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Comment on: "Chemostratigraphic constraints on early Ediacaran carbonate ramp dynamics, Río de la Plata craton, Uruguay" by Aubet et al. Gondwana Research, Volume 22, Issues 3-4, November 2012, Pages 1073-1090

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1. Introduction

The Arroyo del Soldado Group of Uruguay is a key unit for unraveling several, still unsolved cardinal problems in Neoproterozoic research. Thus, we welcome in principle publications contributing to our knowledge of this and other units. Regarding Aubet et al.'s (2012) paper, we contest their age assumptions and chemostratigraphic inferences and thereby call into question the core message of the paper. Moreover, we also show below that it does not make proper acknowledgement of sources.

2. Formal issues

The problems begin already in page 2, where we read: "*The group reaches almost 3000 m in thickness, and has been subdivided into four formations: the Yerbal, Polanco Limestones, Cerro Espuelitas and Barriga Negra formations* (sensu Pecoits et al., 2008; Pecoits, 2010)…"

The reader will understand from this statement that Pecoits et al. (2008) and Pecoits (2010) were the authors that first separated and mapped the mentioned formations of the Arroyo del Soldado Group. However, the Yerbal Formation was formally erected by Gaucher et al. (1998a) and Gaucher (2000), the Polanco Limestones Formation and the Cerro Espuelitas Formation were formally defined by Gaucher et al. (1996) and later described in more detail by Gaucher (2000), and the Barriga Negra Formation was erected by Midot (1984) and later included in the Arroyo del Soldado Group by Gaucher et al. (1998a) and Gaucher (2000). The same stratigraphic subdivision was adopted by Bossi et al. (1998) and Bossi and Ferrando (2001) for the geological map of Uruguay. The previous works have not been cited at all, neither at the referred passage nor elsewhere. Over half a dozen papers were just replaced by two self-citations. This amounts to claiming results from research conducted by others.

In chapter 4.1 Aubet et al. describe limestone–dolostone alternations (rhythmites), hummocky cross-stratification, swaley cross-stratified calcarenites and dolostone rip-up clasts, as if they were unknown before. They also state in page 4 that "*These deposits are interpreted to represent a storm-dominated inner ramp setting*", suggesting that this is a novel interpretation. They fail to mention that the same rocks, at the same sections (Recalde, Los Tapes and parastratotype of the Barriga Negra Formation) were already thoroughly described and classified as such one decade earlier by Gaucher (2000) and Gaucher et al. (2004). The same interpretation of a storm-dominated ramp can be found in Gaucher et al. (2004), a paper cited by Aubet et al. elsewhere but conspicuously absent in chapter 4.1, thus failing to acknowledge previous work done in the studied units.

In page 15 the authors state: "*Water column stratification during the deposition of the lower part of the Arroyo del Soldado Group has been suggested based on the development of iron formation in the upper part of the Yerbal Formation* (Pecoits et al., 2008; Pecoits, 2010)…" Again in this case, iron formation in the Yerbal Formation was first described and water column stratification proposed by Gaucher et al. (1998b, 2004) and Gaucher (2000), not by Pecoits and coworkers, as implied by Aubet et al. (2012).

Finally, the map in Fig. 1B is derived from Fig. 3 of Mallmann et al. (2007), published in Gondwana Research, but no reference is provided. The figure is not derived from Bossi (2003).

3. Scientific issues

3.1. Age constraints

The Yerbal and Polanco formations are assigned a "pre-Gaskiers" age by Aubet et al. (2012) essentially on the basis of detrital zircon ages reported by Blanco et al. (2009). Indeed, in page 13 we read: "*If we assume that the minimum age of deposition is already constrained by the youngest zircons present in the* [overlying] *Barriga Negra*

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Formation at ~566 Ma then, the carbonate sedimentation lasted less than 35 Ma." In other words, Aubet et al. (2012) assign a minimum age of 566 ± 8 Ma to the Polanco Formation because the youngest detrital zircon in the *overlying* Barriga Negra Formation yielded that U–Pb age. This is a gross stratigraphic error, because the zircons are detrital and not of volcanic, i.e. synsedimentary origin (e.g. Miller et al., 2010). The correct reasoning is: the Barriga Negra Formation is younger than the 566 ± 8 Ma zircons it contains, but nothing can be said about the underlying unit, in this case the Polanco Formation. It could be older or also younger than 566 Ma, depending on a number of unconstrained variables.

