Reply to the reviewer comment 2 for "Measurement report: Isotopic composition of CH_4 emitted from gas exploration sites in the Transylvanian Basin, Romania"

We thank the reviewer for their constructive reviews of our manuscript and provide here a point-by-point reply. The comments from the reviewers are shown in blue and our replies in black.

Gas production in Romania is one of the larger methane sources in Europe (as also now shown in satellite observations). The isotopic characterisation of these emissions in this study is of interest as isotopic signatures are a good way of partitioning source types. The paper includes a good introduction to the context of this source sector and of previous studies in the region, including previous isotopic signature measurements.

A biogenic source of the methane was expected (Baciu et al., 2018). The ethane measurements on the gas in this region from previous studies should be mentioned as this also confirms a biogenic origin. Was ethane measured by the portable analysers used in this study.

Reply: The mobile analysers that were used during the campaign (see answer to next point) did not measure ethane online, so this cannot be confirmed.

How large did the methane mole fraction increase above background need to be to calculate the source signatures using the Keeling plot technique? This should be mentioned in the methodology section where it states that samples were collected in the emission plumes. How big were these plumes? What real-time sensors were used to find the plumes?

Reply: Thanks for this note, we have added the following additional description:

We used the following real-time sensors to locate the plumes: LGR MGGA-918, Picarro G2301 or GasScouterTM G4301 (CH_4, CO_2, H_2O), Picarro G2203 (C_2H_2, CH_4). These sensors were used to quantify emission rates as presented in Jagoda et al, 2025, manuscript in preparation). We collected air samples for isotopic analysis in large plumes where the mole fraction increase was at least several ppm to hundreds of ppm, so this was never a limitation in using the Keeling technique.

Figure 2: what do the error bars represent? They are very small in the central region, but much larger for the low and high d13C. Why is this? Please explain in the caption how the error bars were calculated.

Reply: They are the output of the BCES function from the BCES package in python. This function states: Bivariate correlates errors and intrinsic Scatter, translated from the FOTRAN code by Christina Bird and Matthew Bershady (Akrtis & Bershady, 1996). We have added this in the methods instead of the caption.

Line 151 – is there a typo here in the numbers for δD? Most lie between -200 and -170 ‰ (not -280).

Reply: Yes, this should have been -180‰, instead of -280‰.

It is interesting that the d13C isotopic signature from the gas facilities measured in this study (-65.6 ± 0.5 ‰) is much lower than the global average signature for methane from natural gas (around -44 ‰, Sherwood et al., 2017). This needs to be taken into account if incorporating isotopic measurements in regional modelling. I would have liked to have seen the implications of the findings discussed more in the discussion section.

Reply: This data was used in a paper interpreting continuous CH_4 measurements in Cluj-Napoca (van Es, 2025). The simulations in that paper indeed needed the local value for natural gas in order to reproduce the time series better. We have added a remark on this in the revised version, linked

to the suggested statement by the referee that these isotope signatures are far lower than the global average natural gas signature.