

Anonymous reviewer:

My main comment remains, that is the limited pool of poems used to question the "relationship between humanity and volcanoes" (since XIXe century). In order to address this comment, I suggest that

1. either you include more poems in your study
2. or that you repeat in your "Conclusions" section -as you already did for the language- the limitations in terms of representativity related to the limited number of poems/poets considered and the poets' gender (as highlighted during the review process), as well as the assumption that the poets reflects their social environment

Option 1 cannot be pursued, because as we explained in the methodology section our selection of poems represents all poems that could be found that match our criteria. We therefore revised our conclusions session to include the study limitations and assumptions

David Pyle:

The authors have not fully taken on board the depth or breadth of the points raised by two of the reviewers, and this version of this paper doesn't fully explain to the reader the preliminary nature of the analysis and its potential limitations. Being upfront about these limitations will only strengthen the paper - as it will help to point the way to future work.

We agree that being upfront about the limitations of the study will only strengthen the paper, and we have now been even more explicit and detailed than before – please see answers to detailed comments below. However, the analysis presented in this paper is not preliminary: much future work can stem from it, but it will have a different focus (e.g. consider different languages, the poets' scientific knowledge, etc.), as opposed to expanding on the same research question.

Additionally, we have reframed the RQ as: “what does poetry written about volcanoes reveal about the relationship between volcanoes and the societies and times represented by poets who wrote about them?”

Two key points:

- the sample size of poems analysed really is still too small for any meaningful 'quantitative' analysis [it really is not quantitative]; and many 'decades' are exemplified by one poem, or fewer. *As explained in the methodology section, the sample size of poems analyzed reflects all of the poems that are available and that match our criteria. We did indeed perform a quantitative (as opposed to qualitative) analyses of the poems in part of the work. However, the reviewer's point made us understand the need to explicitly mention that although it is quantitative, our analysis is not statistically significant, and that for this to be the case a larger dataset would indeed be needed. This information is included on page 18, lines 37-38: “Due to the limited sample size (n=34), this quantitative analysis cannot be considered statistically significant.”*

- the absence of any discussion of the way the cultural, social, political.. backdrop to the poems has also changed through time is a severe limitation; has writing about nature also changed over the same timescale? And what might be the effect (on the time progression) of having 19thC authors who are privileged northern-European men (like Lord Byron), and late 20thC authors who include women who live in volcanic countries?

We agree that this is indeed a limitation, and we have now clearly mentioned this fact on page 23, lines 6-12:

“It is also worth noting that throughout the 220 years considered in this study, the cultural, social, and political backdrop of the poems has changed significantly. For example, colonialism has the potential of having significantly affected the representation of cultural elements in poetry. Whereas a detailed analyses of how these changes affected the content and tone of the poems is beyond the scope of this work, future studies focussing on this aspect would certainly be valuable.”

Analyzing the evolution in time of backdrop to the poems' detail would require too much background, i.e. European history over two centuries, which is beyond the scope of this paper. This would however be very a very interesting topic for a dissertation or future study. The fact that gender representation is not equitable was already mentioned (page 6, lines 32-34). We have now reinforced this limitation on page 23 lines 3-5, where we have also added that it changes throughout our sample with time:

“Additionally, the majority of poems considered were authored by male poets, due to the scarcity of poems about volcanoes written by female poets, especially for the 19th Century.”

Furthermore, our dataset does not provide any indication that the evolving gender balance of the poets may affect either the connotations (Fig. 1) or themes (Fig. 2) of the poems. Finally, we already mentioned that analyses of the direct experience of volcanoes will be covered in further studies on page 23, lines 14-17:

“In addition to future studies considering a wider variety of languages and cultures, such work might also consider how different attitudes towards human-volcano interactions are captured by those poets who have physically encountered a volcano versus those who are relying on second-hand testimony.”

Editor

Their main points can be summarised as follows:

1. There are not enough sample poems in the analysis
2. The implications from the analysis are too large

One cannot extrapolate from 34 poems over 200 years to the perceptions of all humanity. Just because the poets are “part” of humanity does not mean that they “represent” humanity. You write in the article that the poets are “representatives of the society and cultures they live in”. All that remains is that you frame the analysis and discussion accordingly. You need to remove any statements that indicate that these poems represent humanity as a whole, and tone down the implications of the study.

We have reframed the study around the feelings of the societies (and times) the poets represent. The rephrased research question now reads: “what does poetry written about volcanoes reveal about the relationship between volcanoes and the societies and times represented by poets who wrote about them?”

My other worry also stems from Prof. Pyle’s comments, that there is an absence of “any discussion of the way the cultural, social, political.. backdrop to the poems has also changed through time is a severe limitation”. This issue has also been referred to by referee #3. I have knowledge about how Hawaiian culture considers the volcanoes and thereby their goddess Pele. There are several cultures and power dynamics influencing what a single poet would write about when it comes to the volcanoes and the goddess Pele. Only an analysis of many poems, from many different authors, would be able to illustrate how humanity in Hawaii perceives volcanoes. You don’t need to go into a deep analysis of these issues as they will be numerous the world over. However, you need to be aware of them and mention them. You also need to change your language so that you are aligned with these issues. Again, it’s impossible to extrapolate from one poem mentioning Pele to how all “humanity” in Hawaii perceives the volcanoes.

We have now addressed that on Page 23, lines 6-12.

In addition (and with the Hawaiian example in mind), I believe it is a stretch to make the conclusion that “the relationship between humanity and volcanoes is unidirectional and focused on identity”, “with humans ultimately of neither benefit nor concern to the volcanoes that they write about”. In traditional Hawaiian culture, Pele (the volcano), gives so much to the people, and she is recognised in traditional song and dance. This does not strike me as unidirectional. The poems may indicate a unidirectional relationship, but hopefully this exemplifies that that does not reflect the perception of all of humanity in Hawaii. I am not expecting you to go into a deep analysis of the cultural power dynamics here. However, you have to be aware that volcanoes have huge cultural significance in some indigenous cultures. And as soon as this occurs, then it is almost impossible to avoid a discussion on (or at least mention of) colonialism.

We now mention this on page 2-221, lines 43-2.

In short, you need to emphasise that the poems are a product of the society and culture the poets are a part of. You therefore need to reframe your research question and implications accordingly

This has now been done, please see answer to RQ reframing suggestion above.

One final point from myself is that you state that “the results might better inform our communication with communities living nearby active volcanoes”. Without concrete ideas about how this might happen, then I would ask you to remove this from the text. With only 34 poems in your sample, extrapolating the results to general communication strategies could actually be damaging, as the situation in Hawaii hopefully illustrates. But on the (very!) positive side, your methodology could be an integral part in a deeper analysis with a local or regional community to develop communication strategies.

We simply meant that taking into account the local communities’ views of the volcanoes, as captured by poetry, is an important point to consider. We understand the Editor’s concern about the original wording, and we have rephrased as suggested.

Major changes

By addressing all of the concerns of the reviewers, the main change in this version of the manuscript is that we have rephrased the research question as:

“what does poetry written about volcanoes reveal about the relationship between volcanoes and the societies and times represented by the poets who wrote about them?”

This better reflects the limitations of the study, and fully takes on board the reviewers' and editor's comments. We have consequently reframed the study's implications.

**1In my remembered country: what poetry tells
2us about the changing perceptions of
3volcanoes between the XIX and XXI centuries**

4

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13

14Abstract

15

16In this study we investigate what poetry written about volcanoes from 1800 to the
17present day reveals about the relationship between [volcanoes and humanity-the](#)
18[societies and times represented by the poets who wrote about themand volcanoes](#),
19including how it evolved over that time frame. In order to address this research
20question, we conducted a qualitative content analysis of a selection of 34 English-
21language poems written about the human-volcano interactions. Firstly, we identified
22the overall connotation of each poem. Then, we recognized specific emerging
23themes and grouped them in categories. Additionally, we performed a quantitative
24analysis of the frequency with which each category occurs throughout the decades
25of the dataset. This analysis reveals that a spiritual element is often present in poetry
26about volcanoes, transcending both the creative and destructive power that they
27exert. Furthermore, the human-volcano relationship is especially centred around the
28sense of identity that volcanoes provide to humans, which may follow from both
29positive and negative events. These results highlight the suitability of poetry as a
30means to explore the human perception of geologic phenomena. Additionally, our
31findings may be relevant to the definition of culturally appropriate communication
32strategies with communities living nearby active volcanoes.

