

1 **Supplementary material for**
2 **Heterogeneity of the horizontal environment drives community assemblages and**
3 **species coexistence of prokaryotic communities in cold seep sediments**

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12 Table S1 Geochemical characteristics of surface sediments at sites ROV1, ROV2, ROV3, and ROV4 in Haima cold seeps of the South China
13 Sea. Units used: CH₄, (μmol/g), TIC (μg/mg), TOC (μg/mg), SO₄²⁻ (ppm), Cl⁻ (ppm), Ba (ppm), K (ppm), Ca (ppm), Mg (ppb), Fe (ppb), Cu
14 (ppb), Mn (ppb).

Sites	Depth	CH ₄	TIC	TOC	SO ₄ ²⁻	Cl ⁻	Ba	K	Ca	Mg	Fe	Cu	Mn
ROV1	5	9.46	194.01	26.40	1229.15	20810.38	141.41	379.32	141.68	840.42	0	0	0
	10	9.72	288.82	35.77	597.59	21063.09	125.15	305.89	175.51	895.99	181.22	2.53	0
	15	16.13	269.15	34.04	268.78	21025.46	63.01	339.90	114.13	898.71	162.91	0	0
	20	12.95	288.98	29.98	248.06	21001.65	43.93	349.04	118.24	981.62	0	0	0
	25	12.43	258.49	31.27	292.34	20556.93	40.09	292.11	91.065	834.85	12.95	0	0
	30	16.49	287.01	33.63	219.81	20560.89	23.81	294.45	92.139	851.33	0	0	0
	35	15.44	214.16	30.13	176.08	20049.66	23.04	314.35	59.11	860.06	0	0	0
ROV2	5	2.04	38.21	30.21	2812.97	19993.71	11.53	325.81	324.21	982.07	117.31	0	95.46
	10	1.70	38.32	31.78	2823.39	20311.04	16.85	387.32	380.14	1101.24	6.42	0	362.00
	15	1.62	41.14	32.15	2698.00	20212.43	15.88	396.13	209.76	1064.25	61.68	0	0
	20	1.88	44.62	35.06	2454.80	17860.32	6.02	215.76	180.11	599.56	130.09	0	31.98
	25	1.87	46.09	33.05	2465.61	18677.96	6.14	277.54	230.22	731.32	0	0	0
	30	1.99	50.45	33.08	2469.66	19539.07	0	389.87	358.28	1082.74	0	0	0
	35	1.68	43.14	32.56	2474.70	20119.79	0	273.56	429.57	968.40	0	0	0
ROV3	5	3.67	40.65	30.64	2826.78	20799.91	12.72	286.78	266.91	789.25	165.32	3.84	200.63
	10	2.99	42.06	30.85	2860.07	20820.45	8.53	318.80	277.41	864.18	0.08	0	167.73
	15	3.88	44.45	33.05	2806.60	20914.00	8.76	326.74	290.23	909.02	5.59	0	0
	20	4.78	55.7	34.17	2642.51	20534.51	12.99	356.59	311.79	995.00	48.13	0	0
	25	5.23	68.73	34.13	2705.44	21360.91	13.68	334.0927	300.13	927.76	32.76	0	0
	30	6.16	67.79	35.43	2642.21	20830.70	12.45	345.1606	287.88	966.35	33.84	8.57	0
	35	7.19	50.14	44.53	2561.73	20398.94	11.44	369.4106	268.53	972.48	0	0	0

15 Table. S1 Geochemical characteristics of surface sediments at sites ROV1, ROV2, ROV3, and ROV4 in Haima cold seeps of the South China
16 Sea (continued).

