The evolving language of minerality in wine tasting: a case study of Decanter tasting notes 1976-2019

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Contents

1. SUMMARY

This study is a textual analysis of 20,678 tasting notes published in *Decanter* from 1976-2019. It takes the form of a content analysis of 'minerality' and its cognates to explore the term's history, evolution and application.

The research found that the term has been in circulation since at least the mid-1960s, but did not become widespread until the turn of the century. In the *Decanter* corpus it was first mentioned in 1985, and has been used 1,784 times, or in 8.6% of all tasting notes, making it the fourth most common wine descriptor. It is the most frequently used descriptor in both white and rosé wines and the sixth most common in red wines. At its peak in 2010 it was found in over 15% of all tasting notes, but since then its popularity has started to wane.

Positive predictors of minerality include a citrus character in white wines, and red fruit character in red wines. Tasting notes that include references to high acidity, stone, salt, metal and smoke are all more likely to be found in notes that also cite a 'mineral' character. Ripeness, smoothness, oak, savouriness, sweet spice, toast and a dairy character are all negative predictors of minerality.

2. INTRODUCTION

This paper explores the history, evolution and application of 'minerality' in wine tasting notes. In the rich lexicon of wine terms that have developed in the modern era, few have proved more important, and more divisive, than this one. The study takes the form of a content analysis of 20,678 tasting notes published in *Decanter* from 1976-2019, and analyses the term's usage and rise to prominence.

The study will address the following questions:

1. How common is the term, and to which wines is it most regularly applied?
2. How is the term used, and has its usage changed over time?
3. How do other wine characteristics associate with the concept of minerality? Are there consistencies in usage that might add to our understanding of the meaning of the term?

It is hoped that by doing so it will provide a detailed look at an example of wine language evolution in action, as well as adding to the conversation around the usage of 'minerality' as a tasting term, which has been much discussed in recent years.

3. LITERATURE REVIEW

3.1 Origins and rise in usage

Several studies suggest the term 'minerality' is a neologism coined between the mid-1980s and the turn of the century. Alex Maltman in *Minerality in wine: a geological perspective* says:

> Although terms such as "lean", "austere" and "steely" have long been in the wine lexicon, as have "flinty" and "chalky" for certain European white wines, the term minerality is a recent invention. It seems unclear exactly by whom and when. Certainly wine books before the turn of the millenium [sic] have no mention of any of this.[1]

Jamie Goode in *Wine Science* dates it earlier and quotes Stephen Spurrier as saying 'Mineral…did not exist until the mid-1980s. During most of my time in Paris I don't think I ever used the word.'[2] Goode quotes critic Michel Bettane describing minerality as 'a fashionable word never employed in the 1970s and 1980s.'[3] At a minerality summit in 2020, Goode also states 'Minerality is this term which didn't exist in the wine lexicon until the late 1980. I've chatted to a few people…and they can't recall ever having used the word 'mineral' to describe wines before the 1980s.'[4]

The authors of a French study state 'The word "minerality" has only relatively recently emerged from wine tasting notes but is now frequently used to describe wine…Even though the word minerality cannot be found in most contemporary general English

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[1] Maltman, A. *Minerality in wine: a geological perspective* (Journal of Wine Research, Vol. 24, 2013, pp. 169-181) p. 3

[2] Goode, J. *Wine Science: The Application of Science in Winemaking,* 2nd edition (London: Mitchell Beazley, 2014) p. 42

[3] Ibid p. 43

[4] Wilson, C. *Hallgarten hosts 'minerality' summit and tasting* (Harpers Magazine, 9th January 2020) <https://harpers.co.uk/news/fullstory.php/aid/26450/Hallgarten_hosts__91minerality_92_summit_and_tasting.html> [Accessed 25/10/2021]

dictionaries, *minéralité* has been mentioned in most French wine lexicons since 1988.'[5]

Therefore there appears to be a consensus that the term was coined sometime in the mid-to-late 1980s. However, there are instances of 'mineral' and its cognates appearing in mainstream wine writing in the preceding 20 years.

In *Wine* (1966) Hugh Johnson refers to a mineral character in Chablis and Mosel Riesling. In his description of Grand Cru Chablis, he states:

> The taste of one of these great Chablis is bone-dry, but by no means thin. They have a remarkably powerful scent, and a flavour which I can only describe as slightly mineral, rather than fruity.[6]

And of Mosel Riesling:

> The typical Bernkasteler is one of the drier of the Moselles, with something of the stony, mineral taste which occasionally reminds me of Chablis, yet no less of the fragrance of Riesling grapes than any other.[7]

Pamela Vandyke Price used the term 'minerally' in relation to Chablis in *The Taste of Wine* (1975):

> It is very pale in colour and unlike any other white Burgundy, has a greenish tinge at the edge of the wine; even as it ages, Chablis never really becomes golden in colour. It can have great nobility, but is generally an austere wine, so minerally dry that few wine

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[5] Deneulin P.; Le Fur, Y.; Bavaud, F. *Study of the polysemic term of minerality in wine: Segmentation of consumers based on their textual responses to an open-ended survey* (Food Research International Vol. 90, 2016, pp. 288-297) p. 288

[6] Johnson, H. *Wine*, 1st Edition (New York: Simon and Schuster, 1966) p. 91

[7] Ibid p. 121

drinkers like it at first and most appreciate it only after some experience.[8]

Adrienne Lehrer in *Wine and Conversation* (2009) includes 'mineral' in a list of 145 most used wine descriptors during the 1970s.[9]

The consensus in the current body of research suggesting a genesis sometime during the 1980s can therefore be rejected, but remains highly indicative that although in circulation since at least the 1960s, mineral-related terms did not become commonly used until some time later.

There are also several references that claim a rise in usage since the term's introduction,[10] but it appears no studies have researched this. The only cited evidence uncovered is the same French study noting increased usage in a corpus of French books from 1950-2008. The authors reported a rise until around 1995, but the data was generated by a rudimentary analysis using *Google Books Ngram Viewer* and was only designed to be a small contextual element of the study.[11]

3.2 Meaning and application

Research on the subject focusses primarily on four areas: the concept and definition of minerality, the suggested link between vineyard soil and wine flavours, the sensory characteristics of minerality, and specific chemical compounds that might impart a mineral flavour. Thanks largely to *Minerality in wine: a geological perspective* the

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[8] Vandyke Price, P. *The Taste of Wine* (London: Dorling Kindersley Ltd, 1970) p. 62
[9] Lehrer, A. *Wine and Conversation*, 2nd edition (New York: Oxford University Press, 2009) p. 5
[10] Maltman, A. *Minerality in wine: a geological perspective*, p. 2
 Goode, J. *Wine Science: The Application of Science in Winemaking,* 2nd edition*,* p. 42
 Deneulin Pascale, Le Fur, Yves and Bavaud, Francois *Study of the term of minerality in wine: Segmentation of consumers based on their textual responses to an open-ended survey,* p. 289
[11] Ibid. p. 296

second of these has been resolved and there is an established academic consensus that any 'mineral' character perceived cannot be literally derived directly from the soil.[12] Maltman concludes the following:

> The mineral nutrients in wine normally have minuscule concentrations and they lack flavour anyway. Although attempts to explain the perception of minerality involve allusions to geological materials, these are irrelevant to its origin. Whatever minerality is, it cannot literally be the taste of minerals derived from the vineyard geology.[13]

The fourth area is beyond the remit of this study as it will not be possible to chemically analyse the wines documented in the tasting notes that form the source material. However there is opportunity for further research regarding the conceptual and linguistic aspects of the term, as well as its sensory characteristics.

3.3 Defining minerality

Minerality seems to be a new word invented by the world of wine and is not defined in dictionaries. Despite this lack of an established definition, previous studies have suggested some consistencies regarding the concept of minerality, but remain inconclusive.

For example, a survey of wine professionals undertaken by Ballester et al found 'the definitions of the experts included these main characteristics…as being typical subdimensions of minerality: stone-related odours, seashore-related odours, acidity

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[12] Parr, W.V.; Maltman, A.; Easton, S.; Ballester, J. *Minerality in Wine: Towards the Reality behind the Myths* (Beverages, 4, 77, 2018) p. 5
[13] Maltman, A. *Minerality in wine: a geological perspective* p. 1

and freshness'[14] whilst also noting 'the experts use a great diversity of words to define minerality, which suggests that the definitions of experts are inconsistent.'[15]

Likewise, Deneulin et al linked 'salient flint odours', 'acidity and freshness' and also the concept of terroir with minerality, whilst acknowledging 'inspection of textual networks generated by the representation of "minerality" in wine suggests that this new term possesses different meanings among wine professionals, and is even polysemic within respondents.'[16]

To complicate the picture further, Ballester et al's study also found that any pre-existing conceptions of minerality are not always then applied consistently by the same tasters in practical settings.

3.4 Practical applications

Further studies have looked at practical applications of the term relating to specific wines. Whilst some wine characteristics have been suggested as associating positively with perceived minerality, evidence is not consistent and many contradictory results have been produced. For example, Ballester et al found high acidity and reduction-related terms to be positive predictors of minerality, and sweetness to be negative,[17] whereas Parr and colleagues noted 'of particular interest, no … association was found between perceived sourness/acidity and minerality judgements.'[18] In

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[14] Ballester, J.; Mihnea, M.; Peyron, D.; Valentin, D. *Exploring minerality of Burgundy Chardonnay wines: A sensory approach with wine experts and trained panellists* (Aust. J. Grape Wine Research 19, 2013) p. 49
[15] Ibid. p. 48
[16] Deneulin P.; Le Fur, Y.; Bavaud, F. *Analyses of open-ended questions by renormalized associativities and textual networks: A study of perception of minerality in wine* (Food Quality and Preference, 12/2015, pp. 34-44) p. 43
[17] Ballester, J.; Mihnea, M.; Peyron, D.; Valentin, D. *Exploring minerality of Burgundy Chardonnay wines: A sensory approach with wine experts and trained panellists* p. 50
[18] Ballester, J.; Peyron, D.; Grose, C.; Valentin, D.; Parr, W.V. *Perception of mineral character in sauvignon blanc wine: inter-individual differences* (Wine Studies, vol. 3:4474, pp. 9-12) p. 9

another study, the same authors also found 'reductive notes were not positively associated by either cultural group with perception of mineral character in the wines.'[19] Likewise, a recent Spanish study found sweetness to be a positive, and not negative, predictor of minerality.[20]

The picture therefore is quite muddled, and suggests a need for further clarification.

[19] Parr, W.V.; Ballester, J.; Peyron, D.; Grose, C.; Valentin, D. *Perceived minerality in Sauvignon wines: Influence of culture and perception mode* (Food Quality and Preference 41, pp121-132) p. 128
[20] Zaldívar, E. *Caracterización químico-sensorial en vinos blancos y tintos del atributo mineralidad* (Tesis Doctoral, Universidad de la Rioja, 2017) p. 233

4. METHODOLOGY

4.1 Content analysis

This study takes the form of a content analysis of *Decanter* tasting notes published between 1976 and 2019.

Content analysis 'is a research tool used to determine the presence of certain words, themes, or concepts within some given qualitative data. Using content analysis, researchers can quantify and analyze the presence, meanings and relationships of such certain words, themes, or concepts… In conceptual analysis, a concept is chosen for examination and the analysis involves quantifying and counting its presence.'[21]

In this study, a conceptual content analysis was undertaken for mineral-related terms that quantified their frequency in the corpus.

This type of analysis involves five main steps:

1. Selection of content
2. Definition of units and categories of analysis
3. Development of rules for coding
4. Coding the text
5. Analysis and conclusions

[21] Anonymous, *Content Analysis* <https://www.publichealth.columbia.edu/research/population-health-methods/content-analysis#Description> [Accessed 14/10/21]

4.2 Selection of content

4.2.1 Source material

The source material is *Decanter*'s monthly publications. *Decanter* was first printed in 1975, with its first full year of publications in 1976. It has become Europe's best selling wine magazine with a global print circulation of 41,000.[22] It publishes 12 monthly issues per year, each featuring several hundred tasting notes. As one of the oldest wine magazines in the UK and with no breaks in publication, it provides a detailed, historical archive of tasting notes and has had several hundred contributors since its inception who rotate regularly, to ensure a wide spread of voices.

4.2.2 Limitations of source material

- The number of reviews per year differs considerably, from 349 reviews published in 1976 to 3745 in 2019.

- The wines reviewed also differ widely. The earlier years are skewed towards traditional Old World wines such as bordeaux and burgundy, whereas modern editions are more eclectic.

- Whilst a wide range of reviewers have been employed across the magazine's history, wine styles or colours with fewer reviews can potentially be affected by individual writers' language choices.

- Although this study will examine a substantial number of tasting notes, it cannot be assumed that the language used in *Decanter* is representative of the world

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[22] Anonymous, *Decanter Media Pack,* p.4 <https://keyassets.timeincuk.net/inspirewp/live/wp-content/uploads/sites/34/2021/02/Decanter-Media-Pack-2021.pdf> [Accessed 05/10/21]

of wine during this era. Therefore caution should be taken in drawing conclusions beyond the scope of this magazine.

4.2.3 Sourcing of materials

The editions from 1985-2005, 2015 & 2019 were purchased from various collectors. The editions from 1976, 1980 and 2010 were reviewed at the National Library of Scotland, Edinburgh.

4.2.4 Digitisation

To enable computer-assisted analysis, tasting notes were digitised from the printed editions of the magazine.

The software used to transcribe them was Microsoft Office Lens. The technology operates by converting a photograph of a tasting note into editable text in the form of a Microsoft Word document. This functions with a high degree of precision, but to ensure accuracy, notes were then proofread to correct any misreadings by the technology.

4.2.5 Sampling strategy

For issues of practicality and time constraints, a sample of editions from the period was necessary, as is common in studies of this nature. 'With a period as short as a year, a researcher might conduct a census of all…twelve monthly issues in the year's

publication. However, longitudinal designs often involve extended time periods…where a census is not feasible and sampling may be desirable.'[23]

The study included all 12 editions of the magazine in each sample year, at roughly five-year intervals. Supplements, promotional/sponsored features and *Decanter World Wine Awards* were not included. The years included are 1976, 1980, 1985, 1990, 1995, 2000, 2005, 2010, 2015 and 2019. A corpus of 20,678 tasting notes was compiled.

Choosing twelve issues per five years has been recommended in previous studies as being the optimal amount to ensure a representative number of editions, and a January to December selection as being more effective than a random sample. 'When sampling from a five-year period, a constructed year of 12 issues…is more efficient and accurate than 20 randomly selected issues.'[24] The authors of a study that utilised this sampling strategy stated 'If a random or purposeful sample of issues within a year was taken, the risk of missing important instances…would be high. A fair representation of the magazine's coverage, therefore, could not be stated.'[25]

This strategy has further benefits when examining media publications. 'Previous studies…have shown that the cyclic nature of media content can render simple random sampling inefficient compared to other types of sampling.'[26] This is in evidence in *Decanter*, which tends to focus more heavily on particular regions, styles and grape varieties, in certain months within a year's worth of editions. Therefore full-year blocks were chosen ahead of random samples to ensure the maximum spread across

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[23] Lacy, S.; Riffe, D.; Randle, Q. *Sample Size in Multi-Year Content Analysis of Monthly Consumer Magazines* (J&MC Quarterly, Vol. 75, No.2, 1998) p. 408
[24] Ibid. p. 414
[25] Lester P.; Smith R. *African-American Photo Coverage in Life, Newsweek and Time, 1937-1988* (Journalism Quarterly, Vol. 67, No. 1, Spring 1990) p. 132
[26] Lacy, S.; Riffe, D; Stoddard, S.; Martin, H.; Kuang-Kuo C. *Sample Size for Newspaper Content Analysis in Multi-Year Studies* (Journalism & Mass Communication Quarterly, Dec. 2001) p. 837

different wine styles, with 12 editions per five years to ensure a representative number of samples.

This strategy is considered optimal for examining trends in usage over time. It does, however, have limitations when discussing topics such as first usages of the term in the corpus or first mentions in relation to a particular grape variety as these could conceivably have appeared in an intervening year not covered in the sample. Such issues will be considered and discussed as they occur.