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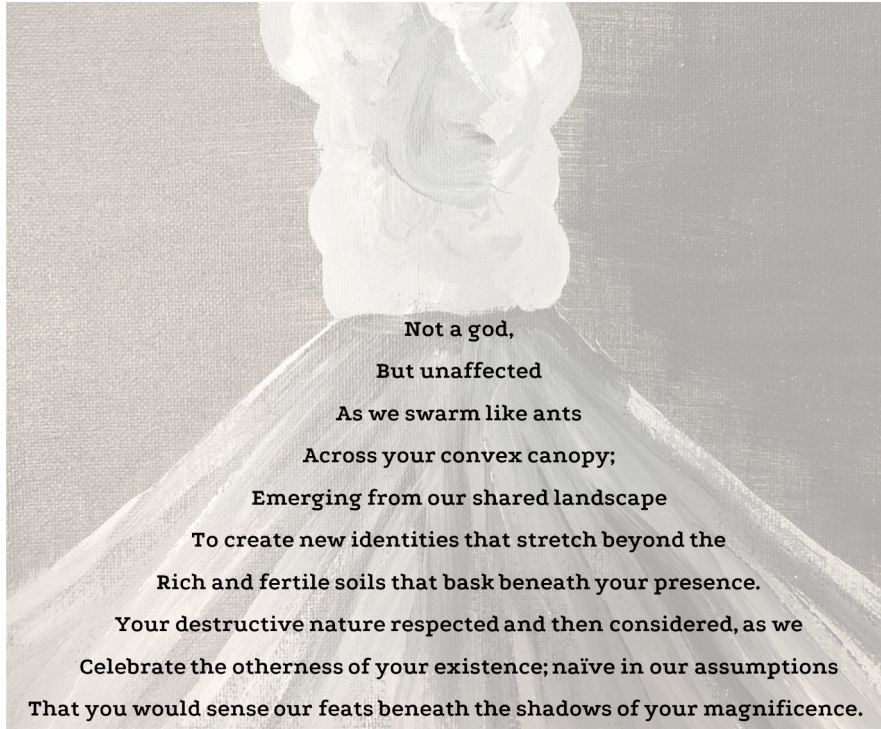
35

36Graphical Abstract

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39



Not a god,
But unaffected
As we swarm like ants
Across your convex canopy;
Emerging from our shared landscape
To create new identities that stretch beyond the
Rich and fertile soils that bask beneath your presence.
Your destructive nature respected and then considered, as we
Celebrate the otherness of your existence; naïve in our assumptions
That you would sense our feats beneath the shadows of your magnificence.

411. Introduction

42

43We live on a geologically active planet, and volcanoes are one of the most visually
44impressive geological features of our world. Whereas most geologic phenomena
45(e.g. orogeny, erosion) occur slowly over a timescale of millions of years, being *de*
46*facto* invisible to us humans, volcanic activity is a fast process that can radically
47change the natural landscape within a matter of hours, directly affecting the nearby
48communities. There are 150 active volcanoes in the world, and at any given time,
49about 20 of them are erupting (Durant et al., 2010;Venzke, 2013). The range of
50volcanic activity is broad (effusive to explosive), and so is the spectrum of feelings
51they inspire (from awe to fear). Certainly, they do not leave us indifferent (see e.g.
52Esperanza et al., 2008)

53

54The areal impact footprint of eruptions depends on their Volcano Explosivity Index
55(VEI). In past times, only large eruptions affecting people (i.e. occurring in inhabited
56areas) would have been reported and become known worldwide. Large eruptions
57(VEI>4) statistically occur every few years, and have footprints of tens of kilometres
58(Brown et al., 2015). Small eruptions (VEI<4) can also significantly affect local
59population, but before the development of modern means of communication their
60occurrence would have frequently gone unreported beyond national boundaries. At
61the beginning of the 19th century there were 10 million people worldwide living within
62100 km of volcanoes that have erupted during the Holocene (Siebert et al., 2011);
63nowadays, that number has increased to 800 million.

64

65Volcanoes constitute a fundamental part of the Earth system, recycling elements
66from the mantle to the surface and the atmosphere. But cohabiting with them comes
67with a unique set of challenges and rewards for local communities. Understanding
68how people perceive volcanoes is fundamental in shaping effective scientific
69communication strategies, including in times of crises (see e.g. Nave et al.,
702016;Donovan et al., 2018;Avvisati et al., 2019). These perceptions may in turn be
71affected by a variety of factors, including: scientific knowledge, spiritual beliefs, oral
72history, and personal experience (direct or indirect), which vary widely in space and
73time across different cultures and historical periods.

74

75Monitoring people's perception of volcanoes is difficult. Psychologists sometimes
76work with local communities in the aftermath of eruptions (Paton et al., 2000;Sword-
77Daniels et al., 2018;Paton, 2019), yet these works mainly focus on a very small,
78specific part of the human-volcano interaction (i.e. the instances in which volcanic
79activity conflicts with human life), and therefore paint a partial, skewed view of this
80relationship. Additionally, these interventions have only become common practice in
81recent times, and therefore cannot shed light on the evolution of the relationship
82between humans and volcanoes over time

83

84A potential medium through which a more nuanced and expansive dataset of this
85relationship can be established is the arts. The arts might be thought of as ubiquitous
86expressions of human nature, and have often been inspired by volcanoes, with
87notable examples including paintings by Turner (Daly, 2011), Warhol (Sigurdsson,
882015), and Munch (Olson et al., 2007). We can conceivably use art pieces to guide
89us in our understanding of how volcano-human relations have changed through time
90(Hamilton, 2013;Alexander, 2016) For example, previous research has shown how
91the colours of sunsets painted by famous artists can be used to estimate
92stratospheric particulate concentrations in the Earth's past atmosphere, revealing
93that ash and gas released during major volcanic eruptions enhanced sunlight
94scattering, making sunsets appear redder, as reflected by the paintings that were
95produced in the aftermaths of such events (Zerefos et al., 2014). Similarly, studies
96have been conducted which have: dated volcanic eruptions through Neolithic cave
97paintings (Schmitt et al., 2014), investigated the extent to which artists have used
98volcanoes to represent societal upheaval and transformation (Sivard, 2011), and
99even demonstrated how drawing volcanoes can be used to empower children in
100informal learning environments (Weier, 2004). These examples concern mainly
101drawings and paintings, aside from which there has been a relative paucity in
102research that investigates how the arts might be used to shed light on changing
103perceptions of volcanoes, and how this information can be directly useful in the
104communication of volcanic hazards and risk in the modern era.

105

106In this study, we begin to address this gap in the literature by choosing to focus on
107another form of art: poetry. While attempts to define what is and what is not poetry
108can be contentious (see e.g. Ribeiro, 2007), here we take poetry to be any written
109form that is composed by the line. We consider prose to be differentiated from
110poetry, in that prose is instead composed by sentences and is written with standard
111grammatical structure. This line-by-line composition of poetry means that it is able to
112convey meaning in a concise manner, which in turn lends itself to analysis and
113interpretation. Poetry provides a powerful medium through which to interpret human
114behaviours and perceptions, and an analysis of poetry as data has been used to
115provide understanding on topics ranging from living with HIV (Poindexter, 2002) and
116dementia (Zeilig, 2014), to attitudes relating to environmental change (Illingworth and
117Jack, 2018) and compassion fatigue in nurses (Jack and Illingworth, 2017). In this
118study, we aim to build on this research, using poetry as a medium through which to
119investigate perceptions of human-volcano interactions. Donovan et al. (2011) and
120Skinner (2011) have also used poetry to gain insight on the human perception of a
121specific, erupting volcano (Montserrat). Instead, we aim to conduct a wider study.

122

123By conducting a detailed qualitative content analysis for a selection of volcano
124poetry, this study aims to understand how poets have interpreted the relationship
125between humans and volcanoes from the beginning of the nineteenth century to the
126modern day. In Section 2, we discuss the methodology that was utilised in this study,
127outlining why this approach was adopted and establishing its validity and reliability.

128Section 3 contains a discussion of how categories and themes emerged from our
129analysis, and how this relates to the research question defined in Section 2. Finally,
130Section 4 contains the conclusions of this study, along with future directions for
131further research.

132

133**2. Methodology**

134

135The methodology that we have adopted in this study involved treating poetry as data,
136allowing for text to be analysed with respect to attitudes relating to volcanoes. While
137several other methods exist for the analysis of textual data (e.g. ethnography,
138phenomenology, grounded theory, etc.), we have chosen qualitative content analysis
139because of its ability to highlight both the context and the content of the chosen text,
140which for a subjective medium such as poetry is essential.

141The methodology that is adopted in this study largely follows that of Illingworth
142(2019), insofar as the qualitative content analysis of the poetry is guided by these six
143steps: formulation of research questions; selection of poetry to be analysed;
144definition of codes and categories to be applied; outline and implementation of
145coding process; determination of trustworthiness; and analysis of results. The first
146five of these steps are outlined below, with the analysis of the results presented in
147Section 3.

148

149We note here that the poems that were analysed in this study are presented
150according to the following format: 'Poem Name' by Author Name (Year of
151Publication), and that links to the full texts of all these poems can be found in Soldati
152and Illingworth (2019).

153

154**2.1 Formulation of research question**

155

156By performing a qualitative content analysis on poetry that has been written about
157volcanoes, but critically not for the purpose of research, this study aims to better
158understand the way in which poets, as representatives of society and culture they
159live in, have interpreted the relationship between humans and volcanoes (both active
160and not). For the purposes of this study, this has been formulated into the following
161Research Question (RQ):

162

163RQ: what does poetry written about volcanoes reveal about the relationship between
164humanity and volcanoes and the societies and times represented by the poets who
165wrote about them?

