Reviewer 1

In this contribution, the authors investigated suspended particles collected from the northeastern Taiwan Strait to provide full-water column assessment of the sources, distribution, and controls of POM in the study area. They quantified terrigenous particulate OC, the sum of biospheric and petrogenic OC using lignin and the stable C isotopic composition of OC. Based on the results, the authors established source to sink coherence by comparing POM characteristics.

Taiwan Strait is a dynamic, shallow strait with an average depth of 60 m and hydrography is shaped by the interplay of complex bathymetry, monsoonal forcing and riverine inputs. The authors are keen to establish the sources distribution and POM controls in such a dynamic area. I appreciate their attempt, but I feel that the current version of manuscript is blurred in some aspects, as given below.

Specific major comments:

[1] I feel that a clarity is needed for how much published data were taken from Lin et al. (2025a, 2025b), as the authors refer often these publications apart from some other sources. In addition, what is really new in this contribution is unclear while reading.

Ans: We thank the reviewer for raising this important point. The novelty of this study lies in providing a full-water-column assessment of POM sources on a continental shelf, with particular emphasis on quantifying the terrigenous contribution. In the revised manuscript, we clarify the motivation for this work by highlighting the difficulty in explaining the occurrence of ^{13}C-depleted POM frequently observed in subsurface and bottom shelf waters. We have added a paragraph in Introduction to explicitly describe this problem.

> Bulk geochemical parameters of OM, such as atomic C/N ratio, the mass ratio of OC to chlorophyll a (OC/Chl), and the stable carbon isotopic ratio of OC ($\delta^{13}C_{OC}$), have been widely used to constrain POM sources (e.g., Gao et al., 2014; Guo et al., 2015; Lee et al., 2023). However, their capacity to distinguish complex POM mixtures in shelf waters is limited. Shelf waters receive terrigenous POM inputs from rivers and from sediment resuspension, and these two sources may differ in bulk properties depending on the extent of OM partitioning during transport and resuspension (Lin et al., 2025a). In addition, marine plankton communities, particularly primary producers, can produce bulk POM signatures that overlap with those of terrigenous OM (e.g., Geider, 1987; Laws et al., 1995; Martiny et al., 2013). This ambiguity is illustrated by the frequent observation of ^{13}C-depleted POM in subsurface and bottom shelf waters (e.g., Wu et al., 2003; Huang et al., 2020; Lee et al., 2023). In contrast to open-ocean settings, where a terrigenous source for the low-δ^{13}C POM in the lower euphotic zone can generally be excluded (Close and Henderson, 2020), the proximity of shelf waters to land makes it difficult to determine whether such isotopic signals primarily reflect terrigenous inputs or in situ marine processes. To alleviate these complications, previous studies have focused on sampling layers where a single POM source is expected to dominate, such as the deep Chl maximum (DCM) or the benthic nepheloid layer (e.g., Liu et al., 2018a; Sun et al., 2024). Although informative for process-oriented investigations, these strategies do not provide an integrated view of POM mixing and transport throughout the water column.

[2] Moreover, why the authors have used 2 step estimation of terrigenous OC using lignin and $\delta^{13}C$ of organic carbon and how it is understood that lignin is appropriate than $\delta^{13}C$ and in what capacity.

Ans: We thank the reviewer for this insightful comment. We adopted the two-step approach for the following reasons.

