

Authors's response to editor's and reviewers' comments

Manuscript title: Eruptive history and $^{40}\text{Ar}/^{39}\text{Ar}$ geochronology of the Milos volcanic field, Greece

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Dear editor,

We are pleased with the additional suggestions of one of the reviewers, Jocelyn McPhie, and your careful revisions. We have addressed all the issues raised by Dr. McPhie and you, except for the deletion or modification of section 4.1.

The detailed point-by-point responses to the reviewers' and your comments are in this attachment below.

The reviewers' and your comments are in black, and our response is in blue.

Your sincerely,

The authors

Referee #1: Jocelyn McPhie

The manuscript is much improved. Most of the deficiencies in the interpretation of the data have been corrected.

We thank Dr. McPhie for the nice words.

However, in revising the Discussion, the authors have introduced a new topic (magma sources) that was not dealt with in the previous version, is not supported by any data presented and relies totally on analogy with another study (Popa et al., 2020). This text (section 4.3.3) should be removed from the Discussion.

We accept Dr. McPhie's argument that the new topic (magma source) in the section 4.3.3 should be removed from the Discussion, and the all sentences related to the crystallinity and vesicularity were removed.

Also, the authors retain review in the Discussion (section 4.1) that ought to be removed or else shifted to the Introduction and shortened..

As we responded to Dr. McPhie in the last round revision, the details of the $^{40}\text{Ar}/^{39}\text{Ar}$ age technique required in the paper depend on the background of the reviewers, as we have already discovered with the previous version of this manuscript. Reviewers with a volcanological/petrology/geochemical background want these sections reduced or removed, whereas reviewers with a background in $^{40}\text{Ar}/^{39}\text{Ar}$ geochronology argue that the discussion of the $^{40}\text{Ar}/^{39}\text{Ar}$ data is too limited. We have proposed a compromise that satisfies the concerns of referees from both communities by presenting the $^{40}\text{Ar}/^{39}\text{Ar}$ data in such a way that both communities are satisfied by reducing figures 5-9 and moving most of the detail in the individual step discussion of the $^{40}\text{Ar}/^{39}\text{Ar}$ results of figures 5-9 to the supplementary material. Therefore, we still keep this content in section 4.1, which explains the reasons why the eruption ages of the MVF can be better estimated by the $^{40}\text{Ar}/^{39}\text{Ar}$ data than by K-Ar data. We also should carefully consider the MSWD value when the error of each individual step age becomes very small (e.g. Schaen et al., 2020).

Finally, in the Abstract and Introduction, the authors suggest that the submarine versus setting as part of the selling point but fail to discuss this aspect further. It is not considered in the Discussion.

We have incorporated this suggestion of Dr. McPhie that added more content of the submarine settings in the Discussion (give line numbers).

Associated editor: Peter Abbott

I have looked over the revised manuscript and have some small, mainly textural, changes that I would like you to consider and implement if you agree.

We accepted all the revision from Dr. Peter Abbott, and the detailed changes can be found in the manuscript with track-changes.

Response to the specific comments of Jocelyn McPhie for texts, tables and figures.

Line number	Comment by Jocelyn McPhie	Comment by authors	New page/line
8	Deleted the “explosive”	Changed accordingly.	P1/L8
9	Deleted the “the” of “since the submarine”	Changed accordingly.	P1/L10
13	Deleted “nowadays”	Changed accordingly.	P1/L13
16	Suggested a hyphen between the “long” and “term”	Changed accordingly.	P1/L16
17	Fix the unit of “km ³ .yr ⁻¹ ” as “km ³ .yr ⁻¹ ” everywhere	Changed accordingly everywhere.	P1-P17
19-21	Deleted the last sentence of the Abstract, indicated with “magma chamber locations are outside the scope of the data presented; this topic should be omitted”	Agree. We removed it from our manuscript.	P1/L19-21
30	Highlighted the hyphen between “growth” and “rate”	We deleted the hyphen.	P1/L30
35	Deleted the “the” in the front of “chronostratigraphic”	Changed accordingly.	P1/L35
46	Deleted the “the” and “VF”, before and after the “Milos”	Changed accordingly.	P2/L46
49	Replaced the “with” with “which has” and deleted the “for the main island”	Changed accordingly.	P2/L49
56	Deleted the “, that is”	Changed accordingly.	P2/L56
57	Pointed out a comma missing in the “Alfieri et al. 2013”	Changed accordingly.	P2/L57
60	Replaced the “lithic blocks” with “clasts”	Changed accordingly.	P2/L60
63	Highlighted the “green lahar unit” with indications of “should explain what this unit is; should have upper case”	Corrected as “phreatic eruption products called “green lahar” by Fytikas, 1977,” We kept the lower case of “green lahar” to be consistent with the original name of Fytikas (1977).	P2/L63-64
68	Deleted the “a”	Changed accordingly.	P2/L68
70	Deleted the “rock”	Changed accordingly.	P2/L70
111	Gave a comment containing “een lahar” and “ee”	We do not know what the comment means.	P2/L111
121	Replaced the “described” with “referred to” and highlighted the “green lahar”	Changed accordingly and the “green lahar” has been explained at line 63-64 of page 2.	P3/L121
143	Highlighted “fresh juvenile pyroclastic material” with comments of “clarify - do you mean juvenile clasts such as pumice clasts from pyroclastic deposits? or do you mean lithified/welded pyroclastic deposits?”	Changed as “fresh pumice clasts”	P4/L143

