The authors would like to thank Yakov Kuzyakov for taking time to make a review of our manuscript and for his useful and constructive 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.

Analysis of soil organic carbon (SOC) and soil inorganic carbon (SIC) from one sample without pretreatments is an urgent necessary and crucial procedure, about which many soil scientists, especially working in arid and semiarid environments are dreaming. Previously, the analysis of SOC and SIC was always after pretreatment with acid to remove SIC, and the SIC was calculated by the difference between total C and SOC. Various other approached to analyze SOC and SIC are mentioned in the Introduction, but all methods are based on a separate and subsequent analyses of SOC and SIC. These shortcomings are clearly mentioned in the Introduction. Beside the problems with assessment of any properties by difference, the pretreatment with acid may modify also the SOC leading to many uncertainties.

We appreciate that you consider, like us, SOC/SIC quantification as an important issue and think that this issue is clearly explained in the Introduction.

In the submitted paper, the authors adjusted the Rock-Eval® approach known from geology and petrology of the oil containing rocks to analyze SOC and SIC simultaneously. 24 soils covering broad range of SOC and SIC contents were used to test the Rock-Eval® approach. This methodical study is urgent necessary and can be accepted after Minor improvements and some addition of the background information to the Rock-Eval® approach.

General comments

- **The Introduction in the Abstract can be shortened, but instead more space can be used for the details of the new approach.**

We added more details on the RE method in the *Abstract* section: "*The Rock-Eval® analysis is a ramped thermal analysis, used in soil sciences since the 2000s, consisting in a pyrolysis of the sample followed by an oxidation of the residue. A single Rock-Eval® analysis on a non-pretreated aliquot provides two parameters estimating the organic (TOC) and inorganic (MinC) C contents of the sample*" (l.17-20)

- **Introduction provides a good overview about the methods for SOC and SIC analyses in calcareous soils.**

Thank you, we also added more details on the RE method in the *1 Introduction* section: "*The RE analysis consists in a pyrolysis of the sample followed by an oxidation of the residue. Temperature boundaries are used to distinguish the signals released by the pyrolytic cracking* *and oxidative combustion of organic C from the signals released by the inorganic C thermal breakdown. The TOC and MinC parameters are then calculated by integrating these signals between these temperature boundaries.*" (l.83-85)

- **Figures are well prepared, but more details need to be explained in the legends of some Figs.**
- **The most Figures and Tables need more explanations.**

We added more details in all the figure captions, especially for the Figure 1 and the Table 3 (previously Table 2).

- **As the Rock-Eval® approach is/was not frequently used in soil science, the authors should provide a short background on the measurement principle, and which obstacles can be in soils compared to the initial applications in geology. It is also not clear / not known (at least for me) what are the shortcomings and potential problems of the Rock-Eval® approach?**

We added more details and rephrased some parts of the text to explain more the RE method. Especially, we added more details on the temperature boundaries, the difference between analyzing a rock and a soil sample with the RE method and the applicability of the conversion factors. For instance, in the *2.2.2 Calculation of the standard parameters* section: "*Regarding the boundary between the S3CO_2 and S3'CO_2 curves, Lafargue et al. (1998) set the temperature at 400°C for rock studies because the siderite and magnesite thermal breakdown starts at 400°C. When the most common carbonate mineral is calcite, operators usually shift this boundary to the local minimum of the CO_2 pyrolysis thermogram sample by sample.*" (l.207-211).

- **Temperature ranges: in various parts of the paper, different temperature ranges are used / presented to differentiate between SOC and SIC are used: 550, 650, 850, 1000 °C. This needs clarification and unification.**

To avoid any confusion, the analyses of the first panel have been reanalysed on the RE6 device of *IFP Energies Nouvelles*. Thus, in the revised Ms, only one device is described, and the results for the first panel have been changed (Figure 4, l.360; Figure 5, l.380; Table 3, l.415). This modification simplified a lot the *2.2.2 Standard cycle of Rock-Eval® analysis* section.