166

167**2.2 Selection of poetry to be analysed**

168

169We began by selecting poetry that mentioned or featured volcanoes in some
170capacity. In doing so we set ourselves three constraints. Firstly, the poetry must be

171written in English, or else have an author-sanctioned English translation; this
172constraint was because English is the only common language that is shared by the
173authors of this study. Secondly, the poems must have been written from 1800
174onwards; this constraint was introduced to make the list more manageable for
175analysis purposes, and because this was when many consider volcanology to have
176first been fully established as a scientific discipline through the research of Ben
177Franklin, James Hutton, Alexander von Humboldt, and others (Sigurdsson, 2000).
178Finally, where possible, we aimed to find at least one poem per decade, in order to
179try and better capture any change in attitudes from the early nineteenth century to
180the present day. Given these constraints, we looked for poetry that mentioned the
181word 'volcano' or 'volcanoes' and which, in the first instance, came from recognised
182poets and/or well-established poetry journals, in the following three databases:
183Poetry Foundation, Poetry Society, and Poetry Archive. Additionally, we reached out
184to the volcanology research community through the volcanology listserv
185(volcano@lists.asu.edu) asking for further suggestions. Finally, we performed a
186manual Google search to fill in decade gaps.

187

188At this stage, we had a list of 53 poems, spanning every decade from the 1800s to
189the 2010s. The two authors then independently read these poems and filtered them
190according to two further criteria: only poems that were 100 lines or less were to be
191considered, and any poet could only have one of their poems considered for further
192analysis. The line limit was introduced in order to make the analysis more
193manageable, and a limit of one poem per poet was introduced to allow for a wider
194selection of voices to be considered, and also to improve the validity of the approach
195in terms of the triangulation of data (see Section 2.5). In instances where there were
196multiple poems from a single poet, we agreed upon the one that we both found to be
197the most aesthetically pleasing, prior to any formalised content analysis. Poems that
198were removed because of length included 'The last days of Herculaneum' by Edwin
199Atherstone (which is over 500 lines long), while poets with more than one poem
200included Emily Dickinson (six poems, for whom 'I have never seen "Volcanoes"' was
201chosen) and PB Shelley (two poems, for whom 'The Cloud' was chosen). Following
202the application of this further selection criteria, 41 poems remained available for
203analysis. Of those, seven were written by women. The higher representation of male
204poets is merely due to the higher number of male poets who wrote about volcanoes
205over the considered time span.

206

207~~At this stage, both~~Both authors ~~then~~ independently read each of the poems and
208categorised them as being either 'Positive', 'Negative', 'Positive & Negative',
209'Neutral', or 'Invalid' in their portrayal of volcanoes from a human perspective (in line
210with RQ), the results of which can be seen in Table 1.

211

212Performing this analysis enabled each of the authors to better familiarise themselves
213with the poetry, and also highlighted any further poems that needed to be removed
214from the study, because they were 'Invalid', i.e. those poems that did not concern the

215relationship between volcanoes and humanity. Following this individual analysis (the
216rows corresponding to 'AS' and 'SI' in Table 1), the two authors met up to exchange
217their analyses and agree upon a broad classification of the poems in terms of
218connotation ('Both' in Table 1). This broad categorisation was useful for three
219reasons. Firstly, it revealed several differences in how the poems had been
220individually categorised, highlighting how these differences could be discussed and
221developed, thereby helping to improve the trustworthiness of the subsequent in-
222depth content analysis by ensuring investigator triangulation (see Section 2.5).
223Secondly, it revealed that this broad categorisation of the connotations of the poems
224as either: 'Positive', 'Negative', 'Positive & Negative', or 'Neutral' was too broad to
225offer any in-depth analysis with respect to the RQ. Finally, this approach revealed
226additional poems that should be removed from the study because they did not
227obviously concern the relationship between volcanoes and humanity. For example,
228'Inside the Ghost Volcano' by Will Alexander (1998) was removed at this stage
229because the volcano was being used as an abstract metaphor from which no
230perspective of the perceived relationship between volcanoes and humanity could be
231directly observed. In total a further 7 poems (the 'Invalid' column in Table 1) were
232removed following this step, resulting in a total of 34 poems on which to perform a
233more in-depth content analysis. This further selection criteria meant that two
234decades were now absent from our study (1940 and 1960). However, given that
235every other decade from the 1800s onwards was still present we were satisfied that
236we had a sufficient temporal representation of poems to conduct a detailed content
237analysis with respect to the RQ.

238

239**2.3 Definition of codes and categories to be applied**

240

241A conventional approach to qualitative content analysis was adopted in this study,
242with preconceived categories being avoided, and categories being determined by the
243implementation of the coding process instead (see Section 2.4). While in some
244instances a directed content analysis might be more appropriate, this methodology is
245usually used in those instances where an existing theory would benefit from further
246description (Hsieh and Shannon, 2005). As the research question to be addressed in
247this study is unique, a directed approach is inappropriate. Similarly, a summative
248content analysis (i.e. one in which the frequency of words and/or phrases was only
249quantitatively assessed) would fail to fully account for the context of the poetry
250alongside its content.

251

252**2.4 Outline and implementation of coding process**

253

254Both authors individually read each of the 34 poems, and assigned codes to sections
255of the text (Table 2). As each new code emerged we individually went back through
256the poems that had previously been coded to check whether these also contained
257any lines that could be labelled with any newly emergent code. After coding all of the

258poetry in this manner, we independently read all of the poems in full again and made
259sure that each of them had been coded accurately and that a saturation of emergent
260codes had been reached, thereby improving the trustworthiness of the approach
261(see Section 2.5). As can be seen from Table 2, this resulted in a total of 28 codes (9
262for SI and 19 for AS). We then read each of the poems again to make sure that no
263coding had been missed.

264

265Following this independent coding process, the two individual codebooks (one for AS
266and one for SI) shown in Table 2 were combined in order to search for emergent
267categories. This categorisation of the individual codes was initially done by SI, before
268being modified by AS, and then ratified by both SI and AS, with both authors
269agreeing upon the five emergent categories (and corresponding codes) shown in
270Table 3: 'Landscape', 'Identity', 'Destruction', 'Spiritual', and 'Creation', each of which
271will be discussed in detail in Section 3. After these codes had been grouped as such
272we went back through each of the individual occurrences (e.g. the 61 segments of
273poetry that were categorised as 'Landscape') to make sure that they did indeed
274belong in this category.

275

276In this combination of codebooks to search for emergent categories, we found that
277some of our early individual coding had been done erroneously, e.g. in 'Ice Child' by
278John Haines (1999), the following section was coded as 'Identity' by SI and
279'Destruction' by AS; however, in the merger of our codebooks we decided that a
280more appropriate category was actually 'Landscape', which as can be seen from
281Table 3 was not associated with either of these codes:

282

283 we find your interrupted life,
284 placed here among the trilobites
285 and shells, so late unearthed.

286

287Following this categorisation, each of the five categories shown in Table 3 were
288further examined for any theme(s) that expressed underlying meaning in relation to
289RQ, the results of which are presented in Section 3.7.

290

291**2.5 Determination of Trustworthiness**

292

293At each stage of the qualitative content analysis that was adopted in this study, the
294individual codes and categories were re-examined in order to confirm that they
295accurately captured the poetry in relation to RQ. Each author carried out this coding
296independently, until there were no further codes or categories found to be emerging
297from the data, i.e. until descriptive saturation had been reached (Lambert and
298Lambert, 2012). Triangulation as a validation strategy (Flick, 2004) was achieved by
299using data drawn from different times and places (the poems) and conducting an
300analysis using two different investigators (the authors). This use of systematic
301sampling, triangulation and constant comparison, and proper audit and

302documentation (see Section 2.2 and 2.4) combined to ensure both the reliability (i.e.
303the consistency with which this analysis would produce the same results if repeated)
304and the validity (i.e. the accuracy or correctness of the findings) of this approach
305(Leung, 2015). Given that the analysis of the poetry as described here represents a
306somewhat subjective approach, the reliability of the findings might be called into
307question. However, as outlined by Morse et al. (2002), our methodological
308coherence, sampling strategy, and saturation of emergent codes ensures the
309reliability, and trustworthiness, of our approach in this qualitative analysis.
310

311**3. Results and Discussion**

312

313As can be seen from Table 3, five major categories emerged from the thematic
314coding of the poems used in this study. We will now discuss each of these emergent
315categories, how they relate to RQ ('what does poetry written about volcanoes reveal
316about the relationship between volcanoes and the societies and times represented
317by the poets who wrote about them humanity and volcanoes?'), and how these
318findings compare to other research that has been conducted into the changing
319perceptions of volcanoes (Section 3.1 - Section 3.5).

320

321Following a discussion of these categories we present a quantitative analysis of the
322poems in terms of how the frequency of these emergent categories have changed
323over time (Section 3.5), followed by a presentation of the overall theme that emerged
324from conducting this analysis, and how this relates to RQ (Section 3.6).