200-202	Highlighted “estimations of crystallinity and vesicularity on the older samples (>1.0 Ma) of Milos VF are all from lava and domes. The younger samples (<1.0 Ma) are from pumiceous pyroclastic units. The other old pumices of the Profitis Ilias and Filakopi volcanoes are not included in this study” with comments of “how did you determine crystallinity of pumiceous samples? Did you correct for the volume occupied by vesicles?” and “The data are therefore not representative and cannot be used to detect trends”	To avoid the issues pointed out by referee McPhie, we removed all texts related to crystallinity and vesicularity and removed the data from Figure 11.	P5-6/L199-205
206-207	Highlighted “We converted these volumes to Dense Rock Equivalent (DRE) based on the magma type of different deposits” with a comment of “Conversion to DRE volumes is required ONLY for non-welded pyroclastic deposits. You need to distinguish between the non-welded pyroclastic units and lavas/domes/welded pyroclastic units.”	The pyroclastic deposits contain pumice clasts, which are non-welded. Therefore, the conversion to DRE is necessary for the Milos’s pyroclastic deposits. Between line 214-217, we indicated that the lava volumes from four domes were not converted to DRE.	P6/L207-208 and L214-217
213-214	Highlighted the “and DRE volumes are converted to include vesicularity” with a comment of “this makes no sense. DRE converts vesicular to non-vesicular - why would you then convert DRE to include vesicularity?”	This sentence has been removed.	P6/L214-215
236	Changed the “steps experiments of groundmass” to “step experiments on groundmass”	Changed accordingly.	P6/L237
241	Changed the “steps experiments of groundmass” to “step experiments on groundmass”	Changed accordingly.	P6/L242
247	Changed the “of this sample” to “on this sample”	Changed accordingly.	P7/L248
251	Pointed out a missing word behind “plateau”	Added the “ages” behind “plateau”	P7/L252
266	Changed the “with ages increasing” to “and ages increase”	Changed accordingly.	P7/L267
267	Pointed out a missing comma behind “~3.2 Ma”	Changed accordingly.	P7/L268
277	Changed the “with a decreasing age” to “and show a decreasing age”	Changed accordingly.	P7/L278
285	Deleted the “a solid in-situ”	Changed accordingly.	P8/L286
287	Replaced the “with” with “for”	Changed accordingly.	P8/L288
295	Changed the “-24” to “G15M0024”	Changed accordingly.	P8/L296
303	Changed the “35” to “G15M0035”	Changed accordingly.	P8/L304
315	Changed the “of its biotite” to “on its biotite”	Changed accordingly.	P8/L317
334	Changed the “of biotite” to “on biotite”	Changed accordingly.	P9/L336
362	Changed the “of biotite” to “on biotite”	Changed accordingly.	P9/L364
382	Changed the “Variations of rock texture and eruption volume with ages” to “Variations of eruption volume with age”	Changed accordingly.	P10/L384
383-388	I think this should be entirely omitted; your data are so biased to young units that it is impossible to detect reliable trends.	Changed accordingly.	P10/L385-390

