

1 **Supplementary information**

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3 Table S1. Results of total organic carbon (TOC) contents, $\delta^{13}\text{C}$ of TOC, and concentrations and stable carbon isotopes of selected lipid
4 biomarkers such as isoprenoid DGDs, non-isoprenoid DGDs, and biphytanes derived from isoprenoid GDGTs.

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Core depth (mbsf)	TOC (wt. %)	$\delta^{13}\text{C}_{\text{TOC}}$ (‰ VPDB)	Lipid biomarkers																		
			Archaeol		<i>sn</i> -2-hydroxyarchaeol		<i>sn</i> -3-hydroxyarchaeol		Non-isoprenoid DGDs		GDGT-0	GDGT-1	GDGT-2	GDGT-3	Crenarchaeol	Biphytane 0	Biphytane 1	Biphytane 2	Biphytane 3	hydroxyarchaeol/archaeol	
			$\mu\text{g/g dw}$	‰ VPDB	$\mu\text{g/g dw}$	‰ VPDB	$\mu\text{g/g dw}$	‰ VPDB	$\mu\text{g/g dw}$	‰ VPDB	$\mu\text{g/g dw}$	‰ VPDB	$\mu\text{g/g dw}$	$\mu\text{g/g dw}$	$\mu\text{g/g dw}$	$\mu\text{g/g dw}$	$\mu\text{g/g dw}$	‰ VPDB	‰ VPDB	‰ VPDB	‰ VPDB
MV282																					
0.02	1.2	-26.6	0.05	-65.0	0.09	-107.4	0.02	n.d.	0.13	-39.4	0.07	0.01	0.01	0.00	0.09	-29.4	-46.2	-39.0	-27.1	1.8	
0.09	1.5	-26.6	0.09	-67.7	0.13	-100.6	0.03	n.d.	0.15	-40.1	0.07	0.01	0.01	0.01	0.08	-32.3	-63.4	-30.9	-26.8	1.6	
0.20	1.1	-26.4	0.06	-62.0	0.11	-103.2	0.03	-92.8	0.16	-41.4	0.06	0.01	0.01	0.00	0.06	-33.9	-46.3	-28.6	-26.6	1.7	
0.33	1.2	-26.4	0.07	-60.3	0.09	-98.6	0.02	n.d.	0.16	-37.9	0.05	0.01	0.01	0.00	0.05	-	-	-	-	1.3	
0.50	1.3	-26.2	0.06	-64.8	0.07	-99.4	0.02	-84.2	0.13	-45.3	0.05	0.01	0.00	0.00	0.05	-36.4	n.d.	-21.2	-29.6	1.3	
0.88	1.5	-26.0	0.06	-60.9	0.07	-103.6	0.02	n.d.	0.12	-42.9	0.05	0.01	0.01	0.00	0.05	-	-	-	-	1.3	
1.05	1.4	-26.2	0.06	-60.8	0.08	-91.0	0.02	-87.3	0.14	-36.0	0.05	0.01	0.01	0.00	0.06	-32.2	-36.0	-29.0	-16.7	1.5	
1.30	1.4	-26.2	0.06	-63.7	0.08	-97.3	0.02	n.d.	0.14	-39.3	0.06	0.01	0.01	0.01	0.06	-	-	-	-	1.3	
1.60	1.5	-26.0	0.06	-61.8	0.08	-98.1	0.02	-89.1	0.14	-38.8	0.05	0.01	0.00	0.00	0.05	-33.5	-38.6	-30.7	-37.6	1.5	
1.90	1.2	-26.5	0.03	-59.2	0.03	-96.0	0.01	n.d.	0.06	-43.8	0.02	0.00	0.00	0.00	0.02	-	-	-	-	1.3	
MV420																					
0.08	1.0	-26.4	0.03	-58.6	0.02	-113.8	n.d.	n.d.	0.09	-34.3	0.12	0.01	0.01	0.01	0.07	-42.7	n.d.	n.d.	n.d.	0.5	
0.20	1.1	-26.3	0.04	-41.7	0.01	-86.8	n.d.	n.d.	0.11	-36.6	0.19	0.02	0.01	0.01	0.12	-	-	-	-	0.2	