325

326**3.1 Landscape**

327

328Landscape is the most recurrent of the five emergent categories, being present in
329every poem that was analysed, regardless of when it was written. Here volcanoes
330serve primarily as a backdrop; they are part of the environment where the poem is
331set, typically a prominent feature that dominates the landscape. For example, in
332'Hunched Back Volcano' by Genevieve Taggard (1914), the poet paints a particularly
333vivid image of an active volcano, anthropomorphised as having a passionate
334(erupting) mouth (crater), set against a backdrop of stars:

335

336 Red is the mouth of Pele, passionate

337 Against the fires of the kindling stars:

338 Fire to fire moves: the heavens wait

339

340By contrast, in 'Mount Broadshield' by Jónas Hallgrímsson (1841) the volcano is now
341quiet and peaceful - an image highlighted by the presence of snow - though it still
342dominates the landscape with its (regal) presence:

343

344 Queen of all our country's mountains,

345 crowned with snow sublime and pure!
346 Once you poured from fiery fountains
347 floods of lava down the moor.
348

349In 'Flowers from the Volcano' by Claribel Alegría (2013), the volcanic crater,
350presumably at least temporarily inactive, becomes part of the human landscape,
351representing the place where the flower growers of the poem now live:

352
353 Farther up, in the crater
354 within the crater's walls
355 live peasant families
356 who cultivate flowers
357 their children can sell.
358

359Even in its absence, the volcano can still dominate the landscape. For example, in
360'Road Trip' by Vijay Seshadri (2016), it is not the volcano itself which provides the
361poem's setting, but rather the beaches that came from its erosion, with their black
362sand and tide pools excavated in its obsidian lava:

363
364 Tomorrow or the day after or the day after that,
365 on the volcano beaches fringed with black sand
366 and heaped with tangled beds of kelp,
367 by the obsidian tide pools that cradle the ribbed limpet
368 and the rockbound star,
369

370These poems also capture the effect that volcanoes have in changing the landscape,
371such as in 'Peace' by D H Lawrence (1929), which provides a description of an
372effusive eruption; firstly, as it occurs:

373
374 Brilliant, intolerable lava
375 Brilliant as a powerful burning-glass
376 Walking like a royal snake down the mountain to-
377 wards the sea.
378

379And then, after the eruption has ceased:

380
381 Peace congealed in black lava on the doorstep.
382 Within, white-hot lava, never at peace
383 Till it burst forth blinding, withering the earth;
384 To set again into rock
385 Grey-black rock.
386

387These descriptions of the changing landscape also highlight how the language that is
388used by poets in their descriptions can both reinforce and counteract scientific

389terminology and understanding. The likening of lava to glass is scientifically
390accurate, as both lava and glass are examples of a silicate melt. In contrast to this,
391the use of colour in this passage, whilst evocative, is not actually grounded in reality:
392lava does indeed turn into black or grey-black rock as it cools down, but is never
393white-hot. The colour choice may have been dictated by a contrast (black vs. white)
394or by the idea, pushed further than it actually occurs in reality, that the hotter
395something gets the closer it gets to white (with lava typically stopping at red-orange),
396and the idea of hot, molten lava still persisting within a cooled, solid outer crust does
397in fact accurately reflect the inward cooling process of lava flows. This is of course
398not to say that poems should ensure scientific accuracy at the cost of their
399aesthetics; we draw attention to these scientific inaccuracies only to highlight that we
400are not interested in how accurately these poems capture volcanic behaviour, but
401rather what the poetry can tell us about the relationship between humanity and
402volcanoes. This use of poetry, mirrors that which Aristotle observed in the *Poetics*,
403i.e. that whilst history deals with specific events, poetry deals with general truths
404(Yanal, 1982).

405

406The fact that volcanoes feature so prominently as a setting in these poems highlights
407that the poets perceived very clearly how humanity relates to volcanoes. Similarly,
408the language used in the poetry acts to position volcanoes as an awesome part of
409our shared landscape, perhaps explaining in part why humans were first drawn to
410them before they became valued for more tangible goods such as precious metals
411and stones (Fisher et al., 1998), as well as soil fertility.

412

413**3.2 Identity**

414

415Volcanoes are often used to represent or highlight part of the poet's identity. They
416are present in their childhood memories, as well as in family history or cultural
417heritage. Identity is the second most recurrent category (after 'Landscape'), missing
418from only two of the analysed decades: the 1860s and 1880s. This ubiquity is
419extremely revealing of the profound tie between humans and volcanoes; here the
420volcanoes are not merely passive elements of the landscape, but rather active
421agents. Even when they are standing still, their presence is so impactful as to be
422defining for the poet, as evidenced in 'Punctuation Marks' by Phillip Nanton (1992),
423set on the author's native island of Saint Vincent (Saint Vincent and the Grenadines),
424whose landscape is metaphorically dominated by the active volcano La Soufrière:

425

426 Come nearer, focus on one dot of an island
427 I was born there, on the rim of a volcano
428 on the edge of a large full stop
429 where the sand is black
430 where the hills turn a gun-barrel blue
431 where the sea perpetually dashes at the shoreline
432 trying to reclaim it all.

433

434 Similarly, in 'Flowers from the Volcano' by Claribel Alegría (2013), the poet's home
435 country of El Salvador is remembered nostalgically, its personal resonance defined
436 by the situation of its volcanoes:

437

438 Fourteen volcanos rise
439 in my remembered country
440 in my mythical country.

441

442 In this poem, the volcanoes represent not only the literal volcanoes in that region, but
443 also the eruption of violence brought about by the civil wars of the 1970s and 1980s
444 across El Salvador, Nicaragua, and Guatemala, and how they too came to form a
445 part of the poet's life and identity.

446

447 This personalisation of the volcano is continued in 'Sonnet 5' by Pablo Neruda
448 (1959), for whom volcanoes become the distinctive feature of his native Chile,
449 elevated to the same rank as the love / lover which the poet found there:

450

451 and on through the streets like a man wounded,
452 until I understood, Love: I had found
453 my place, a land of kisses and volcanoes.

454

455 In many of these instances of identity, the volcano takes centre stage in a formative
456 childhood memory, such as in 'What For' by Garrett Hongo (1982), where the poet
457 expresses the extent to which his childhood identity was itself defined by the
458 presence of volcanoes:

459

460 I lived for the red volcano dirt
461 staining my toes, the salt residue
462 of surf and sea wind in my hair,
463 the arc of a flat stone skipping
464 in the hollow trough of a wave.

465

466 In contrast to this, 'Axis' by Ray Gonzalez (2015) captures the way in which a
467 particular volcano is a matter of family history, a mythical entity that the poet himself
468 did not experience personally, but which is nonetheless present in the defining
469 stories of his heritage:

470

471 The volcano in my grandmother's Mexican village
472 smothered the town, though the girl escaped because
473 the axis of revolution sent her family into exile,

474

475 Here this identity is not necessarily a positive one: the forced exile of the poet's
476 grandmother is remembered as an environmental revolution which they were

477powerless to avoid, but which became a defining aspect of both the grandmother
478and her grandson's assumed identity.

479

480Identity is a nuanced concept, and has both positive and negative connotations
481associated with it. However, what is evident from these poems is that these
482associations are typically not purely adverse, and even when they are they form
483important societal ties that have come to define both past and current generations.
484Although the destructive impacts of volcanoes are well documented and recognized,
485many of the possible societal and cultural benefits are not always fully considered
486(Kelman and Mather, 2008), and the emergence of identity as a key category across
487the majority of the analysed poems serves to further highlight this disparity.

488

4893.3 Destruction

490

491This category considers those poems that make reference in some part to the
492destructive power of volcanoes, in relation to humankind. Poems that were
493categorised as such include those that make reference to physical damage of
494societal assets or destruction to human beings, such as is evident from this extract
495from 'Blankets of Blood' by Arthur Rimbaud (1872):

496

497 Oh my friends! —My heart knows its own brothers!
498 Dark strangers, what if we were to leave? So leave! Leave!
499 O misfortune! How the earth melts upon us,
500 How I shake as it melts on me and you,

501

502These poems also consider those that make reference to physical damage or
503destruction to property or land that is owned and/or cherished by humans, such as in
504this passage from 'Peace' by DH Lawrence (1929):

505

506 Forests, cities, bridges
507 Gone again in the bright trail of lava.
508 Naxos thousands of feet below the olive-roots,
509 And now the olive leaves thousands of feet below the
510 lava fire.

511

512This category also includes those poems that highlight the mental anguish of people
513caused by the negative effects of volcanoes, either directly through their eruptions or
514indirectly through the oppressive nature of living within close proximity to them, as
515can be seen in this extract from 'Negotiations with a Volcano' by Naomi Shihab Nye
516(1995):

517

518 We need dreams the shape of lakes,
519 with mornings in them thick as fish.
520 Shade us while we cast and hook—

521 but nothing else, nothing else.

