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**Clarifications on statements in Badía et al. (2014), Geoderma 193-194: 13-21.**

5 Juan Herrero <sup>a\*</sup> and Juan Mandado <sup>b</sup>

<sup>a</sup> *Estación Experimental de Aula Dei, CSIC, Ave. Montañana 1005, 50059 Zaragoza, Spain*

<sup>b</sup> *Departamento de Ciencias de la Tierra, Universidad de Zaragoza, c/ Pedro Cerbuna 12, 50009 Zaragoza, Spain*

\* Corresponding author E-mail address: [jhi@eead.csic.es](mailto:jhi@eead.csic.es)

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**Abstract.** Both fragmental scientific quotations and misquotations can contribute to the spread of mistakes and cast confusion upon future research. We discuss several erroneous or conflictive statements and some misquotations found in an article published in GEODERMA. Many of the flaws are related with the occurrence of gypsum in soils and with the use of the term 'equivalent' in the designation of analytical results. Our reading of the subject article raises concerns about its validity, with practical implications on the future use of the concepts and data.

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The subject article by Badía et al. (2013) contains several erroneous or contradictory statements and misrepresentations of information from the published literature. Many of the above flaws occur in their discussions related to the occurrence of gypsum in soils and with use of the term "equivalent" in analytical results.

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Guerra and Monturiol (1970) do not use the "French taxonomy system", as stated by Badía et al. (2013) in their Introduction. This system is not mentioned in Guerra and Monturiol (1970), and their earlier publication (Guerra et al., 1968, page ix) states that most of the adopted

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taxonomic units come from Kubiěna (1952), some from the 7<sup>th</sup> Approximation (Soil Survey Staff, 1960), and the remainder are their own.

Desir et al. (1995) studied two experimental sites located in the Ebro Valley, about 50 to 70 km from the area studied by Badía et al. (2013). While the Introduction of Desir et al. (1995) does discuss the slow development of soil due to anthropic actions plus climatic and lithologic characteristics, this is not the same as a "low weathering capacity of the environment", as Badía et al. (2013) state in Section 2.1 and attribute to Desir et al. (1995). Their term "weathering capacity" should be discussed in the context of the geologic history of the sedimentary materials of the central Ebro Valley.

In Section 2.2, Badía et al. (2013) mistakenly attribute the term "electrolytic conductivity" to Rhoades et al. (1982). Electrical conductivity is the standard expression used in soil science. This utilitarian expression does not involve assumptions about the causes (electrolytes or others) of the movement of electrons either in the saturation extract or other media, as is the case with saturated paste or other proportions of soil to water. As electrical conductivity is the standard expression used in soil science, their introduction of the term 'electrolytic conductivity' should be supported or explained.

A striking expression used in the first column of page 15 is that of 'disturbed blocks'. Errata could also be the two times that '150 m depth' occurs at the same column of page 15 instead of 150 cm, or the 'about 350 m of elevation' for the bottom of the valley in the same column, a number that does not fit with the elevations of 580 m and 400 m appearing at the Figure 2 of the subject article.

Concerning mineral composition of soil parent material, we assume that Table 1 presents data as percentages. Some data in Table 1 differ from the sources referenced in the caption, as is the case for  $n = 35$  and  $n = 14$ , while these numbers are  $n = 33$  and  $n = 50$ , respectively, in Table 1 in Arenas and Pardo (1999). Badía et al. (2013) also indicate a value of "0" under "Gypsum" in Table 1, and reference this value to Arenas and Pardo (1999). However, Arenas and Pardo (1999) did not mention gypsum in their listing of mineral composition (Table 1). As these authors did not include gypsum in their analyses for mineral composition, it would seem more appropriate for Badía et al. (2013) to indicate "not determined" for gypsum, rather than assigning a value of "0". In addition, the first data row in Table 1 of Badía et al. (2013) seems to be the result of a miscalculation of means caused by disregarding the size of the populations from the

two first data rows in Table 1 of Arenas and Pardo (1999). Furthermore, Table 1 of Arenas and Pardo (1999) represents their entire study area, not specifically the T5/T6 units mentioned by Badía et al. (2013).

60 A more notable discrepancy with respect to Table 1 of Badía et al. (2013) is the reference to Mandado (1987), presumably in relation to the mineral composition of gypsum. Mandado (1987) presents chemical composition in parts per thousand –a far cry from percent of mineral composition– and also discusses that it is difficult to postulate on the average mineral composition in gypsiferous rocks (Mandado, 1987, pp. 400-414). If Badía et al. (2013) did  
65 somehow estimate percent of mineral composition (e.g. "Quartz and feldspars" or "Clay minerals") from selected data on chemical composition in Table XXVII of Mandado (1987), the calculation would seem speculative, and the process and rationale should be explained to avoid misrepresentation.

