Capítulo 1

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What You Should Know When Writing Scientific Papers in Geosciences Part 1: Guidelines and Resources for English Writing and Style

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Abstract As part of the construction of *The Geology of Colombia: Multivolume book*, a complete editorial guideline was developed to ensure stylistic consistency and the correct use of technical and geological terms. The guideline contains rules and recommendations from the best and most recognized manuals of style and guides related to the discipline, which were carefully selected to guarantee the suitability of the adopted rules; additionally, it was informed by the previous editorial experiences of the Mapa Geológico de Colombia Team of the Servicio Geológico Colombiano. The guideline is a unique compilation work in terms of the synthesis and quality of information. The present two–part work aims to condense the most relevant information gained during the construction of the aforementioned editorial guideline and to give geoscientists a complete and reliable source of recommendations for writing clearer, unambiguous, and more precise contributions. Specifically, this first part aims to share recommendations related to English geoscientific writing and the style of mathematical expressions, figures, and tables.

Keywords: *editorial guideline, preciseness, clarity, geoscientific writing.*

Resumen no técnico En 2020, el Servicio Geológico Colombiano —la entidad pública colombiana encargada del estudio de los recursos y riesgos geológicos del país— realizó el primer libro compendio sobre la geología de Colombia. Durante la elaboración de esta publicación, se realizaron varias actividades para revisar y perfeccionar los capítulos que componían el libro, los cuales fueron escritos por más de 170 investigadores de la geología nacional. Como parte de estas tareas, se realizó el ajuste de los textos finales, ya sin errores de contenido, para garantizar que siguieran las normas ortográficas y gramaticales del inglés —el idioma más hablado del mundo y en el que se difunde entre académicos la mayoría de textos especializados en geología—. Para lograrlo, se construyó un manual o guía con los estándares que permitirían homogeneizar todos los capítulos y presentar la información que contienen de forma más clara. En este capítulo, que corresponde a la primera parte del manuscrito dedicado a las recomendaciones para escribir artículos científicos, se presentan consejos para la escritura geocientífica en inglés, así como la de expresiones matemáticas, figuras y tablas en textos geológicos.

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Resumen Como parte de la realización de la obra multivolumen *The Geology of Colombia* se desarrolló una pauta editorial completa para garantizar la consistencia estilística y el uso correcto de términos técnicos y geológicos. La pauta contiene reglas y recomendaciones de los mejores y más reconocidos manuales de estilo y guías relacionadas con la disciplina, que fueron cuidadosamente seleccionadas para garantizar la idoneidad de las reglas adoptadas; además, se nutrió de experiencias editoriales previas del Grupo Mapa Geológico de Colombia del Servicio Geológico Colombiano. La pauta es un trabajo de recopilación único en términos de síntesis y calidad de la información. Este trabajo de dos partes pretende condensar la información más relevante obtenida durante la construcción de la pauta editorial mencionada y brindar a los geocientíficos una fuente completa y confiable de recomendaciones para escribir contribuciones más claras, precisas y evitar ambigüedades. Específicamente, esta primera parte tiene como objetivo compartir recomendaciones relacionadas con la escritura geocientífica en inglés y el estilo de escritura de expresiones matemáticas, figuras y tablas.

Palabras clave: *pauta editorial, precisión, claridad, escritura geocientífica.*

1. Introduction

Scientific articles are the common way in which scientists share the results of their research projects. Most of the time, these projects have been developed over many years, have required financial support, and they are time–consuming and focused work. The results and the procedures should be shared as clearly as possible to make all the efforts worthwhile. Clarity and unambiguity are characteristics that all scientists should be concerned about when submitting any contribution so the reader can understand the context, the information, and the conclusions and replicate the procedures. When clarity, precision, and unambiguity are guaranteed, articles will be helpful not only for the readers but also for the authors, as they may receive more citations.

Since 2017, the Mapa Geológico de Colombia Team of the Servicio Geológico Colombiano conducted the project of making a compendium work of Colombian geology, a book in which geoscientists all around the world could find relevant information about the geological processes that have occurred in Colombia. Thus, the Team published *The Geology of Colombia: Multivolume book* (TGCMB) with contributions from 179 authors compiled in 58 chapters (Gómez & Pinilla–Pachon, 2020a, b; Gómez & Mateus–Zabala, 2020a, b). In the four years needed to accomplish this project, the Team made up a complete editorial process that included the development of an editorial guideline that governed the style of the book. This editorial guideline was compiled from the most recognized guides and manuals about scientific writing and geosciences terminology. Additionally, this guideline included several Team internal norms that had been learned and adopted in previous editorial works. The collected information helped the editorial board make quick, logical, and defensible decisions not only about the style but also about the correct use of several terms.

In this first article, we summarize the most important rules about English writing and style to help geoscientists (with previous knowledge in English grammar and punctuation) share their works in clearer and more precise contributions. The recommendations are mainly about topics that we found of great relevance during the construction of the editorial guideline because they, first, were mostly unknown by the authors of TGCMB and, second, made a positive difference in the manuscripts by contributing to the lucidity of the documents.

Most of the examples used to clarify the norms presented here are taken from TGCMB, so with them, the most common shortcomings or failures that were identified in the chapters of the work are summarized. Thanks to the thematic style correction and adjustment of the chapters to the editorial guideline, these were corrected, which improved the quality of the final published chapter.

2. Manuals and Guides

As mentioned before, a number of important manuals and guides were consulted to compile the norms for the editorial guideline of TGCMB. Each manual and guide was carefully selected to ensure the suitability of the adopted rules. For stylistic norms, *The Chicago Manual of Style, Sixteen Edition* (TUCPES, 2010) was consulted; it was selected as the main source for style guidelines due to its extensive use for more than 100 years providing advice for the makeup of scientific texts. Some well–known editorial companies use this style guide, such as The Geological Society of America, the Smithsonian Institution Scholarly Press, and Columbia University Press. In addition, other guides from the suite of the University of Chicago Press were used. This includes *The Chicago Guide to Grammar, Usage, and Punctuation* (Garner, 2016), a com-

Table 1. Cases and examples in which passive voice is preferred.

Prefer passive voice when…	Example (passive verbs in bold font)
Describing processes such as in the method section, where the most important item is not who or what carried out the actions but the action itself.	"Two to three grain mounts **were prepared** per sample and **were etched** for different lengths of time in order to obtain countable fission–tracks in the full grain age spectrum" (Urueña–Suárez et al., 2020).
Making general reference to the literature.	"Provenance studies that utilize the crystallization or cooling ages of detrital zircons **have been proven** to be useful in making paleogeographic reconstructions" (Urueña–Suárez et al., 2020). "Recently, interdisciplinary archaeological and volcanological efforts **have been carried out** to identify the impact of volcanic eruptions on pre–Hispanic settlers" (Monsalve–Bustamante, 2020).
It is unnecessary, difficult, or impossible to identify the originator of the action.	"Additionally, pyroclastic flow deposits **have been dated** to 36 030 ± 380 y BP and 33 550 ± 280 y BP" (Monsalve–Bustamante, 2020).
Reporting what is commonly believed to be true.	"(…) the Cerro Machín Volcano **is known** as one of the most dangerous volcanoes in Colombia" (Cortés–Jiménez, 2020).

plete guideline about the correct use of English grammar that was very helpful during the text review.

