Reviewer 1

This is an interesting study which includes an unusually large number of tracers and biomarkers in order to trace the origins of organic matter in shelf and canyon sediments.

The main weaknesses are the limited number of core samples obtained across the Gulf, and the lack of data on the riverine sources of organic matter. As a result, the conclusions are overstated in places.

We agree with the reviewer that the limited number of core samples in the Gulf of Palermo included in this study limits the conclusions we can derive from them. Nonetheless, we are convinced that the use of a very ample array of proxies for organic matter quantity and origin compensates, at least in part, for this limited number of spatial data. Moreover, to further support our contentions, we have justified our interpretation based on other studies carried out in the area under scrutiny in our study. Nevertheless, conscious of the limited spatial resolution of the data, we have toned down the conclusions, replacing many affirmative statements with cautionary verbs, like “may” or “could”, making manifest the uncertainties of our findings.

Line 100: delete “scarce,”

Done

Page 4, line 2: “biomarkers and other sediment organic matter parameters” (or similar – but not just biomarkers)

We have changed “multiple biomarkers” to “multiple sedimentological and geochemical parameters”

Line 119: so these two rivers discharge the same amount of water, on average? What about sediment loads? The latter would be more relevant than water discharges. And what about other “distal sources” which could contribute to the canyons – what might they be (other rivers further upstream etc..)

Unfortunately, no data of sediment yield is available for these rivers, nor for the majority of Italian rivers (Billi and Fazzini, 2017). We agree that this information would be more valuable in the context of distribution of terrigenous OM at sea rather than river discharge, and more work should be done focusing on the role of rivers in the land-ocean continuum.

We can not be certain about the “distal sources” that transport terrigenous OM to the Gulf, and given the lack of sampling of different rivers in Sicily (in this or other studies), we can not conclude which are these distal sources of terrigenous OM. In the text, we merely hypothesize that these distal sources could be either rivers further upstream, such as those that discharge in the adjacent Gulf of Castellammare or input from aerosol:

> “In contrast, terrigenous OC reaching Arenella Canyon would originate from a different source farther up-current from the Gulf of Palermo (e.g., distal rivers such as those that discharge into the adjacent Gulf of Castellammare, aeolian input, or coastal erosion).”

Line 145-155: First you write that 7 cores were collected, but later you write that triplicate cores were collected from one site in each canyon (500m) – please clarify.

We can see why this can be confusing to the reader. To clarify the sampling strategy, as well as provide complete information of the sampled sediment cores, we have added this information in Table S1 in the Supplementary Information:

Core	Location	Coordinates		Depth (m)	Sampling date	Number of cores
		Latitude (N)	Longitude (E)			
S-70	Inner shelf	38.1248	13.4018	72	15/08/2016	1
AC-500	Mid-Arenella Canyon	38.1949	13.4090	544	16/08/2016	3
OC-200	Upper Oreto Canyon	38.1509	13.4140	223	15/08/2016	1
OC-500	Mid-Oreto Canyon	38.1754	13.4281	574	10/08/2016	3
OC-800	Lower Oreto Canyon	38.1864	13.4357	770	15/08/2016	1
EC-200	Upper Eleuterio Canyon	38.1347	13.4978	242	08/08/2016	1
EC-500	Mid-Eleuterio Canyon	38.1471	13.4924	518	08/08/2019	3

Results section:

The descriptions of the data are a bit too long in my opinion. It should be possible to shorten by sticking to the main findings. All the detailed data needs to be shown in a table. The yellow to purple colour ramp used in the figures is not the easiest to interpret.

We do not agree with the reviewer. We believe that the description of the data in the Results section is the adequate length, considering the very ample number of different variables included in the study. All the data is given in a Supplementary dataset (Paradis, 2025).

A *viridis* color scheme (dark blue to yellow) was used in this manuscript since it allows perceptual uniformity of the colors, it is colorblind-friendly, and can be easily interpreted when printed on grayscale. However, we have now opted for the *batlow* color scheme which is universally good for people with tritanopia, deuteranopia, protanopia and for color-blind. This color scheme also better highlights small variations in the dataset, allowing the reader to better understand the data (Crameri et al., 2020). See example of the new figures below.

Also, there are no Results on the mixing models – this should be included here, not in Discussion.