Sites	depth	CH ₄	TIC	TOC	SO ₄ ²⁻	Cl ⁻	Ba	K	Ca	Mg	Fe	Cu	Mn
ROV4	5	5.60	46.76	51.5	2781.42	19712.88	189.93	451.34	314.28	1158.69	2166.42	19.08	1.43
	10	4.96	45.20	38.51	2615.00	18482.57	16.04	290.68	260.08	835.39	0	0	0
	15	6.00	46.84	31.60	2777.14	19809.55	25.93	389.96	354.38	1061.70	10.76	0	0
	20	6.59	57.23	34.90	2640.26	18973.75	31.81	335.25	296.07	946.96	0	0	0
	25	6.64	71.54	36.22	2810.65	20494.66	43.49	379.70	348.72	1038.77	21.69	0	0
	30	6.72	84.24	38.95	2723.19	19720.06	32.66	319.64	284.71	904.28	38.55	0	0
	35	5.87	84.54	39.45	2829.67	20648.00	57.20	399.12	341.68	1079.03	1.60	0	0

17 Table. S2 α -diversity of prokaryotic community in surface sediments at sites ROV1,
 18 ROV2, ROV3, and ROV4 in Haima cold seeps in the South China Sea.

	Sites	Depth	Good coverage	Chao1	Observed species	PD whole tree	Shannon
Bacteria	ROV1	5	0.9963	3323.50	3192	242.41	8.82
		10	0.9963	3055.98	2919	226.45	8.57
		15	0.9969	2383.32	2254	193.46	7.81
		20	0.9979	1779.44	1709	160.56	7.23
		25	0.9976	1811.84	1730	172.41	7.05
		30	0.998	1781.81	1716	160.55	7.19
		35	0.9974	1727.00	1615	161.49	6.29
	ROV2	5	0.9928	6011.12	5757	351.27	10.76
		10	0.9896	6938.10	6504	355.50	10.87
		15	0.9951	4924.10	4752	296.95	10.28
		20	0.9925	5463.42	5154	306.91	10.37
		25	0.9947	4878.43	4686	302.19	10.19
		30	0.9941	5311.15	5110	318.55	10.41
		35	0.9932	5100.56	4811	309.44	10.17
	ROV3	5	0.9923	6347.63	6072	350.37	10.68
		10	0.9913	5635.00	5260	333.66	9.97
		15	0.9994	2281.23	2272	196.73	8.89
		20	0.9991	3424.69	3410	270.75	9.80
		25	0.9988	3587.12	3567	275.26	9.67
		30	0.9993	2430.11	2417	206.20	8.78
		35	0.9988	3307.15	3287	263.28	9.16
	ROV4	5	0.9992	3671.00	3660	256.33	10.33
		10	0.9991	2720.80	2708	229.71	9.31
		15	0.9981	3930.92	3885	294.15	10.13
		20	0.9983	3634.20	3595	261.63	9.93
		25	0.9991	3325.91	3312	246.65	10.10
		30	0.9986	3491.56	3463	263.01	9.76
		35	0.9975	3999.17	3929	280.33	10.35

20 Table. S2 α -diversity of prokaryotic community in surface sediments at sites ROV1,
 21 ROV2, ROV3, and ROV4 in Haima cold seeps in the South China Sea (continued).

	Sites	Depth	Good coverage	Chao1	Observed species	PD whole tree	Shannon
Archaea	ROV1	5	0.9988	547.98	517	74.54	2.14
		10	0.9985	559.01	510	75.50	2.25
		15	0.9983	729.99	684	75.15	3.81
		20	0.9993	363.04	352	43.10	2.71
		25	0.9991	348.84	324	38.29	2.52
		30	0.9993	293.07	270	34.46	2.33
		35	0.9990	432.28	411	48.70	2.89
	ROV2	5	0.9989	2044.14	2034	149.29	8.53
		10	0.9984	1760.32	1738	141.30	8.05
		15	0.9973	2083.68	2034	166.75	8.05
		20	0.9986	1312.05	1288	104.97	7.28
		25	0.9979	1421.50	1379	125.71	7.14
		30	0.9991	713.28	696	87.39	5.26
		35	0.9994	740.45	732	71.59	5.33
	ROV3	5	0.9999	1705.19	1705	159.24	7.41
		10	0.9997	939.28	938	105.13	6.25
		15	0.9997	1478.88	1389	108.81	6.28
		20	0.9965	1784.78	1678	136.82	6.70
		25	0.9968	1996.37	1909	133.66	7.59
		30	0.9978	1170.17	1106	92.18	5.06
		35	0.9962	1718.00	1597	117.67	6.40
	ROV4	5	0.9971	2293.26	2235	198.19	8.28
		10	0.9978	1632.70	1578	138.50	6.64
		15	0.9972	1584.41	1517	127.34	6.19
		20	0.9968	1325.37	1231	109.02	5.18
		25	0.9966	1821.23	1738	153.05	7.11
		30	0.996	1942.19	1834	145.19	6.95
		35	0.9954	1987.01	1841	148.51	7.03