4.2.6 Tasting note definition

From 1995, tasting notes were clearly signposted. However, before 1995 they were often included sporadically in a body of prose. The term 'tasting note' does not appear in dictionaries, so a definition was sought. The most detailed that could be found is in *The Oxford Companion to Wine*, '[tasting notes] are conventionally divided into notes for what is sensed by the eye, the nose, and for the mouth, together with overall conclusions.'[27]

Therefore it was decided that for inclusion in the study, a tasting note must refer to one specific wine and must make a substantive attempt to describe its sensory character. Notes that only gave a quality assessment, with no flavour/aroma/sensory characteristics, were not included. Short notes were permitted if they were deemed to be making a genuine attempt to describe the wine's attributes ('the number of words in a personal average tasting note can vary between one and 100.'[28]) For example, a short review of *Chablis 1er cru Fourchaumes* 'splendidly flinty and full of flavour' (1976,

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[27] Robinson, J. (ed.) *The Oxford Companion to Wine,* 3rd edition (New York: Oxford University Press Inc., 2006) p. 685
[28] Ibid. p. 685

February) was permitted, whereas a review of *Champagne de Saint Gall 1980* 'very familiar style of champagne, with good depth of flavour' (1985, July) was not.

4.3 Definition of units and categories of analysis

Coding is 'a process of selective reduction. By reducing the text to categories, the researcher can focus on and code for specific words or patterns that inform the research question.'[29]

For this study, the units coded for were 'minerality', 'mineral', 'minerals' and 'minerally'.

4.4 Development of rules for coding

Coding rules 'will keep the coding process organized and consistent. The researcher can code for exactly what he/she wants to code. Validity of the coding process is ensured when the researcher is consistent and coherent in their codes, meaning that they follow their translation rules.'[30]

As this paper focusses primarily on a single word, the coding rules are straightforward. For the most part, the terms minerality/mineral/minerals/minerally will be considered together, hereafter referred to under the umbrella term 'Minerality', with a capital 'M'. This is an important methodological consideration, given that 'minerality' has no official definition. This follows a precedent set by previous studies which suggests that these terms appear to be used interchangeably, both in the target of the studies, and within the studies themselves. For example, Maltman states: 'A glance at current writings on wine in newspapers, magazines, web blogs, company literature and the like shows frequent reference to things 'mineral' in wines. Thus a wine may have a mineral taste,

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[29] Anonymous, *Content Analysis* <http://www.publichealth.columbia.edu/research/population-health-methods/content-analysis> [accessed 03/11/21]

[30] Ibid. [accessed 03/11/21]

a mineral edge, a mineral streak, etc., or it possesses something called minerality'[31] and later, 'In striking contrast, modern popular writings are replete with mentions of minerality and the like. For example, a single article in the issue of *Decanter* magazine current at the time of writing employs the words mineral, minerally, and minerality 116 times in just a few pages.'[32] Ballester et al also consider these terms together: 'few mentions of minerality or minerality-related terms were generated at the end of the sorting task, which suggests…the experts did not tend to use minerality-related descriptors to describe their groups.'[33] No previous studies on the subject have suggested, or even considered, that there might be a difference in meaning between these terms apart from that they represent different parts of speech. However, there is an opportunity for elucidation in how they have been applied and whether that application changes throughout the corpus, which will be considered in the analysis.

4.5 Coding the text

4.5.1 Software

Once digitised, tasting notes were transferred into a Microsoft Excel spreadsheet under the following headings:

- Year of publication

- Issue

- Wine details (e.g. producer/name/brand)

- Vintage (if appropriate)

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[31] Maltman, A. *Minerality in wine: a geological perspective* p. 2
[32] Ibid. p. 3
[33] Ballester, J.; Mihnea, M.; Peyron, D.; Valentin, D. *Exploring minerality of Burgundy Chardonnay wines: A sensory approach with wine experts and trained panellists* p. 49

- Country

- Region (if appropriate)

- Sub-region (if appropriate)

- Predominant grape variety (if known)

- Tasting note

- Mention of mineral, minerals, minerally or minerality

Straightforward analyses such as collating the number of occurrences could be done within the Excel software itself to generate much of the data needed for research questions 1 and 2; more advanced analyses were required to answer research question 3, which were done with the assistance of the Sketch Engine software. Sketch Engine is an online text analysis tool that works with large samples of language to identify not only frequency of occurrence of certain terms, but also the regularity of any other terms which appear in close proximity to them.

5. RESULTS AND ANALYSIS[34]

5.1 Discussion of research question 1

5.1.1 Mineral, minerals, minerally, minerality

This paper largely follows the precedent from previous studies that consider minerality-related terms together. In this corpus, 'minerals' and 'minerality' are used as nouns, and 'minerally' an adjective. Whilst 'mineral' can be used in the English language as either a noun or an adjective, in *Decanter* it is used exclusively as an adjective. Despite being no obvious difference in meaning between the terms, there are some idiosyncrasies in how they have been deployed linguistically, further explored in 5.2.1.

5.1.2 Number of mentions

This study looked at 20,678 tasting notes, in which Minerality has been mentioned on 1,784 occasions, or in 8.6% of the sample.

To see how this compares to other descriptors, a search was undertaken for other common tasting terms as listed in the WSET's *Level 2 Wine-Lexicon*,[35] which can be found in Appendix 1. The WSET's materials were chosen as a reliable standard for this analysis as they are globally recognised as the world's leading provider of wine education.[36]

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[34] Ful data for Figs. 3-14, 16-20 are presented in Appendix 3
[35] Wine and Spirit Education Trust *Wines and Spirits: Looking Behind the Label* (London: Wine & Spirit Education Trust, 2014) p. 3
[36] Robinson, J. (ed.) *The Oxford Companion to Wine,* 3rd edition p. 769

By this metric, minerality and its variations are the fourth most widely used descriptors in the corpus as can be seen in Table 1, which lists the 15 most used descriptors. This data includes the lemma and all of its possible variations (e.g. plummy, cherries, minerality) and counts every instance of the terms in the corpus.

Table 1*: Most used flavour descriptors*

Wine Descriptor	Number of times used	% of tasting notes
spice	3808	18.4%
oak	3551	17.2%
cherry	1972	9.5%
mineral	1784	8.6%
plum	1289	6.2%
floral	1221	5.9%
cream	1179	5.7%
apple	1042	5.0%
citrus	911	4.4%
nut	889	4.3%
pepper	849	4.1%
honey	792	3.8%
lemon	715	3.5%
green	700	3.4%
peach	691	3.3%

5.1.3 Wine colour

Minerality is predominantly used to describe white wines, where it has occurred 949 times, as shown in Table 2:

Table 2: Mentions of Minerality by colour

Wine category	Mentions of Minerality	Number of tasting notes	% of mentions of Minerality
White	949	4937	19.2%
Red	681	13205	5.2%
Sparkling	81	1123	7.2%
Rosé	39	281	13.9%
Sweet	27	590	4.6%
Orange	5	46	10.9%
Fortified	4	496	0.8%
All	1784	20678	8.6%

It has also been used quite frequently to describe red wines, which account for 681 of the total. However, this is slightly misleading as there have also been many more reviews for red wines (13,205) than white wines (4,937) across the corpus. Looking at the colour split as a percentage of tasting notes is more illuminating.

Fig. 2: *Mentions of Minerality by wine colour, as a percentage of total tasting notes*
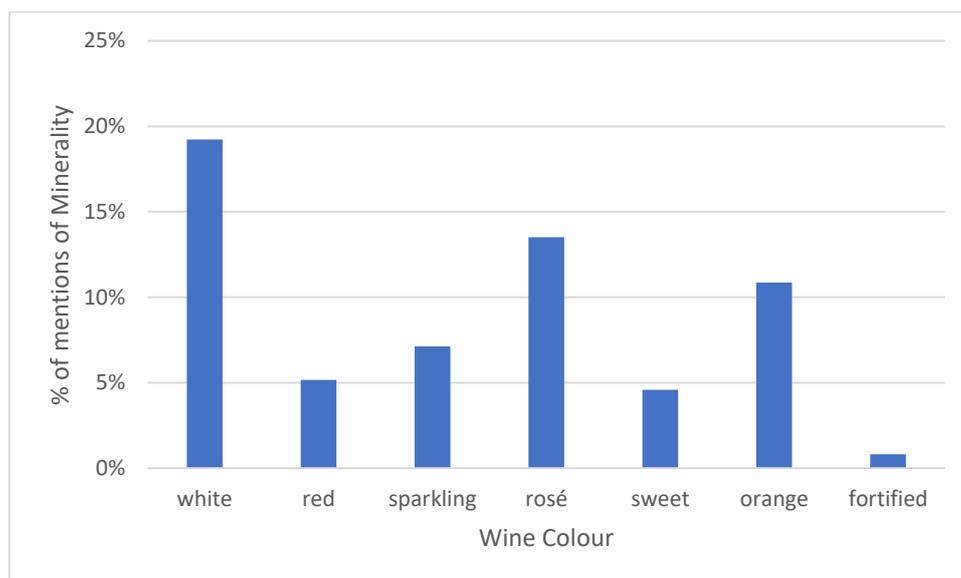
That the term is most associated with white wines (19.2%) is an anticipated result, and consistent with the focus on white wines in the existing literature. There is only one study that considers red wines,[37] and the data here shows that while Minerality is less frequently used to describe red wine (5.2%), it is still a common descriptor. No existing studies consider rosé or sparkling wines.

To understand the relative frequency of these terms compared to other popular descriptors, an analysis was undertaken to find the top ten terms used in each major category of wine as presented in Table 3. Search terms were again selected from the WSET's *Level 2 Wine Lexicon*.

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[37] Zaldívar, E. *Caracterización químico-sensorial en vinos blancos y tintos del atributo mineralidad*

Table 3: *Mentions of Minerality by colour*

Red		
Descriptor	No. of mentions	% of red reviews
spice	2999	22.7%
oak	2841	21.5%
cherry	1893	14.3%
plum	1147	8.7%
pepper	695	5.3%
mineral	681	5.2%
floral	629	4.8%
chocolate	620	4.7%
blackberry	596	4.5%
violet	593	4.5%

White		
Descriptor	No. of mentions	% of white reviews
mineral	949	19.2%
oak	839	17.0%
apple	750	15.2%
citrus	742	15.0%
spice	591	12.0%
honey	519	10.5%
lemon	513	10.4%
peach	501	10.1%
floral	479	9.7%
cream	476	9.6%

Rosé		
Descriptor	No. of mentions	% of rosé reviews
mineral	39	13.9%
cream	38	13.5%
peach	35	12.5%
strawberry	32	11.4%
floral	30	10.7%
cherry	30	10.7%
raspberry	27	9.6%
orange	26	9.3%
redcurrant	15	5.3%
apple	14	5.0%

Sparkling		
Descriptor	No. of mentions	% of sparkling reviews
cream	191	17.0%
apple	178	15.9%
lemon	105	9.3%
citrus	97	8.6%
honey	89	7.9%
floral	84	7.5%
mineral	81	7.2%
spice	69	6.1%
peach	65	5.8%
pear	62	5.5%

The term does not appear in the list of top descriptors for sweet or fortified wines, and there is insufficent data in the corpus to discuss orange wine. This analysis shows Minerality to be the most used descriptor for white and rosé wines, however with only 281 reviews for rosé in the corpus the latter result should be approached with caution. This data shows that the term is the sixth and seventh most commonly used descriptor for red wines and sparkling wines[38] respectively. This indicates that there is an opportunity for further research beyond its application in white wines.

5.1.4 Grape varieties

The term is used across a wide array of grape varieties. Table 4 shows all varieties that have been described as 'mineral' in the corpus.

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[38] Sparkling wines are not discussed further in this study due to the relatively limited data provided by the corpus for this category

Table 4: _Grape varieties described as mineral_

White/pink varieties described as mineral		Red varieties described as mineral
Albarino	Grüner Veltliner	Baboso Negro
Albillo	Hárslevelű	Barbera
Aligote	Malagousia	Bonarda
Arinto	Malvasia	Cabernet Sauvignon
Arneis	Marsanne	Cabernet Franc
Assyrtiko	Melon Blanc	Carignan
Bacchus	Muscat	Carménère
Carricante	Palomino	Ciliegiolo
Cataratto	Pedro Ximénez	Cinsault
Chardonnay	Petite Arvine	Dolcetto
Chasselas	Petit Manseng	Frapatto
Chenin Blanc	Pinot Gris	Gamay
Clairette	Picpoul	Garnacha
Colombard	Pinot Blanc	Listán Negro
Cortese	Ribolla	Listán Prieto
Encruzado	Riesling	Malbec
Falanghina	Roussanne	Mencía
Fetească Regală	Sauvignon Gris	Merlot
Friulano	Sauvignon Blanc	Nebbiolo
Furmint	Semillon	Nerello Mascalese
Garganega	Tocai Friulano	Nero d'Avola
Garnacha Blanca	Torrontés	Petit Verdot
Gewürztraminer	Verdejo	Pinot Noir
Godello	Verdicchio	Sangiovese
Greco	Viognier	Syrah
Grenache Gris	Xarel-lo	Tannat
Grillo	Xynisteri	Tempranillo
		Teroldego

The full corpus represents 173 unique grape varieties.[39] As shown here, 82 (47.4%) have been described as mineral at least once. This further shows the widespread usage of the term across many different styles of wine.

There are few obvious commonalities between these varieties, which supports existing research that suggests the term is used idiosyncratically and inconsistently.

5.1.5 White grape varieties

The white variety most commonly described as mineral is Chardonnay closely followed by Sauvignon Blanc, then Riesling. Table 5 shows the frequency of usage for the top five white grape varieties that have at least 100 reviews.

Table 5: *Top white varieties by frequency*

White grape variety	Total reviews	Mentions of mineral	%
Chardonnay	1782	418	23.5%
Sauvignon Blanc	443	102	23.0%
Riesling	828	164	19.8%
Grüner Veltliner	128	20	15.6%
Chenin Blanc	249	26	10.4%

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[39] Varieties with synonyms such as Pinot Gris/Pinot Grigio, or Vermentino/Rolle are counted as one single variety

5.1.6 Red grape varieties

The same analysis for red wines shows that mentions of Minerality are split more evenly across a larger number of varieties (Table 6), with one notable exception.

Table 6: Top black varieties by frequency

Black grape variety	Total reviews	Mentions of mineral	%
Gamay	264	63	23.9%
Cabernet Franc	108	9	8.3%
Dolcetto	128	8	6.5%
Syrah/Shiraz	901	57	6.3%
Nebbiolo	529	33	6.2%

Minerality is used in 23.9% of all reviews of Gamay, making it the most likely variety of any colour to be described using the term.

Exploring potential for Minerality in different varieties is highlighted in another study as being an interesting avenue for further research.

> To increase clarity in the field, we suggest that more consideration be given to wine variety in future studies, with potential for both sensorial and chemical aspects of minerality to differ as a function of wine variety and wine-production style.[40]

This data suggests that Chardonnay is the strongest candidate for further study, as not only is it the white wine most frequently described as 'mineral', it also has the largest number of reviews and mentions, which lends weight to the evidence presented. Sauvignon Blanc and Riesling are also suggested with confidence given their high likelihood of eliciting the term from reviewers.

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[40] Parr, W.V.; Maltman, A.; Easton, S.; Ballester, J. *Minerality in Wine: Towards the Reality behind the Myths* p. 16

As suggested in 5.1.3, it should be considered that Minerality in red wine is currently an under-explored area. The data here suggests that should such studies be undertaken, Gamay is the best candidate for future research.

5.1.7 Wine styles

Of the major styles of wine (e.g. Chilean Merlot, Australian Shiraz, German Riesling), the most likely to be described as mineral is Sancerre, where the term is mentioned 46.3% of the time.

Table 7 shows the fifteen wine styles most commonly described as mineral that have at least 100 reviews, expressed as a percentage of their total reviews.

Table 7: *Wine styles most commonly described as mineral*

Wine Style	Total Reviews	Mentions of mineral	%
Sancerre (White)	121	56	46.3%
Puligny-Montrachet (White)	149	60	40.3%
Chassagne-Montrachet (White)	128	47	36.7%
New Zealand Chardonnay	108	38	35.2%
Chablis	311	107	34.4%
Australian Riesling	146	38	26.0%
Beaujolais (Red)	248	62	25.0%
Meursault (White)	203	45	22.1%
Alsace Riesling	131	29	22.1%
New Zealand Pinot Noir	111	22	19.8%
Austrian Grüner Veltliner	126	20	15.9%
Portuguese Red Blends	177	29	16.4%
German Riesling	467	73	15.6%
Californian Chardonnay	134	15	11.2%
N. Rhône Syrah	201	22	11.0%

White burgundy is a strong candidate for further study, accounting for four of the top eight wine styles represented. It is notable that Chablis is less commonly described as mineral in the corpus than either Puligny-Montrachet or Chassagne-Montrachet, given that Chablis bears one of the first uses of the term uncovered in the literature review, and remains one of the styles most frequently linked to Minerality in popular literature

on the subject.[41] This suggests that more focus might be given to other subregions within Burgundy as a number of tasters are regularly associating Minerality with these other appellations as well.