0.33	1.1	-26.2	0.04	-47.6	0.02	-108.8	n.d.	n.d.	0.15	-31.9	0.06	0.00	0.00	0.00	0.05	-34.0	-61.6	-22.9	-24.0	0.6	
0.50	1.1	-26.1	0.03	-38.6	0.00	-94.6	n.d.	n.d.	0.11	-34.3	0.03	0.00	0.00	0.00	0.02	-	-	-	-	0.1	
0.70	1.1	-26.7	0.09	-79.8	0.13	-113.9	0.08	-93.1	0.25	-46.9	0.10	0.01	0.01	0.01	0.13	-30.3	-51.4	-28.4	-24.0	1.4	
0.88	1.2	-26.2	0.06	-49.0	0.03	-94.7	n.d.	n.d.	0.10	-41.0	0.06	0.01	0.01	0.01	0.04	-	-	-	-	0.5	
1.05	1.2	-26.0	0.06	-44.2	0.03	-92.4	0.02	n.d.	0.09	-40.2	0.07	0.01	0.01	0.01	0.06	-32.3	-55.7	-30.1	-30.4	0.5	
1.38	1.1	-26.1	0.06	-45.6	0.02	-95.7	n.d.	n.d.	0.11	-41.5	0.07	0.01	0.01	0.01	0.06	-	-	-	-	0.3	
1.6	1.2	-26.1	0.08	-45.3	0.03	-97.0	n.d.	n.d.	0.11	-37.2	0.08	0.01	0.01	0.01	0.07	-34.8	-46.8	-29.4	-28.2	0.4	
1.81	1.2	-26.0	0.07	-47.7	0.03	-86.4	n.d.	n.d.	0.09	-40.1	0.30	0.04	0.05	0.03	0.25	-	-	-	-	0.4	
2.17	1.3	-26.1	0.06	-44.8	0.02	-92.1	n.d.	n.d.	0.09	-39.9	0.27	0.03	0.04	0.03	0.22	-	-	-	-	0.4	
MV740																					
0.08	1.2	-26.3	0.04	-38.5	0.02	-86.2	n.d.	n.d.	0.11	-34.3	0.07	0.01	0.01	0.01	0.05	-36.2	-49.5	-26.8	-25.3	0.5	
0.20	1.1	-26.3	0.04	-43.6	0.02	-87.8	n.d.	n.d.	0.11	-32.6	0.07	0.01	0.01	0.01	0.05	-	-	-	-	0.5	
0.35	1.3	-26.4	0.05	-59.6	0.05	-102.4	n.d.	n.d.	0.12	-37.9	0.09	0.01	0.01	0.01	0.07	-36.1	-57.0	-24.6	-31.7	0.9	
0.45	1.1	-26.4	0.04	-69.6	0.05	-103.7	n.d.	n.d.	0.12	-37.5	0.09	0.01	0.01	0.01	0.06	-31.5	-56.0	-25.2	-31.4	1.1	
0.55	1.2	-26.5	0.05	-65.1	0.05	-103.3	n.d.	n.d.	0.10	-42.7	0.06	0.01	0.01	0.01	0.05	-40.5	-50.6	-27.2	-30.7	1.0	
0.75	1.1	-26.2	0.04	-58.3	0.02	-93.5	n.d.	n.d.	0.11	-40.4	0.08	0.01	0.01	0.01	0.05	-	-	-	-	0.7	
1.00	1.2	-26.1	0.04	-59.5	0.01	-93.7	n.d.	n.d.	0.09	-36.7	0.09	0.01	0.01	0.01	0.07	-31.0	-55.5	-31.4	-26.8	0.3	
1.13	1.1	-26.2	0.03	-54.4	0.01	-96.7	n.d.	n.d.	0.09	-37.4	0.08	0.01	0.01	0.01	0.05	-	-	-	-	0.5	
1.55	1.3	-26.4	0.03	-53.9	0.01	-93.0	n.d.	n.d.	0.08	-33.8	0.07	0.01	0.01	0.01	0.06	-33.4	-50.5	-27.0	-23.5	0.4	
2.00	1.2	-26.2	0.04	-41.2	0.01	-82.1	n.d.	n.d.	0.09	-35.7	0.09	0.01	0.01	0.01	0.06	-	-	-	-	0.3	
2.30	1.2	-26.3	0.04	-52.8	0.02	-88.8	n.d.	n.d.	0.09	-38.6	0.08	0.01	0.01	0.01	0.06	-34.1	n.d.	n.d.	n.d.	0.4	
2.60	1.1	-26.4	0.03	-55.0	0.02	-90.1	n.d.	n.d.	0.08	-37.3	0.06	0.01	0.01	0.01	0.05	-	-	-	-	0.5	