We have added a short description of the mixing models in the results section as well as a figure of the output of the different mixing models:

> "Considering the range of values of terrigenous and marine end-members, there is a general shift of δ^{13}C composition from more terrigenous to more marine with depth (Fig. S4). However, when combining the δ^{13}C values with OC/TN and δ^{15}N, the trend is not that clear. Nevertheless, the fraction of terrigenous OC provided by the Bayesian Markov-Chain Monte-Carlo mixing model in one dimension with only δ^{13}C, as well as in two-dimensional mixing models of δ^{13}C coupled with OC/TN, δ^{15}N, or Δ^{14}C showed a general offshore decrease from 80 to 20-40%, depending on the model (Fig. S5).
>
> The spatial variations of the source apportionment were very similar between the one-dimensional mixing model and the two-dimensional mixing model with OC/TN and δ^{15}N, although these models provided highest uncertainties (Fig. S5). In these three models, the offshore decrease of the terrigenous OC fraction was interrupted by a sudden drop in Oreto Canyon at 200 m (OC-200), which presented minimum terrigenous fraction (15-19%). This low terrigenous fraction presents a stark contrast to the terrigenous OC

fractions (48-60%) in sediment cores collected further downcanyon at 500 m (OC-500) and 800 m (OC-800). The sediment core collected in Arenella Canyon (AC-500) also presented a similarly low terrigenous OC fraction of 20%.

In the dual end-member mixing model with $\delta^{13}C$ and $\Delta^{14}C$ (Fig. S5), both OC-200 and AC-500 also presented the lowest terrigenous fraction, but only of 47-55% in comparison to the lowest terrigenous OC fraction of 15-19% presented by the other models."

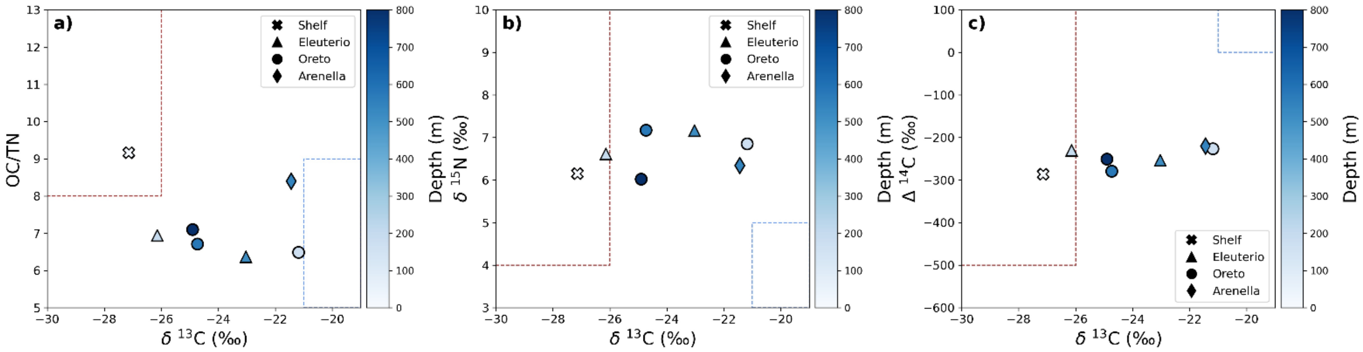

Figure S4. Scatter plots of OC/TN and $\delta^{13}C$ (a), $\delta^{15}N$ and $\delta^{13}C$ (b), $\Delta^{14}C$ and $\delta^{13}C$ (d) used for the two-dimension mixing models, showcasing the values of terrestrial (brown dashed lines) and marine (blue dashed lines) endmembers. See Table 1 for the values and sources of the different endmember values.