But you are right, the RE method used a lot of temperature ranges. We tried to explain them as clearly as possible by explaining (i) the cycle in the *2.2.2 Standard cycle of Rock-Eval® analysis* section: pyrolysis between 200°C and 650°C and oxidation between 200°C and 850°C, and (ii) the calculation of the standard parameters in the *2.2.2 Calculation of the standard parameters* section: use of the 550°C boundary to distinguish S3CO from S3'CO and S3CO_2 from S3'CO_2 and of the 650°C boundary to distinguish S4CO_2 from the S5.

- **The Rock-Eval® approach is a new method in soil science. I guess most soil scientists are not experienced with it (in contrast to EA, and other SOC & SIC analyses). Also the equipment necessary for the Rock-Eval® approach needs to be mentioned and in the final section the its applicability in soil science should be assessed, considering the equipment costs as well as the necessary standardization etc. Are the other soil properties, which can be well analyzed by Rock-Eval® in soils?**

We added more details on the application of the RE method in the *2.2.2 Rock-Eval® thermal analysis* section. We specified the device used for the analysis: "*a RE-6 device consisting in a pyrolysis furnace and an oxidation furnace*" (l.153-154), the sample container: "*The steel crucibles*" (l.158), the duration of the analysis: "*The analysis takes about an hour per sample*." (l.166-167) and the calibration of the RE6 device: "*The calibration of all the RE devices and the quality of the RE analyses are routinely checked […] with the reference values of the 160 000 standard*." (l.230-235). We also described more which RE data are used in soil science in the *1. Introduction* section: "*The RE thermal analysis has been progressively developed and used in soil science mostly to quantify SOC with the TOC parameter (Disnar et al., 2003), and to characterize SOC stability through several indexes directly calculated from the signals (Disnar et al., 2003; Sebag et al., 2016; Malou et al., 2020) or statistically predicted with a machine-learning model (Cécillon et al., 2021).*" (l.88-91)

Specific remarks

L113-123 Please add explanations which C pools will be assessed by this ramping temperature increase

We added this information in the *2.2.2 Calculation of the standard parameters* section: "*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 S3CO*$_2$*, S4CO and S4CO*$_2$ *curves correspond to the SOC cracking and combustion whereas the other half of the S3'CO, the S3'CO*$_2$ *and the S5 curves correspond to the SIC thermal breakdown (Figure 1, Table 2).*" (l.193-196).

L250 the p value presented here is: 1.192 10^{-7}, but in the Fig 4 it is 2.2 10^{-16}. Please check.

In the revised Ms, the p-values presented in the Figures are the p-value of the Student test: testing the significance of difference between the slope and 1. The p-values presented in the text are those of significant difference between the slope and 0 (Fisher test of the lm function), between EA and RE (Student or Wilcoxon test according to the variable distribution) and between the slope and 1 (Student test). We changed the description of these statistical tests in the *2.4 Data analysis* section: "*For the first panel, the normality of the distribution of the parameters […] The significance of difference of the regression slope from 1 was tested with a Student test (H0: $\mu_{SLOPE} = 1$).*" (l.319-335). We also checked, and changed where necessary, that the sentence before the p-value describe correctly the test performed 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 SOC contents estimated by the uncorrected TOC parameter significantly differ from those estimated by EA_{HCl} (Wilcoxon test: $P < 0.05$) while the SOC contents estimated by the corrected TOC parameter do not significantly differ from those estimated by EA_{HCl} (Wilcoxon test: $P > 0.05$).*" (l.366-369) for instance.

Actually, if the points for the Uncorrected TOC regression on Fig 4 are just multiplied with a fixed constant, the regressions for Corrected and Uncorrected TOC should be exactly the same.

We agree with you. We changed the p-value presented in Figure 4 as explained above but the R^2 (see Fig. 4) and the p-value (see caption and text) of the regression slope are the same for the regression *corrected TOC vs* EA_{HCl} and for the regression *uncorrected TOC vs* EA_{HCl}, only the slope changes.

Actually, all p values below 0.001 are the same. It is no matter is the p value 10^{-7} or 10^{-16}.