522

523 The permeating sense of fear that is evident from this extract acts as a powerful
524 testament to the severe mental anguish that experiencing a volcanic eruption and/or
525 living near an active volcano can have on local residents, capturing these negative
526 mental health effects in a manner that does not diminish them in comparison to more
527 tangible examples of volcanic destruction. Research into the mental health impacts
528 following volcanic eruptions have shown that nearby residents are at an increased
529 risk of experiencing symptoms of post-traumatic stress disorder (Gissurardóttir et al.,
530 2019) and mental stress due to the loss (or threat of loss) of property (Horwell et al.,
531 2015). Indeed, such research has also highlighted the importance of implementing
532 psychosocial interventions with volunteers, both during and after a volcanic eruption,
533 in order to alleviate severe mental health risks (Espinoza et al., 2019). By
534 highlighting the mental distress that volcanoes can cause to humans, these poems
535 serve to highlight why this should not be neglected when considering the potential
536 impacts of volcanic activity.

537

538 Finally, this category also considers those poems in which volcanoes are responsible
539 for the fatality of human beings, as can be seen in these lines from 'Flowers from the
540 Volcano' by Claribel Alegría (2013):

541

542 Eternal Chacmol collects blood,
543 the gray orphans
544 the volcano spitting bright lava
545 and the dead guerrillero
546 and the thousand betrayed faces,
547 the children who are watching
548 so they can tell of it.

549

550 Here 'Chacmol' likely refers to a distinctive form of Mesoamerican sculpture
551 associated with sacrifice, and in this poem, the poet asks us to reflect on the role of
552 the volcanoes in shaping the landscape of Central America. Through death, several
553 of these poems invite us to consider how such sacrifices can result in new creation
554 (see Section 3.5), but they also serve as a reminder to the reader of the vast power
555 that these volcanoes possess, encouraging us humans to both respect and, at times,
556 fear their presence.

557

558 Given the severe destruction that volcanoes can wrought, as highlighted by this
559 emergent category, these poems might suggest that communities would not choose
560 to live in such environments of their own volition. However, when such destructive
561 incidents occur in the poetry, they rarely appear in isolation, and instead tend to
562 appear alongside other categories which represent potential benefits, not least
563 'Identity' (Section 3.2) and 'Creation' (Section 3.5). This contrast of categories
564 implies that in many instances the poets were intending to capture a mutuality of

565both potential hazards and benefits. This interpretation further supports the findings
566of other studies which have highlighted that many communities choose to expose
567themselves to the negative consequences of volcanic hazards, so that they might
568enjoy the benefits and opportunities that arise within the human–volcano system
569(see e.g. Bachri et al., 2015;Stoffle et al., 2015).

570

571**3.4 Spiritual**

572

573As can be seen from Table 2 and Table 3, this category emerged from a single code,
574which both authors independently labelled as such. This category represents those
575poems that were considered to make reference to aspects of volcanoes that were of
576spiritual significance. Some of the poems that were coded in this category make a
577specific mention of religious figures, such as these references to Christ in ‘Etna’ by
578Emily Pfeiffer (1889):

579

580 Martyr of mountains, shall I say, the Christ,
581 Bearing earth's sorrows, for its trespass made
582 Sin, that her sons may reap the fair increase
583 Of smiling fields? The offering hath sufficed:

584

585And also, those in ‘St Telemachus’ by Alfred Tennyson (1892):

586

587 In the great name of Him who died for men,
588 Christ Jesus!’ For one moment afterward
589 A silence follow’d as of death, and then
590 A hiss as from a wilderness of snakes,
591 Then one deep roar as of a breaking sea,
592 And then a shower of stones that stoned him dead,
593 And then once more a silence as of death.

594

595Given the selection of English-language poems for this study, there is a strong
596weighting towards poems that make reference to biblical figures from Christianity,
597although other religious figures, such as the Buddha and several Mesoamerican
598deities also feature, especially in those poems which were originally written in
599another language, and yet for which an author-sanctioned translation exists (see
600Section 2.2). For example, in ‘A tale for Puuooo’ by Taeko Jane Takahashi (2002),
601we hear how:

602

603 Pele the goddess pierced and
604 thrusted, spilling lava into
605 Royal Gardens subdivision.

606

607Here, Pele is the goddess of volcanoes and fire in the Hawaiian religion, where she
608is also considered to be the creator of the Hawaiian Islands. In some instances, the

609volcano itself is considered to be the chief religious figure or deity, such as in these
610lines from 'Ice Child' by John Haines (1999), in which the volcano is explicitly
611referred to as a now dormant god:

612

613 Under the weight of this mountain—
614 once a god, now only restless stone,
615 we find your interrupted life,
616 placed here among the trilobites
617 and shells, so late unearthed.

618

619Or in 'Burning Island' by Gary Snider (1970), in which the volcano is given the status
620of a spiritual creator and protector:

621

622 Volcano belly Keeper who lifted this island
623 for our own beaded bodies adornment
624 and sprinkles us all with his laugh—

625

626At times this spirituality manifests itself with the poet (or their protagonist) appealing
627to the volcano for either forgiveness or clemency, such as in 'Negotiations with a
628Volcano' by Naomi Shihab Nye (1995), where the author pleads for mercy with the
629volcano as they might do with another deity or spiritual figure:

630

631 Forgive any anger we feel toward the earth,
632 when the rains do not come, or they come too much,
633 and swallow our corn.
634 It is not easy to be this small and live in your shadow.

635

636These lines also demonstrate how this associated spirituality serves to create an
637'otherness', i.e. that volcanoes and humans might occupy the same landscape but
638they are vastly different entities in terms of both temporal and spatial scales. The
639separation that is imposed by this emergent spirituality also highlights potential
640difficulties for cohabiting. There is at times a perceived unidirectional flow of power
641that makes establishing a truly symbiotic relationship seem improbable, as can be
642seen in the following lines from 'Ice Child':

643

644 Was it God—the sun-god of the Incas,
645 the imperial god of the Spaniards?
646 Or only the priests of that god,
647 self-elected—voice of the volcano
648 that speaks once in a hundred years.

649

650The interpretations of volcanic eruptions have been shown to be interconnected with
651the understanding of tradition by different religions and religious figures (see e.g.
652Gaillard and Texier, 2010). The poems that feature in this category further

653demonstrate that there is clearly a spiritual connection between volcanoes and
654humans, whilst also serving to highlight the spiritual reverence in which volcanoes
655are held, and the distance that this can introduce. By considering the spirituality of
656volcanoes, these poems also ask us to contemplate the persistence of the spiritual
657life system within a particular territory, aligning with previous research which has
658shown how when humans push these boundaries in order to exploit them, the
659system can become disrupted (Vitale, 2017).
660

6623.5 Creation

663

664The final category to emerge from this analysis is one of 'Creation'. Poems that
665feature in this category demonstrate how volcanoes can act as a creative (as
666opposed to, or in addition to being a destructive) force. For example, 'Darkness' by
667George Byron (1816) unknowingly explores the aftermath and potential
668consequences of the 1815 eruption of Mt Tambora, Sumbawa, Indonesia, an event
669whose subsequent volcanic winter resulted in the infamous 'year without a summer'
670(Stommel and Stommel, 1979), as it would have been later discovered. Yet, despite
671the overall negative connotations of this poem, Byron still recognizes that prior to this
672eruption living alongside volcanoes was a positive experience, a source of happiness
673even:

674

675 Happy were those who dwelt within the eye

676 Of the volcanos, and their mountain-torch:

677

678Another poem that demonstrates the creative potential of the volcano is 'Burning
679Island' by Gary Snider (1970), in which the poet asks us to consider the fertile soils
680that volcanoes provide, enabling a peaceful and profitable co-habitation:

681

682 As we hoe the field

683 let sweet potato grow.

684 And as sit us all down when we may

685 To consider the Dharma

686 bring with a flower and a glimmer.

687 Let us all sleep in peace together.

688

689Many residents who live near volcanoes view eruptions as agents of change, often
690change for the good (Dove, 2008), which can in turn influence the extent to which
691they perceive the hazard and risk of living of living near to volcanoes. 'Burning
692Island' highlights the potential benefits of living in volcanic regions, where the rich
693volcanic soils can support highly productive agriculture (Rampengan et al., 2016).
694However, it also draws attention to the fact that the benefits of this relationship would
695appear to be unidirectional – volcanoes do not benefit from cohabiting the landscape
696with humans.-

697

698 Continuing with notions of cohabitating, this category features those poems that
699 demonstrate how such a relationship can be peaceful. For example, in 'Peace' by
700 DH Lawrence (1929) the concept of placatory cohabitation is explored in the very
701 first lines:

702

703 PEACE is written on the doorstep

704 In lava.

705

706 Here the potentially destructive lava gets all the way to the house, yet stops on the
707 doorstep, respectful of the human space. However, even here the potential dangers
708 of this cohabitation are clearly apparent: is this message from the volcano a genuine
709 offering of peace, or a warning shot across the bow; a reminder to humans of their
710 position in the hierarchical relationship that emerges through a consideration of the
711 'Spiritual' (Section 2.4)? 'Negotiations with a Volcano' by Naomi Shihab Nye (1995)
712 further explores the fragile nature of this cohabitation, explicitly wishing for the
713 volcano to remain dormant, and offering to be peaceful themselves if this wish is
714 granted:

715

716 We would be happy if you slept forever.

717 We will tend the slopes we plant, singing the songs

718 our grandfathers taught us before we inherited their fear.

