Dear Reviewer,

Thank you very much for your constructive comments. Below please find our responses to your comments.

The manuscript “Combining colour parameters and geochemical tracers to improve sediment source discrimination in a mining catchment (New Caledonia, South Pacific Islands)” by Virginie Sellier et al. presents a fingerprinting study in the Thio River catchment in New Caledonia using colour and element concentrations individually and combined as tracers, as well as a conventional fingerprinting approach and partial least square regression (PLSR) models based on the entire visible spectrum. The study includes interesting findings, is well described, and fits within the scopes of SOIL (soil and method/ degradation), although I think the soil part could be enhanced in the manuscript (please find detailed comments in the pdf and below). The manuscript represents a statistical approach to compare tracer performance and fingerprinting approaches. Artificial mixture samples help validate results and increases the validity of the paper. Methods are not new but the manuscript elicits well the different results obtained in one catchment and is worth being published after major revision. I attach the pdf with detailed comments (98).

Reviewer’s comments	**Replies**
Generally, I would encourage to use less parentheses. In quite a few cases I had the feeling there is more information in the parentheses than in the actual sentence. In my opinion it disrupts the reading flow and the information should be included into the text.	This syntax problem will be taken into account when revising the manuscript.
Abstract: The Abstract mentions the methodological question of the paper and hints a management advice “focus on the contributions of mining tributaries to reduce sediment inputs”, which is not really observed at the end and seems obvious knowing mining case studies. I would suggest not distract from the methodological focus of the paper with these “lonely” and obvious statement.	The abstract will be modified in line with this comment in order to further highlight the methodological aspect of the study.
The information provided subsequently will be integrated in the revised version of the manuscript.	
Introduction: The introduction seemed to be to be a compromise between a case study, a management advice, and a methodological exploration. I would focus on the latter. The potential extrapolation of the method is repeated in one sentence in Abstract, Introduction and Conclusion. I would suggest stating it once (or twice with Abstract and elaborating a bit more the criteria (comments in the pdf in Conclusion)	The methodological aspect of the article is crucial and will be further highlighted in the introduction. Nevertheless, the 'management' aspect of the study should not be neglected, as the objective of this type of study is to provide guidance to carry out this environmental monitoring on-site. The choice of the selected methods was also based on the equipment that could be deployed on site (e.g. choice of spectrocolorimetry, portable, fast and inexpensive in terms of analysis).

	The extrapolation potential of the method will be more detailed in the conclusions of the revised version of the manuscript.
Research Area: The lateral and longitudinal sediment connectivity seems crucial for this work and is not well addressed in the chapter nor throughout the manuscript. How can you be sure that the contributions you calculate are not due the effect of different lateral and longitudinal connectivity throughout the sub-catchments instead of different erosion values on the slope? You write about channel banks and alluvial deposits (map) which let me doubt that the connectivity is as good as believed. Please provide information (text, maps, pictures etc.) proofing your point! Furthermore, the whole relevance of the study revolves around erosion and there is not one picture displaying the"extensive erosion processes" you mention. Please give us some insights here.	Previous results found in the grey literature (e.g. Immila project report, 2020) indicate that there is a strong remobilization of sediments in New Caledonian hydrosystems, particularly for low intensity floods (<200 m^3/s). However, the magnitude of this process could not be quantified. Tracers such as ^7Be (Le Gall et al., 2017) could be used to trace the contributions of "new" versus "old" sediments and provide more precise indications on the dynamics of sediment remobilisation in New Caledonian hydrosystems.
Methods: Please argue conclusively that your sample size is sufficient for your objectives and the size of the catchment. I would argue that it is not accurate to talk about mining sources and non-mining sources, because you are not sampling sediment sources from mining areas or non-mining areas but you sample mixed sediment samples from tributaries predominantly connected to mining areas or non-mining area- if I understood correctly. so at least for the mining sources you will also have the influence of non-mining areas in the sub-catchment. I have no advanced know-how of the analysis techniques for the sediment samples and the PLSR modelling. Hence, I can not comment on these elaborations. However, this does not imply that I don't trust the authors explanations.	For consistency, the mining and non-mining sources will be referred to as « mining tributaries » and « non-mining tributaries » in the revised version of the manuscript. Several types of samples can be considered for sediment tracing including soil or sediment samples. The sampling of lag deposits has the advantage of being more representative of the entire drainage area, compared to local point-based sampling of soils that will be characteristic of a given more local area (Haddadchi et al., 2013). Moreover, at each sampling site, five to ten subsamples of fine sediment were collected across a 10 m^2 surface which increases the representativity of the sampling scheme. Sampling was based on the knowledge acquired in the catchment, on visual observations made during the two sampling campaigns (2015 and 2017) and on the conditions of accessibility to the sampling areas (i.e. restricted access, no access roads). Erosion zones were notably highlighted by Garcin et al. (2017) and sediment deposition zones were indicated by the inhabitants of Thio and mining engineers who accompanied us in the field to help us carry out the sampling.