The predominant red wine featured is Beaujolais, which was expected given the frequency with which Gamay is described using these terms.

However, whilst this evidence suggests these varieties and styles to be the most fruitful options for further research, it does also potentially show a limitation of the research generated by human behaviour. Just because 46.3% of Sancerre reviews contain a reference to Minerality, it cannot be assumed that this is the most 'mineral' wine style. The results here could be skewed by top-down processing, that is: 'information processing that proceeds from information already stored in memory, especially general assumptions or presuppositions about the material being processed, as when a person forms a hypothesis on the basis of existing schemata and prior experience about what an object might be and then uses sensory evidence to corroborate or disconfirm the hypothesis.'[42]

In other words, tasters are potentially conditioned pre-emptively to associate certain wine styles with being more mineral than others and so more likely to use the term. Therefore in order to shed further light on the concept of Minerality, further analyses are needed and considered in section 5.3.

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[41] Maltman, A. Minerality in wine: Where are we now? <https://www.decanter.com/wine-news/opinion/guest-blog/minerality-in-wine-429893/> [accessed 20/11/21]

[42]Anonymous, *Top-Down Processing* <https://www.oxfordreference.com/view/10.1093/oi/authority.20110803104932817?rskey=ZJnlgC&result=6> [accessed 15/11/21]

5.2 Discussion of research question 2

5.2.1 Mineral, minerals, minerally, minerality

Although no semantic difference was noted between these terms, there are a number of ways in which their usage differs throughout the corpus. Fig. 3 shows the popularity of each of these terms individually.

Fig. 3: *Mentions of mineral, minerals, minerally and minerality*
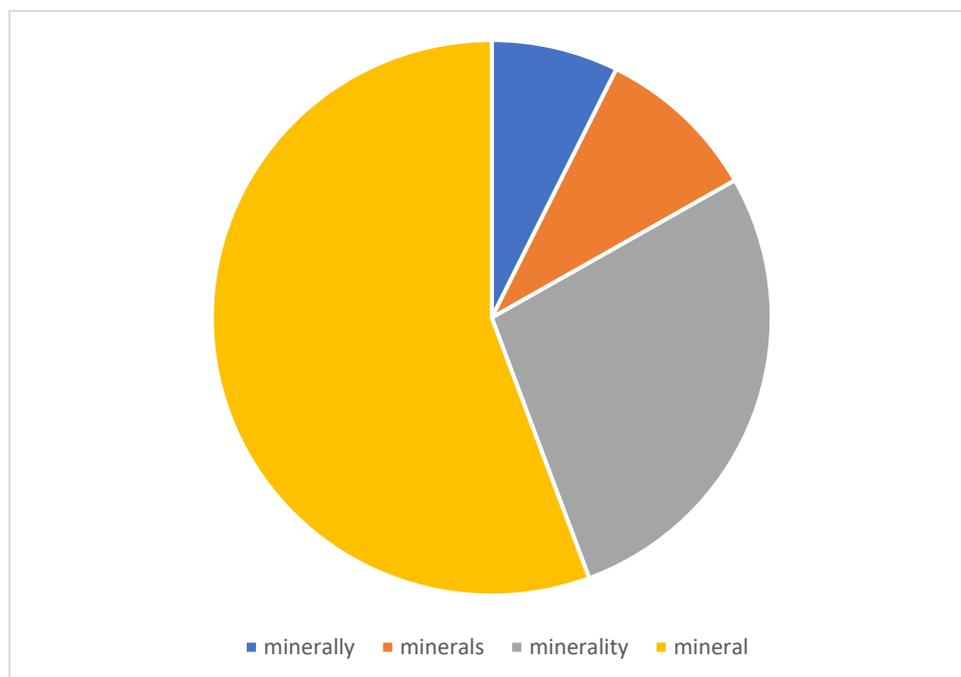
'Mineral' is by far the most common variation with 56% of mentions, followed by 'minerality' with 28%. 'Minerals' and 'minerally' are both much less frequently used. Fig. 4 shows how usage of these variations has changed over time.

Fig. 4: *Mineral, minerals, minerally and minerality over time*
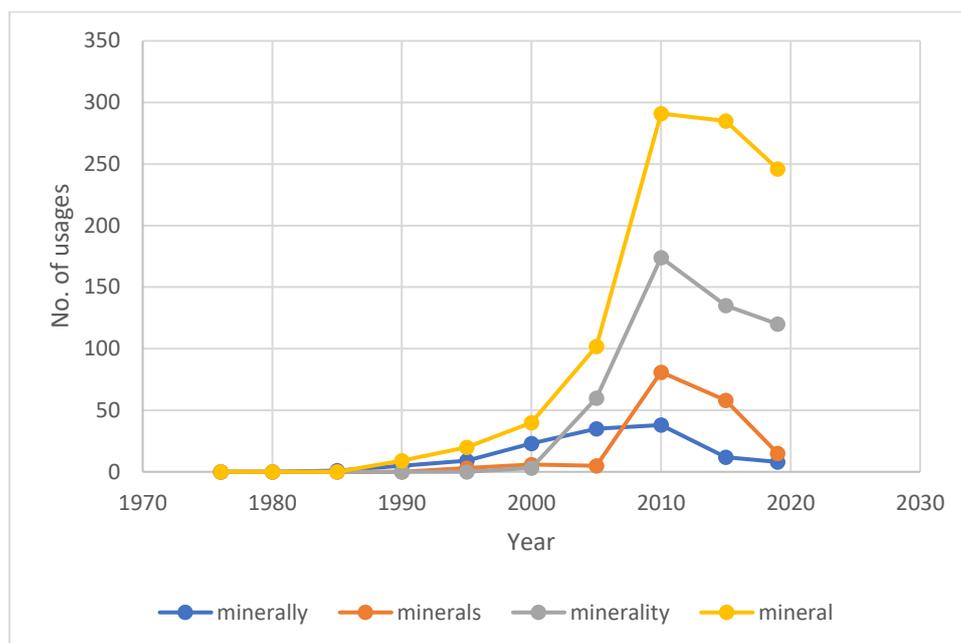
Although the term 'minerality' has become the primary focus for this study and others, this research suggests that it is a much more recent addition to the language than its cognates. In the *Decanter* corpus it did not appear until July 2000, where it was used to describe Cantina Colterenzio Pinot Grigio 1999, from Alto Adige:

> Fresh, crisp, appley fruit. Taut acidity with good firm fruit, minerality and a touch of oilyness. Good concentrated firm finish.

The first mention of any mineral-related term was in December 1985, describing Daniel Bissey's 1982 Vosne-Romanée 1er Cru Les Beaumonts:

> I thought was admirable. It had all the spicy scent of Vosne, with the typical minerally nose which I associate with the Appellation, and a glorious violetty finish. Bravo M. Bissey.

The term does not appear in the corpus again until October 1990, in relation to the Cabernet Riserva, Alois Lageder, Südtirol 1986:

> Quite a full, round, earthy, Sud Tirol nose; black and rather minerally pepper, and a touch of softness too.

It was March 1990 when 'mineral' was introduced and superseded 'minerally' as the most popular cognate, where it remains. The first example was written in relation to Santenay 1er Cru Les Gravières 1987, Olivier Leflaive:

> Positive creamy-ripe nose, with delicate scents of woodland fern; dryish, but well-fleshed oaky fruit concentration, and mineral nerve from the red soil. Archetypal fine Burgundy, for drinking soon.

Finally, it was October 1995 when 'minerals' first appeared describing Châteauneuf-du-Pape, Clos des Papes 1984:

> This is a wine whose bouquet is full of stewed aromas, some red fruit, some pepper; there is some discreet fatness in a generally well-sustained flavour, and while the finish is a little short, the wine could live towards 2004. Flavour associations with these years are resins and minerals rather than garden or hedgerow fruits in sweet or dry form; fruit smells on the bouquets tend to be stewed rather than fresh or clear-cut.

These first occurrences in the corpus provide a valuable historical perspective, however because the study utilises a sampling strategy instead of a comprehensive analysis of every printed edition, it remains possible that earlier examples of each of these terms might exist in editions not included in the sample.

However, what it does show clearly is another noteworthy trend over time. Fig. 5 shows the percentage mentions of each of the terms for every year of the sample.

Fig. 5: *Percentage split of mineral, minerals, minerally and minerality over time*
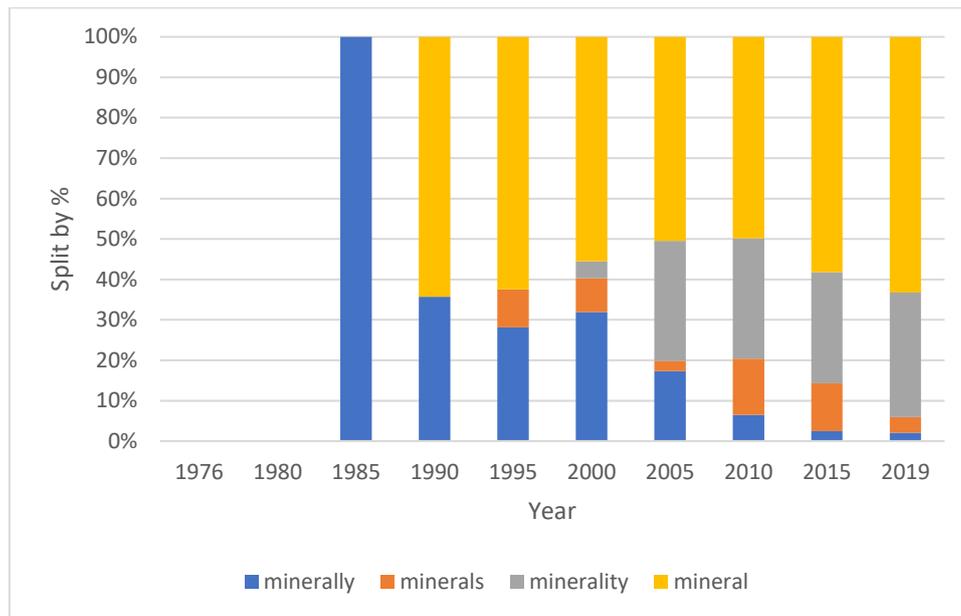
Here we can see that in the early years 'minerally' and 'mineral' were the only cognates used, and then a gradual change over time sees 'minerally' and 'minerals' become almost obsolete. It seems that in today's language just two terms are regularly used; 'mineral' is the adjective of choice and 'minerality' the noun. There are no obvious causes identified that would account for this, and so it is suggested this is most likely an example of changes in fashion and the natural ebb and flow of language. The wine lexicon's ability to evolve is charted in detail in Shapin's *The Tastes of Wine: Towards a Cultural History*[43] (2012) and is also well-documented in Lehrer's *Wine and Conversation* (2009): 'All languages have resources that enable speakers to increase their vocabulary—by adding new words and by extending the meanings of existing words. The wine vocabulary illustrates these processes very clearly.'[44]

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[43] Shapin, S. *The Tastes of Wine: Towards a Cultural History* (Rivista di estetica Vol. 51, 2012)
[44] Lehrer, Adrienne *Wine and Conversation* p. 19

5.2.2 Nose or palate

The existing literature suggests that there is no consensus around whether Minerality is used primarily as a nose or palate sensation.[45] Fig. 6 shows the split of references for the nose and the palate over time.

Fig. 6: *References to perception of Minerality on nose or palate over time*
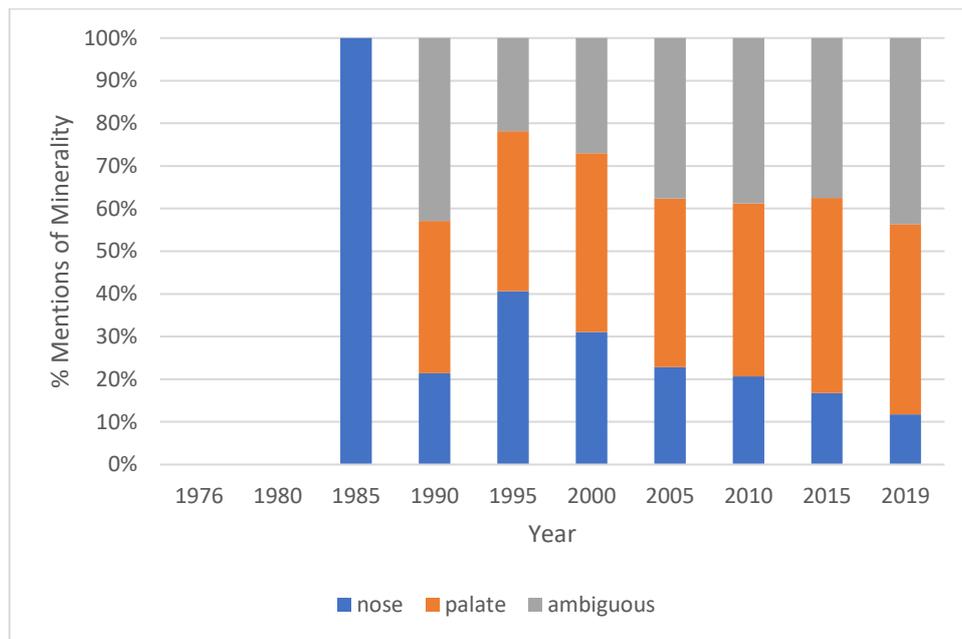
There are a large number of reviews where the term is used ambiguously and it is unclear if the reviewer is referring to a nose or palate sensation. These ambiguous reviews have the potential to sway the data towards either the nose or the palate, and so firm conclusions about whether Minerality is primarily a nose or palate sensation are fraught. However we can conclude that many reviewers find the term to be a useful descriptor for both, and the data suggests it is more regularly used to describe a palate sensation, particularly recently. The proportion of references to the palate has

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[45] Parr, W.V.; Maltman, A.; Easton, S.; Ballester, J. *Minerality in Wine: Towards the Reality behind the Myths* p. 2

remained consistent, whereas there is a clear trend for Minerality to be less directly associated with the nose over time.

There also appears to be no major difference in where a mineral character might be perceived between red and white wine, as shown in Fig. 7.

Fig. 7: References to nose or palate by wine colour
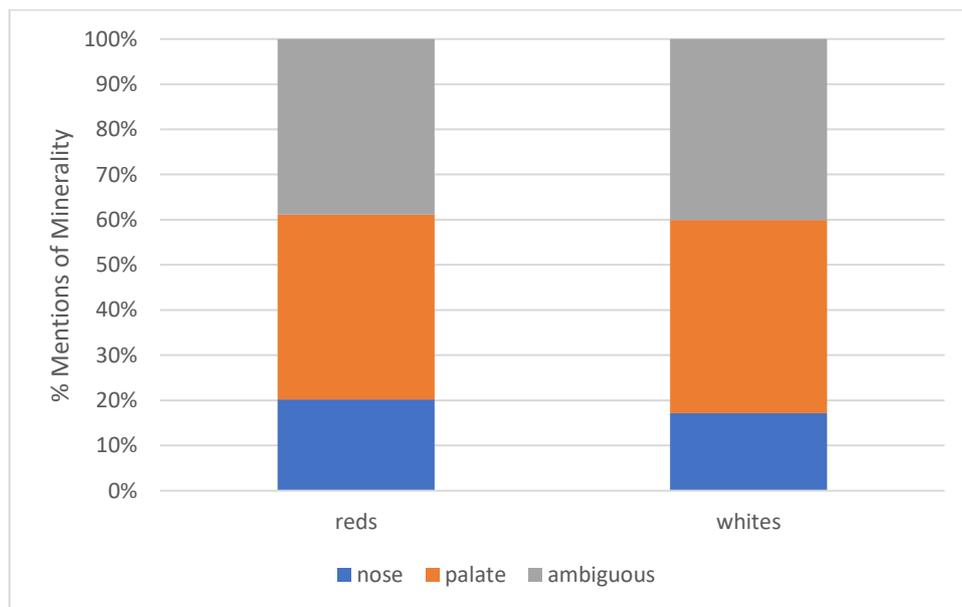
5.2.3 References to Minerality by year

Table 8 shows the number of mentions of Minerality in each year of the *Decanter* corpus.