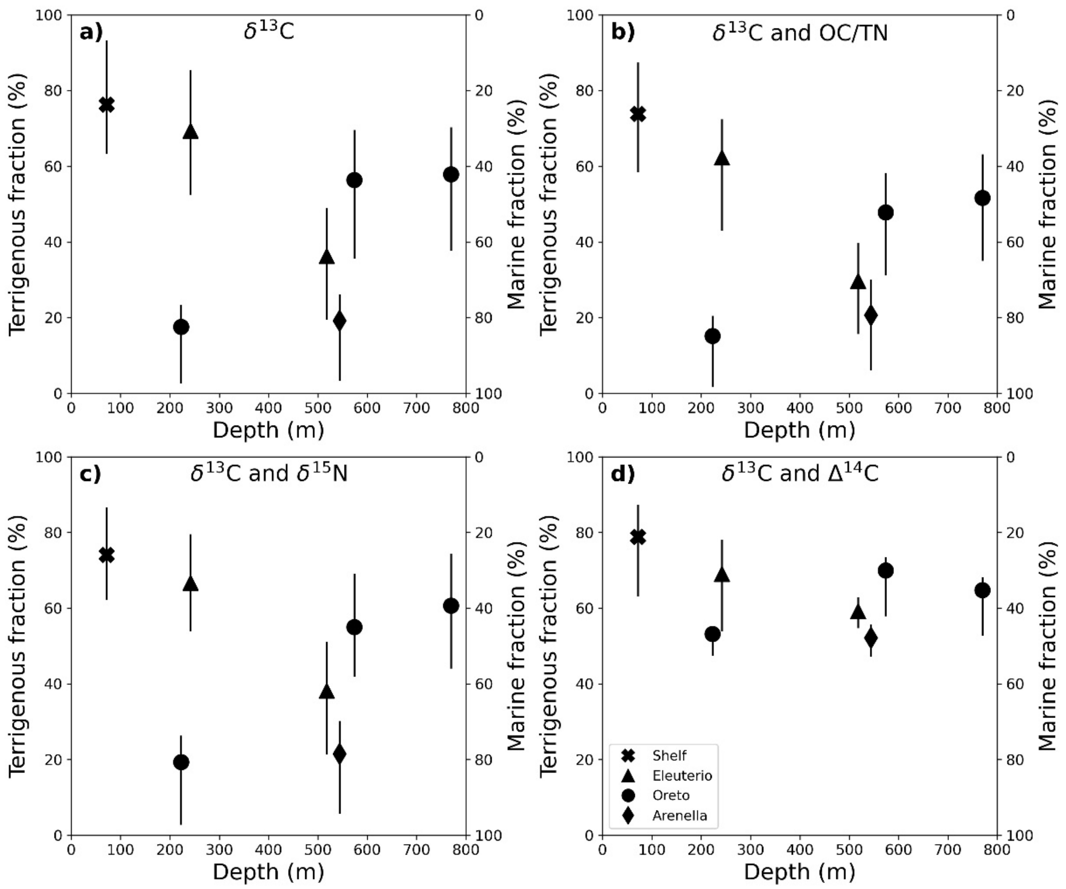

Figure S5. Terrigenous and marine OC fraction with depth obtained from a one-dimensional mixing model with $\delta^{13}C$ (a), two-dimensional mixing model with $\delta^{13}C$ and OC/TN (b), $\delta^{13}C$ and $\delta^{15}N$ (c), $\delta^{13}C$ and $\Delta^{14}C$ (d).

Discussion:

Sediment accumulation rates should be shown in the Results section first. And included in the Methods too.

Sediment accumulation rates have been extensively described and discussed by Paradis et al. (2021). In addition, since sedimentation rates are not the main point of discussion in this manuscript and they are only included in a figure to show the variation of sedimentation rates in the Gulf. Moreover, to provide the reader with a greater understanding of the variation of sedimentation rates in the Gulf, we have also added data reported in other sites. See new figure below.