1) Similar to nearby continental shelves, the northeastern Taiwan Strait contains POM with relatively low $\delta^{13}C$ values in subsurface and bottom waters. Identifying sources of this POM is an important component of our goal to provide a full-water-column assessment of OM sources.
2) The order in which the proxies are used in the two-step approach does not imply that one proxy is superior to the other. Lignin was used in Step 1 because the ambiguity primarily arises from $\delta^{13}C$ signatures. Lignin phenols are diagnostic biomarkers of vascular plants and therefore provide an independent constraint on the presence of terrigenous OM. The underlying hypothesis is that if the low-$\delta^{13}C$ POM has a terrigenous origin, it should contain elevated $\Lambda 8$ (OC normalized lignin concentration) relative to other samples. Such relationships between lignin abundance and $\delta^{13}C_{OC}$ have been widely documented in sedimentary OM (Bianchi et al., 2018).
3) Although the lignin data were useful for diagnosing the relative abundance of terrigenous POM (we found that most low-$\delta^{13}C$ POM samples contained negligible lignin), it remained challenging to quantify terrigenous POC (POC_{terr}) directly from lignin. The main difficulty lies in the uncertainty in the ratio of lignin to total terrigenous OM in the source material ($\Lambda 8_{terr,s}$). This motivated Step 2, in which we quantified POC_{terr} in high-TSM samples using a $\delta^{13}C$-based mixing approach. These high-TSM samples were strongly affected by resuspended seabed sediment based on their spatial distribution, which allows more reliable assignment of endmember $\delta^{13}C$ values.
4) The results from Step 2 provide not only an independent estimate of POC_{terr}, but also $\Lambda 8_{cal}$ (the source signature of $\Lambda 8$ required to account for the measured $\Lambda 8$ in POM samples) that can be compared with the $\Lambda 8_{terr,s}$ used in Step 1. This comparison helps evaluate the limitations and uncertainties of lignin-based POC_{terr} quantification.

To clarify this rationale, we have revised Sect. 3.3.1 in the manuscript.

3.3.1 Estimation of POC_{terr}

We developed a two-step approach to quantify POC_{terr} (details in Texts B1 and B2 of Appendix B). Figure 2 summarizes the workflow. This approach combines the complementary strengths of lignin biomarkers and $\delta^{13}C$ in diagnosing and quantifying terrigenous OM in the water column.

In the first step, lignin concentrations were used primarily to assess the relative abundance of terrigenous OM, particularly in low-$\delta^{13}C$ samples where source attribution based on isotopic composition alone may be ambiguous. Elevated $\Lambda 8$ values were expected if the low-$\delta^{13}C$ POM had a terrigenous origin. The spatial patterns of lignin and its correlation with environmental variables indicated three potential sources (see Sect. 4.3; Table A2): *i*) Pearl River TSM for offshore surface waters, *ii*) Taiwanese river TSM for nearshore waters, and *iii*) seabed sediments for benthic nepheloid layers.

Following source identification, POC_{terr} was estimated from lignin concentrations assuming characteristic lignin-to-POC_{terr} ratios ($\Lambda 8_{terr}$) in the source material:

$$POC_{terr} = \Sigma 8_m / \Lambda 8_{terr,s} \quad (4)$$

where the subscript m denotes measured POM data and s the inferred source. Source-specific $\Lambda 8_{terr,s}$ values were taken from Zhang et al. (2014) and Lin et al. (2025a) (Table A3). Mixing equations were then applied to derive POC, N/C, and $\delta^{13}C_{OC}$ values corrected for terrigenous inputs (POC_{corr}, N/C_{corr}, $\delta^{13}C_{OC,corr}$).

However, lignin-based estimates of POC_{terr} are subject to uncertainty because $\Lambda 8_{terr,s}$ can vary during particle transport (Wakeham et al., 2009). This limitation motivated the second step, in which a $\delta^{13}C$-based mixing model was applied to samples with high TSM. Based on their spatial distribution, these samples can be reasonably attributed to resuspended seabed sediment (cf. Sect. 4.3), allowing more reliable assignment of endmember $\delta^{13}C$ values. To define high-TSM samples operationally, we ranked the dataset by TSM and evaluated the correlation between $\delta^{13}C_{OC,corr}$ (from Step 1) and temperature (cf. Sect. 5.2.3) for subsets with progressively increasing upper TSM limits. The correlation deteriorated when samples with samples with TSM $\geq$ 4 mg L^{-1} were included (Fig. C1 in Appendix C). Therefore, this value was adopted as the threshold separating low- and-high TSM samples.