Table 8: Mentions of Minerality by year

Year	References to Minerality
1976	0
1980	0
1985	1
1990	14
1995	32
2000	72
2005	202
2010	584
2015	490
2019	389
Total	1784

The first mention in this corpus was in 1985 and instances were very limited until the year 2000 when it became more widespread. This, combined with the data from previous studies, confirms that although references to Minerality existed earlier, it did not become a commonly used term until some time around the turn of the century.

The data shows a notable increase in usage over the period of this study, from one mention in 1985, to 584 at its peak in 2010. However, this must be considered in the context of an increase in the total number of tasting notes published, as shown in Table 9.

Table 9: *Number of tasting notes per year*

Year	Total no. of tasting notes
1976	349
1980	719
1985	980
1990	1164
1995	1146
2000	1615
2005	2940
2010	3974
2015	4048
2019	3743
Total	20678

The most useful analysis is to consider mentions of Minerality as a percentage of total

tasting notes, as shown in Fig. 8:

Fig. 8: Mentions of Minerality as a percentage of tasting notes

Fig. 8: Mentions of Minerality as a percentage of tasting notes
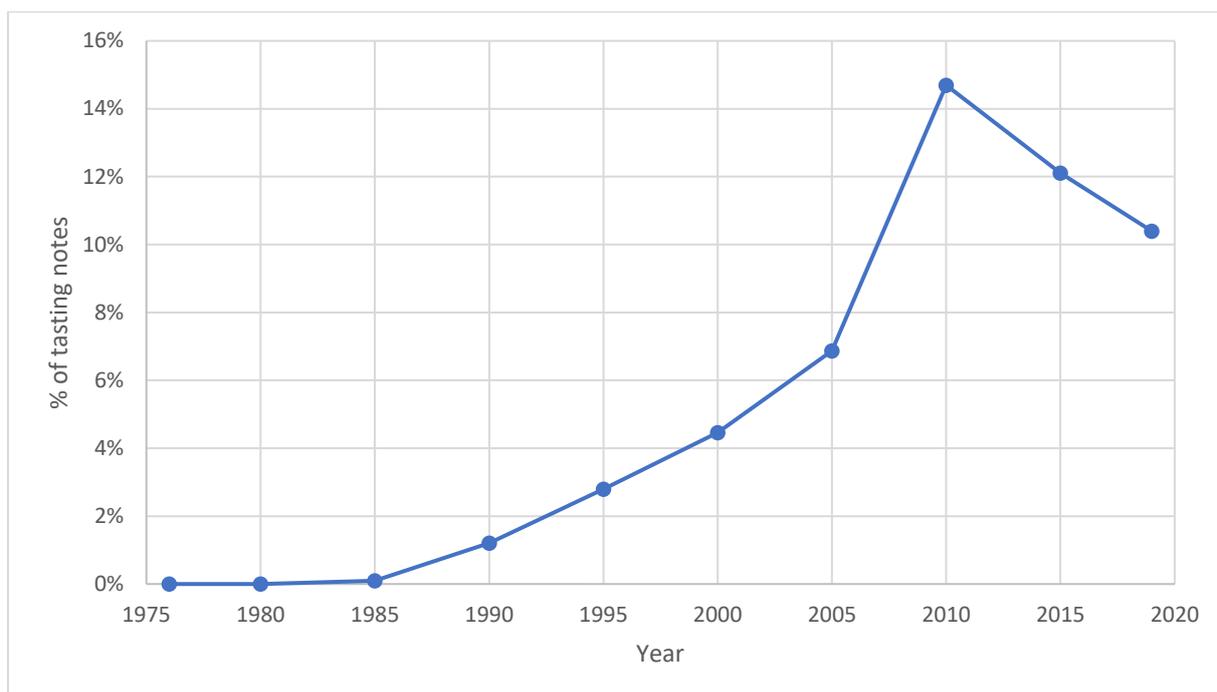
This shows a steady and uniform rise in prevalence for the 15-year period from 1985 to 2000, followed by a much sharper climb from 2000 to 2010. A marked decline occurred between 2010 and the present day.

The reason for this decline is unclear, but there are three possible hypotheses to consider: that wine styles are changing and becoming less mineral, that the term is becoming less popular and falling out of fashion, or that fluctuations in the frequency and range of wines being reviewed each year are affecting the data.

There is evidence to support all three hypotheses. Although the literature shows a diverse interpretation of the meaning of Minerality, there are some consistencies suggested in attributes that most commonly associate with the term, as described in the literature review. Amongst these are a sense of freshness deriving from high acidity, and a citrus character in white wines – characteristics commonly associated with cooler climates, and it is notable that most of the main wine styles associated with Minerality in 5.1.7. hail from cooler regions, and/or high acidity varieties. The link

between Minerality and cool climates has been suggested in previous research on the topic,[46] with Palacios and Molina finding that 'Minerality was associated with certain distinctions such as lower pH and higher acidity in whites particularly those from northern latitudes or marginal cold climate regions.'[47]

Many regions are experiencing the effects of climate change and experiencing warmer growing seasons leading to higher alcohol, lower acidity and riper fruit flavours.

One such example is Chablis, which is also a region whose wines are regularly cited as 'mineral'. One study looking at climate change in this region stated:

> Mean spring/summer temperature increased by almost 0.5 °C per decade between 1963 and 2020 and slightly more so than mean autumn/winter temperature cumulatively. The mean maximum rose considerably more than the mean minimum temperature. Similarly, the number of days reaching or exceeding 35 °C between 1st April and 30 September each year has risen from close to zero to almost six days; much of this occurred between 2015 and 2020.[48]

This appears to be manifesting itself in tasting notes. Fig. 9 shows the number of times Chablis has been described as mineral, as a percentage of its total reviews.

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[46] Deneulin P.; Le Fur, Y.; Bavaud, F. *Study of the polysemic term of minerality in wine: Segmentation of consumers based on their textual responses to an open-ended survey,* p. 289

[47] Palacios, Antonio, Molina, David *Chemical Basis of Minerality perception in Wines* (Excell Ibérica and Outlook Wine, March 2015) p. 27

[48] Biss, A., Ellis, R. *Modelling Chablis vintage quality in response to inter-annual variation in weather* (OENO One, 2021, 55(3), 209–228) p. 213

Fig. 9: *References to Minerality in Chablis*
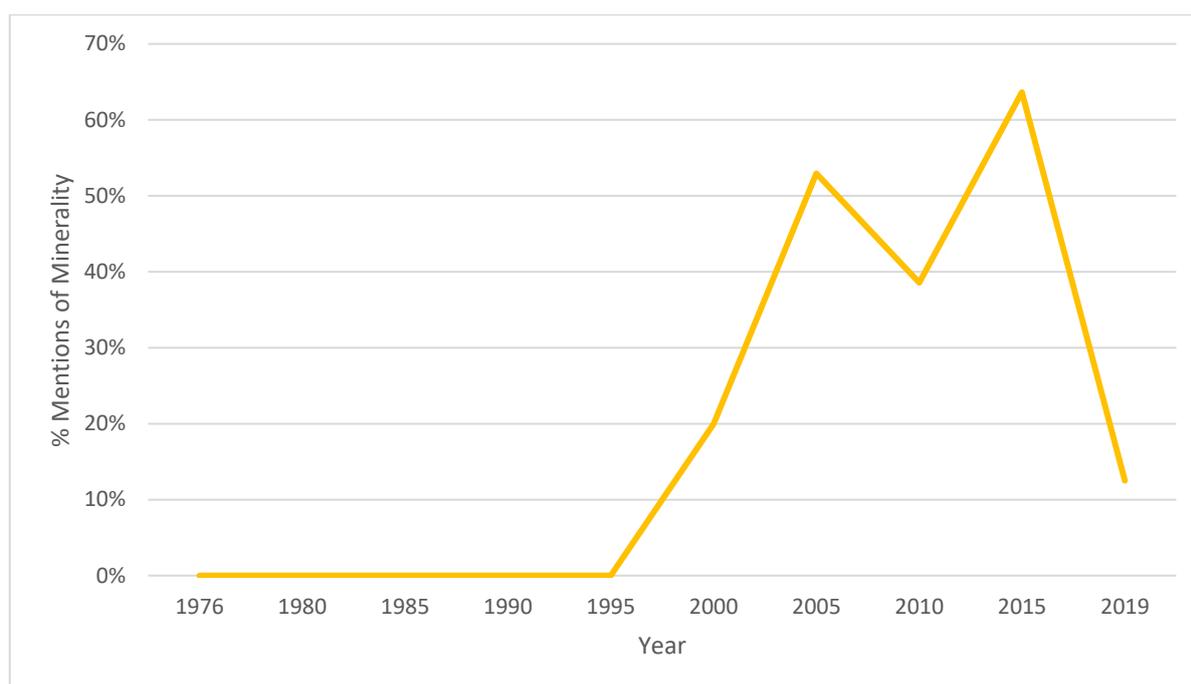
Here a sharp decline can be seen in 2019 compared to the period 2005-2015. The reviews for this year come mainly from the December edition which contained 40 reviews of 2018 Chablis, where Minerality was only mentioned 5 times. Tim Atkin MW said this of the 2018 vintage:

> Make no mistake: this was a climate change vintage, registering temperatures that hit a peak of 38.4C… As you'd expect, given the growing season, the wines are generally on the soft side, although they have tightened up in tank, barrel and bottle to a certain degree. They are mostly wines for comparatively young drinking, with low to medium levels of acidity, which are compensated for by higher ones of dry extract in certain cases.[49]

Therefore this evidence would seem to suggest that hotter vintages like this are less likely to produce a mineral character, and with global temperatures continuing to rise, that may account, at least partly, for a reduction in the prevalence of the term.

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[49] Atkin, T. 2018 Chablis Scores <https://timatkin.com/product/chablis-2018-scores/> [Accessed 20/11/21]

Alternatively this downturn could be a result of the term starting to go out of fashion. There has been an increasing level of controversy over its usage in recent years. Many wine commentators believe the word to be overused, and have expressed a growing sense of frustration at its nebulous definition and liberal application.[50] In January 2020 The International Wine Challenge's magazine *Canopy* surveyed 400 international wine experts to discover the word they would most like to see banned from tasting notes, and 'minerality' was the 'clear winner'. The judges said 'the word is "too generic", "overused", "misused", "vague", "misleading", and "without any proper meaning".'[51] This generic usage was alluded to in 5.1.4 which showed 47.4% of grape varieties represented in the corpus have at one time been described as mineral. Fig. 10 shows that this spread across varieties has increased over time.

Fig. 10: *Percentage of varieties described as mineral*

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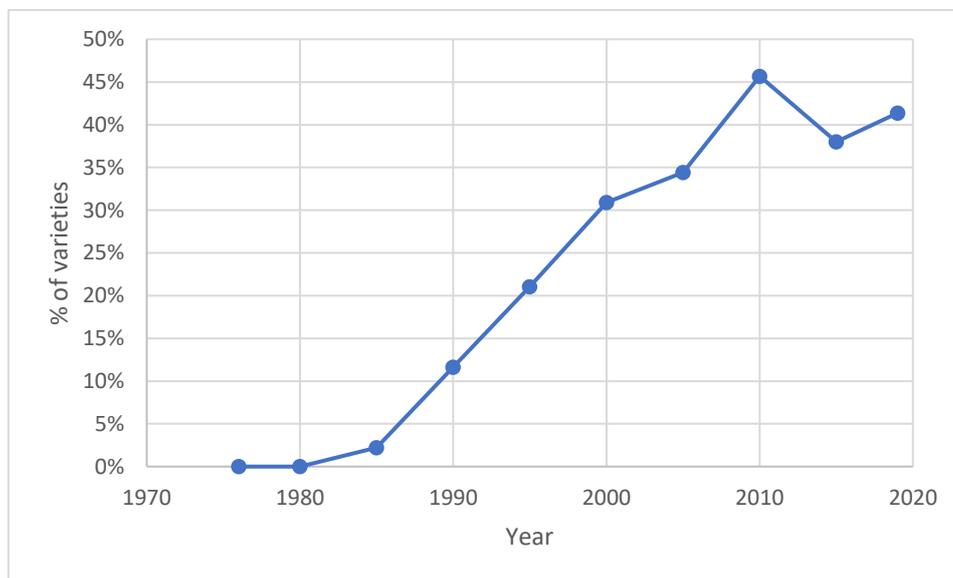
[50] Anonymous, *Old stones, old wines, new theories* <https://worldoffinewine.com/2014/10/28/old-stones-old-wines-new-theories-4418498/> [Accessed 20/11/21]

[51] Boiling, C. Minerality: IWC judges' view (Canopy Magazine, 28th January 2020) <https://www.internationalwinechallenge.com/Canopy-Articles/minerality-iwc-judges%E2%80%99-view.html> [Accessed 20/11/21]

As with the number of reviews using the term, the percentage of varieties described as mineral has increased markedly since the 1980s and peaked in 2010, where of the 81 unique grape varieties reviewed that year, 37 (45.7%) were described as mineral. This has also seen a slight downward trend since 2010 but remains high. This liberal spread across so many different wine styles could be driving such frustrations amongst wine commentators.

One further trend was noted which seems to support this. Fig. 11 shows the number of occasions the term 'minerality' was directly modified by a preceding adjective, in order to add a sense of meaning, for example 'stony minerality' or 'gravelly minerality'.

Fig. 11: Percentage of occasions 'minerality' is modified
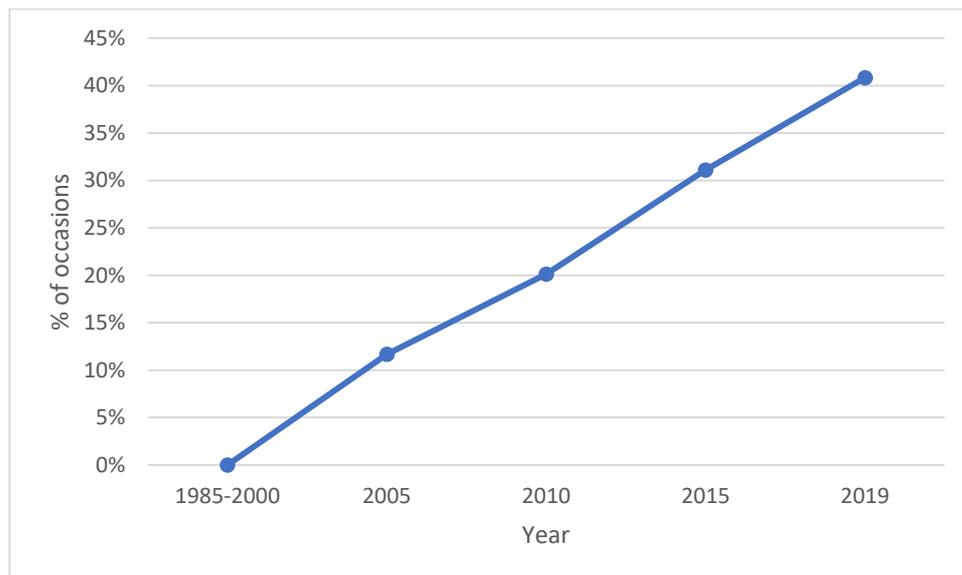
This shows a clear trend that reviewers are increasingly attempting to clarify their use of the term by associating it with another tangible wine characteristic, much more regularly than previously. This would suggest that there is now a greater attempt to achieve precision of language, and overcome the accusations of vagueness highlighted above, and this trend for qualifying the term shows no sign of abating; by

2019 over 40% of instances were qualified in some way. The specific descriptors used will be explored in 5.3.1.

The third hypothesis is that variation in wines being reviewed in the sample is fluctuating and affecting the data. Table 5 showed that the white varieties most commonly described as mineral are Chardonnay, Sauvignon Blanc and Riesling. Fig. 12 shows the proportion of total white wine reviews accounted for by these varieties per year.