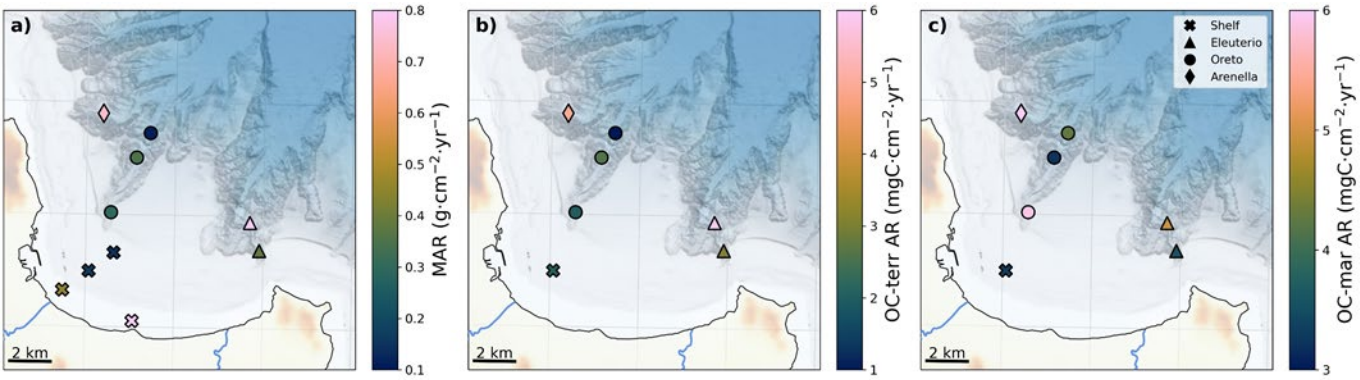

Figure 7. Spatial distribution of: a) mass accumulation rate (MAR) of the studied sediment cores (Paradis et al., 2021) and additional sediment cores from the shelf (Di Leonardo et al., 2007, 2012; Rizzo et al., 2009), b) terrigenous OC accumulation rate (OC-terr AR), and c) marine OC accumulation rate (OC-mar AR). Colour bars are adjusted to highlight the minimum, mean, and maximum values for each variable.

Line 433: what is BIT index again? Need to remind reader.

A short description of the BIT index is included in the revised manuscript as follows:

> "The BIT index, the ratio of brGDGTs and isoGDGTs, is often employed as a proxy of soil-derived terrigenous contribution, where a high BIT index (> 0.6) is indicative of high input of soil-derived OM (Hopmans et al., 2004; Weijers et al., 2014)."

The authors should be careful when stating their conclusion – after all, they are based on only 1, 2 or 3 core samples, which may not be representative of the entire canyons. This shortcoming needs to be acknowledged and the language used more careful.

We agree that the few samples collected in this study limits the assertiveness of our conclusions. On the one hand, to further support our work, we have justified our interpretation based on other studies in the area. However, we acknowledge this does not overcome the main limitation of this study, which is the number of sites in the Gulf of Palermo. Accordingly, we have also toned down the conclusions of our study, employing words like "may", "could" or "would indicate" to manifest the uncertainties of our findings.

Line 480: This pattern is consistent…

We have kept the original wording, since we already say at the beginning of the paragraph that the spatial distribution of weighted-average $\delta^{13}C$ values of HMW FAs is consistent with the eastward direction of the regional current.

Line 485: need more info on distal sources etc.. see earlier comment

As the reviewer correctly states in several points, some of the interpretation is too speculative. This is one of the cases. Given the spatial distribution of the weighted-average $\delta^{13}C$ values of HMW FAs and the current direction, we can infer that the $\delta^{13}C$ signature of HMW FA discharged by the Oreto and Eleuterio rivers are similar (-29 ‰). Since the signature of Arenella Canyon, located further upcurrent, is rather different, we can only hypothesize that the terrigenous OC, in terms of HMW FA, comes from a different source, but we can not be certain of the sources. Hence, we can not elaborate further about which would be the distal sources.

Line 495: remind us what CPI is?

A short description was added here:

> "In addition, the spatial variation in $CPI_{(C24-C32)}$ values of HMW FA across canyons (Fig. S3f), a metric of the degree of degradation of plant-derived OC, points to more degraded HMW FAs deposited in Arenella Canyon, slightly less degraded HMW FAs deposited in Oreto Canyon, and least degraded HMW FAs deposited in Eleuterio Canyon, consistent with the transit of terrigenous OC through the system (Fig. 8)."

Line 476-500: I think there is a bit of a jump between what the data show and the conclusions about riverine sources. This should be provided as a hypothesis rather than a firm conclusion. Temper the language and acknowledge that there are weaknesses in your study design and that other processes may be at play (such as x or y).

As stated before, we agree that with the data we present, we can not be this assertive about the conclusions of our findings, which is why we, according to the reviewer correct suggestion, have toned down the discussion. These are preliminary insights supported by our data and extensive studies in the region, but we are aware that further investigation is needed, which we have also included in this section of the manuscript. Here is a brief example of the smoothened text:

> "Using the weighted-average $\delta^{13}C$ signature of HMW FAs from the shelf and Arenella Canyon as possible end-members of local riverine and distal terrigenous OC source, respectively, only 30 to 40 % of the terrigenous OC delivered by the Oreto River would be deposited in the Oreto Canyon, whereas the majority would originate from another up-current source that this canyon intercepts (Fig. 8). However, additional sampling should be conducted to further refine the endmembers used in this study area (Table 1) and provide more definite understanding of the dispersal of terrigenous and marine OC in the Gulf of Palermo, such as sampling the different rivers and collecting suspended particles to determine marine OC signatures."