719 We will try not to argue among ourselves.

720

721 In considering the potential for a creative and peaceful cohabitation of the landscape,
722 this category demonstrates how such a relationship is conditional, and is reliant on
723 the volcanoes to 'behave' in a certain manner towards (or with respect to) humanity.

724

725 **3.6 Quantitative Analysis**

726

727 After performing this qualitative content analysis, we quantitatively analysed how
728 both the connotation of volcanoes ('Neutral', 'Positive', 'Negative', 'Both') as well as
729 the frequency of the five emergent categories evolved through time in our dataset.

730 Due to the limited sample size (n=34), this quantitative analysis cannot be

731 considered statistically significant. In order to do so, we aggregated our dataset by

732 decade, and normalized the identified connotations and categories to the number of

733 poems in which they were represented (Table 4). Furthermore, we considered the

734 major eruptions which occurred in the Northern Hemisphere (where the majority of
735 the poets used in this study lived) across the considered time frame (Table 5), and

736 correlated these with the connotations and categories of the dataset. The purpose of

737 this quantitative analysis was not to apply a statistical interpretation of the volcano-

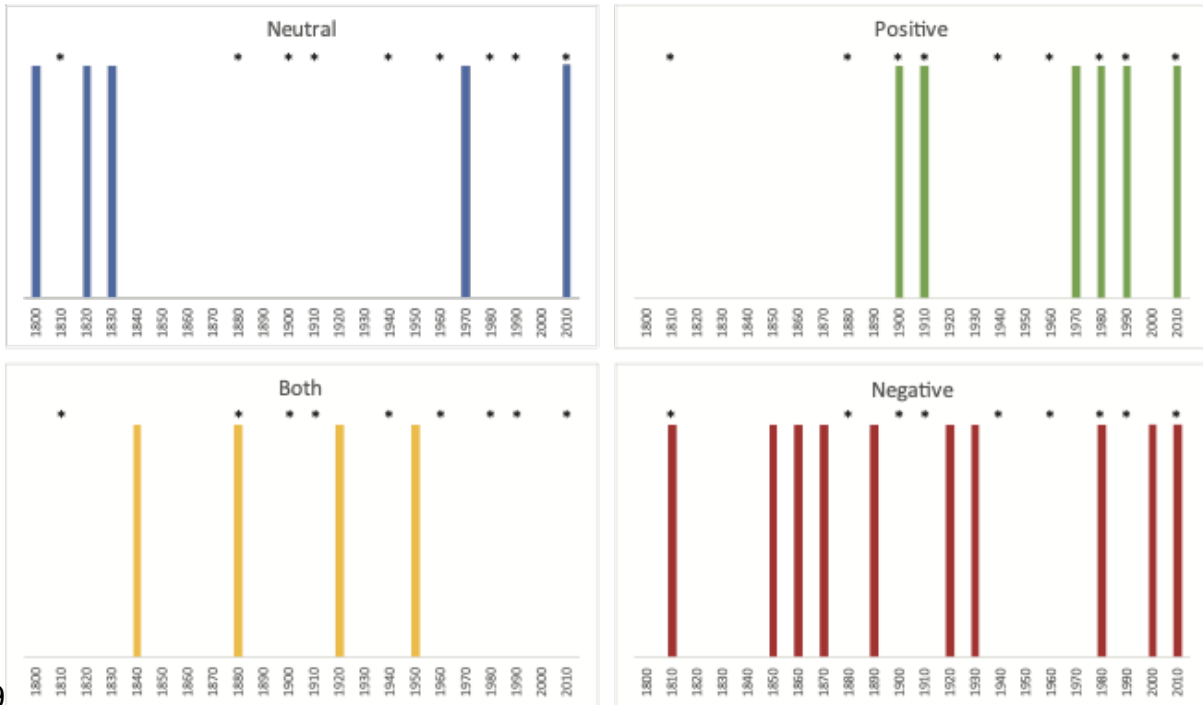
738 human interactions of the analysed poetry; rather it was read alongside the

739 qualitative analysis in support of the emergent theme (Section 3.6) that arose from a

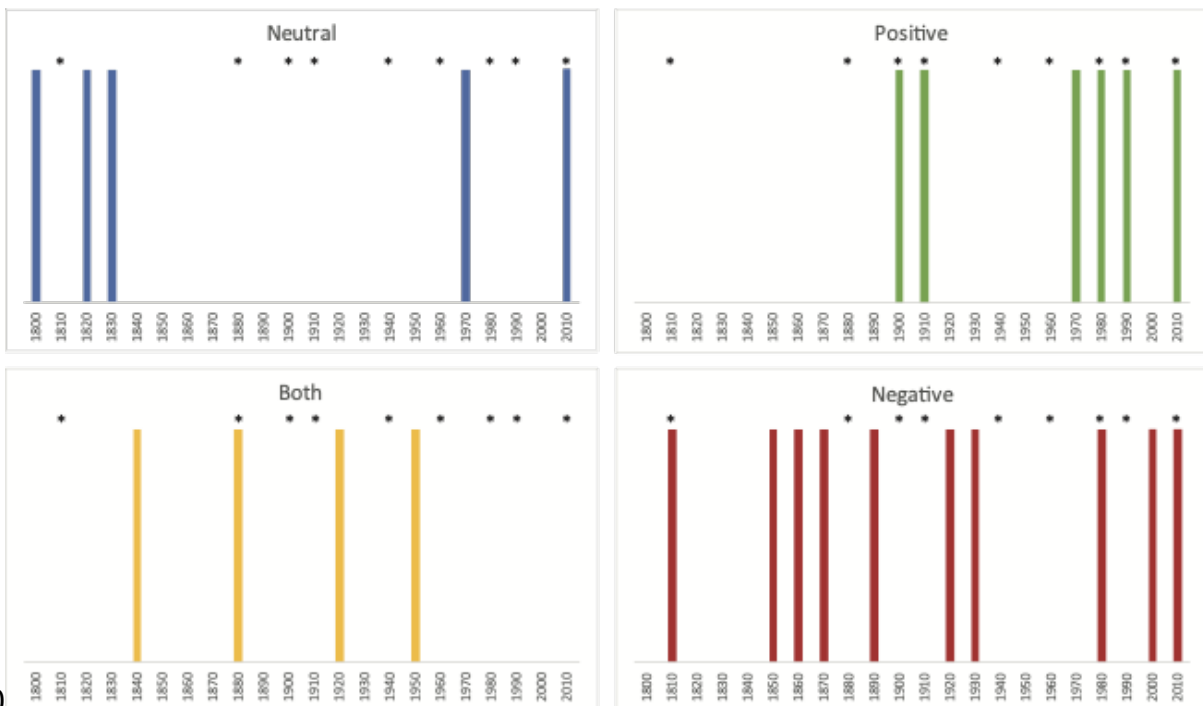
740 consideration of these poems.

741

742As can be seen from Fig. 1, poems in which volcanoes have either a 'Neutral' or 743'Both' a positive and negative connotation, and therefore do not express a partial 744value judgement, can be found consistently throughout the time span considered 745(i.e. from the 1800s to the 2010s). The same can be also said for poems where 746volcanoes are depicted with an overall 'Negative' connotation. In contrast, a 747'Positive' representation of volcanoes only emerges in the 1900s, and does not 748become frequent until the 1970s.



