Editor

L224: “approximately 2.01 m to 5.27 m.” Quoting these values to two decimal places doesn’t sound very approximate! Might it be better to report them as “approximately 2.0 m to 5.3 m”?

- ➔ (Line 224) We have revised “approximately 2.01 m to 5.27 m” to “approximately 2.0 m to 5.3 m”.

Figure 6: label “Discontinous” should be “Discontinuous”

- ➔ (Figure 6 and 9) We have revised “Discontinous” to “Discontinuous”.
- ➔ (Figure 8) The title for the legend has been added to address the previous omission.

L372-373, L377: is precision of two decimal places really justified for these errors? Would integers be more defensible?

- ➔ In accordance with the editor’s suggestion, values have been rounded to the nearest integer. Given the importance of data reliability, the confidence interval has been extended to 99%, and the updated results are provided in Supplementary information S3.
- ➔ (Supplementary information S3)

S3. Seismic data acquisition

1. IPR data uncertainty in glacier thickness estimates

The vertical uncertainty of the GNSS data was estimated to be 0.98 m. At the 99% confidence level, the uncertainties in surface and bed elevation measurements were calculated as ±6.9 m and ±32.7 m, respectively (Figure S5). When incorporating the GNSS vertical uncertainty, the total uncertainties in surface and bed elevations increased slightly to ±7.0 m and ±32.7 m, respectively. Consequently, the overall uncertainty of the IPR-derived ice thickness was estimated to be ±33.4 m.

$$U_{IPR} = \sqrt{(\pm 7.0\text{ m})^2 + (\pm 32.7\text{ m})^2} = \pm 33.4\text{ m}. \quad \text{S3.1}$$

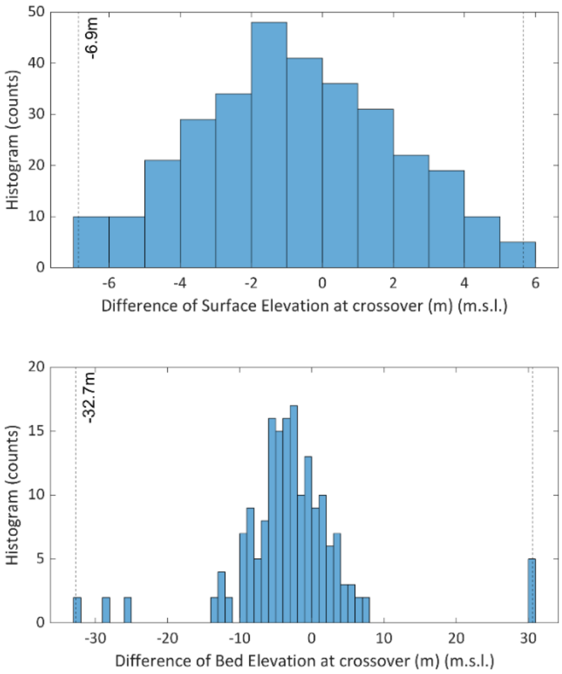

Figure S1. Measurement uncertainty results of surface and ice bottom elevations from IPR data.

2. Seismic data uncertainty in glacier thickness estimates

The uncertainty associated with seismic picking arises from the presence of noise and is quantified as picking uncertainty (U_{pick}), which can be estimated using the following equation (Abakunov et al., 2020):

$$\sigma_{pick} = 2\sqrt{\frac{T^2}{4\pi^2}\frac{1}{SNR}}, \quad \text{S3.2}$$

where T is the period of the central frequency and SNR is the signal-to-noise ratio. Based on this formulation, the SNRs of the first arrival and the ice–water interface signals were determined to be 88.8 dB and 10 dB, yielding vertical uncertainties of 0.2 m and 2.1 m, respectively.

$$U_{pick} = 2.58\, \sigma_{pick} = \pm 5.4\ \mathrm{m}. \quad \text{S3.3}$$

The total picking uncertainty at the 99% confidence level is 5.4 m. Under glacial temperature conditions of –2 ± 2 °C, where the average P-wave velocity in ice is 3800 ± 5 m s^{-1} (Kohnen, 1974), the uncertainty associated with the variability in seismic velocity is estimated to be ±5.3 m. Assuming a firn layer thickness of 100 m, the combined measurement uncertainty of the seismic results at the 99% confidence level is calculated to be 7.6 m.

$$U_{Seis} = \sqrt{(\pm 5.4\ \mathrm{m})^2 + (\pm 5.3\ \mathrm{m})^2} = \pm 7.6\ \mathrm{m}. \quad \text{S3.4}$$

Referee #2

One comment that I think may be worth addressing is the consistent appearance of the seismically derived bed profile beneath the radar derived depth. Is this simple an effect of dominant wavelength? Are the boundaries two slightly different physical reflectors? Something to think about, and maybe add a sentence about.