Another stylistic guide consulted was *A manual for Writers of Research Papers, Theses, and Dissertations: Chicago Style for Students and Researchers* (Turabian, 2013), a more concise manual that condenses the Chicago style guide's recommendations on academic writing. Additionally, internationally used standards, such as *The International System of Units (SI)* (Newell & Tiesinga, 2019) and *The ACS Style Guide: Effective Communication of Scientific Information* (Coghill & Garson, 2006), were consulted to verify the format of numerical values (e.g., decimal marker, thousands separator, large numbers) and the formats of units and symbols. Readers will find throughout the article that although the aforementioned works are the primary sources, some other documents were consulted to complete a lack of information or make the explanations more understandable. These are also very reliable sources and can be found in the reference list.

3. Passive Voice or Active Voice?

It is convenient to start the recommendations with this common question that arises during the construction of the text: should I use passive or active voice? There is an idea that passive voice should be avoided in scientific writing or general writing because many teachers and books argue that active voice makes writing more direct, less wordy, and more forceful. However, there is an increasing trend of including passive voice in research papers from the beginning of modern science (Harmon & Gross, 2010). To understand this trend and the importance of passive voice in academic writing, it is important to overview the difference in the two voices.

In Writing Scientific Research Articles, Cargill & O'Connor (2009) shows the difference between active and passive voice. The first voice uses an active verb; thus, the grammatical subject of the verb actually does the action indicated by the verb.

subject	+	active verb	+	object
Geologist		**dated**		**the rocks**

In contrast, a sentence in passive voice uses a passive verb (formed by the inflected form of be + the verb's past participle), and with this construction, the grammatical subject does not do the action of the verb (dating, in this case), and an object, process, or concept appears in the position of the subject.

subject	+	passive verb	+	agent (optional)
The rocks		**were dated**		**by a geologist**

As mentioned above, active voice helps the reader to recognize exactly who is the agent of the action, while in passive sentences, the agent is often omitted; therefore, this last form is preferred when **the action is more important than the actor.**

Table 1 shows some cases explained by Wallwork (2013) in which passive voice is preferred over active voice. For each case, there are one or two examples from TGCMB.

Until now, we have emphasized the importance of passive voice and the cases where its use is preferred. However, it is also very important to note that today's science writing is presenting an overuse of this form; therefore, we should be careful to make the choice between both. Copeland (2011) strongly recommends avoiding the use of passive voice when **discussing the actions of people** since there will be some portion of interpretation on this; thus, it should be clear to whom the interpretation belongs. Then, when writers want to make unequivocal what they or other people did, they should choose to use active voice. For example, it is better to write directly "Gómez et al. interpreted" than "it is interpreted by Gómez et al."; using active verbs in these cases also makes the text economical in words, something very important for editors.

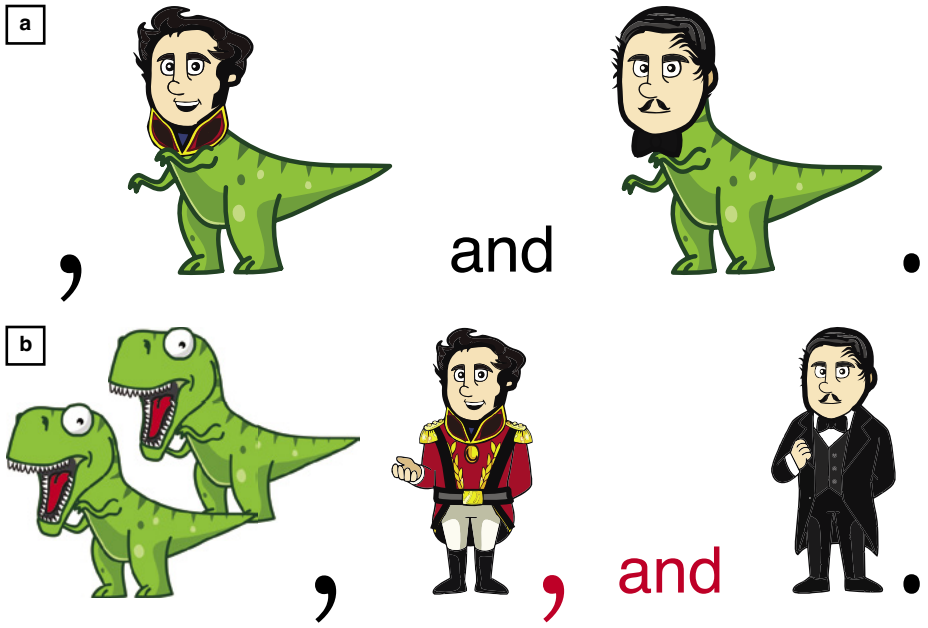

Figure 1. Illustrative example showing the ambiguity caused by avoiding the use of the Oxford comma. (**a**) Statement without Oxford comma and (**b**) with Oxford comma.

4. Punctuation

It is essential that the manuscript is accurate from the punctuation to the most complex explanations; any erratic sign will distract the reader from the subject matter. In this section, we introduce the most important rules, based on common errors detected in the chapters of TGCMB, to consider while writing to avoid confusion and ambiguity. As this is not a grammar guide, we strongly recommend consulting *The Chicago Guide to Grammar, Usage, and Punctuation* (Garner, 2016).

4.1. Oxford comma

In his book *Good English: How to write it*, G.H. Vallins stated: "An errant, or superfluous, or omitted comma may work great havoc". This kind of mess should be avoided by understanding the uses of this punctuation mark. One of these uses —which is not always well–known but is strongly recommended by *The Chicago Manual of Style*— is related to the enumeration of elements in a list. Consider the following example:

> At the museum, I became acquainted with dinosaurs, Bolívar and Santander.

Someone might understand that Bolívar and Santander are the names of the dinosaurs that you saw because the comma after "dinosaurs" could be interpreted as an introduction to an explanation (Figure 1a). These misunderstandings could be prevented by using the Oxford comma. This is done by placing a comma between the penultimate element and the conjunction "and", as follows:

> At the museum, I became acquainted with dinosaurs, Bolívar, and Santander.

The former example disappears the ambiguity and separates every element in the list (Figure 1b).