388-390	should integrate information on submarine versus subaerial setting data here - was the 85% before ~1.48 Ma all submarine?	Changed accordingly.	P10/ L393-398
396-431	This review should be greatly shortened and shifted to the Introduction. Review that does not relate to the data presented (only the technique) should not be in the Discussion.	See the response above this table.	P11/ L404-439
432	Changed the “Figure 13” to “Figure 12”	Changed accordingly.	P11/L440
434	Changed the “that” to “and”	Changed accordingly.	P11/L442
442	Changed the “Figure 13” to “Figure 12”	Changed accordingly.	P12/L450
458	Changed the “Figure 14B” to “Figure 13B”	Changed accordingly.	P12/L466
462	Changed the “Figure 13” to “Figure 12”	Changed accordingly.	P12/L470
465-466	Changed the “they intrude” to “the dyke intruded”	Changed accordingly.	P12/ L474-475
470	Changed the “This has three reasons” to “For three reasons:”	Changed as “This was due to three reasons:”.	P12/L479
483	Pointed out a missing word between “pumice” and “from” and changed the “eastward” to “east”	Changed accordingly.	P13/L492
490	Deleted the “stratigraphic interpretation of the Milos VF based on our”	Changed accordingly.	P13/L499
491	Changed the “ages” to “age data”	Changed accordingly.	P13/L500
516	Deleted the period behind “output”	Changed accordingly.	P13/L525
519	Changed the “volcanic material was” to “the volcanic products were”	Changed accordingly.	P13/ L527-528
519-520	Highlighted the “Given the large errors on these estimates, we only considered the rough difference in density between extruded magma and the calculated DRE values.” With a question mark.	Removed this sentence from our manuscript.	P13/ L528-529
520-521	already said this at 48-49	Deleted the repeated sentence.	P13-14/ L529-530
523	Deleted the “likely”	Changed accordingly.	P14/L532
524	Changed the “throughout the Milos volcanic activity of” to “from”	Changed accordingly.	P14/L533
525	Highlighted the “the average output rate of the Milos VF over the last 3.3 Ma” with a comment of “give what this average rate is”	Changed as “the average output rate (Q_e average= $1.0 \times 10^{-5} \text{ km}^3 \cdot \text{yr}^{-1}$) of the Milos VF over the last 3.3 Ma”	P14/ L534-535
528	Changed the “frist” to “oldest”	Changed accordingly.	P14/L537
529-530	Changed the “These first units have been deposited in the SW of Milos” to “These first units were deposited in the southwest of Milos” Changed the “(see above) thst were mapped as large pumiceous deposits of the basal pyroclastic series by” to “and include the BPS of”	Changed accordingly.	P14/ L538-539
530	Changed the “dome facies by Stewart” to “dome facies of Stewart”	Changed accordingly.	P14/L540
531	Indicated a space missing between “120” and “m”	Changed accordingly.	P14/L540
533	Replaced the “since” with “from”, and “from” with “for”	Changed accordingly.	P14/ L542-543

534	Changed the “reliable” to “reliably”	Changed accordingly.	P14/L544
535	Changed the “dikes (2.66 Ma, sample G15M0016) into the older basal pyroclastic series” to “dykes (2.66 Ma, sample G15M0016) into the BPS”	Changed accordingly.	P14/ L544-545
536	Changed the “SW” to “southwest”	Changed accordingly.	P14/L546
536	Pointed out the “this” with a comment of “this what”	Changed as “These cryptodomes and dykes were”	P14/L546
539	Changed the “SW” to “southwest”	Changed accordingly.	P14/L549
541	Say whether this period was submarine or subaerial	Changed as “During the submarine Period I,”	P14/L551
543	Deleted the “of Figure 11” and indicated that put the “Figure 11” at the end of this sentence.	Changed accordingly.	P14/L553
544	Fix the unit of “ $\text{km}^3\cdot\text{yr}^{-1}$ ” as “ $\text{km}^3\cdot\text{yr}^{-1}$ ”. Changed the “starts” to “began”.	Changed accordingly.	P14/L554
545	Replaced the “is” with “was”	Changed accordingly.	P14/L556
551	Deleted the “see”	Changed accordingly.	P14/L561
552	Changed the “consists” to “consist”	Changed accordingly.	P14/L562
555-556	Deleted the entire sentence	Changed accordingly.	P14/ L565-566
567	Changed the “starts” to “began”.	Changed accordingly.	P14/L567
568	Changed the “starts” to “began”.	Changed accordingly.	P15/L578
570	Deleted the “of material”	Changed accordingly.	P15/L580
576-577	Deleted the “composed”, and deleted the “The tuff ring of Fyriplaka was divided into three members, with on top the deposits of the Tsigrado tuff cone.”	Changed accordingly.	P15/ L586-587
579	Changed the “this was also noted by Fytikas et al (1986)” to “as noted by Fytikas et al. (1986)”	Changed accordingly.	P15/L589
580	Replaced the “with” with “by”	Changed accordingly.	P15/L590
585	Highlighted the “(Principe et al., 2002)” with a comment of “not in reference list”	This reference has been updated.	P15/L595
588	Fixed the “predominately” as “predominantly”	Changed accordingly.	P15/L598
590	Deleted the “plumbing system of the Milos VF.”, and indicated that put something else behind the “Temporal evolution of the magma”	Changed as “Temporal evolution of the magma flux and composition”	P15/L600
591	Deleted the “several of the”.	Changed accordingly, and deleted the “petrographic and”.	P15/L601
592	Highlighted the “chemistry of the magmas did not change significantly between the three different periods” with a comment of “This statement (592) contradicts 594-595 - clearly SiO ₂ varied widely”	Changed as “The volcanic units of Period III are dominantly rhyolitic in composition, whereas during Period I and II the compositions of volcanic units range between basaltic-andesite to rhyolite. However, the K ₂ O/SiO ₂ ratio is constant (0.05 ± 0.02) over the 3.3 Ma evolution of the Milos VF, with one exception, sample G15M0021 collected near Cape Vani which is altered by hydrothermal processes (e.g. Alfieris et al. 2013).”	P15/ L602-607

