Dear Editor:

We would like to thank both you and the reviewers for your constructive comments and suggestions. After careful review, we have incorporated your feedback, which has significantly enhanced our manuscript. We greatly appreciate your thorough review and valuable insights. We hope our responses have sufficiently addressed your questions and concerns.

A detailed, point-by-point response is provided below.

Reviewer 1:

Q1: Figure 6 shows the shot gather before and after robust surface consistent deconvolution, however, the significant difference in amplitude scaling between the panels makes it difficult to discern the key improvements brought by the deconvolution.

Response: This study adopted robust surface consistent deconvolution (RSCD) to mitigate near surface effects through a robust solver (Kirchheimer et al., 2001, Hootman, 2011). The method integrates amplitude and phase constraint signal processing workflows , which can simultaneously obtain the amplitude compensation factor and deconvolution operator of surface consistency to provide relative amplitude preserved data (Wang et al,2017). So the amplitude looks like more balanced after deconvolution, we have recaptured the shot gathers in Figure 6 to make them more visibly. Besides, we have analyzed the power spectrum before and deconvolution, frequency bandwidth was also effectively broadened especially the low frequency parts which are more useful for deep seismic reflection data. We have added these power spetrum pictures (both shallow and deep sections) into revised manuscript.

Q2: The MPFI workflow (Fig. 7) is clearly presented conceptually, but key implementation details are missing. Please specify: Number of iterations and stopping criteria, frequency band segmentation, construction of the low-frequency prior weights and their influence on alias suppression. These parameters are essential for reproducibility and scientific rigor.

Response: MPFI used the priors to further improve the handling of aliased data, which were derived from lower, unaliased, frequencies, where the data are analyzed, *and information on the dips present in the data is extracted. This information is used at higher, aliased frequencies to distinguish between the true dips in the data and their aliases. In this study, the signals of 15-35 Hz band was adopted as the prior values to compute angle-dependent energy curves from the low-frequency Fourier spectrum, which are subsequently constrained to the signals of 35-100 Hz range. The iteration number was set to 200, and the final result was output upon reaching the condition. We have included these descriptions into revised manuscript.*

Q3: Figures 10-11 visually demonstrate improved imaging quality, but the manuscript lacks quantitative measures to support this improvement. Please include metrics such as: Signal-to-noise ratio (S/N) increase (before vs. after regularization), fold enhancement statistics, dominant frequency or resolution changes, migration noise reduction (e.g., variance or coherence measures), etc. Quantitative comparisons would significantly strengthen the validity of the proposed approach.

Response: We have made the following quantitative analysis, and added both figures and descriptions into revised manuscript: 1) Signal-to-noise ratio estimation, the S/N was increased from ~1.5 to ~2.5 in shallow, and from ~2.0 to ~3.5 before and after MPFI. 2) Power spectrums, the dominant frequency and resolution were almost same before and after MPFI. 3) Variance attributes, the variance was slightly decreased for offset domain MPFI, and signicantly decreased for shot domain MPFI, which means the coherence for seismic reflection was improved accordingly after MPFI. The fold statistics curves were already inclued above the stack sections in figures 10-11, which shows the fold was more uniform and/or has increased after MPFI .

Q4: Figures 10 and 11 are intended to show improvements in the shallow and deep sections, respectively. However, as their vertical axes share an identical time range (0.5-6.5 s), this is confusing. Please clarify the specific time intervals that define the "shallow" and "deep" sections in this context. Additionally, I suggest using boxes or arrows to highlight the key areas of improvement in these figures.

Response: Regarding on figures 10 and 11， we would like to clarify as following, the "shallow":0.5-6.5s. the "deep" : 5.5-11.5s. Meanwhile the time annotation was modified, and the arrows was added to highlight the key areas of improvement in figure 10 and 11.

Q5: Figure 12, 13, 14, 15 should in the same color to show the structure and progress in the different methods.

Response: We have made the figure 12-15 the same color (Red Blue and White) in revised manuscript, which are consistent with other figures.

Q6: The improved sections clearly reveal major fault zones (e.g., F1, F2), but the discussion of their geological significance is rather brief. Please elaborate on how the enhanced imaging contributes to understanding the tectonic evolution of the Jiangnan Orogenic Belt and mineralization processes, citing recent geophysical or geological findings.

