that of syn-eruptive; if this is correct, this information could be better stressed, discussed and interpreted, a link with grain size

could be made more explicit, if existing, and ,most important, the implications in terms of trigger processes and hazard included in the paper.

Thanks. We have double checked this point, both in the database and in Figs. 8-11, and actually the thickness of the post-eruptive lahar units is not larger than the one of the syn-eruptive units. An issue might have arisen from Fig. 9, which has the colour bar scale different from the one of Fig. 8; we can improve this in the final editing of the paper.

>>Magnetization study suggest that some units had emplacement temperatures above 100°C; the implication of that in terms of occurrence of vapour phase, sedimentary structures and transport properties should be discussed. Does that imply the fluid phase was multiphase? How is that included in the physical modelling?

Thanks. We have added the following paragraph in the discussion section to link this point on temperature with the modelling presented in the companion paper of de'Michieli Vitturi et al. (this issue):

The companion paper of de'Michieli Vitturi et al. (this issue) 3orcesi s3e salso the nexus between water temperature, flow viscosity, and their consequential impact on fluid dynamics. Specifically, when the dominance of frictional 3orcesi s attributable to the yield slope term, the initial divergence between high- and low-temperature scenarios appears negligible. However, discernible dissimilarity appears over time for the inundation area of the colder flow case (i.e., 27 °C) with respect to the warmer counterpart (i.e., 100 °C), the latter case being close to the 120 °C one reported from paleomagnetism. Remarkably, the temperature-induced variations assume a pivotal role in shaping the dynamic characteristics of the hotter flow. The diminished viscosity associated with elevated temperatures not only amplifies fluid mobility but also prompts a notable acceleration in sediment settling velocity. This, in turn, initiates a debulking mechanism, thereby intensifying overall flow mobility. Consequently, this intricate interplay contributes to a reduced footprint of deposited material from the flow, altering the spatial distribution of sediments. However, the overall impact on the inundation area is typically quite reduced, being typically less than 10-20% even considering a thickness threshold of 1 mm (see de'Michieli Vitturi et al., this issue) (LINES 888-901).

Line 222 In spite of being Sarno one of the most affected municipalities, no reference to 1998 Sarno lahar events in terms of triggering, dynamics, sources, impact areas and deposit facies is offered in this paper. As this is one of the most recent and significant (including in terms of victims) events affecting the studied area, it is surprising the lack of explicit reference and comparison in the paper.

Thanks. We have specified on this point at the end of Section 3.1 (LINES 235-243).

Looking forward receiving the final version of this important research paper.

Many thanks again.

Mauro and co-authors

Mauro Antonio Di Vittorio