595-596	this sentence makes no sense. Worldwide, there are many examples of crystal-rich pumice - Toba, Fish Canyon Tuff, Bandelier Ignimbrites etc etc	Deleted the all text related to crystallinity and vesicularity.	P15/ L607-610
598-599	Your data set is incomplete so this statement is unwarranted. Also, you have not said whether crystallinity of pumiceous products have been corrected for vesicularity	Deleted the all text related to crystallinity and vesicularity.	P15/ L610-613
602-619	Text 605 - 612 should be omitted - (1) your data set is incomplete and (2) none of your samples have high (~50modal%) crystallinity this paper, Popa et al., 2020, is not in reference list. correct only where crystallinity is very high - approaching 50 modal%	Deleted the all text related to crystallinity and vesicularity.	P15-P16/ L615-632
620-636	Fix the unit of “km ³ .yr ⁻¹ ” as “km ³ ·yr ⁻¹ ”.	Changed accordingly.	P16/ L633-651
621-622	Deleted the “with a range of 8×10 ⁻⁶ – 9×10 ⁻² km ³ .yr ⁻¹ ” with a comment of “makes no sense”.	Deleted it accordingly.	P16/ L634-635
622-624	Deleted the sentence.	We kept the “No data are available for the ratio between intruded magma in the crust below Milos and extruded volcanics (I:E).” to estimated the magma flux underneath the Milos VF based on the White et al. (2006).	P16/ L635-637
626-627	Deleted the “Compared with other SAVA volcanic centres,”	Changed accordingly.	P16/L640
627-636	this text is very hard to follow. I have tried to fix it up.	We clarified the text, with the suggestions of referee McPhie.	P16/ L640-651
646-651	Deleted the entire sentences related to crystallinity, vesicularity and magma sources of the Milos VF.	Changed accordingly, and replaced the “The evolution of the Milos VF volcanic rocks changed over time in composition from basaltic- andesite-rhyolite volcanism to mainly rhyolite.” With “Period I and II are characterised by andesitic to rhyolitic lavas and pyroclastic units, whereas those of Period III are dominantly rhyolitic. The K ₂ O/SiO ₂ ratio is constant over the 3.3 Ma history of the Milos VF.”	P17/ L666-669
653	Deleted the “2-3” with a pointing for replacement.	Changed as “two-three”	P17/L670
Table 4	add information on the unit the sample belongs to	Changed accordingly.	Table 4
Fig. 11	The only data you can rely on are the ages and the compositions. Delete the crystallinity and vesicularity plots entirely	Changed accordingly, including the figure caption.	Fig. 11
Fig. 13	Changed the “Figure 14” to “Figure 13”	Changed accordingly.	Fig. 13
Fig. 14	Changed the “constraint” to “constrained”. Left a comment of “what do open symbols mean?” in the caption of Figure 14.	Changed accordingly.	Fig. 14

Response to the specific comments of Peter Abbott for text and tables.