➔ As noted by the reviewer, the ice thickness estimated from radar data is consistently greater than that from seismic data across most of the survey area. This discrepancy may result from an overestimation of the radar wave velocity (0.169 m/ns) used in the ice. Although Ju et al. (2025) adopted this representative value from the literature (Reynolds, 2011), it may differ from the actual radar wave speed in the study area. Additionally, the uncertainty in ice bottom picking from the radar data is relatively large (±32.7 m), and this must be considered when comparing the two datasets. Nevertheless, the consistency between the two datasets remains within the bounds of uncertainty, supporting their mutual reliability. This consistency further validates the integrated application of both methods for characterizing subglacial lake environments.
(Lines 380-385) We have added the sentence "The ice thickness derived from radar data is generally greater than that obtained from seismic data across most areas. This discrepancy may be attributed to an overestimation of the radar velocity. Ju et al. (2025) adopted a commonly used literature-based radar velocity of 0.169 m/ns, which may differ from the actual radar velocity in the study area. Additionally, the uncertainty in measuring the ice bottom in the radar data is ±32.7 m, and this must be considered when comparing the two datasets. Despite these factors, the two datasets show a high level of consistency within the uncertainty bounds. This consistency supports the mutual reliability of both methods and validates their integrated application for subglacial lake characterization.".

L82: qualitatively? aren't matching absolute amplitudes

➔ In land-based seismic data, the amplitude of each shot gather can vary due to several factors. When integrating multiple shot gathers during data processing, amplitude normalization is essential. As shown in the workflow (Fig. 5), anomalous amplitude attenuation was applied to suppress outlier signals by interpolating between adjacent traces.

L112: how do you know it's cyclic as opposed to simply a single drainage/refilling event?

➔ We thank the reviewer for identifying this potential oversight. Given the limited duration of monitoring, there is currently insufficient evidence to confirm the periodicity of the observed surface elevation changes. Accordingly, the sentence has been revised as follows:
(Line 112) We have revised the sentence "These patterns of elevation change strongly suggest that SLD2 is an active subglacial lake, **with cyclic** drainage and refilling likely contributing to the presence of subglacial sediments (Siegfried et al., 2023)." to
"These patterns of elevation change strongly suggest that SLD2 is an active subglacial lake, **and that such** drainage and refilling are likely contributing to the presence of subglacial sediments (Siegfried et al., 2023)."

L169: refracted vs pseudoacoustic? difference in terminology ?

➔ To avoid potential misunderstanding, we have clarified that the term "refracted wave" refers to the apparent velocity derived from the first arrivals in the raw shot gather data. The revised sentence emphasizes that both the direct and refracted wave velocities were empirically measured from the observed travel-time curves.
(Lines 168-171) We have revised the sentence "In these shot gathers, the velocity of the direct wave is estimated to be approximately 1800 m/s, and the refracted wave velocity in firn-ice transition is

approximately 3800 m/s" to
"In these shot gathers, both the direct wave and the refracted wave velocities were derived from first-arrival travel-time analysis. The direct wave velocity was estimated to be approximately 1800 m s^{-1}, while the higher-velocity arrival—interpreted as a refracted wave traveling through the firn–ice transition zone—exhibited an apparent velocity of approximately 3800 m s^{-1}".

L223: would these be due to crevasses or topography variation? simply filtering artifacts? what is the reason for spurious arrivals?

➔ The seismic velocities cited in this sentence correspond to the minimum and maximum P-wave velocities of water, firn, and ice. The sentence has been revised to eliminate any potential ambiguity. (Line 225) Assuming seismic wave velocities between 1396 m s^{-1} **(water)** and 3800 m s^{-1} **(ice)**, the corresponding vertical resolutions, which are calculated using the quarter-wavelength criterion, range from approximately 2.0 m to 5.3 m.

Figure 6: why is the (③) reflection in 21Y so much more geometrically complex than the glacier-lake interface

➔ The geometric complexity of reflection (③) in line 21Y, as compared to the glacier–lake interface (①), is attributed to the combined influence of multiple signal interferences. Specifically, the discontinuous character of reflection (①) and the presence of a ghost reflection (②) create overlapping waveforms that interfere with the interpretation of reflection (③). This interference results in apparent geometric irregularities that may not reflect actual subsurface features. Consequently, it remains unclear whether reflection (③) corresponds to a true subglacial interface—such as a sedimentary boundary—or whether it is an artifact of waveform interference. To reduce this interpretational uncertainty, we are currently preparing to apply deghosting techniques in future data processing. This additional step is expected to enhance the clarity of complex reflection patterns, particularly in regions such as reflection (③), where distinguishing structural boundaries is challenging. The refined results will be presented in subsequent studies.