Response: we have included the brief descriptions as following into revised manuscript: The newly processed seismic profile has improved the imaging quality of two major faults the Yifeng–Jingdezhen fault (F1) and Pingxiang–Guangfeng fault (F2), which contributes to understand mineralization processes better in the study area. F1 is nearly vertical, extending westward to central Hunan and eastward to connect with the Shexian–Suzhou fault zone, with its middle segment obscured by the Poyang Lake Basin. Distinct differences in reflection characteristics, as well as crustal structure and physical properties, are observed between the southern and northern sides of F1. F2 represents the middle segment of the Beihai–Pingxiang–Jiangshan–Shaoxing fault zone, a crust-scale deep fault dipping northward that cuts through the detachment surface down to the Moho and causes its offset . It acts as a critical channel for magma upwelling, and obvious differences in crustal reflection features exist on its two sides. According to the reflection characteristics, distribution, surface geology and other data, F2 may be identified as the southern boundary of the Qin-Hang belt and the northern boundary of the South China Block.

Reviewer 2:

General Comments:

Q1: Some of the tectonic/stratigraphic components of the survey area are difficult to follow due to their absence on the map in Figure 1 (such as the three segments of the JOB, and some important basins like the Xiuwu Basin). Including these in the map will make the geology more accessible to the reader.

Response: We have modified Figure 1 to include the three segments of the JOB, as well as several important basins and mountains (e.g., the Xiuwu Basin, Jiuling Mountain, Jiugong Mountain, and Pingle Sag) in the revised manuscript.

Q2: Can the authors elaborate on and contrast the methods and parameters used for the refraction static corrections and the tomography static corrections in the text? (i.e. how many layers were assumed in the former, what kind of inversion was used in each etc.

Response: The refraction static correction method we adopted is the delay-time refraction method, a traditional approach for simple layered media with fast computational speed and low resolution. Three layers were assumed in this study. The refraction tomography method is an advanced inversion technique based on ray tracing, formulated as an iterative Gauss-Newton algorithm that minimizes the difference between observed traveltimes and those predicted by ray tracing through a velocity-depth model (Bishop et al., 1985). We utilized the full offset range of 0 to 16,000 m in this study. Identical parameters were selected for both methods, including a final datum of 1500 m and a replacement velocity of 5000 m/s.

Q3: I suggest some more detail be added to section 3.4: typically, deconvolution is used to sharpen reflection signals and suppress multiples. However, the authors motivate their use of deconvolution as a form of noise attenuation (lines 189-190). While this effect can be a byproduct, it is not usually the principal aim of deconvolution. Can the authors elaborate on how the deconvolution enhances S/N? Given the 1 ms gap mentioned in line 196, is it correct to say that the authors are applying a spiking deconvolution operator? This usually introduces more noise rather than suppresses it. Finally, Figure 6 does show a difference in data but, to my eye, it looks more like a difference in amplitude balancing than anything. Are the colour bars identical for the before/after images? I think this image would be more informative with the inclusion of colour bars and the power spectra.

Response: Thank you very much for your valuable suggestions. Lateral heterogeneity of near-surface conditions, combined with variability induced by excitation and reception factors, leads to significant discrepancies in seismic data energy and wavelet consistency. Surface-inconsistent noise can cause phase instability, making it difficult for conventional deconvolution to yield satisfactory processing results (Zhuravko et al., 2015). This study employed robust surface-consistent deconvolution (RSCD) to mitigate such effects via a robust solver (Kirchheimer et al., 2001; Hootman, 2011). The key parameters were set as follows: a predictive distance of 1 ms, an operator length of 240 ms, and a white noise percentage of 0.01. The robust solver can detect surface-inconsistent outlier spectra during the decomposition step and then reduce the weights of the affected traces. It is robust to strong outliers caused by inconsistent noise and generates unbiased results (Wang et al., 2017). Meanwhile, this method integrates an amplitude and phase-constrained signal processing workflow, which can simultaneously derive the surface-consistent amplitude compensation factor and deconvolution operator to provide relative amplitude-preserved data.