749



750

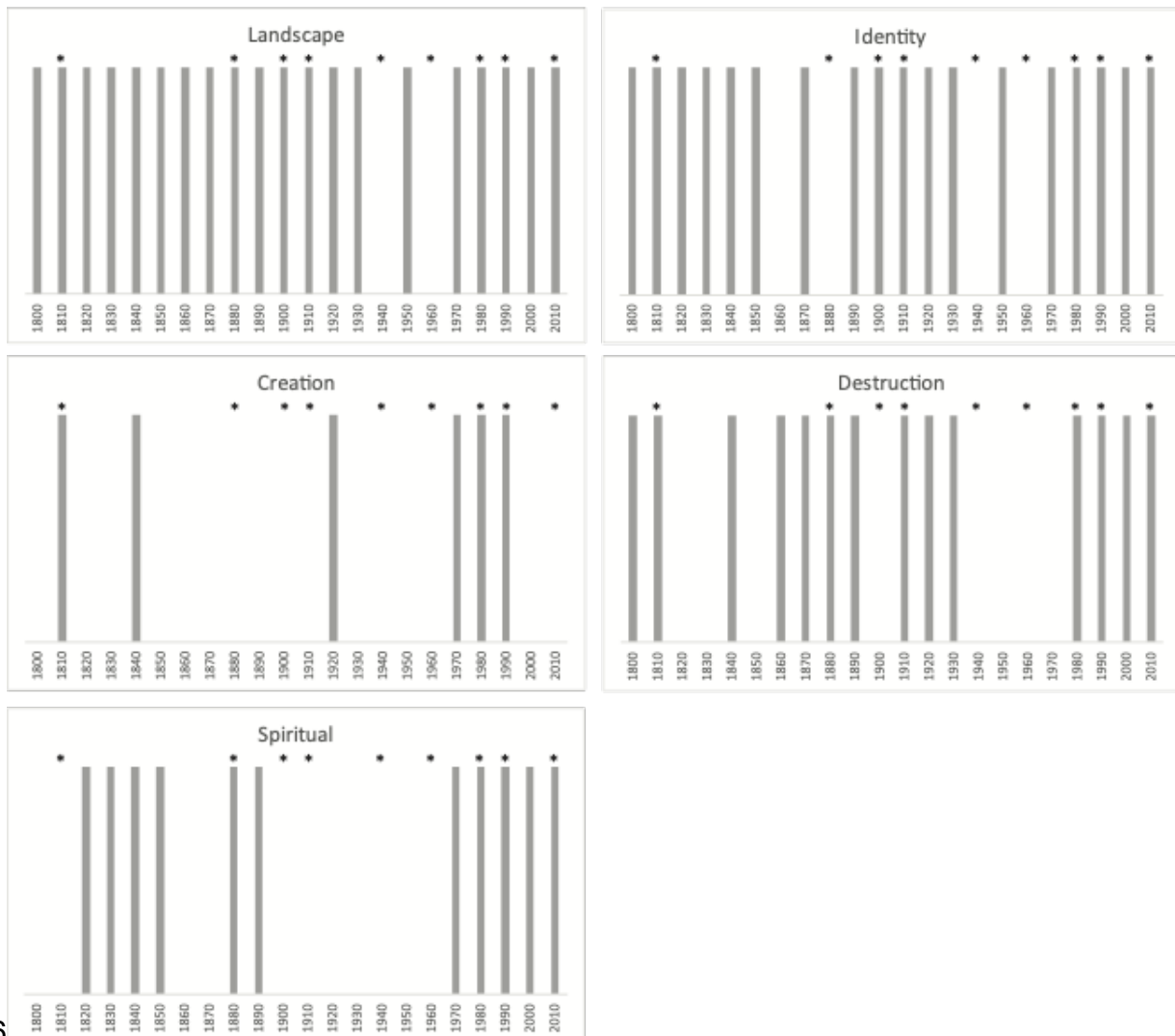
751 *Figure 1. Connotations ('Neutral', 'Positive', 'Negative', or 'Both') of the considered*
752 *poems, arranged chronologically and aggregated by decade. Asterisks indicate*
753 *major eruptions (as shown in Table 5).*

754

755 Plotting major eruptions alongside the associated connotations of the selected
756 poems (Fig. 1) does not reveal any obvious correlation. This can be attributed to the
757 fact that the vast majority of the analysed poems do not focus on specific volcanic
758 eruptions, but rather that they consider human-volcano interactions more generally.
759 One notable exception is the poem 'Darkness' by George Byron (1816), which as
760 discussed in Section 3.5 is grounded in the eruption of Mount Tambora in 1815, and
761 the subsequent 'year without summer'. During this eruption, volcanic ash was
762 injected high into the stratosphere, where it circled the globe and persisted for a
763 considerable time, visibly filtered the sunlight, and causing a negative thermal
764 anomaly of at least half a degree Celsius in the Northern Hemisphere, as well as a
765 famine that ultimately killed over 70,000 people (Brohan et al., 2016). This event
766 inspired artists in all fields (e.g. Turner's famous sunset paintings, and Mary
767 Shelley's *Frankenstein*), with Byron's poem also bearing witness to this event:

768

769 I had a dream, which was not all a dream.
770 The bright sun was extinguish'd, and the stars
771 Did wander darkling in the eternal space,
772 Rayless, and pathless, and the icy earth
773 Swung blind and blackening in the moonless air;
774 Morn came and went—and came, and brought no day,
775



776

777 *Figure 2. Emerging categories in the considered poems, arranged chronologically*
 778 *and aggregated by decade. Asterisks indicate major eruptions (as shown in Table*
 779 *7795).*

780

781 At the categories scale (Fig. 2), we see that the volcano-human interactions in
 782 relation to the ‘Landscape’ occur in all represented decades (as discussed in Section
 783 2.2 the 1940s and 1960s are not represented in this analysis). The notions of
 784 ‘Identity’ that are associated with these interactions are almost as ubiquitous, with
 785 the only exceptions being the 1860s and 1880s.

786

787 As can be seen from Fig. 2, the ‘Destruction’ in the volcano-human interactions of
 788 the selected poetry is represented more frequently across the considered time period
 789 than the ‘Creation’ of such interactions. There is also somewhat of a correlation
 790 between ‘Destruction’ and each of the major volcanic eruptions that happened in this
 791 period, with the 1900s being the only decade which featured a major volcanic
 792 eruption in the Northern Hemisphere (Table 5) and which did not feature a poem that
 793 considered the destructive nature of volcano-human interactions (again noting that
 794 the 1940s and 1960s are not represented in this analysis). This would indicate that

795even if poets were not writing about specific volcanic events, their attitudes might
796have been affected by them (and the social and economic impacts that these large
797volcanic events resulted in), leading to poems that more readily considered the
798'Destructive' rather than 'Creative' nature of such interactions.

799

800The 'Spiritual' category occurs across the considered time period, with a notable gap
801in the first half of the twentieth century. This might in part be explained by the
802tensions between poetry and religion that had manifested themselves throughout the
803Victorian age (because of the constraints in the selection of the poetry discussed in
804Section 2.2, the majority of the poems from this era came from either British or
805American writers), with religion becoming increasingly personal and secular as
806society became more democratic (Fraser, 1986). Similarly, the re-appearance of this
807category in later poems corresponds to the emergence of a new Romantic
808movement that began in the 1960s, in which people (and poets) began identifying
809themselves as 'spiritual but not religious' (Thomas, 2006), which could explain the
810re-emergence of 'Spirituality' in the poetry of this period.

811

812

813**3.7 An emergent theme**

814

815In considering the five categories identified in this analysis of the poetry, a clear
816theme emerges with respect to the RQ (what does poetry written about volcanoes
817reveal about the relationship between volcanoes and the societies and times
818represented by the poets who wrote about them~~humanity and volcanoes?~~): that
819there is a strong sense of identity associated between humans and volcanoes.

820

821An analysis of these poems has revealed that humans and volcanoes occupy the
822same 'Landscape', and that whilst there is a certain reverence associated with their
823'Destruction', there are also many positives associated with living alongside them.
824Surprisingly however, these positives are mainly linked to notions of 'Identity' (e.g.
825family histories and cultural heritages) rather than the physical benefits of 'Creation'
826(e.g. fertile soils). These poems also highlight that this is a unidirectional relationship,
827in part because of the distancing brought about by the associated 'Spirituality' or
828otherness of the volcanoes, with humans ultimately of neither benefit nor concern to
829the volcanoes that they write about. A different selection of poems, including work
830from indigenous communities who grant volcanoes a higher cultural stand (e.g.
831personification or divinization), might yield a different perspective.

832

833This emergent theme is further supported by the quantitative analysis discussed in
834Section 3.6, where over the time period considered there is a relative ubiquity of the
835'Identity' to emerge from the poems. Similarly, despite the major cultural and societal
836changes that have occurred over this time period, attitudes towards the human-
837volcano interaction have not noticeably shifted in favour of one category or another;
838the volcanoes have remained an ever present, suggesting that they are impervious

839to these changes and further highlighting their unidirectional relationship with
840humanity.
841

842**4. Conclusions**

843

844The purpose of this study was to investigate what poetry written about volcanoes
845reveals about the relationship between humanity and volcanoes. By conducting a
846qualitative content analysis of a selection of poems written from the 1800s to the
847present day, a series of themes emerged that characterised this relationship. The
848volcanoes as 'Landscape' and 'Identity' were seen as dominant, with consideration
849also given to the 'Destruction' and 'Spirituality' associated with these human-volcano
850interactions, and to a lesser extent their potential for 'Creation'. The main theme to
851emerge, both from these categories and the poems themselves, is that there is a
852strong sense of identity associated with volcanoes by humans (e.g. in terms of family
853histories, cultural heritage etc.), and that it is the humans (and not the volcanoes)
854that are affected by this relationship. A quantitative analysis of the frequency with
855which these categories occurred throughout the decades of this dataset supported
856the findings of this qualitative analysis, thereby further improving the validity and
857reliability of the main finding of this study, i.e. that the relationship between humanity
858and volcanoes is unidirectional and focused on identity.