Fig. 12: Percentage of Chardonnay, Riesling and Sauvignon Blanc white wine reviews per year
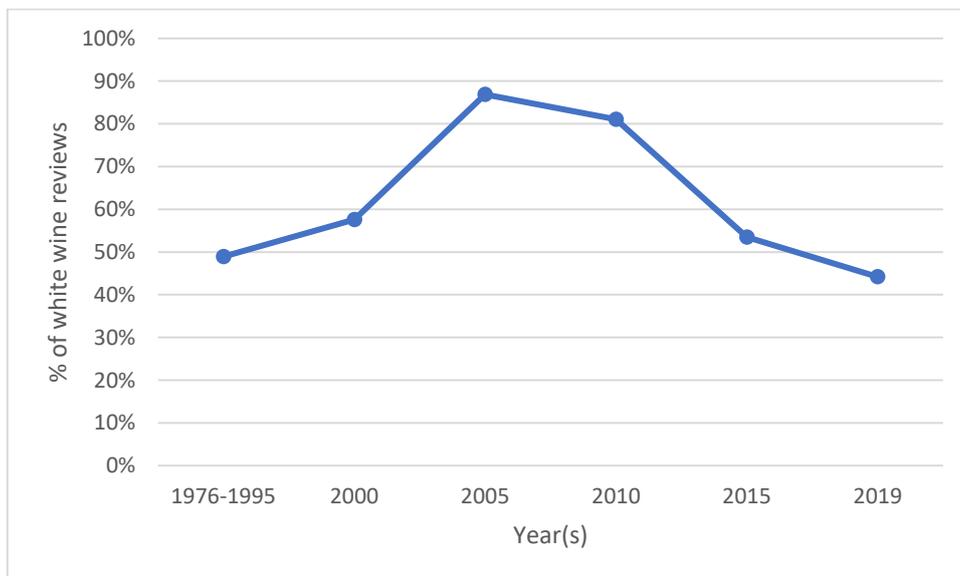
In 2005 and 2010, over 80% of all white reviews were for these three varieties compared to 53.5% in 2015 and 44.2% in 2019. A smaller proportion of reviews focussed on these key 'mineral' varieties is likely to have affected its prevalence. So although the data in this study suggests that the term is becoming less widely used, further study would be needed that looked at the intervening years not covered in the

sample to understand how much influence fluctuations in varieties have on the term's usage.

However, reviews for these varieties still show a marked decrease in Minerality descriptors since 2010 where 41.6% of reviews referenced Minerality compared to 17.2% in 2019, as shown in Fig. 13.

Fig. 13: Percentage of 'mineral' reviews in Chardonnay, Riesling and Sauvignon Blanc
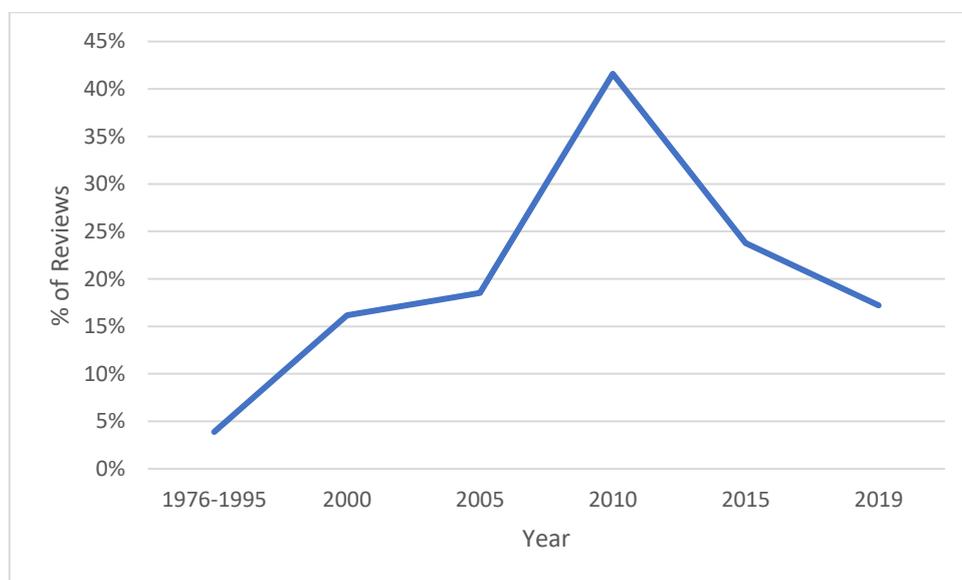
5.2.4 Wine colour

Whilst Minerality has always been used predominantly to describe white wines, in the earlier years of the study this was almost exclusive. Its application to reds has grown since the turn of the century, peaking at almost 10% in 2015, as shown in Fig. 14.

Fig. 14: *Frequency of usage over time by wine colour*
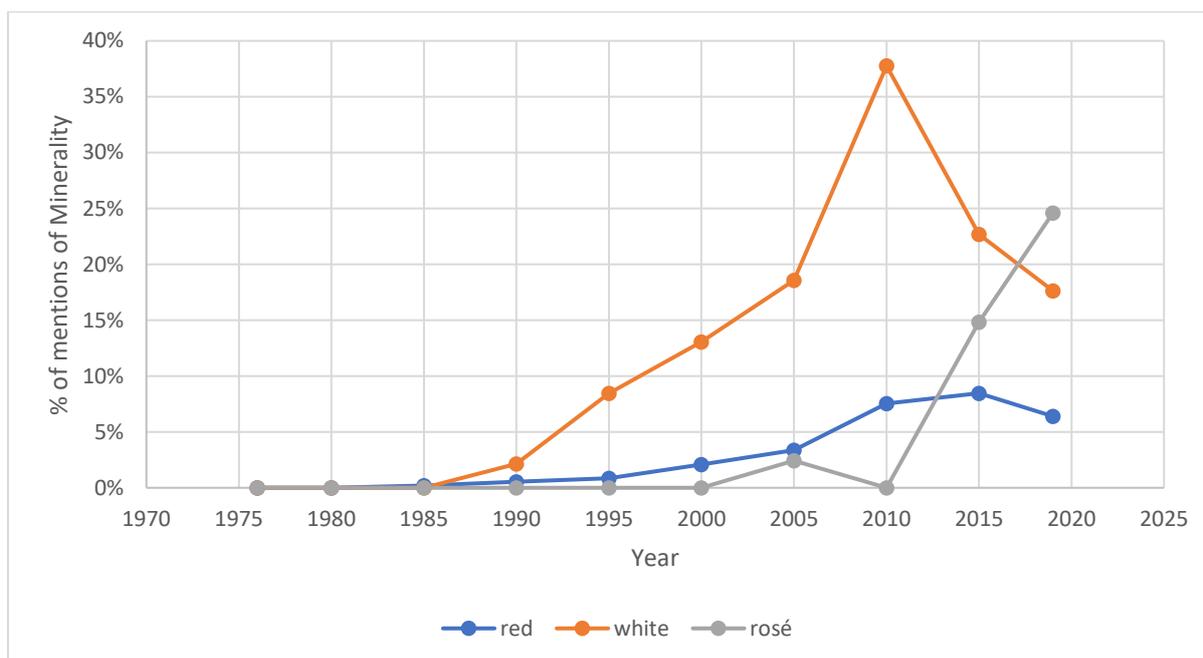
The rise in usage for white wines has been much steeper, with the term used in almost 10% of all white tasting notes by 1995, rising to a peak of 37.8% in 2010. Since 2010 for whites and 2015 for reds, both colours have seen a drop in usage that is consistent with previous analyses. Usage with rosé has taken the longest to gain traction and was practically non-existent until 2015, but has shown a dramatic increase since then. However this style of wine has far fewer reviews in the corpus, with just 281 entrants in total and 37 usages of the term. Therefore results are more likely to fluctuate and are less reliable than the data produced for red and white wine. For styles of wine with fewer reviews, there is greater potential for individual commentators who might have a fondness of the term to skew the data. However, when considering other major styles and categories of wine, the data is more commonly drawn from several contributions spread across a year's worth of editions featuring a much wider range of writers. The data produced in such cases is therefore considered more robust and reliable, although because of the nature of the source material in this study, this factor can

never be entirely mitigated. In the instance of rosé, almost all 'mineral' reviews were found in August 2019 and clearly display one individual's penchant for the term.

5.3 Discussion of research question 3

Whilst the existing literature suggests the term is used idiosyncratically, it remains plausible that there are some consistencies in its usage that might further our understanding of its meaning. By exploring other terms that have come to coexist alongside Minerality, conclusions can be drawn about what attributes most commonly associate positively or negatively with a 'minerally' wine.

5.3.1 Direct modifiers

The first analysis looks at direct modifiers of these terms, to see which descriptors have become regularly employed by tasters with the intention of elucidating the perceived mineral sensations.

Fig. 11 showed that the term has become increasingly qualified over time, suggesting attempts to achieve greater precision of usage. Table 10 shows the specific adjectives employed across the corpus that directly precede the two nouns 'minerals' and 'minerality'. This data is limited only to terms that have been used at least three times in the corpus.

Table 10: Direct modifiers of 'minerality' and 'minerals'

Term	Frequency	Category		Term	Frequency	Category
good	17	hedonic		earthy	5	earthy
lovely	17	hedonic		smoky	5	smoky
fine	16	hedonic		steely	5	metal
nice	14	hedonic		stone	5	stone
chalky	13	stone		attractive	4	hedonic
salty	10	salt		clean	4	acidity
stony	10	stone		elegant	4	hedonic
saline	9	salt		refreshing	4	acidity
great	8	hedonic		cool	3	acidity
flinty	8	stone		piquant	3	acidity
slatey	7	stone		spicy	3	spice

Looking at the semantic relationships between these words, the majority of the terms belong to only four semantic fields: hedonic liking, stone-related terms, acidity/freshness terms and salt-related terms, as shown in Fig. 15.

Fig. 15: Direct modifiers of 'minerals' and 'minerality' by semantic fields
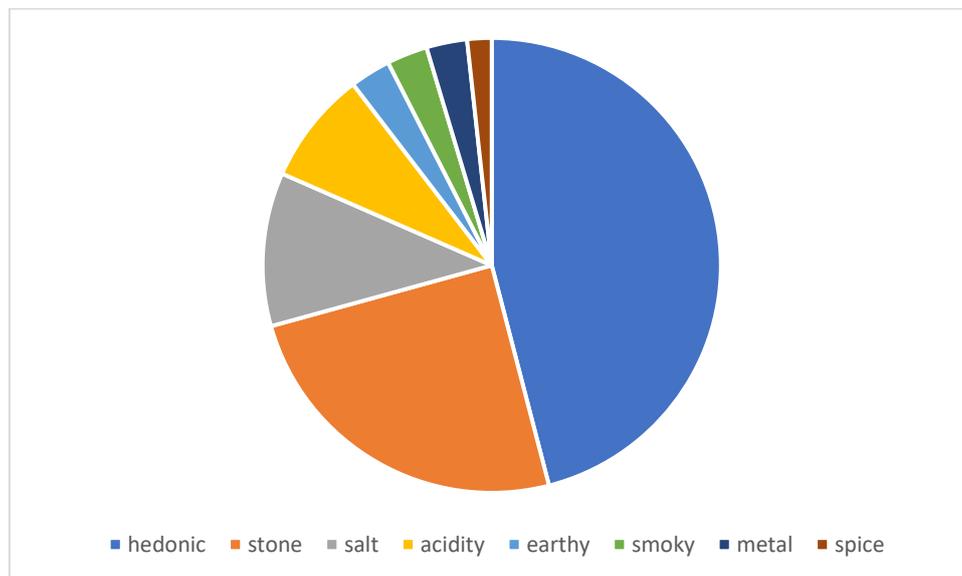
Hedonic liking terms account for almost half the total modifiers. This is unsurprising as minerality and its cognates are used exclusively as positive attributes in the corpus. It is hypothesised therefore that Minerality is used to describe a desirable attribute in wine tasting. However, *Decanter* only publishes tasting notes for wines that have been positively reviewed, so any negative connotations are unlikely to have registered in this analysis.

The other three semantic fields of stone-related terms, acidity/freshness terms and salt-related terms support some of the findings in previous studies. Ballester et al highlighted the same semantic fields when they asked respondents to define the term Minerality.

> We can easily note that 53% of the cited words [used to define Minerality] can be related to only three semantic fields. Indeed, all the stone-related terms accounted for 21% of total citations, acidity/freshness-related terms for 17% and seashore-related terms for 15%.[52]

However they also found that in practical settings the same respondents were not consistent in using those terms to describe a 'mineral' sensation. This study would suggest that there is some consistency between the conceptual definitions of Minerality and its practical deployment.

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[52] Ballester, J.; Mihnea, M.; Peyron, D.; Valentin, D. *Exploring minerality of Burgundy Chardonnay wines: A sensory approach with wine experts and trained panellists* p. 49

5.3.2 Positive and negative predictors

As well as looking at words directly employed to modify these terms, analyses were undertaken to look at other descriptors that have come to coexist frequently in the same tasting note. These were then compared to notes without reference to Minerality, to see which descriptors act as positive or negative predictors for the term.

To generate this data a list of all words that appeared in every tasting note was compiled, together with their frequency in both 'mineral' and 'non-mineral' reviews, using the Sketch Engine software. Stop words (e.g. and, of, an) and irrelevant non-descriptive words (e.g. wine, aromas, Chardonnay) were removed, and the list was limited to the 100 most frequent descriptors for both 'mineral' and 'non-mineral' reviews. This can be found in Appendix 2.

These descriptors were then placed into semantic categories for clarity of analysis.

Fig. 16 shows a comparison for the frequency of appearance of terms relating to each semantic category for 'mineral' and 'non-mineral' white wines.

Fig. 16: *Frequency of terms appearing in tasting notes*
for 'mineral' and 'non-mineral' white wines
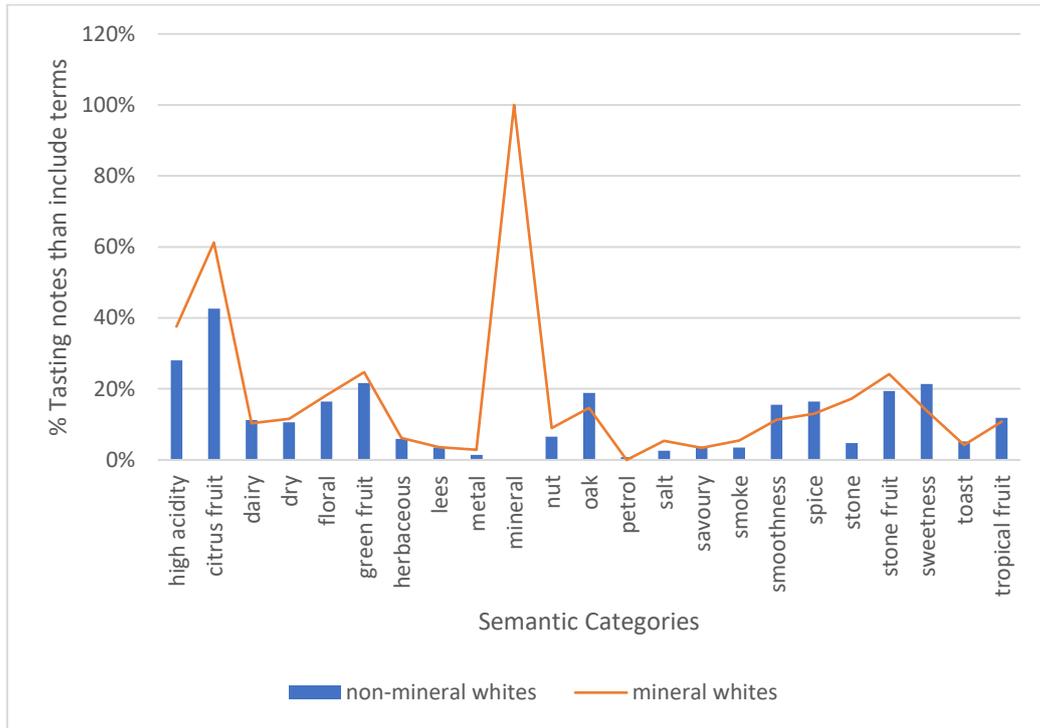
This graph shows that descriptors relating to high acidity, a citrus fruit character and references to stone-related terms are all notable positive predictors of Minerality. Notes containing references to oak, sweetness, smoothness and spice are much less frequently described as mineral.

Fig. 17 shows the same data listed with the percentage increase or decrease for each category.