Thus, the amplitude appears better balanced after deconvolution, and we have reprocessed the shot gathers in Figure 6 for enhanced visual clarity. In addition, we conducted power spectrum analysis of the data before and after deconvolution, which reveals an effective broadening of the frequency bandwidth—particularly in the low-frequency range, which is critical for deep seismic reflection data. Deep seismic reflection surveys often prioritize low-frequency information, as it is essential for capturing the true response of deep strata (Taner and Koehler, 1981; Cary and Lorentz, 1993; Kazemi et al., 2016). We have added the above details, identical color bars, and power spectrum plots (for both shallow and deep sections) before and after deconvolution to the revised manuscript.

Q4： Throughout the paper, there is no textual discussion or figure that considers power spectra of the data. Incorporating these would be useful not only for evaluating the pre-processing steps such as the noise suppression (section 3.3), but especially for evaluating the MPFI regularization, the chief methodology of the paper. I suggest the authors incorporate some images and discussion of the original data in the f-k domain as well as after application of the regularization, specifically focusing on regions of the interpolated traces. What does the frequency content look like before MPFI? What about after? Are there any artefacts introduced? There is a lot of untapped discussion for Figures 5,6,9,10, 11 and their corresponding text if they had power spectra plots and comparisons.

Response: We have conducted rigorous quantitative analysis and textual discussion (including spectrum analysis) for each key processing step. Power spectrum plots and comparative analyses have been added for Figures 5, 6, 9, 10, 11, 12, 13, 14, and 15, along with signal-to-noise ratio (S/N) estimation and variance attribute analysis for Figures 10–11 (before and after MPFI) in the revised manuscript.

1) Signal-to-noise ratio estimation: The S/N ratio increased from approximately 1.5 to 2.5 in shallow sections and from approximately 2.0 to 3.5 in deep sections after MPFI implementation (Figs. 10 and 11).

2) Power spectra: Obvious low-frequency anomalies were observed before noise attenuation, indicating abundant low-frequency noise (e.g., surface waves), which was suppressed to a normal level after denoising (Fig. 5). The frequency bandwidth was effectively broadened after deconvolution, especially in the low-frequency range—an improvement that is highly beneficial for deep seismic reflection data (Fig. 6). The frequency content remained nearly unchanged before and after MPFI, with a slight loss of high-frequency components observed in shallow sections post-MPFI (Figs. 9, 10, 11). Nevertheless, the S/N ratio was significantly improved after MPFI, particularly when using the shot-domain infilling method.

3) Variance attributes: Variance slightly decreased for offset-domain MPFI and decreased significantly for shot-domain MPFI, indicating enhanced coherence of seismic reflections in both the stack-only sections (Figs. 10, 11) and migrated stack sections (Figs. 14, 15) after MPFI. Compared with the stack-only sections from the two contractors (Figs. 12–13), the newly processed results with shot-domain MPFI exhibited a statistically significant reduction in variance.

Q5: Are the seismic sections in Figures 10 and 11 migrated, as Table 1 implies? If so, I suggest explicitly stating this in the captions to distinguish them from merely stacked sections. Same for Figures 12 and 13, and 14 and 15.

Response: The seismic sections in Figures 10, 11, 12, and 13 are stack-only sections without migration, while Figures 14 and 15 represent pre-stack time-migrated sections. We have explicitly stated this distinction in the figure captions to clarify the difference between stack-only and migrated sections.

Q6: I believe the discussion would be strengthened by discussing assumptions and potential drawbacks/challenges of this regularization. For example, how crooked can the profile be before the regularization underperforms? What, if any, assumptions are being made by the method (such as repositioning shots that were taken with an offset to the line)? What are the implications of out-of-plane signals? Are there any implications/alterations of the amplitude? (this would be important to know for amplitude-based analysis like AVO).

Response: Matching pursuit Fourier interpolation (MPFI) iteratively extracts the maximum values of the wavenumber-domain spectrum and continuously subtracts them from the original data. Through multiple iterations, coherent signals—characterized by relatively large values in the wavenumber domain—are sequentially identified. In essence, MPFI constitutes a data reconstruction process. For 2D seismic data, MPFI transforms the data into the frequency-wavenumber domain along the time, common midpoint (CMP), and offset directions to identify coherent signals and attenuate random noise. MPFI regularization demonstrates greater stability for 3D data than for 2D data, and out-of-plane energy is treated as noise by 2D regularization methods.