In the same way, the Oxford comma can avoid misunderstandings and facilitate reading when it is used in lists of long elements. Consider the following example:

> **Abstract** (…) A compilation of sparse bedrock and detrital low−temperature thermochronometric data, new detrital apatite fission−track and apatite (U−Th)/He data from modern river sediments and stratigraphic patterns of adjacent Miocene − Pliocene basins document episodic tectonic development of the Sierra Nevada de Santa Marta.

It is well–known in academic writing is that a good **Abstract** should stand by itself. Because the abstract is the first thing a reader looks at, this part of the paper must present the research in a clear and concise manner. This means that the writer should be extremely cautious about every aspect of it, including the punctuation. In the above example, enumerations of elements before the verb (the underlined word) are hard to separate, not only because they are long phrases but also because they internally include the conjunction "and", which usually leads to the last item on a list. To make clear when we are introducing the last item, we should use the Oxford comma:

a

The volcanoes of the MMVF are aligned NW-SE, parallel to the Coconucos Volcanic Chain (CVCh) (Figure 1); it is included La Palma (Figure 6a) -corresponding to 3 adjacent vents-, Santa Leticia (Figure 6b), Merenberg (Figure 6c), El Morro (Figure 6d), Marsella (Figure 6e), Tálaga, and Pensil Volcanoes. The volcanic edifices, mostly pyroclastic cones with associated lavas, are built on Jurassic and Permian intrusive igneous rocks and ignimbrites of the Neogene Guacacallo Formation (Marquínez et al., 2003a, 2003b; Rodríguez et al., 1998; Rodríguez et al., 2017; Velandia et al., 2001a).

b

The volcanoes of the MMVF are aligned NW–SE, parallel to the Coconucos Volcanic Chain (CVCh) (Figure 1); it is included La Palma (Figure 6a) —corresponding to 3 adjacent vents—, Santa Leticia (Figure 6b), Merenberg (Figure 6c), El Morro (Figure 6d), Marsella (Figure 6e), Tálaga, and Pensil Volcanoes. The volcanic edifices, mostly pyroclastic cones with associated lavas, are built on Jurassic and Permian intrusive igneous rocks and ignimbrites of the Neogene Guacacallo Formation (Marquínez et al., 2003a, 2003b; Rodríguez et al., 1998; Rodríguez et al., 2017; Velandia et al., 2001a).

Figure 2. Comparison in the use of hyphens and dashes in two paragraphs. **(a)** Paragraph containing only the hyphen and **(b)** paragraph in which the hyphen, en dash, and em dash are used.

Abstract (…) A compilation of sparse bedrock and detrital low–temperature thermochronometric data, new detrital apatite fission–track and apatite (U–Th)/He data from modern river sediments, and stratigraphic patterns of adjacent Miocene – Pliocene basins document episodic tectonic development of the Sierra Nevada de Santa Marta.

4.2. Semicolon

One of the three uses of semicolons, which everyone should apply to avoid confusion, is the separation of items in a list or series when they are long and complex or present internal punctuation (TUCPES, 2010). This will help visually separate the items and thus facilitate reading. Consider the next example:

"Currently, five of those systems are being investigated for geothermal exploration: Nevado del Ruiz by CHEC–EPM, ISAGEN, and the Servicio Geológico Colombiano–SGC (Alfaro, 2015), Chiles–Cerro Negro by ISAGEN–CELEC (Alfaro, 2015), and the Azufral Volcano, San Diego, and Paipa areas by the SGC (Alfaro et al., 2015, 2017; Rueda & Rodríguez, 2016)."

With all the information, the internal punctuation, and the citation it is very difficult to identify and differentiate the items in that paragraph. However, if the semicolon is applied correctly, the confusion disappears:

"Currently, five of those systems are being investigated for geothermal exploration: Nevado del Ruiz by CHEC–EPM, ISAGEN, and the Servicio Geológico Colombiano–SGC (Alfaro, 2015); Chiles–Cerro Negro by ISAGEN–CELEC (Alfaro, 2015); and the Azufral Volcano, San Diego, and Paipa areas by the SGC (Alfaro et al., 2015, 2017; Rueda & Rodríguez, 2016)."

Some may think that using a period (.) instead of a semicolon is a way to separate the items. However, a period is not a punctuation mark for enumeration, so that would not be the best option. Additionally, be cautious, as sometimes you do not need a semicolon because the colons are enough to make the separation.

4.3. Hyphen, en dash, and em dash

This is another recommendation from *The Chicago Manual of Style* and it goes beyond simply being esthetic; the use of the hyphen (-), the en dash (–), and the em dash (—) is important because of the ways that they separate or join different information in the text:

- Hyphen (-): it is used to separate the same word in different lines (line breakers).
- En dash (–): it is used to join compound nouns, compound adjectives, range of numbers.
- Em dash (—): it is used instead of commas, parentheses, or colons to introduce explanatory notes.

Figure 2 shows an example taken from TGCMB. In Figure 2a there is no differentiation in hyphenation, while in Figure 2b the hyphens, en dashes, and em dashes are used for different information.

In the example, readers can note that the use of different marks for hyphenation makes the text more visually understandable. With just a quick look to the paragraph on the right, one can recognize an explanatory note "—corresponding to 3 adjacent vents—" and a direction formed by two compass points "NW–SE", while the separation of the words between lines is still barely noticeable, which is expected.

4.4. Quotation marks

Correct use of quotation marks is often confused with italicization. Here, we present the use of this punctuation sign and some examples from TGCMB:

1. For direct quotation: This is when using the exact words from the original source. According to *The Chicago Manual of Style*, direct quoted words, phrases, and sentences in the text are enclosed in double quotation marks (" "); single quotation marks (' ') are used to enclose quotations within quotations. For example,

The activity of this volcano is unknown; however, von Humboldt (1800) provided the following description: "Páramo of Socoboní, a high conical rock (dicunt) of black rocky texture, an ancient volcano that supposedly still rumbles".

2. "Scare quotes": This is to alert the readers that a word or phrase is used in a nonstandard, ironic, or other special sense (TUCPES, 2010). For example,

The Cretaceous was a "greenhouse" world (Hu et al., 2012; Larson & Erba, 1999) with high partial pressure of atmospheric carbon dioxide, high global temperatures, high rates of plate tectonic (mid–ocean ridge) activity, and no or very restricted polar ice caps.

3. "So called": When you mean and use the "so called". It often refers to something that is so–called but not truly. For example,

The petrologic nature of the "Medellín Dunite" revisited: An algebraic approach and proposal of a new definition of the geological body.