	If we compare our study with sediment tracing studies carried out in other catchments of equivalent surface area, the number of source samples taken in our study (i.e. 2 sources, n1 = 8, n2 = 16) is consistent. For example, the study by Evrard et al. (2019) indicates that 37 source samples (3 sources, n1 = 12, n2 = 8, n3 = 6) were sampled in the study area (450 km²). The study by Brosinsky et al. (2014) collected 152 source samples (6 sources with a number of samples per source between 10-36) across a catchment area of 445 km².
Results and Discussion: I would assume that gully erosion is the dominant erosion for mining areas, whereas non-mining areas with a dense vegetation cover show other processes. Hence, eroded sediments differ, which helps the finger-printing of course. However, they probably also differ in organic and inorganic carbon content influencing your tracer properties. How was that explored and taken care of?	Inorganic and organic carbon contents may indeed be relevant for tracing sediment sources, and more specifically for tracing the contributions linked to areas affected by contrasted erosion processes (surface vs. subsurface, Laceby et al., 2017). Analyses of organic and inorganic carbon contents in the source samples were carried out. The statistical results of these analyses showed that these tracers did not provide any discrimination of sources, which is why these tracers were not further explored.
Furthermore, Ca and K is soluble in water. How can it be a conservative tracer in New Caledonia? Please elucidate more on the anthropogenic or natural process that explain the tracer's differences (e.g. K concentrations or colour difference) between mining and non-mining sources? I understand that these are the results of the statistical analysis but please let the reader know about your knowledge of the environment. Your argumentation is purely statistical which, as shown for the FDVS-PLSR model,might not always make sense. What processes, geological or paedogenetic background values, etc. are responsible for these differences?! Your manuscript focuses mainly on the characteristic of the geology, which in case of the eroded mining sediments make sense. However, in case of the erosion of the non-mining sites I believe the properties of cover beds and soils should be the focus throughout the chapters,since in this climate you might have meters of soil development and cover beds above the underlying geology (which did not derive from the underlying geology itself but most probably slope upwards) that are actually	Subsurface processes dominate both the sediment contributions from mining and non-mining sources as demonstrated in our previous study (Sellier et al., 2020) so that using lithological tracers is relevant to characterize and trace the contributions from non-mining sources. These differences in terms of the contents in geogenic elements (K, Th, U, ...) is demonstrated in the study by Sevin (2014) who specifically analyzed the different lithologies found in New Caledonia. Ca is present in the Earth's mantle (3%) and K is also present although in trace amounts. During the processes of obduction that led to the formation of New Caledonia, the mantle rocks (peridotites) were hydrated/altered by water, which transformed the source rock and depleted it in highly soluble elements including Ca and K (Noël, 2018). These alteration processes continued thereafter and led in particular to the formation of the laterite profile including (from the bottom to the top) peridotites (unaltered rocks), saprolites, yellow laterites, red laterites, ferruginous crust. These different layers of the profile reflect an increasingly important stage of alteration of the

eroding and NOT the geology itself. It seems that the few non-mining tributaries provide a lot of sediment to dilute the dominantly mining contributions along the River.	initial source rock (peridotites) from the bottom to the top of the profile resulting in particular in an increasingly higher accumulation of iron due to its low solubility in water: peridotites << saprolites < yellow laterites (goethite) < red laterites (hematite) < ferruginous armour (hematite). These minerals including goethite and hematite, will respectively give a yellow colour to the 'yellow laterites' and a red colour to the 'red laterites' (Trescases, 1973). These colours are not found in soils derived from volcano-sedimentary formations, because by definition these formations have much lower metal contents. Soils derived from these formations by weathering are therefore less concentrated in heavy metals and do not show the red and yellow colours characteristic of lateritic soils. Regarding the solubility of K and Ca, they do are soluble to some extent, but this does not mean that they were totally removed from the lateritic profile in view of our results. The residual traces of these elements allow us, as the statistical approach showed, to trace the contributions of both mining and non-mining sources. K in particular has already demonstrated its effectiveness for tracing the lithological contributions of sediment (Zebracki et al., 2015). The sediment tracing study by Sellier et al. (2021) that estimated the contributions of mining sources and non-mining sources to sediment during floods confirmed that K is temporarily conservative (analysis of sediment core).
I wonder how results look when you standardize the contribution by area? Have you tried that ?	This will be calculated in the revised version of the manuscript
Conclusion: In my opinion your discussed factors influencing colour and element concentrations are just one out of many possible ones. Please think about other factors that are worth mentioning. Furthermore, your limited criteria (Ni ores and peridotite massifs) for the	The conclusion will be revised at the light of this comment

expansion of the method might work for New Caledonia but it seems not sufficient to extrapolate to the world! Please revise that throughout the manuscript and in the conclusion!	
Figures: Please insert in the map figures: - the tributaries' sub-catchments outline is shown, - a light hillshade in the back to get a feeling for the relief, - display the cake diagrams on the right connected to the sample location with lines.	This will be done when revising the manuscript.

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