Moreover, Aubet et al. (2012) seem unaware of the results published by Gaucher et al. (2011), showing that the Barriga Negra Formation represents the base of the Arroyo del Soldado Group and not its middle part, as assumed before (e.g. Gaucher, 2000). In the new stratigraphic scheme, the Barriga Negra Formation correlates with the lower and middle Yerbal Formation. Thus, the entire Arroyo del Soldado Group is younger than 566 ± 8 Ma, which is consistent with U–Pb SIMS ages of basement granites as young as 583 ± 7 Ma (Gaucher et al., 2008), and with the occurrence of the index fossil *Cloudina riemkeae* in the Yerbal and Polanco formations (Gaucher and Poiré, 2009, and the references therein).

Given these age constraints, it is clear that Aubet et al.'s interpretation of K–Ar ages of clay fractions cannot be right. The two coarser illite fractions dated (2–6 μm and <2 μm) yielded ages of 636 ± 8 Ma and 575 ± 12 Ma respectively. Whereas Aubet et al. (2012) recognize that the coarsest fraction matches the age of basement plutons, they interpret the <2 μm fraction as authigenic, ignoring the fact that basement granites (Gaucher et al., 2008) and detrital zircon grains of the Barriga Negra Formation (Blanco et al., 2009) yielded U–Pb ages within error of their K–Ar age. It is clear that only the age of the finest illite fraction (<0.4 μm), with a K–Ar age of 513 ± 10 Ma, represents diagenetic overprint and cooling of the Arroyo del Soldado Group. This is readily explained by the weak thermal overprint of the unit, which is best constrained by the Thermal Alteration Index (TAI) of acritarchs of 3 to 4 (Gaucher, 2000), implying temperatures not higher than 200 °C (e.g. Teichmüller et al., 1998). Similar results were obtained by illite crystallinity studies (Gaucher, 2000 and the references therein; Pamoukaghlián et al., 2004). Using the same Ar diffusion model of Aubet et al. (2012) and choosing a more realistic temperature of 200 °C and a timeframe of 1 Myr, we obtain a negligible 3% Ar diffusion average. The detrital nature of the <2 μm illite fraction is thus confirmed.

3.2. Chemostratigraphy

Aubet et al. (2012, p. 14) hypothesize that: "*The negative* [$\delta^{13}C$] *excursion recorded in the Polanco Limestones Formation, however, is facies controlled and only occurs in shallow-water strata associated with storm events and thus, it appears to be likely a local rather than a basin-wide phenomenon*." They base this assertion on the lack of a negative $\delta^{13}C$ anomaly in the basinal Los Tapes section and in the "mid-ramp" South Isla Patrulla Section. The basinal section is the least adequate to pinpoint a negative excursion, because the strong isotopic gradient between shallow and deep water largely masks and smoothes out secular $\delta^{13}C$ variations, as demonstrated by Frimmel (2004) for Neoproterozoic cap carbonates of the Port Nolloth Group in Namibia.

As for the Isla Patrulla Section, Aubet et al. (2012) only studied an incomplete, 250 m-thick profile of carbonates with no visible contact either with the underlying Yerbal Formation or the overlying Cerro Espuelitas Formation. If we consider that the thickness of the Polanco Formation exceeds 900 m (Gaucher et al., 2004) it becomes clear that their fragmentary section may represent the transition between units B and C or—more probably—the one between units D and E of Gaucher et al. (2004, 2009). In no way can the section studied by Aubet et al. (2012) demonstrate the absence of the negative excursion in that particular area. It is worth noting that still unpublished data clearly show the occurrence of the negative $\delta^{13}C$ excursion recorded in unit B of the Polanco Formation at four different sections separated 200 km, including one near Isla Patrulla. We are thus confident of the primary nature of the negative $\delta^{13}C$ perturbation, which is—significantly—mirrored also by $\delta^{53}Cr$ and εNd values (Frei et al., 2011).

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