5. Spelling

For the correct spelling of geological terms in *The Geology of Colombia: Multivolume book*, three highly recommended specialized dictionaries were consulted: *Glossary of Geology* (Neuendorf et al., 2011); *Metamorphic Rocks: A Classification and Glossary of Terms* (Fettes & Desmos, 2007); and *Igneous Rocks: A Classification and Glossary of Terms* (Le Maitre et al., 2002). Use of these resources will guarantee an accurate use of terminology in your manuscript. The *Merriam–Webster* dictionary (Merriam–Webster, s.f.) is also widely recommended; it is an online resource for checking the meaning, spelling, synonyms, and antonyms of words in English (not just geological terms).

5.1. Names of people and places

Usually, the names of people and places are considered proper nouns, i.e., names that are formal or official (Garner, 2016). The first letter of the important words of these names are always capitalized (e.g., Notre Dame Cathedral, University of Arizona). If the names are from languages other than English, use the convention for those languages (Turabian, 2013).

5.1.1. Last names with uppercase

The experience of the Mapa Geológico de Colombia Team, from consulting different sources and assisting with international meetings and congresses, has allowed them to identify an ambiguity in the use of last names. There is no one rule for identifying which part of the name is the last name because this changes according to culture and language. For example, in American English, it is common for people to write their full name as their first name plus their family name—or last name— (e.g., Mark Twain); in French, it is common for people to write their first name, their middle name, and their family name (e.g., Philippe Alain Laurent); and in Latin–American Spanish, it is common to use the first name, the middle name, and the two family names (e.g., Juan Carlos Díaz Cruz). As there are some variations in these formulas and they could change in other languages, it is difficult for a reader to identify the components of a name.

Considering the aforementioned ambiguity, the recommendation applied in the book is that for all mentioned full names through the text, the family name(s) is/are always and completely capitalized. For example, the correct way to write the examples is Mark TWAIN, Philippe Alain LAURENT, and Juan Carlos DÍAZ CRUZ. Take into account that this does not apply for author–date citations or reference lists, since the full names are not used in those structures.

5.1.2. Last names with particles

Particles such as *von, der, van,* and *de* may or may not be considered the first part of the last name; thus, they may be either lowercased or capitalized (in author–date citations and reference lists, otherwise they are fully capitalized); when in doubt, consult biographical dictionaries (Turabian, 2013). Merriam–Webster has some biographical entries that are useful for this. In case they are lowercase, keep this form even in the beginning of paragraphs or after a period. Here, there are some examples consulted and used in TGCMB:

- von Humboldt, Alexander
- van der Lelij, Roelant
- van der Hammen, Thomas

5.1.3. Foreign institutions

It is strongly recommended to always use the proper name of foreign institutions and businesses in their original language, especially in the affiliation of authors' data. This will avoid misunderstandings while giving the corresponding recognition to the institutions or authors and can help to increase the institutions' visibility. The style of writing for these names is to use roman type and capitalization according to its original usage:

- Servicio Geológico Colombiano
- Universidad Industrial de Santander
- Universidade de São Paulo
- Johannes Gutenberg Universität Mainz
- Geological Survey of Norway

In the list, the last institution is not in its original language since writing it in that way would make it difficult to identify and read. In this case, we opt to use the name in English.

5.2. Titles

For titles, follow the recommendations of *The Chicago Manual of Style* using the headline style in the main title and section

Authors' Biographical Notes

Jorge GÓMEZ TAPIAS is a geologist and has worked as a cartographer at the Servicio Geológico Colombiano for 20 years, during which time, he has authored approximately 70 geological maps. He is the coordinator of the Grupo Mapa Geológico Colombiano of the Dirección de Geociencias Básicas, which was recognized by Colciencias as a research group in 2017. GÓMEZ is the first author of the Geological Map of Colombia at a scale of 1:1 M —editions 2007 and of the 26 map sheets of the Geological Atlas of Colombia at a scale of 1:500 000 and is the co–editor of the book *Compilando la geología de Colombia: Una visión a 2015.* Since February 2018, he has served as vice president for South America on the Commission for the Geological Map of the World. He was a co–coordinator and the first author of the Geological Map of South America at a scale of 1:5 M 2019. Since October 2020, he was elected as a member of the International Union of Geological Sciences (IUGS) Nominating Committee for the term 2020–2024. Currently, he is the editor–in–chief of *The Geology of Colombia.* GÓMEZ is in charge of coordinating all the activities related to the project and the editorial process.

Figure 3. Example of titles of works cited in the text. Highlighted in yellow, there is a foreign work in italics with sentence style capitalization; highlighted in blue, there is the name of a book italicized with headline capitalization.

titles of the document. Avoid the use of fully capitalized titles. The main rules for headline style are the following:

1. Capitalize the first word and all the major words (nouns, pronouns, verbs, adjectives, adverbs).
2. Lowercase articles (the, a, an).
3. Lowercase prepositions (up, on, at, in, etc.) and conjunctions (and, or, for, nor).
4. Lowercase last names particles that would be lowercased in text (von, der, van).

Here, there are some examples from TGCMB:

- Contribution of New Airborne Geophysical Information to the Geological Knowledge of Eastern Colombia.
- The Petrologic Nature of the "Medellín Dunite" Revisited: An Algebraic Approach and Proposal of a New Definition of the Geological Body.

5.2.1. Titles of works

When mentioning titles of works in your document, there are some recommendations to consider, according to *The Chicago Manual of Style*:

1. Always preserve the original spelling: Present the title of the work exactly as it appears in the original work and use the headline style capitalization (see Section 5.2).
2. Italics or quotation marks: This choice is determined by the type of cited work. Titles of books and periodicals are italicized, while titles of articles, chapters, and other shorter works are enclosed in quotations marks but not italicized.
3. Foreign titles: This type of title capitalizes the first word and any other word that should be capitalized in the original language (this is called sentence style capitalization). Additionally, it is recommended to present this type of title in italics (Figure 3).

5.3. Foreign words

According to *The Chicago Manual of Style*, unfamiliar foreign words and phrases should be presented in italics. If the word or phrase is used many times, it should be italicized only the first occurrence. For example, this was used for the first occurrence of the German word **Lagerstätte** in Noè & Gómez–Pérez (2020):

> Hence, the Paja Formation is a fossil *Lagerstätte* (Gómez–Pérez & Noè, 2017; Maxwell et al., 2016), a geological formation that exhibits great diversity and exceptional fidelity of preserved palaeobiodiversity (Selden & Nudds, 2012).

However, if the foreign words are familiar and listed in Webster's dictionary they should not be italicized but presented in roman. For example, the use of the Latin expression **in situ** (https://www.merriam-webster.com/dictionary/in%20situ) in Restrepo & Toussaint (2020) followed this rule:

> The use of U–Pb zircon in situ dating with laser ablation multi–collector inductively coupled plasma mass spectrometry (LA–MC–ICP–MS) reassessed the ages of several metamorphic units.