Figure 8: use same orientation as Figure 1.

Although we devised Figure 8 as a more artistic illustration of the sediment dispersal mechanism, we modified the figure to keep the same layout as the other figures in the manuscript. We believe that this way, the reader will be able to quickly interpret the message. Here is the modified Figure 8:

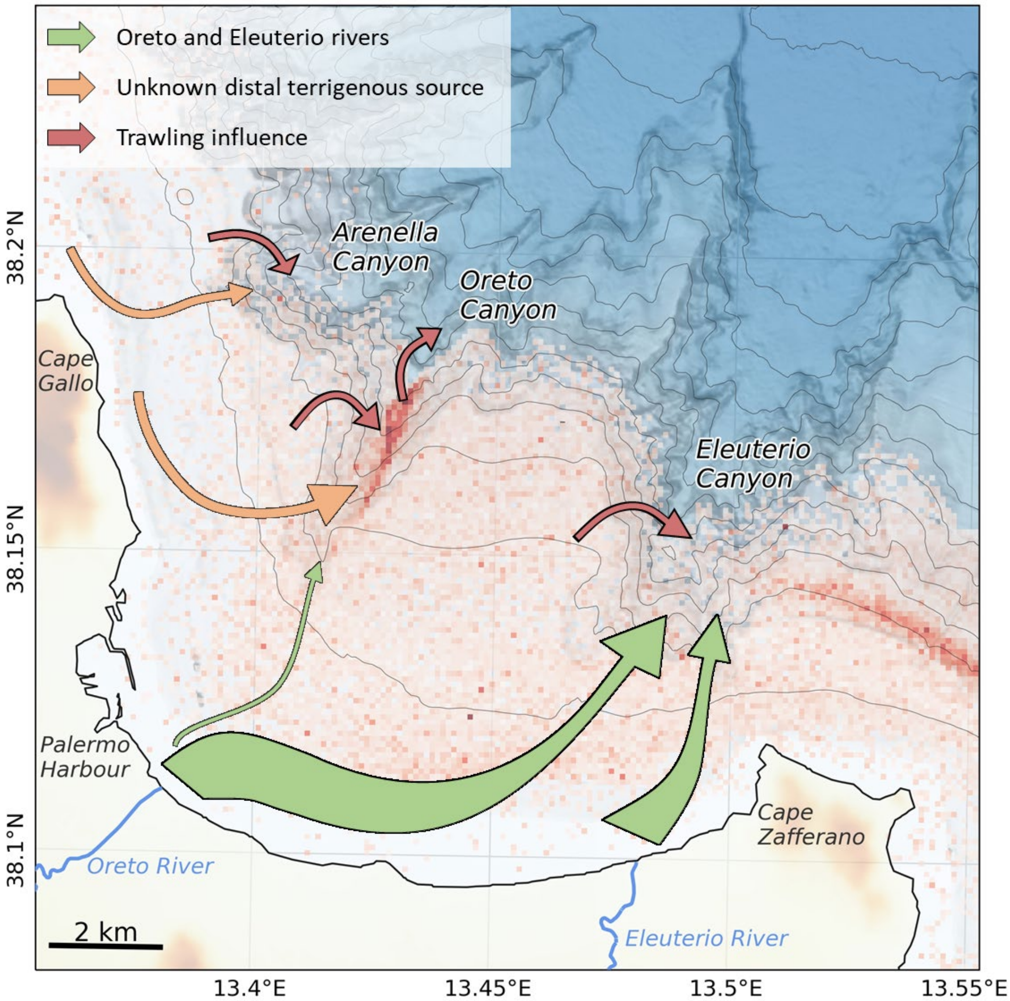

Figure 8. Schematic diagram of the dispersal pathways of terrigenous OM across the shelf of the Gulf of Palermo and its submarine canyons. The colour of the arrows indicates distinct terrigenous OM sources (Oreto and Eleuterio rivers, or unknown distal terrigenous source) or dispersal mechanism (trawling influence) whereas the size represents the magnitude of the terrigenous OM transported.

We have also included bottom trawling as a potential dispersal mechanism, since Reviewer 4 rightfully pointed out the influence of this anthropogenic activity.

Page 21 first sentence: “dire consequences” too strong language.

We modified this to “could impair ecosystem functioning”.