Regarding the tolerance of profile curvature to regularization performance, the method generally exhibits robust performance for crooked profiles. We analyzed and compared pre-stack time migration (PSTM) stack sections and their corresponding migrated common reflection point (CRP) gathers at two major bending points with curvature angles of 19° and 4°, respectively. The CRP gathers and stack sections before and after regularization at these two positions show good consistency. The amplitude trends at the corner position 2 remain essentially consistent for both shallow and deep sections (Figs. 16 g, h). The amplitude trends at the corner position 1 were also generally consistent for both shallow and deep sections (Figs. 16 i, j), but the result may not be reliable because seismic reflections form an imaging blank zone both before and after regularization. In practice, the Fresnel zone radius serves as a *fundamental geophysical constraint governing the method's performance threshold, and the maximum allowable profile crookedness before regularization degrades is quantitatively defined by the Fresnel radius of target reflectors at the dominant seismic frequency. For shallow targets (0.5–5 km) and a dominant frequency band of 10–50 Hz in conventional seismic surveys, the Fresnel radius ranges from approximately 100 to 700 m; for deep targets (15–30 km) and a dominant frequency band of 10–30 Hz, this radius increases to 700–1750 m. The regularization method maintains optimal performance when the lateral deviation of any segment of the crooked profile is less than 1/4 of the Fresnel radius of the corresponding target. If the lateral deviation exceeds the Fresnel radius, the regularization may fail to match the kinematic and dynamic characteristics of the coherent wavefield, leading to signal distortion, loss of small-scale geological features, and invalidation of the regularization constraints.*

Regarding amplitude implications and alterations after regularization, the algorithm only modulates amplitudes in the frequency-wavenumber domain to suppress random noise and enhance coherent signal continuity. Amplitude scaling is strictly constrained by the spectral energy of the original coherent signals, with no arbitrary amplitude gain or attenuation (Trad et al., 2009; Poole et al., 2015). We conducted amplitude analysis on migrated CRP gathers for both shallow and deep reflectors at the 4° curvature point, and the corresponding figures have been added to the revised manuscript. Amplitude-based analysis confirms that the relative amplitude variation trend with offset is preserved, ensuring the reliability of amplitude-dependent attributes for lithologic and fluid interpretation.

Q7: In the final comparisons (Figs. 12-15), the regularized data does show a visual improvement to the imaging capabilities. Are there any other quality controls that can be used to assess the imaging performance? (For example, semblance attributes, spectral amplitude comparison, difference plots etc.)

Response: We have performed the following quantitative analyses for the final comparisons (Figs. 12–15), with corresponding figures and descriptions added to the revised manuscript:

1) Variance attributes: Compared with the stack-only sections from the two contractors (Figs. 12–13), the newly processed results with shot-domain MPFI show *a statistically significant reduction in variance, indicating improved coherence of seismic reflections. The same observation applies to the pre-stack migration sections (with and without MPFI) (Figs. 14–15).*

2) Power spectra: The frequency content remains nearly unchanged before and after MPFI, with a slight loss of high-frequency components in shallow sections post-MPFI. However, the S/N ratio is significantly improved after MPFI, especially when using the shot-domain infilling method (Figs. 14–15).

Q8: In section 4, the order of figures does not match the order of those referenced in the text (7; 10; 11; 8; 9). The orders should match to improve readability.

Response: We have revised the manuscript to ensure the order of figure citations in the text is fully consistent with the sequence of the figures.

Response to Specific Comments:

Thank you very much for your suggestions. All specific textual comments have been revised accordingly. In particular, Line 208 has been revised as follows: The data are transformed from the space-time domain to the space-frequency domain by fast Fourier transform (FFT) (Schonewille et al., 2013).

Response to Figure Comments:

1）A scale bar has been added to Figures 2b and 2c.

2）Zoomed regions of the shot gathers have been added to Figures 4b and 4c, making the differences in first breaks before and after static correction more visually distinct and clear.

3）Source number annotations have been added to Figure 8 in the revised manuscript.