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23 Table S3 Topological features of co-occurrence network of prokaryotic communities

in surface sediments at sites ROV1, ROV2, ROV3, and ROV4 of Haima cold seeps in the South China Sea.

	Sites	Average degree	Average clustering coefficient	Average path length	Modularity
Bacteria	ROV1	29.144	0.642	2.878	0.486
	ROV2	27.403	0.535	3.207	0.606
	ROV3	14.144	0.638	3.593	0.644
	ROV4	12.401	0.477	4.127	0.578
Archaea	ROV1	8.198	0.473	3.513	0.634
	ROV2	31.739	0.544	3.04	0.499
	ROV3	21.993	0.577	3.745	0.673
	ROV4	13.071	0.495	4.002	0.646

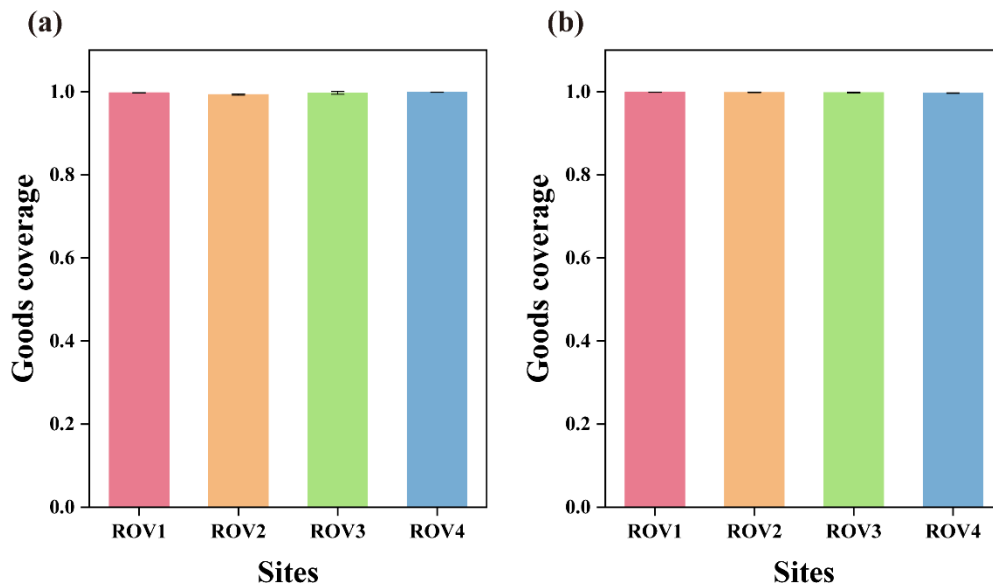
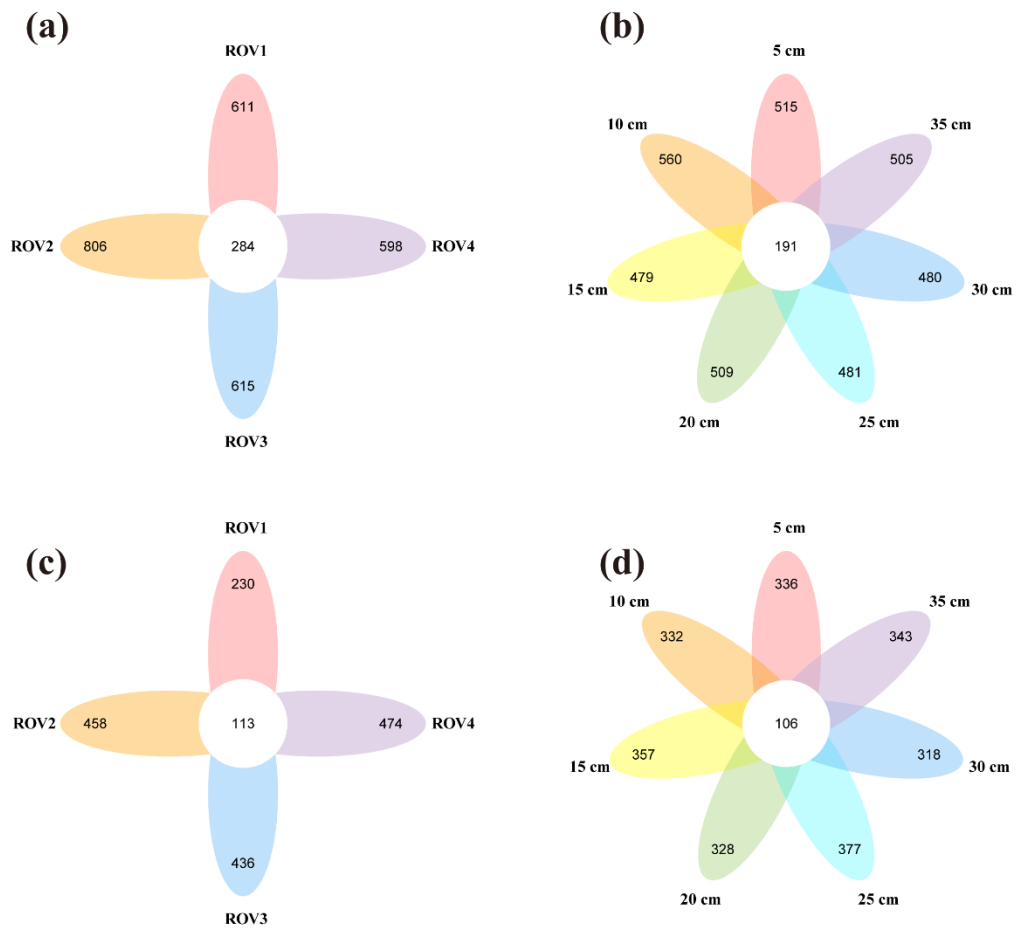
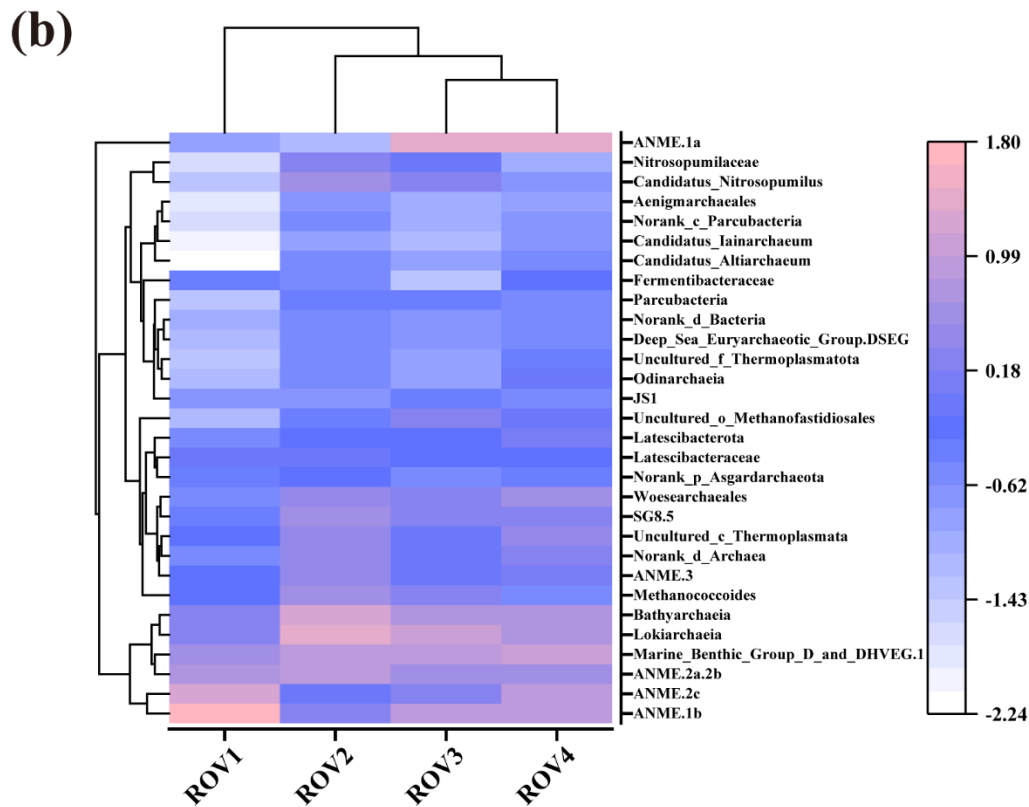
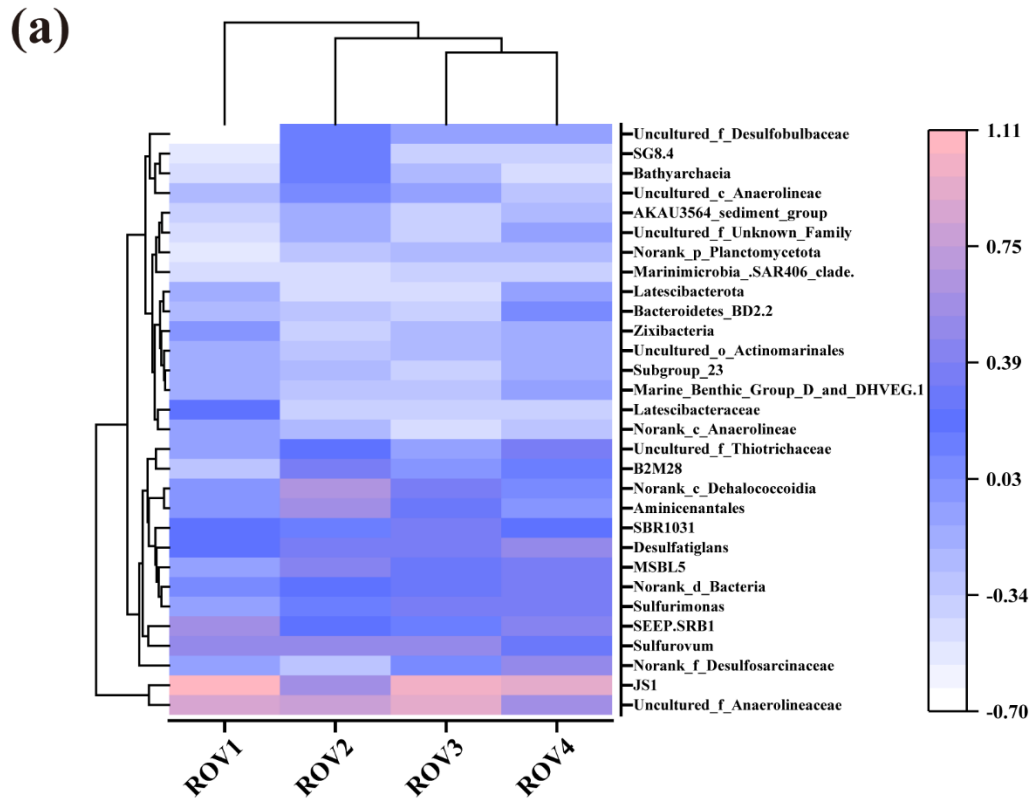


Fig. S1 Good coverage index of (a) bacteria and (b) archaea at sites of Haima cold seeps in the South China Sea.



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30 Fig. S2 Flower plots showing the number of shared and non-shared operational
 31 taxonomic units of bacteria grouped by (a) site and (b) depth, and archaea grouped by
 32 (c) site and (d) depth. Note: ROV1, ROV2, ROV3, and ROV4 are site numbers.



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 34 Fig. S3 Heatmaps of differences in (a) bacterial and (b) archaeal community
 35 composition based on 30 most abundant taxa at sites ROV1, ROV2, ROV3, and

36 ROV4 of Haima cold seeps in the South China Sea.