Line number	Comment by Peter Abbott	Comment by authors	New page/line
7	Changed the “to determine” to “for determining”	Changed accordingly.	P1/L7
8	Changed the “to establish” to “for establishing”	Changed accordingly.	P1/L8
9	Deleted the “the” in “the submarine”	Changed accordingly.	P1/L10
12	Pointing a word missing between “has” and “emerged”.	Added the “been” in between.	P1/L13
13	Deleted the “nowadays”	Changed accordingly.	P1/L13
51	Pointing a word missing between “and” and “subsequent publications”, and changed the “by Fytikas (Fytikas, 1989; Fytikas et al., 1986) to “of Fytikas (1989) and Fytikas et al. (1986)	Changed accordingly.	P2/L51-52
52	Changed the “(Stewart and McPhie, 2003, 2006)” to “(2003, 2006)	Changed accordingly.	P2/L53
55	Deleted the “that has been”	Changed accordingly.	P2/L55
66	Typo “uncomformable”	Changed to “uncomformably”	P2/L66
73-74	You switch between Myrs and Ma, should this not be consistent throughout the manuscript?	All the “Myrs” has been changed to “Ma” in the manuscript.	P2/L73-74
93	Changed the “is” to “are”	Changed accordingly.	P3/L93
96	Pointed the wrong unit	Changed as “km ² ”	P3/L96
115-116	Pointed a comma missing	Changed accordingly.	P3/L115-116
144	Changed the “in” to “into”.	Changed accordingly.	P4/L144
151	Typo “Magnet”	Changed as “Magnetic”.	P4/L151
158	Deleted the “respectively”, and suggested that put the “respectively” to the behind of “7 and 1 hours”	Changed accordingly.	P4/L158
158-159	Highlighted the “CLICIT facility of the OSU TRIGA reactor.” with a comment of “Expand acronyms”	Changed as “Cadmium-Lined in-Core Irradiation Tube (CLICIT) facility of the Oregon State University Training Research, Isotopes, General Atomics (TRIGA) reactor.”	P4/L159-160
173	Highlighted the “Ohm” with a comment of “use symbol”.	Changed as “Ω”.	P5/L174
179	Highlighted the “298.56” with a comment of “include units. Or if it is a ratio make that clearer”.	Changed as “The ⁴⁰ Ar/ ³⁹ Ar atmospheric air value of 298.56”.	P5/L180
188	Deleted the repeated “in”.	Changed accordingly.	P5/L189
209	Changed the “(Croweller et al., 2012)” to “Croweller et al. (2012)”	Changed accordingly.	P6/L210
236	Changed the “steps” to “step”	Changed accordingly.	P6/L237
240	Highlighted the “because of the least scatter in this experiment” with a comment of “This dosen’t make sense so please rephrase”	Changed as “because its MSWD value is the only one smaller than 2.5 in this experiment”.	P6/L241
241	Changed the “steps” to “step”	Changed accordingly.	P6/L242
261	Pointed some missing words.	Changed as “the ⁴⁰ Ar/ ³⁹ Ar result from our sample and the K-Ar age data”	P7/L262
295	Deleted the “of the”.	Changed accordingly.	P8/L296

304	Pointed a missing word.	Added the “the age of” in.	P8/L305-306
384	Pointed a missing word, and changed the “of” to “for”.	Deleted.	P10/L386
389	Replaced the “During” with “Between”.	Deleted.	P10/L391
429	Pointed a miss “s” of “need”.	Changed accordingly.	P11/L437
462	Deleted the “ed” of the “considered”	Changed accordingly.	P12/L470
463	Changed the “is” to “as”.	Changed accordingly.	P12/L471
470	Changed the “has” to “was due to”.	Changed accordingly.	P12/L479
487	Changed the “that” to “from which”.	Changed accordingly.	P13/L496
534	Typo “reliable”.	Changed as “reliably”.	P14/L544
544	Deleted “the”.	Changed accordingly.	P14/L554
547	Changed the “We are not successful to” to the “We did not successfully”	Changed accordingly.	P14/L558
550	Changed the “a submarine setting” to the “submarine settings”	Changed accordingly.	P14/L561
566	Deleted the “,”, and added a “the”.	Changed accordingly.	P15/L576
Table 1	Instead of using the referring to the original references here using the superscripts, please add them in a separate column.	Changed accordingly.	Table 1