The $\delta^{13}C$-based binary mixing model treats POC as a mixture of sedimentary and marine OC. Sedimentary endmembers were site-specific, whereas marine endmembers were derived from the $\delta^{13}C_{OC}$-temperature relationship of low-TSM samples (cf. Sect. 5.2.3). POC_{terr} was calculated as:

$$POC_{terr} = POC_m \times f_{sed} \times f_{terr,sed} \quad (5)$$

where POC_m is measured POC, f_{sed} the sedimentary fraction of POC derived from the binary mixing model, and $f_{terr,sed}$ the terrigenous fraction of sedimentary OC (Table A4). In this step, $\delta^{13}C_{OC,corr}$ could not be obtained because $\delta^{13}C_{OC}$ was prescribed from the $\delta^{13}C_{OC}$-temperature relationship. Therefore, only POC_{corr} and N/C_{corr} were computed for high-TSM samples. The estimated f_{sed} values were further used to calculate the source signature of $\Lambda 8$ ($\Lambda 8_{cal}$) required to account for the measured $\Lambda 8$ ($\Lambda 8_m$) in high-TSM samples:

$$\Lambda 8_{cal} = \Lambda 8_m / (f_{sed} \times f_{terr,sed}) \quad (6)$$

Comparison of $\Lambda 8_m$ and the corresponding $\Lambda 8_{terr,s}$ used in Step 1 helps evaluate the limitations and uncertainties of lignin-based POC_{terr} quantification.

[3] In their previous publication, Lin et al. (2025a), the authors described source to sink processes, OM composition and oxygen consumption. This should be categorically explained to understand the importance of already published one from the present manuscript content, not to mention that the hydrographic, POM and carbonate chemistry data for the present study were taken from Lin et al. (2025b). My question is why not the authors can focus on new, unpublished data to revise the manuscript?

Ans: We added a sub-section "3.1 Data sources and previously published data" to clarify which part of the dataset has been used in Lin et al. (2025a), and which part of the dataset is new.

155 **3 Data**

3.1 Data sources and previously published data

A subset of the hydrographic observations used in this study was previously reported in Lin et al. (2025a), which focused primarily on sedimentary geochemistry. In that study, Chl, surface-water salinity, bottom-water temperature, and bottom-water TSM were used only to provide environmental context. Lin et al. (2025b) is the companion dataset associated with the
160 present study and archived in Zenodo. It provides the underlying measurements, including geochemical data POM that are analyzed and discussed here for the first time.

[4] After using lignin and $\delta^{13}C$, the authors mentioned in lines 300-305 that "the available evidence does not allow us to resolve which process is chiefly responsible for the low **Λ**8 values". This part shows some incorrect handling of data and interpretation. The authors should know what their data can or cannot reveal; after so many corrections and recalculations and re-estimations in the manuscript, such a vague statement bespeaks that the authors have no clear-cut idea to understand or reconcile lignin and $\delta^{13}C$ data in this manuscript. This needs more vigorous approach of data reconciliation and that is missing in the manuscript.

Ans: We thank the reviewer for raising this important point. We checked the literature again and realized that we misinterpreted the data of Wakeham et al. (2009). In this paper, the notation "Λ_m" represents lignin concentration *per unit dry weight of sediment*, whereas in most literature (e.g., Bianchi et al., 2018; Hedges et al., 1997; Hernes and Benner, 2006) and our manuscript, and Greek letter Λ denotes OC normalized lignin concentration. We calculated the OC normalized lignin concentration (Λ8 in the table below) of density fractions presented in Wakeham et al. (2009, https://doi.org/10.1016/j.marchem.2009.08.005):

Table 1 of Wakeham et al. (2009). Text in blue color denote values calculated from their data.