Fig. 17: Positive and negative predictors of Minerality by percentage for white wines
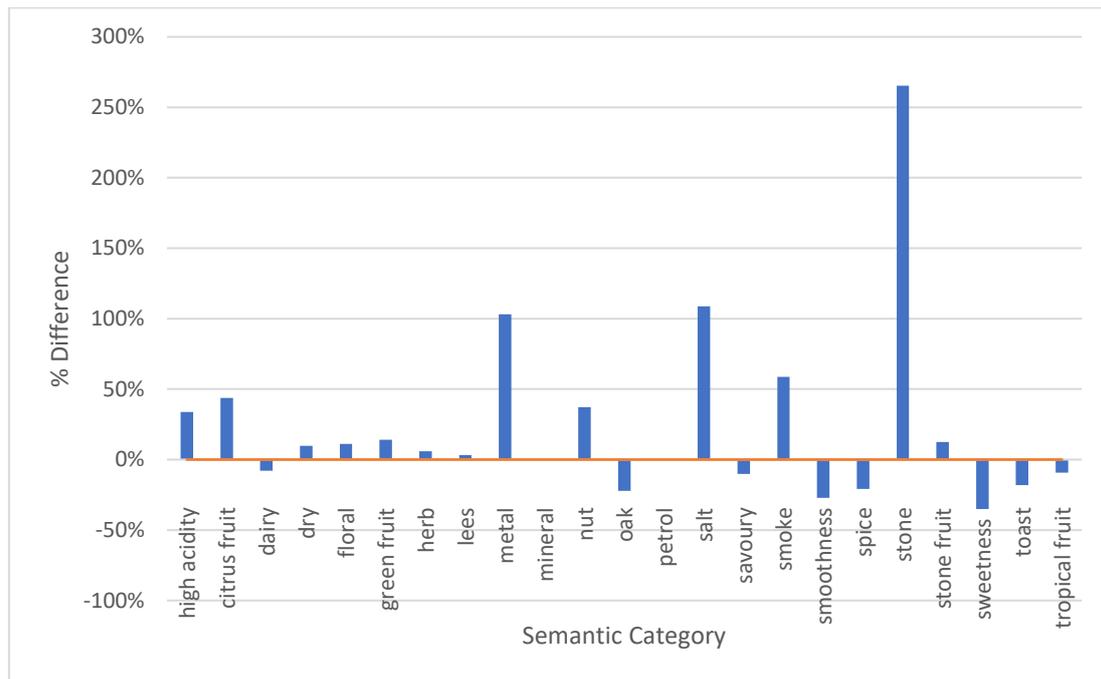
Here we can see that the biggest percentage increases are for stone-related, metal-related and salt-related terms which are all 100-300% more likely to be found in a 'mineral' rather than a 'non-mineral' tasting note. Smokiness also sees a sizeable increase. In terms of fruit flavours, citrus is the most likely fruit character to appear in a 'mineral' tasting note, with smaller increases for stone fruit and a decrease in likelihood for tropical fruit. When coupled with the increase to references of high acidity, this would seem to suggest that Minerality associates most commonly with less ripe, more crisp and citrussy styles of wine. Increases in ripeness tend to associate negatively with perceived Minerality.

This study finds seven negative predictors for Minerality in white wine: most notably sweetness, followed by smoothness, oak, spice, toast, savouriness, tropical fruit and a dairy character.

There is little existing research on which red wine characteristics act as positive or negative predictors of Minerality. This analysis follows the same method as for white wines, however semantic categorisation proved slightly more challenging with red

wines, as tasting terms are often more ambiguous. For example 'green' could be referring to tannins, high acidity, or a vegetal aspect in the wine. Such descriptors have been included in a miscellaneous category.

Fig. 18 shows the frequency of the appearance of terms for 'mineral' and 'non-mineral' reds.

Fig. 18: *Frequency of terms appearing in tasting notes for 'mineral' and 'non-mineral' red wines*
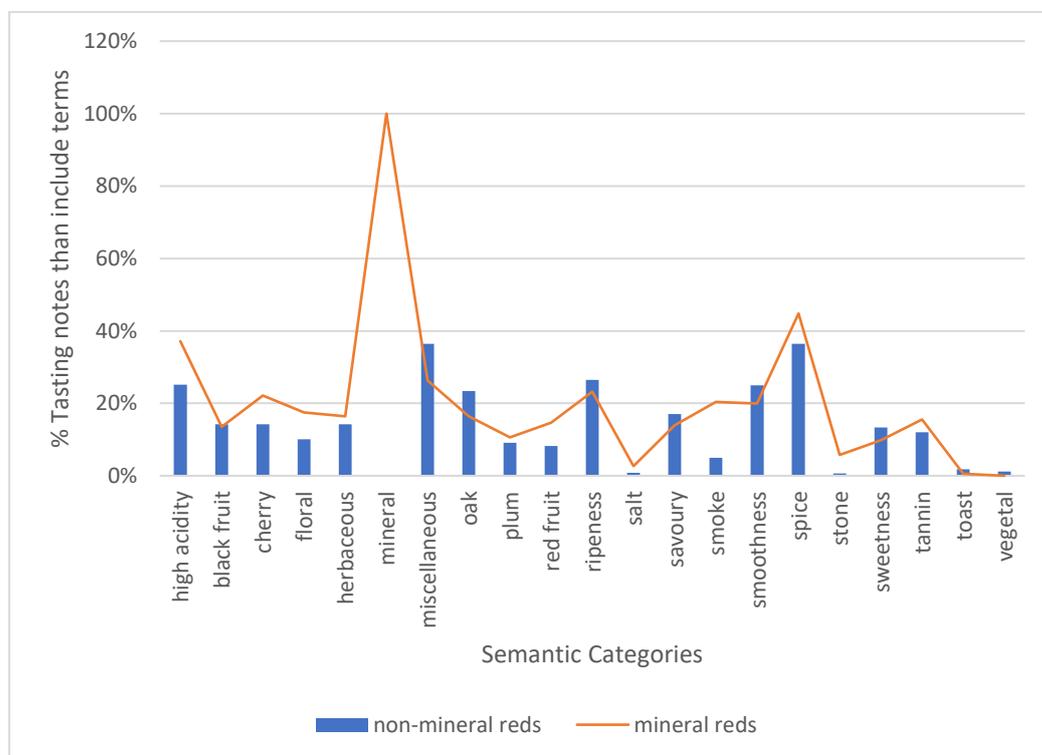
There are many similarities here with the corresponding white wine analysis. High acidity also acts as a notable positive predictor in red wines whereas references to oak, ripeness and smoothness are all less likely to occur alongside Minerality. The largest positive and negative predictors by percentage increase and decrease can be seen in Fig. 19.

51

Fig. 19: Positive and negative predictors of Minerality by percentage for red wines
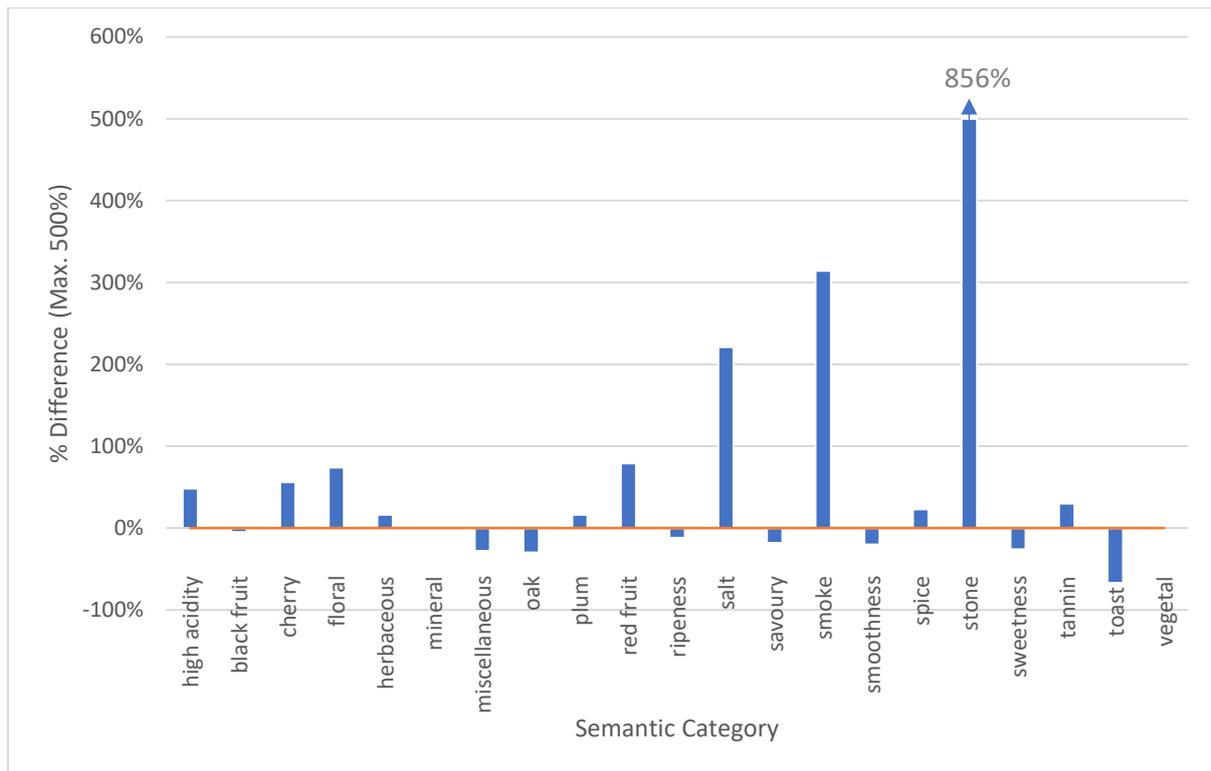
The biggest increases can be seen for references to stone-related terms, as well as salt and smoke which were also three of the four largest predictors for white wines. In terms of likely fruit characters, Minerality is most commonly purported in wines with red fruit flavours. Cherries and plums are included as separate entities in this analysis as they can refer to either red or black fruit, but both are positive predictors of Minerality, particularly cherries. Ripeness, savouriness, oak flavours and sweetness are all negative predictors, as they were with white wines.

In fact of the 12 semantic categories that are common to both red and white wines, there is a high level of consistency as to whether they are likely to be positive or negative predictors of Minerality, as shown in Table 11.

Table 11: *Common Positive/Negative predictors by % increase/decrease*

Semantic Category	Positive/Negative (White Wines)	+/- %	Positive/Negative (Red Wines)	+/- %
High acidity	Positive	34%	Positive	48%
Floral	Positive	11%	Positive	74%
Herbaceous	Positive	6%	Positive	16%
Oak	Negative	-22%	Negative	-30%
Salt	Positive	109%	Positive	221%
Savoury	Negative	-10%	Negative	-18%
Smoke	Positive	59%	Positive	314%
Smoothness	Negative	-27%	Negative	-20%
Spice	Negative	-21 %	Positive	23%
Stone	Positive	265%	Positive	856%
Sweetness	Negative	-35%	Negative	-26%
Toast	Negative	-18%	Negative	-67%

The only category not consistent is 'Spice', which is showing as a negative predictor in white wines and a positive predictor in red wines. This category contains a number of quite different flavour characteristics. Apart from generic references to spice or spiciness, there are four individual flavours that are used with such frequency that they registered in this analysis: vanilla, cinnamon, pepper and liqourice. The sweet spices of vanilla and cinnamon are commonly considered oak-derived, whereas the pungent spices of pepper and liqourice are linked more with other compounds not related to oak. We can see in Fig. 20 that the specific spice characteristics being referred to are often different in red and white wines.[53]

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[53] Generic references to 'spice', 'spicy', 'spiced', 'spices' have been removed from this data

Fig. 20: References to spice by percentage for red and white wines
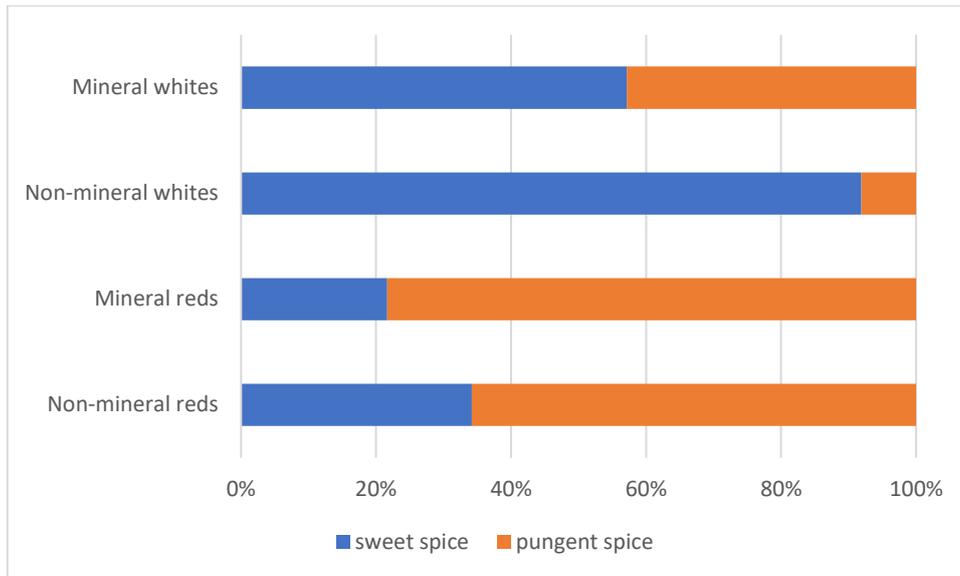
This data shows that over 90% of references to spices in 'non-mineral' white wines refer to sweet spices of vanilla or cinammon, whereas a reference to spiciness in 'mineral' white wines is much less likely to be referring to a sweet spice sensation. In red wines, references to sweet spice are less common for 'mineral' and 'non-mineral' styles, but almost 80% of references to spice in 'mineral' red wines are referring to the pungent spices of pepper or liquorice. When considered alongside the trend for oak to associate negatively with Minerality, it is hypothesised that a sweet spice sensation might associate negatively with the term, whereas a pungent spice character associates positively.

5.3.3 Links to reduction

Stone, salt and smoke-related terms are consistently associating positively with perceived Minerality in this study, both as direct modifiers of the term, and through regularly appearing alongside Minerality in the same tasting note. Parr et al list these

terms as reductive characteristics[54] most likely deriving through the compounds benzenemethanethiol (gunflint) and methanethiol (seashore).[55] Whilst the term reduction and its cognates are rarely used in the corpus, with only 63 mentions and 10 tasting notes where it appears together with Minerality, the high prevalence of reduction-derived terms suggests that this is a key contributor to perceived Minerality in both red and white wines.

[54] Ballester, J.; Peyron, D.; Grose, C.; Valentin, D.; Parr, W.V. *Perception of mineral character in sauvignon blanc wine: inter-individual differences* p. 12

[55] Parr, W.V.; Maltman, A.; Easton, S.; Ballester, J. *Minerality in Wine: Towards the Reality behind the Myths* p. 14

6   CONCLUSION

This study sought to explore the history, evolution and application of the term 'minerality' and its cognates, by answering the following research questions.

How common is the term, and to which wines is it most regularly applied?

The corpus contained 20,678 tasting notes, in which Minerality has been mentioned on 1,784 occasions, or in 8.6% of the sample. That makes it the fourth most popular tasting descriptor. It is mainly attributed to white wines, but is common across red, rosé and sparkling wines too. It is the most frequently used descriptor for white and rosé, and the sixth most popular for red wines which suggests there is potential for future research beyond its application in white wines. Its use across a wide array of grape varieties indicates the term is idiosyncratic in meaning.

The white grape varieties most commonly described as mineral are Chardonnay, Sauvignon Blanc and Riesling, and Gamay is the most common red variety. Sancerre and Beaujolais are the most frequently attributed red and white styles, but the white wines of Burgundy are also very common recipients of the term.

How is the term used, and has its usage changed over time?

Whilst no semantic difference between the terms 'mineral', 'minerals', 'minerally' and 'minerality' was noted, each term shows a different evolution. 'Mineral' is the most commonly used variant having superseded 'minerally' in the 1990s. 'Minerality' did not appear in the corpus until 2000. In recent times, 'minerally' and 'minerals' have

become largely obsolete. The literature review found references to Minerality since at least the 1960s, but the data suggests it did not become commonplace until this century. Its usage peaked in 2010, since when its popularity has started to wane. It is commonly used to describe both a nose and palate sensation, but is more commonly directly associated with the palate, in red and white wines. Whilst Minerality has been criticised for lacking consistency in meaning, the sustained increase in the term being directly modified suggests an increase in precision of usage over time.

How do other wine characteristics associate with the concept of minerality? Are there consistencies in usage that might add to our understanding of the meaning of the term?