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.

L346 if the Rock-Eval® obtained results should be corrected by EA analyses, what is the actual advantage of Rock-Eval®?

The coefficients used for statistical corrections have been determined on large soil panels and are now applied on other soil panel without redoing EA. However, you are right, these statistical corrections lead to uncertainties when applied on other soil type or depth. This is why we specified that our study focused on agricultural topsoils in the *Abstract* section: "*30 agricultural topsoils*" (l.28), in the *1 Introduction* section: "*30 agricultural topsoils*" (l.104) and 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: "*Thus, for these 30 agricultural topsoils, …*" (l.373-376) and "*Thus, for these 30 agricultural topsoils, ...*" (l.410-403). We also propose some new insights to avoid statistical corrections in the *4 Conclusion* section: "*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, […] the SIC pyrolytic and oxidative thermal breakdown.*" (l. 528-532)

Figures

Fig 1 Explanation of all abbreviations on the Figs is necessary.

We move 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 so that it closer to the Table 2 where the nine curves are described. Moreover, we changed the caption of the Figure 1: "*Example of the 5 thermograms and 9 curves (S1, S2, S3CO, S3'CO, S3CO_2, S3'CO_2, S4CO, S4CO_2 and S5) obtained during the Rock-Eval® analysis of a calcareous agricultural topsoil with a SOC content of 15.68 gC.kg^{-1}soil and a SIC content of 11.61 gC.kg^{-1}soil. 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.*" (l. 179-186).

Legend: … model of … scenarios. But not any scenarios are presented in Fig 1

We are sorry but we do not understand what you are calling "scenarios". Do you mean cycle analysis?

Fig 5 the side figure-insets need more explanations

We changed the caption of the Figure 5: "*The oxidation thermograms presented on both sides of the plot are examples of the S4CO_2 and S5 curves obtained for six soils of the first panel: three with SIC contents < 62.50 gC.kg^{-1}soil (N° 1-3) and three with SIC contents > 62.50 gC.kg^{-1}soil (N° 4-6).*" (l.384-386). We also changed the description of this part of the figure: "*The S5 curves of the samples with SIC contents > 62.50 gC.kg^{-1}soil drop sharply at the end of the final oxidation isotherm, unlike the S5 curves of the samples with SIC contents < 62.50 gC.kg^{-1}soil (Figure 5).*" (l.420-422).

Figs 4, 6, 8: the presented measurement error – is this the 95% confidence interval, or the analytical measurement error of the equipment? If equipment – then for EA or for Rock-Eval®?

The measurement error presented in the figure is the analytical error of the two methods (EA and RE). We added a legend for this grey area on the figures: "*Analytical errors*" (Figure 4 and 5), we changed the caption of the figures: "*The grey area, centred on the grey line y = x, represents the analytical error of the two methods.*" and the description of this area in the *2.4 Data analysis* section: "*The grey area in the graphs corresponds to the analytical error of the two methods (EA and RE). To build this area, a relative error of 5% was applied to the x-axis (EA) according to the norm ISO (1995b). For the TOC and the MinC parameters, a relative error of 2% and 1.7%, respectively, was applied on the y-axis (RE).*" (l.349-351)

The individual points presented on Figs 4, 6, 8: are these means of some replications or individual measurements without replications? The regressions should be based on individual replications.

You are right, we did not mention it. We specify in the *2.3 Experimental design* section which samples are replicated and which are not. For instance: "*For each sample of the first panel, the SOC and SIC contents were measured one time by EA_{HCl} and $EA_{550°C}$, respectively, and one* *time by RE.*" (l.291-292). The regressions are indeed based on individual replication. We specified it in the *2.4 Data analysis* section "*Least squares regressions between SOC content estimations by* EA_{HCl} *vs uncorrected TOC or corrected TOC and between SIC content estimations by* $EA_{550°C}$ *or* EA_{TC-SOC} *vs uncorrected MinC or corrected MinC were tested with the lm function (Fitting Linear Models) of the statistical R software 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).