

The authors would like to thank the Referee#1 for his/her careful reading and his/her useful and precise comments. We agree on all of them, see our detailed response below. Please note that the reviewer comments are in bold and that the line numbers correspond to the ones of the Ms with track change. The sentences or the quotations in italics are the modified parts of the Ms.

This study presents a methodological protocol to determine soil organic content and soil inorganic content. Using Rock-Eval thermal analysis offers some benefits over Elemental analysis method, where the SOC is estimated by the difference between Total Soil Carbon and SIC. Rock Eval eliminates the chances of calculation error, and experimental error associated with the EA method.

Comments:

- 1. In general, the formatting needs to be checked. Chemical formula should be written with proper subscript, and units should be given with proper superscript and subscript.**

We checked subscript and subscript where necessary, in the *2.2.2 Calculation of the standard parameters* section for instance.

- 2. Material-The soil type for the 24 samples should be mentioned. This will help to establish the effectiveness of using RE for different soil types.**

Thank you for this remark. The paper will be improved with this information. We added the Table 1 in the *2.1 Material* section (l.129) with the Land use, Soil type, Depth, Texture, pH, TC, SOC and SIC contents for each soil of the first panel.

- 3. Sec 2.2.1: which acid was used for acid treatment?**

We improved the description of the EA method, especially the pretreatments before the EA in the *2.2.1 Elemental analysis* section:

- decarbonation pretreatment: *"The Ag-foil capsules were filled with 30±5 mg of soil and 50 µL of demineralized water and placed in a vacuum desiccator with a 100 mL-beaker of concentrated HCl (37%) during 8h. The capsules were then dried at 60 °C for 48h before being closed and analysed with the elemental analyser (Harris et al., 2001; Cardinael et al., 2015)."* (l.138-141)
- decarbonation pretreatment: *"The capsules were filled with 30±5 mg of soil and placed in a muffle furnace at 550°C during 6h (Bertrand et al., 2007). The capsules were then closed and analysed with the elemental analyser."* (l.142-144).

4. L105: The authors need to provide a justification on why no replicates were conducted.

We did not conduct replicates on the first panel because we performed regressions, which need non-replicated values. We added this precision in the 2.4 *Data analysis* section: “Least squares regressions [...] were tested [...] on non-replicated values” (l.325-328) and in the caption of the Figure 4: “Plot of the SOC content estimated by the uncorrected and the corrected TOC parameters of the RE analysis on one aliquot vs the SOC content estimated by EA_{HCl} on one aliquot for the 30 soils of the first panel.” (l.359-361) and the Figure 5: “Plot of the SIC content estimated by the uncorrected and the corrected MinC parameter on one aliquot vs the SIC content estimated by EA_{550°C} on one aliquot for the 30 soils of the first panel.” (l.379-381) for instance.

Moreover, the repeatability of the EA has already been assessed: “a relative error of 5% was applied to the x-axis (EA) according to the norm ISO (1995b).” (l.350). Some studies already assessed the repeatability of the RE method: “a relative error of 2% and 1.7%, respectively, was applied on the y-axis (RE). These relative errors come from an IFPEN study of intern repeatability conducted on five replicates of five soils (data not shown). These relative errors are consistent with Behar et al. (2001) measurements on rock and kerogen samples.” (l.351-354).

In the new Ms version, we also added four RE and EA analyses on three geostandard materials and on a calcite sample, see 2.3 *Experimental design* section: “To evaluate the precision and the accuracy of the RE method, the TC, SOC and SIC contents of the three geostandard materials and the calcite sample were measured by EA and RE on four aliquots (SM 3). These samples were analysed with a RE analysis cycle with an extended final oxidation isotherm of 7 min.” (l.311-313). We added the results in SM 3 and the results interpretation and conclusion in the 3.3 *Adaptation of the RE standard cycle of analysis* section: “[...] On these samples, the precision of the RE method is comparable or better for inorganic content, than the precision of the EA method.” (l.495-502).

5. Figure 1: message from figure not adequate. What is S, S2. Why these temperature ranges were selected. The denotations for S-S3 appears later in the text, but it should be given at the first instance of their appearance.

Thank you very much for this remark. It is extremely important that the reader can easily understand how the RE method works. We moved the Figure 1 from the 2.2.2 *Standard cycle of Rock-Eval® analysis* section to the 2.2.2 *Calculation of the standard parameters* section (l.176), just above the Table 2 (previously Table 1). We also changed the caption to add more information: “Example of the 5 thermograms and 9 peaks (S1, S2, S3CO, S3'CO, S3CO₂, S3'CO₂, S4CO, S4CO₂ and S5) obtained during the Rock-Eval® analysis of a calcareous agricultural topsoil with a SOC content of 15.7 gC.kg⁻¹soil and a SIC content of

11.6 gC.kg⁻¹soil. The brown areas correspond to the curves formed by the pyrolytic cracking and the oxidative combustion of SOC and are integrated in the TOC parameter calculation. [...] FID: Flame Ionization Detector; IR: InfraRed.”.