The descriptors most frequently directly associated with Minerality are hedonic liking terms, and it is used exclusively as a positive attribute in this corpus. Other common descriptors used to elucidate its meaning fall mainly into three semantic categories: stone-related terms, acidity/freshness terms and salt-related terms.

The most important positive predictors of Minerality in white wines are stone-related, metal-related and salt-related terms all of which are 100-300% more likely to appear in a 'mineral' tasting note. References to high acidity and a citrus character are also very common. The term associates negatively with sweetness, smoothness, oak, spice, toast, savouriness, tropical fruit and a dairy character. A red fruit character and high acidity are positive predictors of Minerality in red wines. Ripeness, savouriness, oak flavours and sweetness are all negative predictors, as they were in white wines. There is a high level of consistency between positive and negative predictors in red and white wines.

Stone, salt and smoke-related terms frequently coexist alongside Minerality, and often modify it directly. These descriptors most likely derive from reduction, suggesting this might be one of the major contributors in creating a 'mineral' sensation in wine.

It is hoped that the results presented in this study add an interesting element to the conversation around Minerality in wine. While it seems clear the term means different things to different tasters, there are consistencies in usage that have emerged that suggest other wine attributes that might contribute to a 'mineral' character in wine. The paper charts the application and evolution of the term to provide a historical and linguistic perspective that was missing from current research on the topic.

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Appendix 1: Full list of terms searched for analysis in table 1

Category	Term(s) Searched For
Floral	Floral (florality), blossom (blossomy), rose (roses, rosey), violet (violets, violetty)
Green Fruit	Apple (appley, apples), gooseberry (gooseberries), pear (peary, pears), grape (grapey, grapes), green
Citrus Fruit	Citrus (citric, citrussy), grapefruit (grapefruity, grapefruits), lemon (lemony, lemons), lime (limey, limes)
Stone Fruit	Peach (peachy, peaches), apricot (apricots), nectarine (nectarines)
Tropical Fruit	Banana (bananas), lychee (lychees), mango (mangoes), melon (melony, melons), passion fruit (passion fruity, passion fruits), pineapple (pineappley, pineapples)
Red Fruit	Redcurrant (redcurranty, redcurrants), cranberry (cranberries), raspberry (raspberries), strawberry (strawberries), cherry (cherries, cherried), plum (plummy, plums)
Black Fruit	Blackcurrant (blackcurranty, blackcurrants), blackberry (blackberries), blueberry (blueberries)
Dried Fruit	Fig (figgy, figs), prune (pruney, prunes), raisin (raisined, raisins), sultana (sultanas), kirsch, jamminess (jam, jammy)

Appendix 1: Full list of terms searched for analysis in table 1

Under-ripeness	Green bell pepper (capsicum, green pepper, green peppers, bell pepper, bell peppers), grass (grassy), leafiness (leafy, leaves), tomato (tomatoes), potato (potatoes)
Herbaceous	Asparagus (asparagussy)
Herbal	Eucalyptus, mint (minty), medicinal (medicine), lavender, fennel (fennels, fennely), dill
Vegetable	Cabbage (cabbages, cabbagey), peas (pea), beans (bean), olive (olives)
Sweet Spice	Cinnamon (cinnamony), cloves (clove, clovey), ginger (gingery), nutmeg (nutmeggy)
Pungent Spice	Pepper (peppery), liquorice (liquoricey), juniper (junipery)
Autolytic	Yeast (yeasty), biscuit (biscuits, biscuitty), bread (bready), toast (toasty), pastry, lees (leesy)
Dairy	Butter (buttery, buttered), cheese (cheesey), cream (creamy), yoghurt (yoghurty)
Oak	Vanilla, toast (toasty), cedar (cedary), charred, smoke (smokey, smoky), resinous
Kernel	Almond (almonds, almondy), coconut (coconuts, coconutty), hazelnut (hazelnuts, hazelnutty), walnut (walnuts, walnutty), chocolate (chocolates, chocolatey), coffee

Animal	Animal (animally), Leather (leathery), meaty (meat), farmyard (farmyardy)
Maturity	Vegetal, mushroom (mushrooms, mushroomy), hay, wet leaves, forest floor, game (gamey), savoury (savouriness), tobacco, cedar (cedary), honey (honeyed), cereal
Mineral	Mineral (minerals, minerality, minerally) earth (earthy), petrol (petrolly), rubber (rubbery), tar (tarry), stone (stoney, stony, stones) steel (steely), wet wool (woolly)

Appendix 2: Uncategorised tasting terms for analysis in 5.3.2

	Non-mineral whites				Non-mineral whites (cont.)	
Descriptor	Mentions	Category		Descriptor	Mentions	Category
oak	650	oak		mango	59	tropical
citrus	448	citrus		racy	59	acidity
dry	422	dry		oily	59	smooth
apple	367	green fruit		fat	58	smooth
crisp	332	acidity		perfumed	58	floral
creamy	324	dairy		smooth	57	smooth
floral	312	floral		steely	56	metal
sweet	292	sweet		saline	56	salt
lemon	289	citrus		mouthwatering	55	acidity
peach	282	stone fruit		waxy	54	smooth
lime	247	citrus		flowery	53	floral
soft	228	smooth		quince	53	green fruit
spicy	221	spice		pepper	53	spice
honey	220	sweet		grassy	53	herb
spice	205	spice		appley	52	green fruit
nutty	176	nut		fleshy	52	smooth
tropical	175	tropical		peaches	50	stone fruit
refreshing	174	acidity		almond	50	nut
honeyed	174	sweet		tart	48	acidity
freshness	168	acidity		sugar	48	sweet
pear	165	green fruit		salty	47	salt
grapefruit	163	citrus		toast	46	toast

apricot	163	stone fruit		apricots	43	stone fruit
stone fruit	138	stone fruit		silky	43	smooth
melon	127	tropical		flinty	43	stone
toasty	125	toast		taut	43	acidity
savoury	120	savoury		citric	42	citrus
pineapple	113	tropical		austere	42	acidity
vanilla	113	spice		peel	42	citrus
lemony	112	citrus		honeysuckle	40	floral
smoky	109	smoky		limey	40	citrus
zesty	106	citrus		stony	38	stone
oaky	103	oak		cream	38	dairy
apples	98	green fruit		greengage	36	green fruit
flowers	91	floral		citrussy	36	citrus
buttery	87	dairy		nuts	35	nut
straw	87	sweet		nectarine	35	stone fruit
tangy	86	acidity		toasted	35	toast
herbal	84	herb		grapey	34	green fruit
lean	84	acidity		spices	34	spice
orange	83	citrus		chalky	31	stone
stone[56]	76	stone		luscious	31	sweet
blossom	72	floral		fennel	31	herb
lees	70	lees		perfume	30	floral
full-bodied	69	smooth		earthy	30	savoury
leesy	69	lees		petrol	30	petrol
herbs	67	herb		zingy	30	acidity

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[56] Excludes 'stone' followed by the lemma 'fruit'

Descriptor	Mentions	Category
peachy	65	stone fruit
zest	63	citrus
gooseberry	59	green fruit

	pithy	29	citrus
	cinnamon	29	spice
	smoke	29	smoky

	Mineral whites	
Descriptor	Mentions	Category
mineral	555	mineral
minerality	308	mineral
citrus	194	citrus
oak	117	oak
dry	110	dry
apple	108	green fruit
lime	102	citrus
peach	91	stone fruit
floral	88	floral
minerals	78	mineral
lemon	73	citrus
creamy	71	dairy
crisp	65	acidity
minerally	59	mineral
freshness	57	acidity
honey	54	sweet
stone fruit	53	stone fruit
grapefruit	53	citrus
pear	49	green fruit

	Mineral whites (cont.)	
Descriptor	Mentions	Category
pineapple	21	tropical
apples	20	green fruit
toast	20	toast
toasty	20	toast
lemony	19	citrus
austere	18	acidity
mouthwatering	18	acidity
zest	18	citrus
lees	17	lees
herbal	17	herb
leesy	17	lees
orange	16	citrus
cream	16	dairy
nuts	16	nuts
slatey	15	stone
silky	15	smooth
peachy	15	stone fruit
tang	14	acidity
brisk	14	acidity

spicy	48	spicy		oaky	13	oak
apricot	48	stone fruit		citrussy	12	citrus
tropical	47	tropical		hazelnut	12	nuts
nutty	46	nuts		vanilla	12	spicy
stone[57]	43	stone		oily	12	smooth
spice	43	spicy		pears	12	green fruit
stony	40	stone		oil	12	smooth
zesty	39	citrus		buttery	11	dairy
honeyed	39	sweet		nectarine	11	stone fruit
sweet	38	sweet		peaches	11	stone fruit
lean	37	acidity		honeysuckle	11	floral
refreshing	35	acidity		almond	11	nuts
taut	34	acidity		pepper	11	spicy
smoky	31	smoky		greengage	11	green fruit
chalky	31	stone		gooseberry	11	green fruit
flowers	30	floral		smooth	10	smooth
racy	30	acidity		mango	10	tropical
soft	28	smooth		waxy	9	smooth
saline	27	salt		spices	9	spicy
blossom	27	floral		wood	9	oak
steely	27	metal		zingy	9	acidity
flinty	27	stone		grassy	9	herb
savoury	25	savoury		flower	9	floral
tangy	25	acidity		fennel	9	herb
herbs	24	herb		tangerine	9	citrus

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[57] Excludes 'stone' followed by the lemma 'fruit'

salty	24	salt
melon	24	tropical
peel	23	citrus
quince	23	green fruit
full-bodied	21	smooth
smoke	21	smoky

gunflint	8	stone
citric	8	citrus
florality	8	floral
earthy	7	savoury
tart	7	acidity
mandarin	7	citrus

	Non-mineral reds	
Descriptor	Mentions	Category
ripe	2874	ripeness
oak	2292	oak
rich	2259	misc.
fresh	1535	acidity
cherry	1493	cherry
sweet	1484	sweetness
spicy	1329	spice
spice	1232	spice
soft	1126	smooth
savoury	703	savoury
smooth	569	smooth
tannic	564	tannin
plum	556	plum

	Non-mineral reds (cont.)	
Descriptor	Mentions	Category
mint	218	herb
wood	215	oak
crunchy	200	acidity
refreshing	198	acidity
plums	190	plum
ripeness	187	ripeness
sweetness	187	sweetness
grippy	178	tannin
crisp	176	acidity
jammy	168	ripeness
damson	156	plum
green	156	misc.
leafy	149	herb

floral	520	floral		perfume	145	misc.
cassis	515	black fruit		minty	144	herb
smoky	504	smoke		blueberry	136	black fruit
chocolate	483	misc.		lean	132	acidity
blackberry	463	black fruit		leathery	128	savoury
blackcurrant	461	black fruit		cinnamon	125	spice
freshness	459	acidity		chocolatey	123	misc.
raspberry	444	red fruit		tar	123	savoury
vanilla	430	spice		bitter	120	tannin
oaky	424	oak		rose	116	floral
liquorice	422	spice		earth	115	savoury
silky	380	smooth		smoke	113	smoke
pepper	379	spice		gamey	109	savoury
lively	373	acidity		redcurrant	108	red fruit
fleshy	370	smooth		mocha	107	misc.
earthy	357	savoury		austere	105	misc.
perfumed	351	misc.		mulberry	105	red fruit
grip	319	tannin		bramble	104	black fruit
creamy	317	smooth		leaf	103	herb
spices	293	spice		herbaceous	103	herb
cherries	290	cherry		blackberries	100	black fruit
herbal	277	herb		tarry	99	savoury
velvety	276	smooth		flowers	99	floral
herbs	271	herb		cedary	91	misc.
peppery	268	spice		voluptuous	85	smooth
violets	267	floral		menthol	85	herb

69

tobacco	264	herb
coffee	264	misc.
meaty	262	savoury
violet	255	floral
cedar	247	misc.
chewy	246	tannin
plummy	243	plum
leather	242	savoury
strawberry	236	red fruit
richness	228	misc.
toasty	221	toast

spiced	83	spice
tea	83	herb
jam	81	ripeness
eucalyptus	80	herb
vegetal	80	vegetal
sour	78	acidity
graphite	75	stone
fine-grained	73	tannin
olive	70	vegetal
cranberry	68	red fruit
raspberries	68	red fruit

	Mineral reds	
Descriptor	Mentions	Category
mineral	386	mineral
minerality	153	mineral
ripe	145	ripeness
cherry	130	cherry
fresh	126	acidity
oak	100	oak
spice	89	spice
minerals	81	mineral
spicy	81	spice
rich	79	misc.

	Mineral reds (cont.)	
Descriptor	Mentions	Category
perfume	14	misc.
redcurrant	14	red fruit
vanilla	14	spice
rose	14	floral
chewy	13	tannin
tobacco	13	herb
cranberry	13	red fruit
flowers	12	floral
earth	12	savoury
oaky	12	oak

savoury	77	savoury		velvety	12	smooth
sweet	61	sweet		rounded	11	misc.
minerally	61	mineral		meaty	11	savoury
floral	52	floral		saline	11	salt
freshness	50	acidity		mint	11	herb
raspberry	48	red fruit		graphite	10	stone
plum	46	plum		damson	10	plum
earthy	43	savoury		tea	10	herb
soft	41	smooth		herb	10	herb
liquorice	37	spice		dusty	10	tannin
tannic	36	tannin		smoke	9	smoke
cassis	34	black fruit		coffee	9	misc.
smoky	32	smoke		sour	9	acidity
spices	31	spice		plums	8	plum
silky	31	smooth		flinty	8	stone
blackberry	30	black fruit		plummy	8	plum
pepper	25	spice		leaf	8	herb
herbs	23	herb		jam	8	ripeness
crunchy	22	misc.		brisk	8	acidity
blackcurrant	21	black fruit		spiced	7	spice
austere	21	misc.		blueberry	7	black fruit
violets	21	floral		green	7	misc.
cherries	21	cherry		bitter	7	tannin
refreshing	20	acidity		mocha	7	misc.
strawberry	20	red fruit		cinnamon	7	spice
violet	20	floral		garrigue	7	herb

71

creamy	19	smooth		salty	7	salt
herbal	19	herb		sweetness	6	sweet
chalky	19	misc.		sappy	6	misc.
grippy	18	tannin		balsamic	6	misc.
lively	18	acidity		menthol	6	herb
fleshy	18	smooth		stone	6	stone
crisp	17	acidity		fine-grained	6	tannin
cedar	17	misc.		racy	5	acidity
chocolate	16	misc.		raspberries	5	red fruit
grip	16	tannin		meat	5	savoury
leather	15	savoury		jammy	5	ripeness
smooth	15	smooth		tar	5	savoury
stony	15	stone		minty	5	herb
peppery	14	spice		toasty	4	toast

Appendix 3: Data for Figs. 3-14, 16-20

Figs. 3, 4 & 5 data

year	mentions	total tasting notes	minerally	minerals	minerality	mineral
1976	0	349	0	0	0	0
1980	0	719	0	0	0	0
1985	1	980	1	0	0	0
1990	14	1164	5	0	0	9
1995	32	1146	9	3	0	20
2000	72	1615	23	6	3	40
2005	202	2940	35	5	60	102
2010	584	3974	38	81	174	291
2015	490	4048	12	58	135	285
2019	389	3743	8	15	120	246
total	1784	20678	131	168	492	993

Fig. 6 data

year	mentions	total tasting notes	nose	palate	ambiguous	total
1976	0	349	0	0	0	0
1980	0	719	0	0	0	0
1985	1	980	1	0	0	1
1990	14	1164	3	5	6	14
1995	32	1146	13	12	7	32
2000	72	1615	23	31	20	74
2005	202	2940	48	83	79	210
2010	584	3974	129	253	242	624
2015	490	4048	84	229	188	501
2019	389	3743	46	175	171	392
total	1784	20678	347	788	713	1848

Fig. 7 data

	nose	palate	ambiguous	total
reds	140	284	270	694
whites	170	423	396	989

Fig. 8 data

year	mentions	total tasting notes	Mentions of minerality as % of tasting notes
1976	0	349	0.0%
1980	0	719	0.0%
1985	1	980	0.1%
1990	14	1164	1.2%
1995	32	1146	2.8%
2000	72	1615	4.5%
2005	202	2940	6.9%
2010	584	3974	14.7%
2015	490	4048	12.1%
2019	389	3743	10.4%
total	1784	20678	8.6%