6 Table S2. Summary of pyrosequencing reads

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	Core depth (mbsf)	Summary of SSU rRNA tags				
		Number of total reads	Archaeal reads	Bacterial reads	Eukaryotic reads	Unknown reads
MV282	0.02	12214	8835	134	2790	455
	0.09	8875	7016	36	1652	171
	0.20	8222	8060	24	53	85
	0.33	7304	7224	5	34	41
	0.50	6182	6157	9	9	7
	0.88	8886	8780	13	32	61
	1.05	6283	6266	0	15	2
	1.30	5058	5005	6	10	37
	1.60	1902	1875	2	9	16
	1.90	3550	3542	0	4	4
MV420	0.08	3155	3028	23	29	75
	0.20	4189	4079	22	32	56
	0.33	5164	1436	64	3508	156
	0.50	2175	2041	1	44	89
	0.70	2307	2259	1	3	44
	1.05	1537	1520	0	10	7
	1.38	5207	4757	71	107	272
	1.60	7012	6985	6	8	13
	1.81	3706	3669	5	7	25
	2.17	12017	11865	11	80	61
MV740	0.08	522	445	17	29	31
	0.20	506	458	0	28	20
	0.35	674	589	1	75	9
	0.45	583	534	0	35	14
	0.55	706	673	1	6	26

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9 Table S3. Heat map and taxonomic affiliation three dominant methanomicrobial OTUs along the depth. The color gradient from white to
 10 brown indicates low to high relative abundance values.

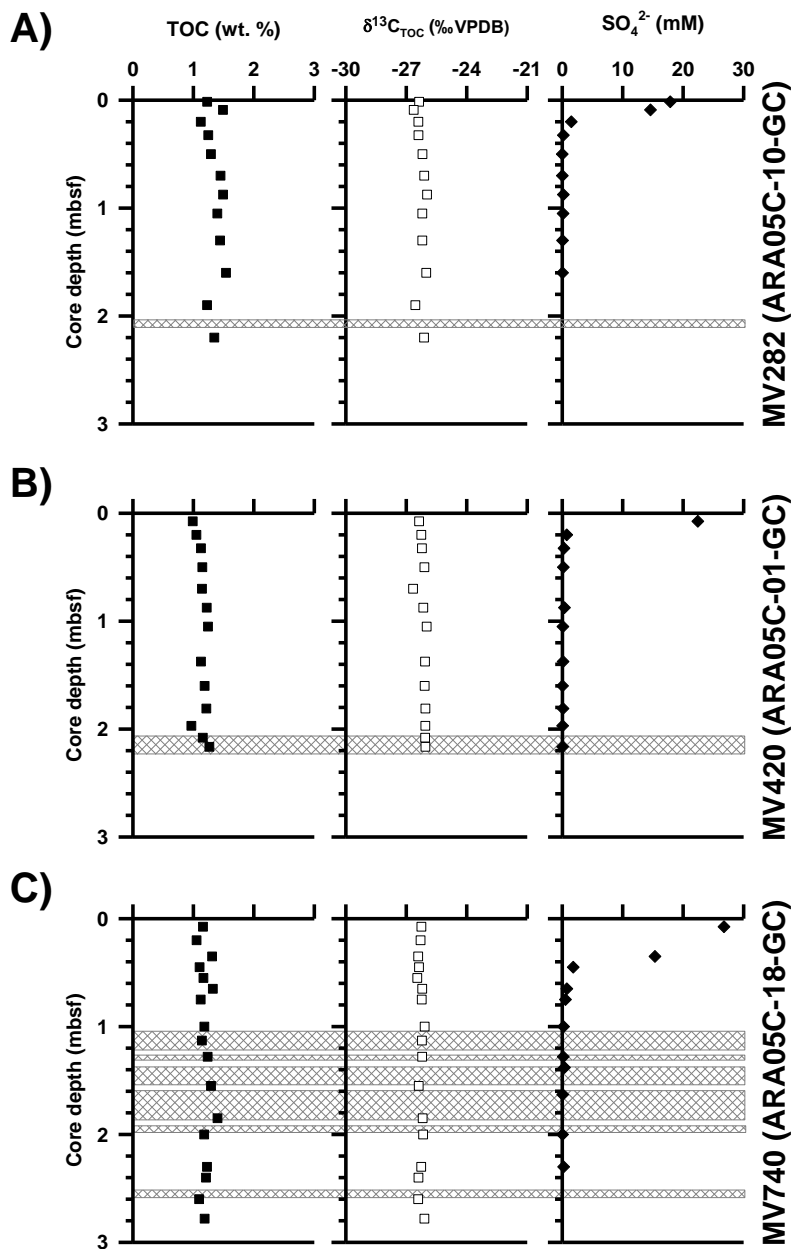
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Taxonomy							MV282										MV420										MV740				
OTU_ID	phylum	class	order	family	genus	species	Core depth (mbsf)										Core depth (mbsf)										Core depth (mbsf)				
							0.02	0.09	0.20	0.33	0.50	0.88	1.05	1.30	1.60	1.90	0.08	0.20	0.33	0.50	0.70	1.05	1.38	1.60	1.81	2.17	0.08	0.20	0.35	0.45	0.55
c116	Euryarchaeota	Methanomicrobia	Methanosarcinales	ANME3_f	ANME3_g	ANME3_s	2.5	2.0	14.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	5.5	3.4	6.1	0.2	6.7	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
c1698	Euryarchaeota	Methanomicrobia	Methanosarcinales	ANME3_f	ANME3_g	ANME3_s	1.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c1784	Euryarchaeota	Methanomicrobia	Methanosarcinales	ANME2_f	ANME2c_g	DQ084449_s	1.7	3.4	6.8	1.2	0.0	0.0	0.1	0.0	0.0	0.7	0.0	0.0	0.1	0.9	1.3	0.3	0.0	0.0	0.1	0.1	0.0	0.7	3.7	11.2	14.9