6. Abbreviations

Abbreviations help geologists communicate. The prime reason for using them is to save space and avoid distracting the readers with unnecessary repeated names or phrases. In the body of the text, always consider if the use of the abbreviation is necessary, and if so, introduce the abbreviation for the first time just after its meaning and place it between parentheses, like this:

> The Paramillo de Santa Rosa Volcanic Complex (PSRVC) is part of the northernmost volcanism in the Central Cordillera of Colombia…

The use of abbreviations is mainly recommended in illustrations, tables, and graphics; for those elements saving space is key. When applying this usage, always remember to explain the abbreviations in the captions or notes of the illustrations, tables, or graphics (Figure 4).

6.1. Plurals for letters, abbreviations, and numerals

When using capital letters as words, numerals as nouns, or abbreviations in plural, the correct spelling should be made by adding an "s" in lowercase (Turabian, 2013). Some examples commonly used in geosciences include the following:

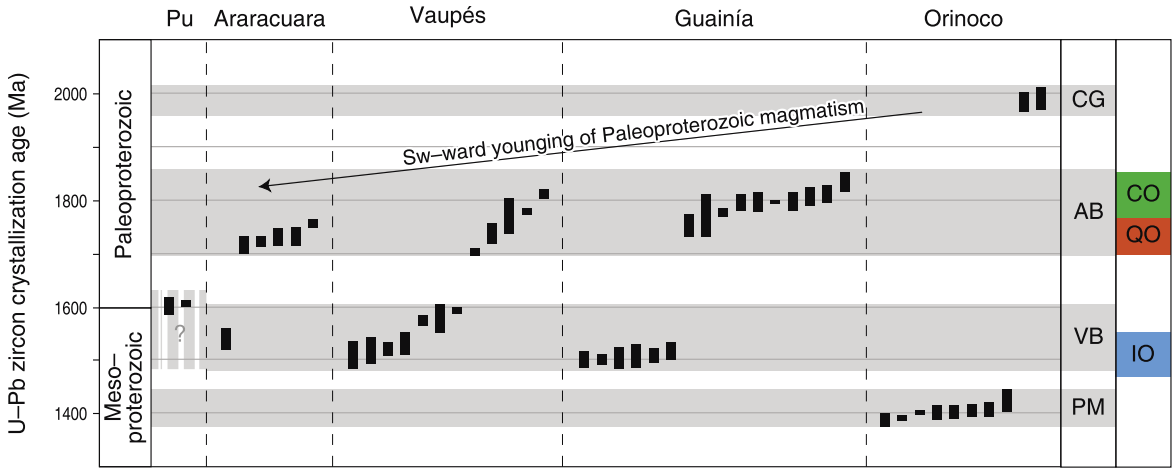

Figure 6. Rank–order plot, organized by geographic region, of the U–Pb geochronologic database available for the westernmost Guiana Shield. (Pu) includes orthogneiss protolith crystallization ages from the basement of the Putumayo Foreland Basin; (Araracuara) includes all samples dated from the Araracuara basement high; (Vaupes) includes all samples dated from the Apaporis River, Vaupes Department, and neighboring regions in Brasil; Guainia) includes all samples dated from the Inirida and Atabapo Rivers, the Guainia Department, and neighboring regions in Venezuela; (Orinoco) includes all samples dated from the Orinoco River, the Vichada Department, and neighboring regions in Venezuela. (CG) Cuchivero Granites; (AB) Atabapo Belt; (VB) Vaupés Belt; (PM) Parguaza Massif, are after Cordani et al. (2016b). (CO) Cauaburi Orogeny; (QO) Querari Orogeny; (IO) Icana Orogeny, are after Almeida et al. (2013).

Figure 4. Example of figure where the use of abbreviations was necessary due to the limited space. Each abbreviation is explained in the caption of the figure. Taken from Ibañez & Cordani (2020).

REEs (rare earth elements)

HFSEs (high field strength elements)

LILEs (large–ion lithophile elements)

6.2. Scholarly abbreviations

Although abbreviations are not highly recommended in academic writing, because the text should be as clear as possible and they could cause confusion, there are some scholarly abbreviations that are widely known and used in scientific articles that do not need to be explained. Table 2 shows some of the most common scholarly abbreviations used in geoscientist papers with their meaning, usage, and examples.

6.3. Other recommendations

If it is necessary to use abbreviations that are not as widely known, here are some recommendations for correct usage:

1. Do not assume the reader knows the meaning of abbreviations. For instance, in Colombia, some places of geological relevance are frequently abbreviated. When using these types of abbreviations, it is important to consider that researchers from other countries could read the paper, so the abbreviation should be defined the first time it is used.
2. Too many abbreviations could make the text unreadable, so if, for example, you are using an abbreviation twice throughout the whole text, consider using the meaning instead.
3. Be consistent. Much confusion can be caused by abbreviations because the writer is not consistent with their use, so be sure of using the same abbreviation (spelling, punctuation) throughout the whole text.

7. Mathematical Expressions

In geosciences, mathematical expressions are always necessary. Whether you are writing an age or an equation, there are some recommendations to make all this information clearer. Most of the guidelines for these can be found in *The International System of Units* (Newell & Tiesinga, 2019). You can also find information in *The ACS style guide*: *Effective communication of scientific information* (Coghill & Garson, 2006).

7.1. Decimal and thousand markers

The decimal marker is the symbol that separates the integral and decimal parts of the number. The *Conférence générale des poids et mesures* (CGPM) establishes that this symbol could be a point (.) or a comma (,). However, in most English academic texts, a point is the most commonly used symbol; thus, this is the one recommended for scientific articles.

The lower boundary of the Quaternary is at 2.58 Ma.

As the widespread use of both symbols for the decimal marker could cause confusion, the thousand marker has been established as a non–separation space, but only when the number has more than four digits (four digits numbers have no space, e.g., 4500).

The Holocene began 11 700 years BP.

Table 2. Explanation of some of the most common scholarly abbreviations.