Fraction g/cm3	% of mass	TOC % dw	% of OC % TOC	Lignin, Σ8 ug/g dw	Lignin, Λ8 ug/g OC	Fraction Λ8/Bulk Λ8
Mexico Margin, 400 m water depth						
<1.6	5.9	28.61	20.92	0.14	0.49	**0.37**
1.6-2.0	54.3	10.65	72.52	0.08	0.75	**0.57**
2.0-2.5	21.4	2.52	5.03	0.08	3.17	2.42
>2.5	18.9	0.40	1.53	0.03	7.50	5.71
Bulk sed		6.85		0.09	1.31	1.00
Gulf of Mexico, 540 m water depth						
<1.6	0.3	44.70	10.77	0.22	0.49	**0.03**
1.6-2.0	2.0	7.20	12.79	0.78	10.83	**0.69**
2.0-2.5	76.0	1.10	73.95	0.22	20.00	1.27
>2.5	21.8	0.13	2.51	0.19	146.15	9.30
Bulk sed		1.59		0.25	15.72	1.00
Gulf of Mexico, 50 m water depth						
<1.6	0.5	42.10	14.43	0.27	0.64	**0.01**
1.6-2.0	2.1	12.60	19.86	2.80	22.22	**0.28**
2.0-2.5	63.7	1.34	63.37	0.77	57.46	0.72
>2.5	33.7	0.10	2.34	0.67	670.00	8.40
Bulk sed		1.63		1.30	79.75	1.00
Mississippi River						
<1.6	0.8	31.02	16.38	2.94	9.48	**0.16**
1.6-2.0	33.7	2.90	61.26	1.11	38.28	**0.65**
2.0-2.5	56.3	0.61	21.65	0.09	14.75	0.25
>2.5	9.3	0.12	0.70	0.47	391.67	6.60
Bulk sed		1.82		1.08	59.34	1.00
Eel River shelf, 60 m water depth						
<1.6	0.5	33.66	18.41	4.39	13.04	**0.38**
1.6-2.0	0.8	15.67	20.50	4.11	26.23	**0.76**
2.0-2.5	14.3	1.33	36.87	1.22	91.73	2.67
>2.5	84.1	0.20	24.23	0.17	85.00	2.47
Bulk sed		0.64		0.22	34.38	1.00

We found that the low-density fractions, while enriched in lignin on a dry weight (dw) basis, exhibited lower Λ8 relative to the bulk sediment (bold text in the table). This is because OC was enriched more strongly in low-density fractions than lignin. Our result of "$\Lambda 8_{cal}$ averaged only 17 ± 10 % of $\Lambda 8_{terr,s}$", where $\Lambda 8_{terr,s}$ represents the value of riverine or seabed sediment and $\Lambda 8_{cal}$ the theoretical value of source material that can explain the measured value in POM, is consistent with their observation. However, because the reduction in Λ8 of low-density fractions relative to bulk sediments was highly variable and appeared site-specific, we did not attempt a detailed correction of the lignin-based POC_{terr}, but simply provided a first-order assessment of the potential magnitude of the bias. We have revised the relevant paragraph in a new section (Sect. 5.1.2, Uncertainty in POC_{terr} estimation).

▪ **5.1.2 Uncertainty in POC_{terr} estimation**

Lignin-based estimates yielded low POC_{terr} concentrations, with f_{terr} averaging 0.14 ± 0.08 and 0.06 ± 0.09 for high- and low-TSM samples, respectively (Table A2). In contrast, f_{terr} values of high-TSM samples were revised to 0.68 ± 0.14 using the $\delta^{13}C_{OC}$-based mixing model (Table A4). The higher f_{terr} values from the $\delta^{13}C$-based approach are considered more reliable for high-TSM samples, as these are primarily sourced from seabed sediments known to contain a high proportion of terrigenous OM (Lin et al., 2025a). To investigate the discrepancy between the two approaches, we back-calculated $\Lambda8_{cal}$ that would reconcile the measured POM $\Lambda8$ with the mixing-model results (Eq. (6)). $\Lambda8_{cal}$ averaged only 17 ± 10 % of $\Lambda8_{terr,s}$ (Table A4), implying either lignin degradation in the water column and/or a greater contribution from lignin-depleted source material. Elevated $(Ad/Al)_V$ ratios in offshore surface waters support lignin degradation, whereas samples without marked changes in $(Ad/Al)_V$ ratios suggest that additional processes must be involved.