Regarding soil texture in gypsum soils, Section 2.2 mentions a correction for the clay value in  
70 the laser-diffraction analysis for particle-size distribution (PSD) according to Taubner et al. (2009). This correction is unrelated to the major problems of textural analyses on gypseous soil samples, which include the shape and physical properties of the gypsum grains (crystals), the physicochemical effects of their dissolution and the resultant saturation in calcium and sulfate ions, or the nonsense of washing gypseous soil samples prior to the determination of PSD. The  
75 hard question, i.e., how well the laser-diffraction works with gypseous soil samples, is neither answered nor discussed by Badía et al (2013). However, further in their text, from the discussion at the last paragraph of Section 3.3., one could draw the conclusion that the problem is solved by the laser-diffraction instrument.

In Section 3.1, the wording "diagenetic processes (formation of secondary carbonates)" is  
80 confusing and seems to indicate that the formation of secondary carbonates does not occur in a soil environment. The confusion increases because the next paragraph mentions secondary carbonates "in pores or pseudomycelia", suggesting pedogenic processes. Is use of the term "diagenetic processes" intended to distinguish processes other than pedogenic, or simply a poor choice of words? In Section 4, the authors mention that measurement of pedogenic gypsum  
85 content "can be difficult to perform on gypsum-rich soils using standard methods", but neglect to specifically define those methods. Without such information, readers are left to wonder.

The concept of equivalent gypsum is misused and misinterpreted throughout the subject article. This concept, as reviewed by Herrero et al. (2009), was introduced in Spanish by Herrero (1991, page 49) and later the equivalent gypsum content (EGC) was defined in English (Herrero et al., 1992) as “total sulfates expressed as gypsum”. This expression was coined to set aside the shortcomings of gypsum content determinations in routine chemical laboratories when dealing with soils containing sulfate minerals other than gypsum. Artieda et al. (2006) stressed that the methods based on the loss of crystal water of gypsum do not rely on  $\text{SO}_4^{2-}$  determinations and thus estimate the gypsum content *sensu stricto*, without interference from other sulfate minerals contained in the sample.

As Badía et al. (2013) are using a thermogravimetric method (discussed in Section 2.2), it seems nonsensical to talk about "equivalent gypsum", unless they claim that the thermogravimetric method they used is titrating components other than gypsum. In such a case, they should identify those components. The statement "the present taxonomy systems persist in using just the gypsum concept" seems to claim that the expression equivalent gypsum should be used instead of gypsum content, even though this was not the purpose of the original definition of EGC. Furthermore, other methods titrating gypsum in the lab do not rely on sulfate determination, as is the case of Lebron et al. (2009), an article referenced by Badía et al. (2013). Conversely, non-invasive methods for determining the chemical composition can be used to estimate the gypsum content of the soil, even in the field. This is the case for methods based on x-ray fluorescence spectrometry, as proposed by Weindorf et al. (2009, 2013), where even further developments can be expected. If the concept of EGC is understood, it is easy to decide if the result of a specific analytical method must be designated as gypsum content or as EGC.

Also, the authors of the subject article attribute the 150° C desiccation temperature used in the thermogravimetric method to Nelson et al. (1978) and Vieillefon (1979). However, both articles actually mention 105° C for desiccation and do not say that "gypsum is converted to anhydrite upon heating to 150° C". Furthermore, it is unclear which thermogravimetric method was used by Badía et al. (2013), as the method of Nelson differs from the more complex method of Vieillefon that involves the addition of distilled water.

When the method of Nelson (1982) is mentioned in Section 2.2, the authors, instead of talking about calcium carbonate equivalent, state that "total carbonate content was measured". How and why they measured total carbonate content with a calcimeter, in spite of the presence of dolomite

presented in Table 1 of Badía et al. (2013), should be explained. This clarification could help the reader understand why throughout their article they mention such a range of terminology:  
120 equivalent calcium carbonate, equivalent calcium carbonate content, equivalent CaCO<sub>3</sub>, calcium carbonate equivalent, content of equivalent calcium carbonate, total equivalent CaCO<sub>3</sub>, and calcium carbonate equivalent content. If these terms refer to the same concept, it would be better to use a single expression.

In summary, the aforementioned points bring into question the terminology, methodology,  
125 and references to previous work within the subject article.

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