Fig. 9 data

Chablis	total reviews	mineral reviews	%
1976	2	0	0.0%
1980	0	0	0.0%
1985	4	0	0.0%
1990	1	0	0.0%
1995	1	0	0.0%
2000	45	9	20.0%
2005	17	9	52.9%
2010	179	69	38.5%
2015	22	14	63.6%
2019	40	5	12.5%

Fig. 10 data

Year	total no. unique varieties reviewed	varieties described as mineral	%
1976	41	0	0.0%
1980	46	0	0.0%
1985	45	1	2.2%
1990	43	5	11.6%
1995	38	8	21.1%
2000	55	17	30.9%
2005	61	21	34.4%
2010	81	37	45.7%
2015	121	46	38.0%
2019	145	60	41.4%

Fig. 11 data

minerality	mentions	occasions modified	%
1985-2000	3	0	0.0%
2005	60	7	11.7%
2010	174	35	20.1%
2015	135	42	31.1%
2019	120	49	40.8%

Fig. 12 data

Year	Total white tasting notes	Chardonnay, Riesling & Sauvignon Blanc reviews	%
1976-1995	1052	515	49.0%
2000	290	167	57.6%
2005	678	589	86.9%
2010	940	762	81.1%
2015	1023	547	53.5%
2019	946	418	44.2%

Fig. 13 data

year	Chardonnay, Riesling & Sauvignon Blanc reviews	mineral	non mineral	%
1976-1995	515	20	495	3.9%
2000	167	27	140	16.2%
2005	589	109	480	18.5%
2010	762	317	445	41.6%
2015	547	130	417	23.8%
2019	418	72	346	17.2%

Fig. 14 data

year	red	mineral	%	white	mineral	%	rose	mineral	%	total tasting notes
1976	182	0	0.0%	105	0	0.0%	14	0	0.0%	349
1980	499	0	0.0%	117	0	0.0%	5	0	0.0%	719
1985	512	1	0.2%	251	0	0.0%	7	0	0.0%	980
1990	542	3	0.6%	327	7	2.1%	5	0	0.0%	1164
1995	710	6	0.8%	260	22	8.5%	2	0	0.0%	1146
2000	1055	22	2.1%	291	38	13.1%	9	0	0.0%	1615
2005	1967	66	3.4%	678	126	18.6%	82	2	2.4%	2940
2010	2809	212	7.5%	940	355	37.8%	4	0	0.0%	3974
2015	2706	229	8.5%	1023	232	22.7%	27	4	14.8%	4048
2019	2223	142	6.4%	947	167	17.6%	126	31	24.6%	3743

Fig. 16 data

Semantic category	non-mineral whites	%	mineral whites	%
high acidity	1121	28.09%	356	37.59%
citrus fruit	1700	42.60%	580	61.25%
dairy	449	11.25%	98	10.35%
dry	422	10.57%	110	11.62%
floral	656	16.44%	173	18.27%
green fruit	864	21.65%	234	24.71%
herbaceous	235	5.89%	59	6.23%
lees	139	3.48%	34	3.59%
metal	56	1.40%	27	2.85%
nut	261	6.54%	85	8.98%
oak	753	18.87%	139	14.68%
petrol	30	0.75%	0	0.00%
salt	103	2.58%	51	5.39%
savoury	150	3.76%	32	3.38%
smoke	138	3.46%	52	5.49%
smoothness	620	15.53%	107	11.30%
spice	655	16.41%	123	12.99%
stone	188	4.71%	163	17.21%
stone fruit	776	19.44%	229	24.18%
sweetness	852	21.35%	131	13.83%
toast	206	5.16%	40	4.22%
tropical fruit	474	11.88%	102	10.77%
no of tasting notes	3991		947	

Fig. 17 data

Semantic Category	% increase/decrease
high acidity	34%
citrus fruit	44%
dairy	-8%
dry	10%
floral	11%
green fruit	14%
herb	6%
lees	3%
metal	103%
nut	37%
oak	-22%
salt	109%
savoury	-10%
smoke	59%
smoothness	-27%
spice	-21%
stone	265%
stone fruit	12%
sweetness	-35%
toast	-18%
tropical fruit	-9%

Fig. 18 data

term	non-mineral reds	non-mineral reds	term	mineral reds	mineral reds
high acidity	3151	25.18%	high acidity	253	37.15%
black fruit	1779	14.21%	black fruit	92	13.51%
cherry	1783	14.25%	cherry	151	22.17%
floral	1257	10.04%	floral	119	17.47%
herbaceous	1777	14.20%	herbaceous	112	16.45%
mineral	0	0.00%	mineral	681	100.00%
miscellaneous	4559	36.43%	miscellaneous	179	26.28%
oak	2931	23.42%	oak	112	16.45%
plum	1145	9.15%	plum	72	10.57%
red fruit	1029	8.22%	red fruit	100	14.68%
ripeness	3310	26.45%	ripeness	158	23.20%
salt	103	0.82%	salt	18	2.64%
savoury	2138	17.08%	savoury	95	13.95%
smoke	617	4.93%	smoke	139	20.41%
smoothness	3123	24.95%	smoothness	136	19.97%
spice	4561	36.44%	spice	305	44.79%
stone	75	0.60%	stone	39	5.73%
sweetness	1671	13.35%	sweet	67	9.84%
tannin	1500	11.98%	tannin	106	15.57%
toast	221	1.77%	toast	4	0.59%
vegetal	150	1.20%	vegetal	0	0.00%
no of tasting notes	12516		no of tasting notes	681	

Fig. 19 data

Semantic Category	% increase/decrease
high acidity	48%
black fruit	-5%
cherry	56%
floral	74%
herbaceous	16%
miscellaneous	-28%
oak	-30%
plum	16%
red fruit	79%
ripeness	-12%
salt	221%
savoury	-18%
smoke	314%
smoothness	-20%
spice	23%
stone	860%
sweetness	-26%
tannin	30%
toast	-67%
vegetal	0%

Fig. 20 data

	Non-mineral reds	Mineral reds	Non-mineral whites	Mineral whites
spice	2937	208	460	100
sweet spice	555	21	602	12
pungent spice	1069	76	53	9
total	4561	305	655	123

Appendix 3: Research Paper Proposal

IMW Research Paper Proposal Submission Form			
Student ID	23955	**Date of submission**	18/10/21
RPP Version No	8	**Name of Advisor**	Alex Hunt MW

Note: RPPs must be submitted via your Advisor to the IMW			
Proposed Title			
The evolving language of minerality in wine tasting: a case study of *Decanter* tasting notes 1976-2019			
Research Questions: Define the subject of your Research Paper and specify the specific research questions you plan to pursue. (No more than 200 words)			

Within the rich tapestry of language employed to describe wine, few terms have proved as controversial and divisive as 'minerality'. This paper will examine the term's usage in *Decanter* wine tasting notes from 1976-2019 and explore its history, evolution and application.

'Minerality' is believed to be a relatively recently invented term, with several major studies on the topic suggesting that it was coined sometime between the mid-1980s and late 1990s.[58] Its rise in popularity has been remarkable. A 2013 study by Cees Van Casteren MW of 258,000 notes in *Wine Spectator* found that it was used in over 10% of all of that publication's reviews, making it more popular than other common terms such as 'fruity', 'floral' and 'oaky'.[59,60]

The study will seek to answer the following questions:

1. How common is the term, and to which wines is it most regularly applied?
2. How is the term used, and has its usage changed over time?
3. How do other wine characteristics associate with the concept of minerality? Are there consistencies in usage that might add to our understanding of the meaning of the term?

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[58] Maltman, Alexander *Minerality in wine: a geological perspective* (Journal of Wine Research, Vol. 24, 2013, pp. 169-181)
 Goode, Jamie *Wine Science: The Application of Science in Winemaking,* 2nd edition (London: Mitchell Beazley, 2014) p.42
 Deneulin Pascale, Le Fur, Yves and Bavaud, Francois *Study of the polysemic term of minerality in wine: Segmentation of consumers based on their textual responses to an open-ended survey* (Food Research International Vol. 90, 2016) pp. 288-297
[59] *Minerality in Wine: Metaphor or Reality* (Wine Business Monthly, July 2013)
<https://www.winebusiness.com/wbm/?go=getArticle&dataId=118546> [Accessed 14/10/21]
[60] Unfortunately the original research and presentation was stored on a laptop which was subsequently stolen so further elucidation for the purposes of this research is not possible (Van Casteren 2021, pers comm.)

Background and Context: Explain what is currently known about the topic and address why this topic requires/offers opportunities for further research. (No more than 200 words)

The three questions proposed will look to address some of the opportunities for further research presented from reviewing the existing literature.

1. How common is the term, and to which wines is it most regularly applied?

Whilst there are many studies that cite the widespread commonality of the term, no previous research has been undertaken that explores how prevalent the term is, within the context of other popular wine tasting descriptors. Equally, while there appears to be some perceived wisdom amongst wine professionals about particular varieties, styles or colours of wine that have the potential to display a mineral character, no studies have explored which wines are most commonly described in this way. It is hoped that understanding this further might add interesting depth to the discussion on the topic as well as assisting future researchers in focusing their studies towards particular styles and varieties, which is an area highlighted as being ripe for further research.

> 'To increase clarity in the field, we suggest that more consideration be given to wine variety in future studies, with potential for both sensorial and chemical aspects of minerality to differ as a function of wine variety and wine-production style.'[61]

2. How is the term used, and has its usage changed over time?

The newness of the term and its growth in usage are two common themes encountered in almost every study on this subject reviewed. However, it appears that this increase in usage has been tested only fleetingly in a French study from 2016.[62] Here the authors noted a significant rise in its usage, which peaked around 1995. However this was only a small contextual element of the study, produced using *Google Books Ngram Viewer*, and was not looking to produce robust data. This historical perspective regarding the origins and evolution of the term is missing from the current body of research.

Equally, no studies have been undertaken to elucidate upon how the word is used linguistically. For example, is there a difference or evolution in how 'mineral', 'minerals', 'minerally' and 'minerality' are deployed? Has it always been applied to the same wines, and in the same way?

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[61] Parr, Wendy, Maltman, Alexander, Easton, Sally, Ballester, Jordi *Minerality in Wine: Towards the Reality behind the Myths* (Beverages, 4, 77, 2018) p. 16

[62] Deneulin Pascale, Le Fur, Yves and Bavaud, Francois *Study of the polysemic term of minerality in wine: Segmentation of consumers based on their textual responses to an open-ended survey* (Food Research International Vol. 90, 2016, pp. 288-297)

It is hoped that by exploring these considerations and others, a fuller picture of the term can be presented.

3. How do other wine characteristics associate with the concept of minerality? Are there consistencies in usage that might add to our understanding of the meaning of the term?

To look at how the term is used in practice, some studies have sought to examine how other wine tasting terms associate with the concept of minerality, but research in this area is quite limited. The studies that do exist are often contradictory in their conclusions. There is clearly scope for more research in this area. The data in this corpus will contain a large amount of real-life, unprompted usages of the term that should be able to elucidate further on which other terms have come to coexist alongside minerality, and it is hoped consistencies may appear that could shed further light on its meaning.

Sources: Identify the nature of your source materials (official documents, books, articles, other studies, etc.) and give principle sources if appropriate. (No more than 150 words)

- Ballester, Jordi, Peyron, Dominique, Grose, Claire, Valentin, Dominique, Parr, Wendy Veronica *Perception of mineral character in sauvignon blanc wine: inter-individual differences* (Wine Studies, vol. 3:4474, pp. 9-12)
- Ballester, J.; Mihnea, M.; Peyron, D.; Valentin, D. *Exploring minerality of Burgundy Chardonnay wines: A sensory approach with wine experts and trained panellists* (Aust. J. Grape Wine Research 19, 2013)
- Bell, Judith *Doing Your Research Project,* 7th Edition (New York: Open International Publishing Ltd. 2018)
- *Decanter* Magazine publications from 1976-2019 (Decanter Magazine Ltd.)
- Deneulin Pascale, Le Fur, Yves and Bavaud, Francois *Study of the polysemic term of minerality in wine: Segmentation of consumers based on their textual responses to an open-ended survey* (Food Research International Vol. 90, 2016, pp. 288-297)
- Goode, Jamie *Wine Science: The Application of Science in Winemaking,* 2nd edition (London: Mitchell Beazley, 2014)
- Lehrer, Adrienne *Wine and Conversation,* 2nd edition (New York: Oxford University Press, 2009)
- Maltman, Alexander *Minerality in wine: a geological perspective* (Journal of Wine Research, Vol. 24, 2013, pp. 169-181)
- Parr, Wendy, Maltman, Alexander, Easton, Sally, Ballester, Jordi *Minerality in Wine: Towards the Reality behind the Myths* (Beverages, 4, 77, 2018)
- Peynaud, Emile (translated by Schuster, Michael) *The Taste of Wine: The Art and Science of Wine Appreciation*, 2nd edition (New York: John Wiley & Sons, 1983)
- Rodrigues, Sáenz-Navajas, Franco-Luesma, Valentin, Fernández-Zurbano, Ferreira, De La Fuente Blanco, Ballester, *Sensory and chemical drivers of wine minerality aroma: An application to Chablis wines* (Food Chemistry 230, 2017, pp. 553-562)

Research Methodology: Please detail how you will identify and gather the material or information necessary to answer the research question(s) and discuss what techniques you will use to analyse this information. (No more than 500 words)

The primary source materials for this study will be *Decanter* publications from 1976-2019. *Decanter* is the oldest consumer wine publication in the UK and is now Europe's best selling wine magazine with a global print circulation of 41,000.[63] It publishes over one hundred wine tasting notes each month. This study will compile a database of every tasting note printed in all 12 monthly publications from the magazine at four to five year intervals, namely: 1976, 1980, 1985, 1990, 1995, 2000, 2005, 2010, 2015 and 2019.

The full archive of printed magazines is held at the National Library of Scotland, Edinburgh from where this data will need to be transcribed and digitalized, so it can be subjected to computer-assisted analysis.

1. How common is the term, and to which wines is it most regularly applied?
2. How is the term used, and has its usage changed over time?

These two questions can be answered by conducting a conceptual content analysis of the term using computer software which will be able to chart its usage accurately.

> 'Content analysis is a research tool used to determine the presence of certain words, themes, or concepts within some given qualitative data (i.e. text). Using content analysis, researchers can quantify and analyze the presence, meanings and relationships of such certain words, themes, or concepts… In conceptual analysis, a concept is chosen for examination and the analysis involves quantifying and counting its presence. The main goal is to examine the occurrence of selected terms in the data.'[64]

3. How do other wine characteristics associate with the concept of minerality? Are there consistencies in usage that might add to our understanding of the meaning of the term?

This can be answered through two further content analyses. Firstly an analysis will be undertaken to look at direct modifiers of the term minerality and its variations to see which specific sensory characteristics, or other aspects in the wine, the taster was directly associating with the term. Secondly a wider analysis will look at other words that have come to coexist alongside this term in the same tasting notes. By comparing this to other tasting notes that do not include the term it should be possible to explore which wine attributes associate positively or negatively with minerality, to add to the conversation surrounding its meaning.

Potential to Contribute to the Body of Knowledge on Wine: Explain how this Research Paper will add to the current body of knowledge on this subject. (No more than 150 words)

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[63] *Decanter Media Pack,* p.4 <https://keyassets.timeincuk.net/inspirewp/live/wp-content/uploads/sites/34/2021/02/Decanter-Media-Pack-2021.pdf> [Accessed 05/10/21]

[64] *Content Analysis* <https://www.publichealth.columbia.edu/research/population-health-methods/content-analysis#Description> [Accessed 14/10/21]

It is hoped that this study can add a broader historical context to the work done on wine language analysis by the likes of Adrienne Lehrer in her book *Wine and Conversation*. This study will examine not only how the term 'minerality' is used today, but also how its usage has evolved over time. It is also hoped that this study will open the door to further study in this area with regard to the evolution of other terms used to describe wines.

Proposed Time Schedule/Programme: This section should layout the time schedule for the research, analysis and write-up of the Research Paper and should indicate approximate dates with key deliverables. *Dates of submission to both Advisors and the IMW must be those specified by the IMW.*

- July 2021 – Revise Research Paper Proposal as per recommendations in refer report, and consider implications for Research Paper
- August/September 2021 – Analysis of results
- October 2021 – Submit amended Research Paper Proposal and write up Research Paper
- 5th November 2021 – Submission of final Research Paper to adviser
- 13th December 2021 – Submission of final Research Paper to the Institute