One possibility is the mixed contribution of lignin-rich and lignin-poor source materials. In estimating POC_{terr} (Table A2), we adopted $\Lambda8_{terr,s}$ values from either riverine TSM (4.6–11.2 mg lignin g^{-1} OC) or seabed sediments (5.3–72.4 mg lignin g^{-1} OC). If the actual source is a mixture of both, POC_{terr} would be overestimated in surface waters but underestimated in subsurface and bottom waters. Given the larger volume of subsurface and bottom waters, our estimates are likely biased low overall. Another possibility is preferential resuspension of lignin-poor OM. This is supported by density-fractionation experiments (Wakeham et al., 2009), which showed that although lignin concentrations (normalized to sediment dry weight) increased in low-density fractions, $\Lambda8$ decreased because OC was enriched more strongly than lignin. The magnitude of $\Lambda8$ reduction relative to bulk sediments was highly variable and site-specific, precluding a robust correction. Instead of a detailed correction of the POC_{terr} estimates for low-TSM samples, we provide a first-order assessment of the potential magnitude of the bias. If the average $\Lambda8_{cal}/\Lambda8_{terr,s}$ ratio were applied to low-TSM samples, f_{terr} would increase by approximately sixfold (1/0.17). Even under this scenario, terrigenous OM would remain a secondary component for low-TSM samples. Therefore, our results support the conclusions of previous studies that terrigenous POM makes only a limited contribution to shelf waters above the benthic nepheloid layer (e.g., Ho et al., 2021; Liu et al., 2018a, 2022).

Minor comments:

[5] Section 2.1, Lines 75-80: The authors mentioned that the shelf off SE China or through the funnel-shaped Penghu Channel, which serves as the primary pathway for volume transport (Jan et al., 2002). If any estimate on the volume transport is available, it is better to include here with reference(s).

Ans: We have added the number of volume transport through the Penghu Channel in summer to the revised manuscript.

season. During summer, under the influence of the southwest monsoon, the Taiwan Strait exhibits a net northeastward transport (Jan et al., 2002). Oceanic waters from the northern South China Sea enter the strait either along the shelf off southeastern China or through the funnel-shaped Penghu Channel, which serves as the primary pathway for volume transport during this season (~1.2×10^6 m^3 s^{-1}; Jan et al., 2002). The inflow is dominated by the South China Sea Water (SCSW),

[6] In the same paragraph, it is mentioned that tidal current velocities decreased progressively. Any estimate of tidal velocities may be included here.

Ans: We have added the relevant numbers to the revised manuscript.

strong oscillatory currents particularly in the Penghu Channel and Kuanyin Depression. Tidal current amplitudes decreased from ~0.8 m s^{-1} at the northeast and southeast entrances to ~0.2 m s^{-1} in the central strait (Wang et al., 2003).

[7] Line 143: Change to Andrew

Ans: We have corrected the spelling.

[8] Lines 295-310: Terrigenous POM persists during both alongshore and cross-shelf transport. Any reason from biomarker data why land-derived POM survives during the both transport?

Ans: We have clarified this point in the revised manuscript (Sect. 5.1.1) using lignin biomarkers. Higher $(Ad/Al)_V$ ratios offshore indicate longer exposure to degradation in SCSSW than in nearshore TCW, consistent with longer transit times (~15 vs. ~5 days). However, both timescales are short relative to the slow degradation kinetics of lignin (Benner et al., 1987). This mismatch explains why lignin, and thus a fraction of terrigenous POM, can persist during both alongshore and cross-shelf transport.

consistent with estuarine patterns (Reeves and Preston, 1989). Lignin was also detected in low-TSM waters, occurring in nearshore TCW as a result of Taiwanese river discharge and along-shore hypopycnal transport (Lin et al., 2025a), and in offshore SCSSW, in line with the inferred cross-shelf contribution from the Pearl River plume (Bai et al., 2015; Jan et al., 2006). This interpretation is supported by higher $(Ad/Al)_V$ ratios offshore, implying longer exposure of lignin to photochemical or biological degradation in SCSSW than in TCW. The offshore-nearshore difference in $(Ad/Al)_V$ ratios is consistent with longer water transit times from the Pearl River mouth to the northeast Taiwan Strait (in ~15 days; Bai et al., 2015) than from the outlets of Taiwanese rivers to the northern end of our transects (in ~5 days; estimated from Wang et al., 2003). In both cases, however, the transport times remain short relative to the slow degradation kinetics of lignin (Benner et al., 1987). Together, these observations explain that lignin, and thus a fraction of terrigenous POM, can persists during both along-shore and cross-shelf transport.