6. What is the purity of the nitrogen used?

According to our supplier AirProduct, the purity of the nitrogen and the pure air used for the RE analysis is 99.999%. We added the information in the 2.2.2 *Standard cycle of Rock-Eval® analysis* section: “a pyrolysis of the sample under an inert nitrogen atmosphere (purity = 99.999%) and an oxidation of the residue under pure air (purity = 99.999%)” (l.160-161).

7. L125: The author must specify how these thermograms correlate to SIC and SOC (As mentioned later in Table1). As a reader it's not directly given and needs to be inferred.

In the 2.2.2 *Calculation of the standard parameters* section, we added a sentence to describe it: “The SOC pyrolytic cracking and oxidative combustion occur at lower temperature than the SIC pyrolytic and oxidative thermal breakdown. Thus, the S1, S2, S3CO, half of the S3'CO, the S3CO₂, S4CO and S4CO₂ curves correspond to the SOC cracking and combustion whereas the other half of the S3'CO, the S3'CO₂ and the S5 curves correspond to the SIC thermal breakdown (Figure 1, Table 2).” (l.193-196).

8. L165: I appreciate that the author has taken the recalcitrant carbon into account.

Thank you for your comment. The thermoresistant organic matters cause some problems for thermal analysis because their cracking or combustion temperatures overlaps the ones of the SIC thermal breakdown. As mentioned in the 4. *Conclusion* section, work still needed to solve this issue: “The TOC and MinC parameters still need to be statistically corrected even with the adaptation of the oxidation phase. To be independent of statistical corrections, which could depend on the SOC and SIC forms in the analysed soil, further study should focus on the distinction between the signals from the pyrolytic cracking and oxidative combustion of SOC organic matter and the signals ones from the SIC pyrolytic and oxidative thermal breakdown.” (l.528-532).

9. Figure 4: why EA was selected for comparison? Since SOC is estimated by the difference between TC and TIC, TOC is an estimate, as mentioned in the introduction. Shouldn't LOI method come here? Please provide a solid justification for the use of EA. Rather TC from EA and TC from RE could have been co-related.

We compared the RE analysis with the EA because these two methods are based on the measure of the gases emitted by a sample oxidation (EA) or pyrolysis + oxidation (RE). We did not use the LOI because this method is based on the measure of the mass loss during

a sample oxidation, which is not the case of the RE analysis. However, we agree with you, this comparison could be interesting to perform, as the one with calcimetry to estimate SIC for instance. Thus, we added a sentence in the 4. *Conclusion* section to make this precision: *“In this study, the RE method has been compared with the pretreated EA values to compare two methods based on the measure of the gases emitted by the sample oxidation (EA) or the sample pyrolysis and oxidation (RE). Comparison with other C quantification methods could be interesting to perform as MinC parameter vs calcimetry or TOC parameter vs loss on ignition method for instance.”* (1.524-528).

10. p values should be denoted as $p < 0.001$ for all numbers less than 0.001.

We made the modification where necessary. See in the 3.1 *Comparison between the estimations of SOC and SIC contents of the 30 soils (first panel) measured by RE and EA* section for instance.

Table 2: what is the p-value for these numbers? 12 ± 20 seems statistically insignificant.

The Table 3 (previously Table 2) shows the average contribution of each curve (S1, S2, S3CO, ..., S5) in percentage to its parameter (TOC or MinC) in our soil panel. There is no comparison with reference values here because these reference values of contribution do not exist. Thus, no statistical test has been performed here, explaining why no p-value are shown. This table is original because never shown in a RE paper. Giving a range of order of the contribution of each gas during pyrolysis and oxidation to the TOC and MinC parameter calculation is interesting to show that the S5 curve is the most important curve to observe for SIC quantification because it contributes for 90% of the calculation of MinC. See in the 3.1 *Comparison between the estimations of SOC and SIC contents of the 30 soils (first panel) measured by RE and EA* section: *“The oxidative thermal breakdown of SIC occurs at temperatures $> 650^\circ\text{C}$ and forms the S5 curve (Figure 5), whose integration provides the main contributor to the MinC parameter (about 90%, Table 3). The S5 curves of the samples with SIC contents $> 62.50 \text{ gC.kg}^{-1}\text{soil}$ drops sharply at the end of the final oxidation isotherm, unlike the S5 curves of the samples with SIC contents $< 62.50 \text{ gC.kg}^{-1}\text{soil}$ (Figure 5). [...] the underestimation of SIC contents $> 62.50 \text{ gC.kg}^{-1}\text{soil}$ by the MinC parameter is probably caused by an incomplete thermal breakdown of a too large amount of SIC in the RE crucibles [...]”* (1.418-426).

However, the previous results have been obtained on the overall first panel (20 calcareous soils and 4 non-calcareous soils). The four non-calcareous soils brought a lot of variability, and it was not correct to include the non-calcareous soils here. Thank you for your comment which make us realized this. We changed the results by considering only the calcareous soils (26). The variability is still high for some curves (*e.g.*, S3'CO₂) because it depends on the C forms in the sample, especially the amount of thermoresistant organic matters and/or thermolabile inorganic C forms.