Abbreviation	Meaning	Usage	Example
et al.	From the Latin *et alii*, which means and others.	In a reference citation, when the reference has **more** than two authors, give only the first name listed and followed by "et al."	(Gómez **et al.**, 2018) Gómez **et al.** 2018
ca.	From the Latin *circa*, which means about or approximately.	Used before an approximated date.	These accretionary belts are known as the Ventuari–Tapajós (**ca.** 2000–1800 Ma), Rio Negro–Juruena (**ca.** 1780–1550 Ma), and Rondonian–San Ignacio (**ca.** 1500–1300 Ma).
e.g.	From the Latin *exempli gratia*, which means for example.	It is used to introduce examples to illustrate something just said. Should not be confused with i.e.	These data were processed with GeoGraphix, where the main seismic reflectors and structures were identified (**e.g.**, faults, folds, onlaps, toplaps, progradations).
i.e.	From the Latin *id est*, which means that is.	It is used to make a clarification or explanation of something just said. Should not be confused with e.g.	The Cauca River valley has been a tectonically active intramountain basin during the Neogene, **i.e.**, at least since 21 Ma.
cf.	From the Latin *confer*, which means compare.	The reader is referred to other material for comparison of the information about the topic under discussion.	The described pattern for the Late Triassic to Jurassic magmatic belt is a probable record of a magmatic flare–up with magmatic tempos between 10 and 20 my (**cf.**, Paterson & Ducea, 2015; Kirsch et al., 2016).
m a.s.l.	It means meters above sea level.	It is used to give the elevation or altitude of a geographic location such as a mountain. Because the m is a unit symbol (for meters), it should not be followed by a period.	The Sierra Nevada de Santa Marta has a maximum altitude of 5775 **m a.s.l.**
etc.	From the Latin *et cetera*, which means "and others of the same kind", "and so forth".	This indicates that there are other things on the list besides the ones that have already been mentioned. Be careful, in scientific writing most of the time it is better to be explicit and mention all the items.	Tethyan fauna allows one to correlate Barremian successions with standard biozones and biohorizons from the Mediterranean area, based on the *Psilotissotia, Nicklesia, Pulchellia, Gerhardtia, Heinzia*, **etc.**
vs.	Abbreviation of versus	Used to compare two things and ideas. Often used in diagrams that show an X–axis versus a Y–axis.	Y (ppm) **vs.** Sr/Y diagram K_2O **vs.** Na_2O diagram

Note: To write these types of abbreviations always use roman style (do not italicize them) and use the punctuation as shown in the table.

The non–separation space for the thousand marker is especially useful to avoid the separation of the number between lines. In the following example, the first reference uses the non–separation space in the scale, but the second one uses the regular space, which causes the split of the number in two different lines.

Gómez, J. & Montes, N.E., compilers. 2020. Geological Map of Colombia 2020. Scale **1:1 000 000**. Servicio Geológico Colombiano, 2 sheets. Bogotá.

Gómez, J. & Montes, N.E., compilers. 2020. Geological Map of Colombia 2020. Scale **1:1 000 000**. Servicio Geológico Colombiano, 2 sheets. Bogotá.

To use this non–separation space, press the combination Alt + 08201 for a Windows computer or the combination Ctrl + Shift + Space for a Mac.

For numbers with many decimal digits (more than four), use this same separation technique to make their reading easier. Start counting from the decimal marker and leave a space every three digits, e.g., the Planck constant is $6.626\,070\,15 \times 10^{-34}$ J•s^{1} (Newell & Tiesinga, 2019).

7.2. Value of a quantity

The value of a quantity is the product of the number and the unit (Newell & Tiesinga, 2019). The correct way to represent it is to separate the numerical value from the unit; thus, the numerical value will always precede the unit, and both will be separated by a space regarded as a multiplication sign. For example:

Correct: 16.5 °C
Incorrect: 16.5°C
Also incorrect: 16.5° C The symbol of degree (°) cannot be separated from the symbol of the scale (C) because both symbols form the unit.

However, there is an exception to this rule for something commonly used in geosciences: coordinates. For this, the symbols for degree (º), minute (´), and second (´´) are next to the numerical value, and no space remains:

Correct: 75° 10’ 37”
Incorrect: 75 ° 10 ’ 37 ”

7.3. Ranges and series

While writing ranges and series, the unit of measurement is retained until the end (Coghill & Garson, 2006). For example:

10–12 mg
5, 10, and 20 kV
60–90°
between 25 and 50 mL

Note that the en dash (–) is used to separate the ranges and series. However, when one or both numbers in a range have a symbol as adjective (see Section 7.4.2), use the word “to” or “through” instead of the en dash, for example, –20 to +120 K.

For writing, geological age follows the same principle but always **puts the older age before the youngest**. For example: “These ages can be correlated with the **98–60 Ma** ages obtained from Gorgona Island”. Note that we are talking about 98 Ma and 60 Ma, and because this is a range, we keep the unit (Ma) until the end and we place the older age first.

7.4. Symbols

Symbols differ from abbreviations because they are the representation of a technical or scientific concept that is usually internationally standardized. In scientific papers, the most commonly used are the chemical symbols (found in the Periodic Table), the unit symbols, and the mathematical symbols.

7.4.1. Unit symbols

Unit symbols are mathematical entities and should not be followed by a period as many abbreviations are (see Table 2) except at the end of a sentence (Newell & Tiesinga, 2019). They also do not have a plural form (cf., section 6.1). Unit names must not be abbreviated because standardized unit symbols already exist, e.g., it is incorrect to abbreviate second with “sec” because the symbol “s” has already been established for this unit. Some of the base units presented in geoscientific publications include the following mandatory abbreviations (in parentheses, the corresponding unit symbol): second (**s**), meter (**m**), kilogram (**kg**), and kelvin (**K**).

The International System of Units also recommends the use of the following base quantity symbols: time (*t*), length (*l, x, r*), mas (*m*), and thermodynamic temperature (*T*). Unlike the unit symbols, these are recommendations and should be written in italic font.

7.4.2. Mathematical symbols

Mathematical symbols are signs used to represent mathematical actions or relations between mathematical objects. Depending on the function they are carrying, they should be correctly placed in the following ways:

- **Symbols as conjunctions**: A mathematical operator that functions as a verb or conjunction can be recognized because it always has numbers or variables on both sides (Coghill & Garson, 2006). When using mathematical symbols in this way, leave a space before and after them. For example:

4×5 cm
$k \geq 420$ s^{-1}

In geosciences, one common symbol used as a conjunction is the one for giving a standard deviation, standard error, or uncertainty. When using it, place a space between the numbers and the ± symbol:

The age of metamorphism of the Florencia Migmatites is 1015 ± 8 Ma.

- **Symbols as adjectives:** When mathematical symbols are not part of an equation and are modifying just one number, no space between the number and the symbol should be placed.

±15 to ±20 °C
±1%
at 100X magnification
I hypothesize the presence of a zone of fluid accumulation
>**130 km** depth.

Another recommendation is to always make sure you are using the right symbol. It is very common to confuse some of them with alphabetical letters. For example, it is common to confuse the letter **x** and multiplication sign **×**. To use the multiplication sign, press the combination Alt + 158 for a Windows computer.

The Chicago Manual of Style has a helpful list to consult of some of the common mathematical signs and symbols. One of the most commonly misused symbols is the tilde operator (~), most of the time used as "approximately", but its correct use is for "similar to" or "asymptotical equal to" (TUCPES, 2010). For "approximately" in the case of ages, the use of the abbreviation "ca." is recommended (see Table 2).