859

860The outcomes of this study support other research findings which have
861demonstrated that many communities are willing to accept the associated risks of
862living near volcanoes, including active ones, in order to experience the cultural and
863societal benefits (i.e. 'Identity') that they afford (see e.g. Schmincke, 2004;Kelman
864and Mather, 2008). Furthermore, by asking us to consider the emergent
865unidirectional nature of this relationship, this study also challenges us to re-consider
866the importance of humanity in our interactions with volcanoes. Unlike many other
867elements of our natural environment that have a strong sense of cultural and social
868identity attached to them – for example, glaciers (Gagné et al., 2014), rivers
869(Macklin, 1999), and rainforests (Roosevelt, 2013) – volcanoes are unlikely to be
870affected by e.g. anthropogenic climate change. Indeed, aside from humans,
871volcanism is itself a key driver in short-term climatic variations.

872

873The main limitation for this study is that only English-language poems were
874considered. This means that there is likely a bias towards certain attitudes or
875behaviours, especially those that were found to emerge from the 'Spirituality'
876category. Future research could, and should, include poetry written in multiple
877languages to account for this limitation, as doing so would reveal a broader
878understanding of how poets interpret human-volcano interactions, especially for
879communities from the Southern Hemisphere. Additionally, the majority of poems
880considered were authored by male poets, due to the scarcity of poems about
881volcanoes written by female poets, especially for the 19th Century. It is also worth

882 noting that throughout the 220 years considered in this study, the cultural, social, and
883 political backdrop of the poems has changed significantly. For example, colonialism
884 has the potential of having significantly affected the representation of cultural
885 elements in poetry. Whereas a ~~detailed analyses~~ [detailed analysis](#) of how these
886 changes affected the content and tone of the poems is beyond the scope of this
887 work, future studies focussing on this aspect would certainly be valuable. Finally, the
888 limited size of the analysed dataset, i.e. 34 poems, advises caution when
889 extrapolating the findings of this study to the poets' fellow human beings.
890

891 In addition to future studies considering a wider variety of languages and cultures,
892 such work might also consider how different attitudes towards human-volcano
893 interactions are captured by those poets who have physically encountered a volcano
894 versus those who are relying on second-hand testimony. Furthermore, by outlining
895 how poems can be used as a form of data to provide further insight into how human-
896 volcano interactions are perceived, this study suggests that a similar approach might
897 also be adopted for other geoscientific events or phenomena.

898
899 This study has demonstrated that poetry is a powerful medium through which to
900 consider perceptions of our natural environment. Our methodology could become an
901 integral part of a deeper analysis to develop communication strategies, ~~and that the~~
902 ~~results might better inform our communication~~ with communities living nearby active
903 volcanoes. For example, it could provide more appropriate (i.e. locally sourced)
904 language to engage the communities in conversation. It is in fact critical that local
905 cultural and religious beliefs be taken into account when communicating volcanic
906 hazard, as demonstrated by several social volcanology studies (Cashman and
907 Cronin, 2008; Donovan, 2010; Lavigne et al., 2008; Paton et al., 2008). We welcome
908 interested readers to get in contact with us for participation in the next stage of this
909 research, in which we hope to broaden our analysis beyond the constraints of the
910 English language.

911

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914**Data Availability**

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916The poems that were selected for the analysis, along with their coded categories, are
917available through Soldati and Illingworth (2019;
918<https://doi.org/10.17605/OSF.IO/2D5K6>).

919

920**Author Contribution**

921

922AS and SI worked together to conceive the design of this study, conduct the
923research and analysis, and write the paper.

924

925**Competing interests**

926

927Author SI is the chief executive editor of *Geoscience Communication*.

928

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930

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1083 Tables

1084

1085 Table 1: classification of the 41 poems according to their portrayal of the relationship
1086 between volcanoes and humanity as either 'Positive', 'Negative', 'Positive &
1087 Negative', 'Neutral' or 'Invalid'. Here the rows represent who the coding was
1088 performed by ('AS' - Arianna Soldati; 'SI' - Sam Illingworth; 'Both' - Arianna Soldati
1089 and Sam Illingworth).

Code	Positive	Negative	Positive & Negative	Neutral	Invalid
AS	5	8	7	10	11
SI	13	16	0	9	3
Both	9	12	5	8	7

1090

1091

1092 Table 2: the codes that emerged from an individual content analysis of the 34
1093 poems, arranged according to the number of times they occurred ('AS' - Arianna
1094 Soldati; 'SI' - Sam Illingworth). *The number of occurrences is not limited to one per
1095 poem.

Code	Code	Description	Occurrences*
Landscape	AS	Simple description of volcanoes as part of the environment	30
Human	AS	Referring to fellow human beings	28
Destruction	AS	Associated with destruction	24
Spiritual	AS	Evoking a spiritual connection or being	23
Destruction	SI	Something that brings / is associated with destruction	15
Creation	SI	Associated with new life and fostering life	13
Plants	AS	Reference to plants / flowers	13
Spiritual	SI	Associated with spiritual / religious feelings and/or presence	12

History	AS	Bringing a historical perspective	12
Death	AS	Associated with death	12
Animals	AS	Reference to animals	11
Identity	SI	Associated with a sense of identity for a person / people	8
Fear	SI	Something to be feared / afraid of	8
Cohabiting	SI	Living alongside the volcano (both positive and negative consequences)	8
Natural Beauty	SI	Described as something beautiful and/or awesome.	7
Setting	SI	The volcano is a neutral setting for the poem	6
Universe	AS	Reference to stars/planets	5
Force / Power	AS	Evoking the strength of the volcano	5
Childhood	AS	Reminiscing of childhood	4
Peace	AS	Relating to peace/absence of war	3
Positive Metaphor	SI	The volcano is used as a positive metaphor / simile	2
Creation	AS	Evoking the creation of land or life	2
Rocks / Minerals	AS	Reference to the rock/mineral element of landscape	2
Wish	AS	Expressing a desire, wish	2
Time	AS	Encompassing the passage of time	2
Quiet	AS	Related to a feeling of stillness, quiet	2
Pain	AS	Related to physical pain	1

Fear	AS	Related to a feeling of fear	1
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1096

1097 Table 3: the categories that emerged from the coding process, alongside their
 1098 corresponding codes, and arranged according to the number of times they occurred
 1099 ('AS' - Arianna Soldati; 'SI' - Sam Illingworth). *The number of occurrences is not
 1100 limited to one per poem. **This code originally had both positive and negative
 1101 connotations.

Category	Corresponding Codes (Author)	Occurrences*
Landscape	Landscape (AS); Natural Beauty (SI); Universe (AS); Rocks/Minerals (AS); Force / Power (AS); Animals (AS); Plants (AS); Setting (SI)	61
Identity	History (AS); Heritage (AS); Humans (AS); Identity (SI); Childhood (AS); Positive Metaphor (SI); Time (AS)	49
Destruction	Death (AS); Pain (AS); Destruction (S); Destruction (AS); Fear (SI); Cohabiting** (SI); Fear (AS)	36
Spiritual	Spiritual (AS); Spiritual (SI)	25
Creation	Creation (SI); Creation (AS); Wish (AS); Cohabiting** (S); Peace (AS); Quiet (AS)	8

1102

1103 Table 4. Poem connotation and categories by decade. In this table each decade was
 1104 considered to have an associated connotation if at least one poem written in this
 1105 decade was considered to be either 'Neutral', 'Positive', 'Negative', or 'Both'.
 1106 Similarly, a particular decade was assumed to be associated with an emergent
 1107 category if at least one of the poems that were written in that decade was
 1108 categorised as such.

Decade	Connotation				Categories				
	Neutral	Both	Positive	Negative	Landscape	Identity	Creation	Destruction	Identity
1800	x				x	x		x	
1810				x	x	x	x	x	
1820	x				x	x			x
1830	x				x	x			x
1840		x			x	x	x	x	x
1850				x	x	x			x

1860				x	x			x	
1870				x	x			x	
1880		x			x			x	x
1890				x	x	x		x	x
1900			x		x	x			
1910			x		x	x		x	
1920		x		x	x	x	x	x	
1930				x	x	x		x	
1940									
1950		x			x	x			
1960									
1970	x		x		x	x	x		x
1980			x	x	x	x	x	x	x
1990			x		x	x	x	x	x
2000				x	x	x		x	x
2010	x		x	x	x	x			x

1109

1110

1111 Table 5. Some of the major eruptions from the 1800s to the present day. These are
 1112 defined as those eruptions having had either a Volcanic Explosivity Index (VEI)
 1113 greater than three, and having occurred in the Northern Hemisphere, where the
 1114 majority of the authors of the considered poems lived, or having had a global impact
 1115 and resonance. Data taken from the Global Volcanism Program (Venzke, 2013).

1116

Volcano	Eruption Year
Tambora	1815
Krakatoa	1883
La Soufrière, Pelée, Santa Maria	1902
Novarupta	1912
Paricutin	1943-54

Vesuvius	1944
Hekla	1947-48
Surtsey	1963
St Helens	1980
El Chichon	1982
Redoubt	1989
Pinatubo	1991
Eijafjallajokull	2010

1117