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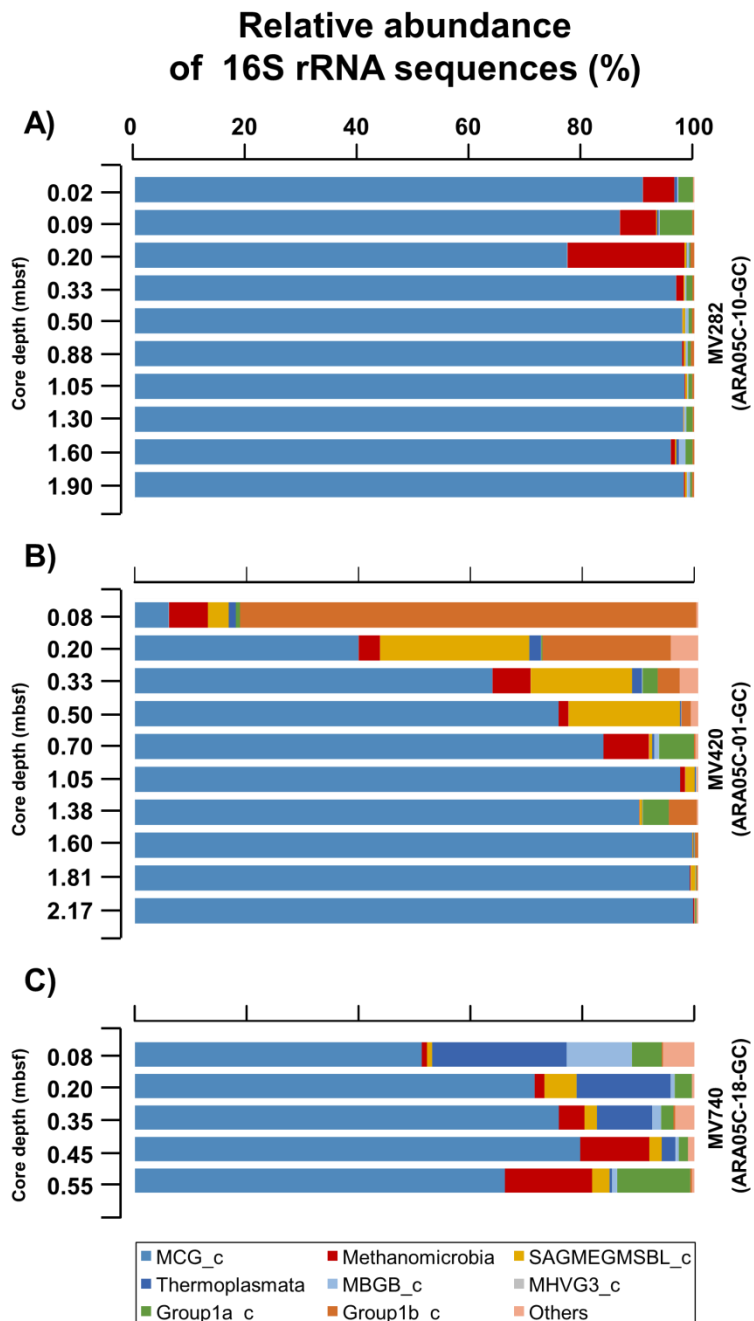
14 Fig. S1. Depth profiles of total organic carbon (TOC), $\delta^{13}\text{C}_{\text{TOC}}$ and sulphate concentrations
 15 for sediment cores from MV282, MV420, and MV740. Grey hatched bars indicate gas-gaps
 16 in sediment layers. Note that the sulphate concentration data are from Paull et al. (2015).



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19 Fig. S2. Relative abundances of archaeal communities at the class level along the depth (A)
 20 MV282, (B) MV420 and (C) MV740.



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