7.5. Large numbers

Always opt to use scientific notation in large numbers (more than four digits) or a prefix that represents the factor.

For example, prefer 1.2×10^6 s instead of 1 200 000 s. Additionally, it is better to write and easier to understand **5.8×10^{-5}** m or **58 µm** than **0.000 058** m. Note that when using the prefix, there is not space left between the symbol of the prefix and the symbol of the unit.

8. Figures and Tables

Figures and tables are useful for organizing and presenting data so the reader can find them in an easier and quicker manner. Additionally, they are relevant for supporting important points and statements in your document. All of these elements should be considered when designing figures and tables so they can be effective in communicating your point to the readers.

8.1. Formatting tables

Following Turabian (2013), a table should have several important elements, each of which is described below. Additionally, an example from TGCMB is shown in Figure 5.

- Title: This is the label of the table (for figures, it is called the caption). It is at the top of the table and should contain the numeration and a short description sufficient to present the nature of the data.
- Body: It includes the column heads and cells containing the data. Try to order this section by a principle that helps readers quickly find what you want them to see.
- Footnotes: The footnotes for tables could be of three main kinds. The first one is the source line, which is introduced by the word *Source(s)* (capitalized, in italics, and followed by a colon) and contains the list of the works from which you compiled the data. The second one is the general notes, which are comments that apply to the entire table and begin with the word *Note* (capitalized, in italics, followed by a colon). The third one is the specific notes, which explain specific items by assigning letters or symbols and then explaining them.

8.2. Citing figures and tables

For citing tables and figures in the text, recommendations from *The Chicago Manual of Style* were adapted. These are the most important:

- Capitalize the words "figure" and "table" when referring to a particular object, e.g., Figure 1, and in the same way, for tables, e.g., Table 1.
- When two or more figures and tables are cited in the text, the plural word is also uppercased with the numbers separated by commas, e.g., Figures 1, 2, 3 and Tables 1, 2, 3.
- When several parts of the same figure are cited in the text, use the singular word uppercased with the numbers separated by commas, e.g., Figure 2a, 2b.
- When citing a range of parts of the same figure, where the middle ones are also included, they are cited using an en dash with no space before and after the symbol, e.g., Figure 8e–h.
- Do not capitalize the words table(s) and figure(s) when they are not referring to a particular item.

8.3. Credit lines in figures and tables

The credit lines in figures and tables are brief statements in the title where author(s) specify if they were taken, modified, or based on other's work. These lines usually contain one of the following words, which indicate different actions.

- After: Taken in the same way it appears in the original work (nothing was modified).
- From: Used in the same manner as "After".
- Modified from: There were some minor changes in comparison to the original work.
- Simplified from: Part of the information presented in the figure or table was taken from other sources, but there was also a process of simplification.
- Based on: It was made based on another one from other author(s). It is considered to be intellectually honest.

Table 1. Recent volcanoes in Colombia are listed from south to north. **Title**

Volcano/complex name	Geographical coordinates		Elevation (m a. s. l.)	Type **Body**
	Latitude N	Longitude W		
Southern segment				
(1) Chiles–Cerro Negro	0° 49' 21.05"	77° 56' 57.05"	4748	2 composite volcanoes
(2) Cumbal	0° 57' 21.67"	77° 53' 6.54"	4764	2 composite volcanoes plus other vents
(3) Azufral	1° 5' 4.500"	77° 43' 0.057"	4070	Composite (older); tuff ring–dome complex (current)
(4) Galeras	1° 13' 16.90"	77° 21' 33.18"	4276	Composite volcano built on horseshoe structures
Central segment				
(5) Doña Juana	1° 29' 51.56"	76° 56' 20.97"	4160	Composite volcano built on caldera remnant; dome complex (current)
(6) Ánimas	1° 33' 58.22"	76° 51' 17.93"	4160	Composite volcano; dome complex
(7) Petacas (?)	1° 37' 20.22"	76° 50' 34.54"	4000	Composite volcano; dome complex (?)
(8) Sucubún (?)	2° 01' 7.11"	76° 34' 23.36"	4080	Dome built on eroded caldera
(9) Sotará	2° 6' 26.87"	76° 35' 26.08"	4420	Dome complex and composite volcano
(10) Coconucos Volcanic Chain	2° 19' 00.00"	76° 23' 00.00"	4646	15 NW–SE aligned vents; composite
(11) Nevado del Huila	2° 55' 25.80"	76° 1' 42.92"	5364	Composite; N–S–aligned dome complex
Northern segment				
(12) Cerro Machín	4° 29' 11.92"	75° 23' 10.30"	2750	Tuff ring–dome complex
(13) Nevado del Tolima	4° 39' 30.87"	75° 19' 46.18"	5215	Composite volcano
(14) Nevado del Quindío (?)	4° 42' 53.03"	75° 23' 19.64"	4700	Composite eroded edifice; seismic activity registered
(15) Cerro España–Cerros de Alsacia	4° 45' 17.00"	75° 22' 18.62"	4533	Eroded caldera; small cones and domes aligned NNE
(16) Santa Rosa (?)	4° 47' 48.28"	75° 27' 50.02"	4600	Eroded caldera; seismic activity registered; hot springs
(17) Santa Isabel	4° 48' 10.57"	75° 22' 29.14"	4965	Composite; dome complex
(18) Cisne (?)	4° 50' 33.43"	75° 21' 8.65"	4700	Composite; dome complex
(19) Nevado del Ruiz	4° 53' 35.11"	75° 19' 8.99"	5321	Composite volcano; adventitious volcanoes and vents
(20) Cerro Bravo	5° 05' 27.22"	75° 17' 32.88"	4000	Dome complex
(21) Romeral (?)	5° 12' 21.60"	75° 21' 50.40"	3858	Eroded caldera; 7000 y BP age reported
Northern Central Cordillera (off the range axis)				
(22) Guadalupe (?)	5° 16' 55.41"	75° 08' 4.52"	2561	Dome complex
(23) El Escondido (*)	5° 31' 15.45"	75° 02' 40.15"	1624	Tuff ring–dome complex
(24) Berlín (*)	5° 35' 20.83"	74° 55' 51.10"	812	Maar
(25) San Diego (*)	5° 38' 56.49"	74° 57' 36.18"	1153	Pyroclastic ring–maar complex; intracrater tuff cone

Note: The numbers in parentheses identify the volcanic structures in Figures 1, 6, 16, 29. **General notes**

(*) Recent volcanoes without confirmation of Holocene activity.

(?) Volcanoes without well–preserved morphology but with associated seismic activity or considered active in the literature. **Specific notes**

Figure 5. Example for formatting tables taken from Monsalve–Bustamante (2020).

