

Interactive comment on “Methane hydrate stability and anthropogenic climate change” by D. Archer

Anonymous Referee #2

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I acted as handling editor for this paper when submitted to the Reviews of Geophysics. Unfortunately this paper fell foul of an AGU policy not to publish anything that had appeared in some form previously on the Web. The revised version submitted to RoG appears to be identical to the current version in Biogeosciences discussions and reflects significant improvements made in response to three referees (hence making it significantly different from the original Web version). Before the AGU intervened to decline publication, I had prepared a checklist of editorial corrections. As far as I can see the only change that has been made from my list is the production of the manuscript in numbered sections. Therefore I have reproduced below the corrections that I suggested based on my detailed reading of the paper last year.

Most of the corrections are minor, but there are two key paragraphs which need rewriting; also Table 1 should be converted to text (it contains too little systematic information to be worth retaining as a table), and attention needs to be given to the figure captions.

Section	Original (or correct style)	Change <i>to</i> or change <i>in this way</i>
Abstract, last line	Release	Release as
1.1.1, line 3	oxidized forms of carbon are most stable, such as CO ₂ , the carbonate ions in seawater, and CaCO ₃ minerals.	oxidized forms of carbon, such as CO ₂ , the carbonate ions in seawater, and CaCO ₃ minerals, are most stable.
1.1.2, line 5	Mg ²⁺	Mn ²⁺
1.1.2, line 7	mathanogenesis	methanogenesis
1.1.2 line 10] .].
1.1.2 para 2 line 2	depleted, ,	depleted,
1.1.2 para 2 line 4	methane-sulfate	methane-sulfate
1.2.1, para 2, 2 lines from base	does	do
1.2.1, paragraph beginning "The concentration of OH", line 5	several of gases	several gases
1.2.1, last sentence	Therefore, the release of 1 Gton C of methane catastrophically to the atmosphere would raise the methane concentration by 33%. 10 Gton C would triple atmospheric methane.	Therefore, the release of 10 Gton C of methane catastrophically to the atmosphere would triple atmospheric methane.
1.2.2	oxidiation	oxidation
2.1	in the few	in the top few
2.1 para 2 line 2) .).
2.1 para 2	Wellsbury	correct style 1
2.2.1	melting of hydrate to methane bubbles	decomposition of hydrate to yield methane bubbles
2.2.1 para 2	Sultan	correct style 1
2.2.2 para 1 line 1 (also para 2, line 1)	Pore water flow	Pore-water flow
2.2.2 line 1	upward flowing	upward-flowing
2.2.2 para 2	<i>Fleming</i> et al.	?is this the 2002 reference (otherwise it is not cited in the paper)
2.2.2 para 2	off of New Jersey	off New Jersey
2.2.2 line 10	There are approximately..... in a belt called the mud volcano belt beginning.....	There have been discovered approximately... ..in a belt beginning....
2.3.1, para 1	in situ temperatures	in-situ temperatures
2.3.1 para 2	diffusion controlled	diffusion-controlled

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2.4.1, para 1	melting Artic.....Dansgaard Oeschger climate	melting the Arctic..... Dansgaard- Oeschger climatic
2.4.1 para 2	Dickens	<i>Dickens</i>
2.4.2 line 1	has holes in it	exhibits holes
2.4.3, para 1	accumulates more quickly than the excess porosity can be squeezed out.	accumulates excess porosity through rapid de- position.
2.4.3, para 1	or potentially	and potentially
2.4.3 para 2	<i>[Paul, 1978].....calculates</i>	<i>Paul [1978] calculated</i>
2.4.4	found enhanced lifetime	found an enhanced lifetime
2.4.4 para 1	<i>Rehder</i>	style correction 1
2.4.6, para 1	<i>Clark</i>	style correction 1
2.4.6, para 1	Water column concentration	Water-column concentration
2.4.6, para 2	time scales	timescales
2.5, para 1	<i>Milkov [2002]</i>	this reference is not in the list – is the year correct?
2.5, para 4	slope area fraction	slope-area fraction
2.5, para 5	<i>Archer</i> <i>CZCS</i> cutoffs was Sediment surface.....	style correction 1 spell out in full (both times that it occurs cutoffs were Utilizing sediment surface.....
2.5 para 6	<i>Milkov</i> influential <i>Kvemvolden</i>	year not given for reference influential paper of <i>Kvemvolden</i>
2.5 para 8	deep core	deep-core
2.6 para 1	stratigraphic (occurs twice)	stratigraphic
2.6 para 2		Nine references are given in a block here – are they all necessary? Better to cite a smaller number unless there are specific points that need more.
2.6 para 2	methane hydrate have been.....seawater [<i>Macdonald...</i>	methane hydrate wereseawater by <i>Macdonald et al.</i> [
2.6 para 3	<i>Milkov [2001]</i> CCSM In situ temperatures there no observations	not in reference list spell out in full (and/or give a reference where this model is published) In-situ temperatures there are no observations
2.7 para 1	in a process called thermokarst <i>Kolbert.....Pearce.....Stockstad</i> Model projects	to form terrain called thermokarst Since the <i>Stockstad</i> reference is available, eliminate the others from the manuscript as they are not refereed sources Models project