[9] The authors said that "Seabed sediments on this region are dominated by terrigenous OM (Lin et al., 2025a)". However, they also mentioned that "subsurface shelf waters contained negligible lignin consistent with SCSW receiving a greater contribution from Pacific-origin waters. From this line, I understood that negligible lignin is derived from Pacific waters. The study area is proximal to both Taiwan and mainland China terrestrial fluxes that dominated likely by lignin. Given this, the above statement seems to me "odd" in the study area, which is shallow and dynamic strait.

Ans: We have clarified this point in the revised manuscript (Sect. 5.1.1). Although the study area receives substantial terrigenous input, the low lignin concentrations in offshore subsurface waters can be explained

by source water mass and supply limitations. These waters are primarily derived from SCSW, which is likely lignin-poor due to a stronger contribution from Pacific-origin waters. In addition, weak resuspension under calm sea-state conditions limited the upward transport of sediment-derived lignin, while low river discharge confined plume influence to a narrow coastal zone, reducing lignin supply to subsurface layers. These factors together explain why lignin can be minimal in subsurface waters despite strong terrigenous influence in sediments.

By contrast, lignin concentrations were minimal to negligible in most offshore subsurface waters. Although seemingly counterintuitive given the proximity of these waters to land, this pattern can be explained by water-mass origin, limited lignin supply, and calm hydrodynamic conditions during sampling. Offshore subsurface and bottom waters are derived from SCSW (Fig. C2), which is likely lignin-poor due to a greater contribution from Pacific-origin waters (Nan et al., 2015; You et al., 2005). The more frequent detection of lignin in bottom than subsurface waters suggests that resuspension was insufficient to transport sediment higher into the water column, consistent with the calm sea state during the cruise. Subsurface waters may also receive lignin from overlying river plumes, but low river discharge prior to and during sampling confined the plume to a narrow coastal band (Lin et al., 2025a), limiting supply to deeper waters. This lignin-poor layer would likely contract under rougher conditions, which are common in summer. Notably, offshore subsurface waters also correspond to the location where low-δ^{13}C POM is most frequently observed (Fig. 4). Their low lignin concentrations further indicate that this isotopic signature is unlikely to result from terrigenous inputs.↵

[10] In Fig. C6, why just one data has not been excluded in the regression analysis, though given r^2 value is low?

Ans: We thank the reviewer for raising this important point. In the original analysis, one data point was excluded from the regression based on its apparent deviation from the overall data distribution. Recognizing that such subjective exclusion may be contentious, we have retained this data point in the revised analysis. We have updated the statistical results in Fig. C6 and Sect. 5.2.2 (POC/Chl ratios track photoacclimation). With the full dataset included, the correlation between POC and Chl for the DCM samples is no longer significant. Therefore, instead of relying on regression-derived overall POC/Chl ratios, we now compare nearshore waters and DCM layers using their measured POC/Chl ratios. The difference between the two groups is evaluated using a Mann-Whitney test, which shows that nearshore waters exhibit significantly higher values than DCM layers.

Two sample subsets showed elevated Chl concentrations and merit further examination: nearshore waters and offshore DCM layers (Fig. 3d). Nearshore waters, enriched by riverine nitrogen input in summer (1–3 μmol L^{-1} nitrate plus nitrite; Huang, 2022), had a ratio of 75.0 ± 12.5 g C g^{-1} Chl (Fig. C6a). Offshore DCM layers, which are nitrogen-depleted (<1 μmol L^{-1} nitrate; Tseng et al., 2020), showed no significant correlation between POC and Chl (Fig. C6b). Based on measured POC/Chl ratios, nearshore waters exhibited significantly higher values than DCM layers (p < 0.001, Mann-Whitney test).