9. Common Errors in Writing

During the editing process of the chapters of TGCMB, there was an essential step called "style correction" (Gómez et al., 2020), in which grammatical, punctuation, and spelling errors were corrected by American Journal Experts. The editorial board identified some of the most common errors that style correctors indicated in the documents and compiled them. These identified corrections were compared to the standards found in different manuals of English writing (Wallwork, 2013; Garner, 2016), which resulted in the ability to classify and understand them without being an expert in English grammar and punctuation. In the following examples, readers can find errors usually made by authors whose native language is not English.

9.1. Article omission

The main usage of the definite article (the) is to refer to something specific. However, this distinction between general or specific is not always easy. For something to be specific, one should be able to answer the question "which one(s)". In the first example, it is clear that authors are not referring to any development of paleosol profiles, but to the one occurring to the top of the Giron Formation. The adjustment of the preposition will be mentioned in the next numeral.

Not this: Development of paleosol profiles to the top of the Giron Formation shows evidence of humid conditions in tropical latitudes.
But this: **The** development of paleosol profiles to the top of the Giron Formation shows evidence of humid conditions **at** tropical latitudes.
Not this: Additionally, Silurian (Ludlow) spores occur in weakly metamorphosed rocks of Quetame Massif.
But this: Additionally, Silurian (Ludlow) spores occur in weakly metamorphosed rocks of **the** Quetame Massif.

9.2. Incorrect use of prepositions

This is one of the toughest topics to address. In English, a high number of prepositions exist, and each of them is used in several different ways according to verbs, nouns, or position in text. This is why most nonnative authors make mistakes when using them. We want to share just a few of the most common. Readers can find a thorough explanation and more examples in Wallwork (2013).

In cases when the origin is mentioned, the correct preposition is *from* not *of*.

Not this: In this block, Jurassic rocks rest unconformably upon Paleozoic sedimentary strata and are overlain disconformably by Lower Cretaceous continental fluvial deposits of the Rio Negro Formation or by marine carbonate rocks of the Cogollo Group (Aptian age).
But this: In this block, Jurassic rocks rest unconformably upon Paleozoic sedimentary strata and are overlain disconformably by Lower Cretaceous continental fluvial deposits **from** the Rio Negro Formation or by marine carbonate rocks **from** the Cogollo Group (Aptian age).

When referring to a precise date, the correct preposition is *on*. It is also important to know the differences between *in*, *on*, and *at*.

Not this: Ecuadorian earthquake of April 16, 2016.
But this: Ecuadorian earthquake **on** April 16, 2016.

The word *divide* emphasizes separation and is (most of the cases) accompanied by the preposition *into*.

Not this: …the basin is divided in Alto Patía and Buga–Cartago sub–basins.
But this: …the basin is divided **into** the Alto Patía and Buga–Cartago sub–basins.

9.3. Subject–verb disagreement

The alignment of the subject with the verb conjugation in terms of number generates frequent mistakes. To avoid these mistakes, authors should pay close attention to whether the subject is a singular or plural noun.

Not this: …the presence of spilites and other low–grade mafic rocks are only reported in the Ebéjico Terrane.
But this: …the presence of spilites and other low–grade mafic rocks **is** only reported in the Ebéjico Terrane.
Not this: A wire model have been estimated supported by three profiles based on gravity forward modeling.
But this: A wire model **has** been estimated supported by three profiles based on gravity forward modeling.
Not this: …this small mountain range lie only 85 km to the south of an abyssal plain ca. 3.5 km deep in the Caribbean Sea.
But this: …this small mountain range **lies** only 85 km to the south of an abyssal plain ca. 3.5 km deep in the Caribbean Sea.

9.4. Incorrect usage of punctuation marks

As mentioned in Section 4, punctuation marks are essential for guaranteeing the correct understanding of statements. In the following example, there are some misuses of comma (again, we strongly recommend consulting different uses in the recommended bibliography).

Never use comma between a subject and its verb.

Not this: The main problems that need to be solved, are related with the recent recognition of…
But this: The main problems that must be solved are related to the recent recognition of…

Use a comma to separate two independent clauses (a set of words that contains a subject and a verb and can stand alone as a sentence).

Not this: There is seismic activity along W–E structures related to the Sandra Ridge but is less well constrained compared to that of the continental areas.
But this: There is seismic activity along W–E structures related to the Sandra Ridge, **but this activity** is less well constrained compared to that of the continental areas.

9.5. Misspellings

The incorrect spelling of words is a common mistake that can be easily avoided with dictionaries or glossaries of the discipline.

Not this: and (3) ubiquotous 30–20 Ma AFT and AHe age peaks across the range.
But this: and (3) **ubiquitous** 30–20 Ma AFT and AHe age peaks across the range.

Not this: …two discontinuos NW–SE scarps appear between the Amaime River and Sonso town (Quebrada Honda and La Novillera scarps).

But this: …two **discontinuous** NW–SE scarps appear between the Amaime River and Sonso town (i.e., the Quebrada Honda and La Novillera scarps).

10. Conclusions

This first part is dedicated to compiling the most relevant information about stylistic rules and writing recommendations that are useful for avoiding imprecision and ambiguity. Most of the norms presented are obtained from manuals with extensive use in their field, and the rest are the result of the previous editorial experience of the Mapa Geológico de Colombia Team. We contextualized every recommendation with examples from TGCMB, thus making the document an essential guide for those who are preparing any contribution in geosciences. We have presented guidelines of great importance related to grammar, punctuation, and spelling in English writing but also about style of mathematical expression and figures and tables.

As this document was not created with the aim to be a grammar and punctuation guide, there are many important topics in English writing not addressed here that should be consulted or learned during the construction of a scientific paper. However, we expected that the sources cited could be taken as primary sources and reliable documents, and we strongly encourage readers to consult them to clarify doubts on specific cases not included in the illustrative examples. Additionally, the section of common errors in writing was created to alert authors about possible mistakes that need careful attention.

The Geology of Colombia: Multivolume book was a crowning achievement in the editorial work of the Mapa Geológico de Colombia Team; it included a lot of expertise and experience in the subject but also consolidated knowledge and provided valuable lessons. That is why it is of great importance to the Team to share this information and present it in the easiest and most comprehensible way so that it can be used by everyone, from students and early career scientists to senior professionals.

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Explanation of Acronyms, Abbreviations, and Symbols

BP	Before present
cf.	*confer*, compare
CGPM	*Conférence générale des poids et mesures*
e.g.	*exempli gratia*, for example
i.e.	*id est*, that is
Ma	Mega–annum, million years
s.f.	sin fecha
SI	The International System of Units
TGCMB	*The Geology of Colombia: Multivolume book*