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Interactive comment on "Global Inventory of Gas Geochemistry Data from Fossil Fuel, Microbial and Biomass Burning Sources, Version 2017" *by* Owen A. Sherwood et al.

Anonymous Referee #2

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Review of Sherwood et al., Global inventory of gas geochemistry data from fossil fuel, microbial and biomass burning sources, version 2017

This paper and the accompanying dataset represents a very large contribution toward understanding the composition of methane from fossil fuel sources, which will be helpful in many "top-down" modeling and measurement studies. The authors have done a lot of work assembling data for composition of fossil fuel sources and this is a valuable contribution. But I have some questions and comments.

Overall, I thought the paper emphasized the fossil fuel sources and their isotopic composition too much – which, I understand that fossil fuel CH4 is the authors' "thing" and that fossil fuels are the hot topic right now. But despite the inclusion of all of

the alkane ratios and even the isotopic ratios of some of the alkanes in the database, these are not discussed in the paper. Also, the data are heavily weighted toward fossil fuel sources: the amount of biogenic data in the database is so much less, and so much older! Where are all of the isotopic measurements of Arctic methane sources in your biogenic data, just as one example? People have been making measurements of methane emitted from lakes and tundra there for decades. Biasing your database toward fossil fuel sources doesn't really help your argument that models have relied on "outdated source signature values". Much more recent data are available in this area (see below for some suggestions).

Specific comments:

Lines 27-28: "Most global models. . .": this is a strong statement – some of us use recent measurements of sources, sometimes even measurements of sources we make ourselves! Plus, as mentioned above, your biogenic data are not "globally representative" if you don't include Arctic wetlands and more recent sources.

32: Permanent?

34: What does mean (unweighted) mean?

35: be specific about the d13C values you calculate here versus what has been used previously

35-36: "thus highlighting potential underestimation of fossil fuel CH4 emissions in previous CH4 budget models" – it is not clear how this conclusion was reached.

47: today? This reference is from 1992. Please update.

53-59: other papers have indicated that changes in CH4 consumption by the OH radical may be the cause

61: I know you wrote "in part", but you didn't define the counterpoint to top-down: the bottom-up inventory.

75-86: I take issue with this somewhat. Many of these papers you cite were written by people who pioneered the measurements of methane isotopes and made the source signature measurements, so you should try not to disparage these older studies. The measurements were really, really hard to make back then (they are still not a picnic, and it's not fun when modelers think they are). Finally, there have been efforts at least at the regional level to match source isotope/alkane measurements to top-down measurements in the same area. Townsend-Small et al., 2012; 2015; 2016 would be good examples.

87-88: What do you mean, there have been no original measurements of fossil fuel isotopic signatures since 1994? Are you being serious? This is a review paper of fossil fuel isotopic measurements that you discuss in your next paragraph.

182-185: you cite global top-down studies that utilize C2:C1 in your introduction, and several of these studies that you cite do not use alkanes anyway.

189-200: The issue of instrument calibration is a huge problem here – each lab uses different calibration standards. I realize you can't really screen for that but you should note it somewhere in your paper

234-241: The database that NOAA sent me has 8734 rows for fossil fuel sources, as you note here, but only 107 for non-fossil sources. You wrote there are 1,972 non-fossil data records.

380-389: I don't understand the "hinge point". Needs more explaining.

394: the $\pm$ 5‰ in d2H of CH4 is the measurement variability, not the variability of CH4 in the atmosphere. That's about as good as the measurement can get.

395-398: still not understanding the "hinge point" aspect of this figure.

417: Do you mean shale gas versus conventional gas? Or dry gas versus wet gas? Shales can have oil too.

438-445: I'm not sure where you are going here – neither the Peischl, Karion, nor Petron papers used d13C for source apportionment in their papers, so I am failing to see how this is relevant.

451: you have not discussed the patterns in C2:C1 in the data at all in this paper (nor any of the other alkanes).

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