2.7.1		Apart from re-ordering references, join the second (single-sentence) paragraph with the first one.
2.7.2, para 2	glacial time	glacial times
2.7.2 para 3	<i>Hubberten....</i>	style correction Remove reference to Table 1
2.8, para 1	Nankia structurally focused <i>Milkov and Sassen</i> <i>Milkov [Milkov and Sassen, 2001]</i> estimates	Nankai structurally-focused add year <i>Milkov and Sassen</i> [2001] estimate
2.8, para 2	a field called Messoyakha, a field called Mallik	in the Massoyakha field, in the Mallik field
2.8, para 3	supply order of 10% of methane extraction rate in order 10 years reservoir. Most	of the order of 10% of the current methane extraction rate on a decadal scale reservoir, since most
3.1.1	HSZ	spell out
3.1.2, para 1	Earthquake	earthquake
3.1.2, para 2	dominating for deeper Figure 6 from [<i>Mienert et al.</i> , <i>Mienert</i> calculates <i>Sultan et al.</i> assert to dissolve laboratory analyses of volume changes upon this.....an in any case	dominating deeper Figure 6 from <i>Mienert et al.</i> [<i>Mienert et al.</i> [2005] calculate <i>Sultan et al.</i> [2004] assert to produce dissolved laboratory experiments on volume changes with this.....and in any case
3.2.1	$\delta^{13}\text{C}$ in Figure 7 from [<i>Zacho et al.</i> carbon records record the $\delta^{13}\text{C}$ perturbation a bit before the benthics do,	$\delta^{13}\text{C}$ signature of the carbon in Figure 7 from <i>Zachos et al.</i> [carbon records shown an earlier $\delta^{13}\text{C}$ pertur- bation than that of benthic forams,
3.2.2, para 1		This section on $\delta^{18}\text{O}$ inferences is poorly written and seems to assume no familiarity with isotope data by the reader. The first statement does not mesh well with the succeeding statements. The key issue is to include some references that make the key interpretation, perhaps mentioning alternatives that are ruled out.
3.2.2, para 2	The lightening of the carbon isotope is attributed to the release of some amount of isotopically light carbon	The change in the carbon isotope values is attributed to the release of isotopically light carbon
3.2.2 para 3	<i>Kent</i>	style correction
3.2.2, para 4	<i>Bralower.....Schmitz</i>	style correction

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3.2.2, para 6	would go away a few decades.... temperature anomaly would die away, namely, stopped plunging negative (.....) <i>Kump</i>	would decay away a few decades.. temperature anomaly would also die away; hence, halted its decline Remove parentheses around these sentences style correction
3.2.3, para 1	all the coal.	all the coal reserves.
3.2.3, para 2	5° (occurs twice)	5°C
3.2.3, para 4	Perhaps the land $\delta^{13}\text{C}$ shift is correct,..... then you get periodic	The meaning of this sentence and the following one is unclear. What land $\delta^{13}\text{C}$ shift is being referred to and where is it previously argued not to be correct. then periodic meltdowns are the result.
3.3	<i>Santa Barbara Basin and the Clathrate Gun Hypothesis</i>	This whole section of two paragraphs is not fit for purpose. Clearly there is a need to refer to the clathrate gun hypothesis, but this account is too telegraphed and doesn't clearly present the arguments for and against. It should start with the evidence. I suggest a rewrite of this section with a possible increase of 50% in length if necessary
4	Risks for the Future	The beginning of this section would be a good place to summarize the previous estimates by using the material from Table 1.
References	CO ₂ (numerous places) also CH ₄ in Sowers reference also CaCO ₃ in Zeebe reference Hansen et al (2005)	CO ₂ CH ₄ CaCO ₃ doi needed to complete the reference
Figure captions		Virtually all the figure captions do not include enough information for them to be understood by the reader.
	Figure 1 caption	Give reference for the Modtran model
	Figure 2 gauged the difference	Explain 1, 10, 100 Add (a) on left and (b) on right to the diagram gauged by the difference
	Figure 3	define time scales
	Figure 4 methane stability Hydrate solubility <i>Levitius</i>	Label the x axis (presumably temperature in °C) methane hydrate stability Hydrate stability <i>Levitius et al.</i>
	Figure 6 from [Mienert et al.,	from <i>Mienert et al.</i> [Why are the left and right axes different? What differs between the two diagrams? What are A, B, C and D? Spell out LGM, PD, BHSLS.

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Figure 7

Explain the meaning of the lines. Is the heavy line a generalized line from the various faint lines with actual data? Location of sites from which data was obtained should be given.

Figure 8

Description is inadequate. Presumably this is a model result.

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- When a series of references are cited, the usual conventions are often not followed regarding wording. For example: (Smith, 2004, 2002) should be given in chronological order without giving the author name twice, hence (Smith, 2002, 2004). I have not listed all the places where this needs to be modified – this is for the author to check all multiple citations in the text.
- A somewhat similar issue arises in the reference list where the publications of a given senior author should be given as single-authored papers, two-authored paper, X et al papers, chronologically from older to younger within each group.
- Where a reference is given at the beginning of a clause the form is often given as: (Smith, 2004) said... This should be Smith (2004) said..... I call this **correct style 1**
- *Volcanos* should be *volcanoes* throughout the manuscript (do a global *replace* including the heading of 2.6.1)
- The text often introduces a technical term by saying something is "called" something. This way of writing is used too often and, in many cases, for phrases whose meaning should be obvious in context. I would prefer it to be largely eliminated from the manuscript if the author can bear to do so, but have just mentioned some examples below, occasionally using bold type to highlight the bit that is to be changed.

Interactive comment on Biogeosciences Discuss., 4, 993, 2007.

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