PROPER TERMINOLOGY IN ANALYTICAL GEOCHEMISTRY

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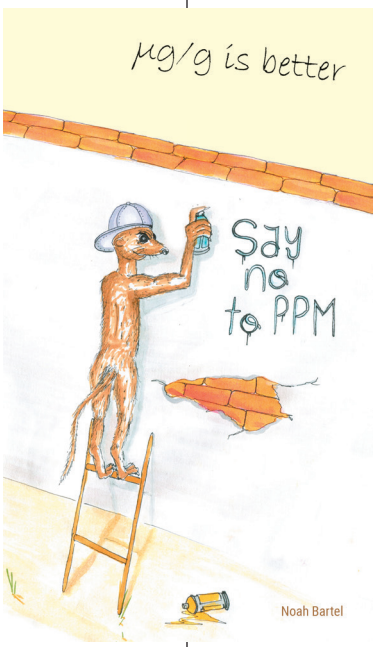
Success in science has basically two components: (1) what one might call the "research component," involving the testing of a hypothesis or the acquisition of a unique data set that provides insight into the workings of nature; (2) the "communications component", which involves the dissemination and archiving of the knowledge that has been won. For me, the importance of this second, communications, aspect within the scientific process seems all too often underappreciated. Problems that many of us have certainly encountered in the geochemical literature range from incomplete descriptions of an analytical method, to the use of ambiguous jargon, to authors simply using the wrong terminology, etc. A case in point is a manuscript that I recently had the pleasure to review. I will refer to its authors as "Smith and Jones", who were reporting on a new analytical method which they found to have a "significantly improved *sensitivity*" as compared to a long-established reference method. In truth, the newly developed laboratory strategy by Smith and Jones gave a somewhat lower signal intensity for a give sample size (i.e. a lower sensitivity) but had an improvement of signal-to-noise ratio of at least 100x over that of the reference method. My enthusiastic congratulations to Smith and Jones for an important methodological breakthrough, but please state that your discovery offers a "significantly improved *selectivity*".

Within the field of analytical geochemistry, one often finds a vast divergence from established vocabulary and "correct" metrological terminology. The obvious question from the reader is, "How does one define 'correct'?" It turns out that quite an extensive literature exists on this topic, and, in particular, I point the reader to the Joint Committee for Guides in Metrology (2012) contribution, commonly referred to as the "VIM3 guide". This document is a rather heroic effort to unify the terminology used across diverse fields of analytical science and engineering. In it, one sees that the "correct" terms often diverge greatly from what one commonly reads in geoscientific literature. I have to confess that VIM3 can be a challenging document to read, especially when encountering the definitions for such terms as "the repeatability of condition of measurement" and "true quantity value". Nonetheless, VIM3 is a document that all scientists working with quantitative data should be familiar with.

A second source of information is the Joint Committee for Guides in Metrology (2009) "Guide to the Expression of Uncertainty in Measurement", otherwise known as the "GUM guide", and which, likewise, can be downloaded from the *Bureau International de Poids et Mesures* website. This second information source focuses specifically on the description of analytical uncertainty and various conceptual components for describing the reliability of quantitative results. More specifically, the GUM guide provides extensive discussion of such topics as estimating analytical uncertainty and establishing the confidence level that the "true" result lies within a specified range. GUM is another document well worth being familiar with.

So, now I would like to mention a few examples of terminology that are well-established – and widely misused – within the list of geochemical jargon. One term that one should studiously avoid is "ppm", even though the majority of geochemistry publications continue to make use (and abuse) of it. So, what is the problem with "ppm"? The problem is that it is ambiguous in meaning: is the author referring to μg/g (parts-per-million by mass), or μmol/mol (atomic ppm) or even μl/l (volume fraction within a gas)? A second example of widely misused term is that of "analytical error", which actually suggests a mistake or blunder made during an analytical procedure. If you are describing the number provided after the plus-or-minus, then this should properly be referred to as the "analytical uncertainty". Finally, the term "standard" is generally wrong when talking about a substance that is used for calibrating analytical instrumentation. Generally correct is the term "reference material", which VIM3 defines as a "material, sufficiently homogeneous and stable with reference to specified properties, which has been established to be fit for its intended use in measurement or in examination of nominal properties". Now that's a definition!



I will conclude with a couple of additional tips where one can seek information about proper usage of terms in metrology. I can strongly recommend the contribution of Potts (2012), which gives clear and easily readable definitions of no less than 73 terms and concepts relevant to the analytical geochemist. Also worth a look is the recently established on-line guide at www.geoanalyst.org/glossary, which provides a more humorous take on the topic.

REFERENCES

Joint Committee for Guides in Metrology (2009) Evaluation of Measurement Data — An Introduction to the "Guide to the Expression of Uncertainty in Measurement" and related documents. JGCM 104:2009, 20 pp

Joint Committee for Guides in Metrology (2012) International Vocabulary of Metrology – Basic and General Concepts and Associated Terms (VIM). JGCM 200:2012, 3rd edition, 91 pp

Potts PJ (2012) Glossary of analytical and metrological terms from the International Vocabulary of Metrology (2008). Geostandards and Geoanalytical Research 36: 231-246

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