

SI Dataset 2-Stable isotope data for C₂₊ species in natural gas basins in this study

Country	Field / Protraction	C ₁	C ₂	C ₃	iC ₄	nC ₄	iC ₅	nC ₅	δ ¹³ CO ₂ (‰)	δ ¹³ C ₁ (‰)	δ ¹³ C ₂ (‰)	δ ¹³ C ₃ (‰)	δ ¹³ C ₄ (‰)	δ ¹³ nC ₄ (‰)	δ ¹³ C ₅ (‰)	δ ¹³ nC ₅ (‰)	δDC ₁ (‰)	δDC ₂ (‰)	δDC ₃ (‰)	δDiC ₄ (‰)	δDnC ₄ (‰)	δDiC ₅ (‰)	δDnC ₅ (‰)		
USA	Haynesville	93.97	3.2	0.435	0.127	0.0673	0.0295	0.0111	4.91	-38.78	-19.88	-15.54					-157	-109.7	-107						
USA	Haynesville	96.06	0.0912	0.0029	0.0002	0.0005	nd	nd	-0.14	-35.05							-142.5								
USA	Haynesville	96.48	0.31	0.0148	0.0014	0.0022	0.0003	0.0002	-0.19	-35.91	-29.56						-142.6								
USA	Haynesville	95.88	0.092	0.0031	0.0002	0.0005	nd	nd	0.24	-35.37							-144.4								
USA	Haynesville	96.36	0.122	0.004	0.0002	0.0006	nd	nd	0.1	-35.3	-30.51						-140.9								
USA	Marcellus	96.48	2.91	0.157	0.0037	0.0147	0.0011	0.0012		-35.76	-42.03	-43.5					-166.6	-189.1							
USA	Marcellus	93.46	2.54	0.126	0.0028	0.0099	0.0005	0.0005		-35.62	-40.93	-42.13					-167.5	-183.5							
USA	Marcellus	97.13	2.1	0.0915	0.0019	0.0065	0.0003	0.0002	13.87	-34.14	-38.14						-170	-184.2							
USA	Marcellus	78.62	14.34	4.4	0.415	1.03	0.183	0.228		-44.01	-34.25	-29.67					-207	-171.1	-152.5						
USA	Marcellus																								
USA	Marcellus	98.44	1.1	0.02	nd	0	0	nd		-26.92	-33.1						-169.8	-191.5							
USA	Hadrian, Keathley Canyon	72.32	14.75	7.88	0.729	1.8	0.377	0.44		-55.64	-40.53	-32.03	-32	-29.07	-29.31	-27.66	-247.7	-160.1	-117.6	-117.9	-105.5	-105.1	-97.2		
USA	Hadrian, Keathley Canyon	96.40	1.182	1.067	0.139	0.41	0.09	0.017		-60.39	-40.37	-30.16					-177								
USA	Hadrian, Keathley Canyon	97.98	0.792	0.471	0.035	0.155	0.008	0.007		-58.02	-39.67	-28.75					-178.3								
USA	Hoover-Diana, Alaminos Canyon	91.66	3.63	2.51	0.471	0.39	0.112	0.0653		-60.01	-31.48	-27.25					-214.5	-126.1	-112.2						
USA	Hoover-Diana, Alaminos Canyon	89.18	4.11	2.65	0.407	0.356	0.0796	0.0545		-58.86	-31.66	-27.54					-217.5	-132.2	-113.8						
USA	Hoover-Diana, Alaminos Canyon	91.91	3.82	2.04	0.494	0.621	0.263	0.145		-56.64	-28.76	-26.56					-203.2	-122.6	-116						
USA	Hoover-Diana, Alaminos Canyon	91.34	3.46	1.88	0.47	0.61	0.26	0.21		-53.71	-28.86	-26.51	-26.01	-27.3	-26.01	-23.75									
USA	Hoover-Diana, Alaminos Canyon																								
USA	Hoover-Diana, Alaminos Canyon	90.54	4.78	3.09	0.521	0.48	0.101	0.0617		-57.8	-30.68	-27.31					-212.6	-129.7	-115.7						
USA	Hoover-Diana, Alaminos Canyon	88.86	4.77	3.83	0.856	0.8	0.235	0.145		-58.55	-30.72	-27.2					-212.1	-127.7	-114.2						
USA	Julia / Walker Ridge	45.757	14.34	20.336	2.128	7.422	2.126	2.528		-58.56	-46.06	-36.82	-33.87	-32.02	-30.78	-30.01	-278.3								
USA	Julia / Walker Ridge	39.715	16.643	20.742	2.172	8.104	2.481	3.228		-57.01	-45.33	-35.89	-33.63	-31.57	-30.54	-29.65	-301.4								
USA	Julia / Walker Ridge	49.4	15.88	18.87	1.84	5.96	1.52	1.73	-18.83	-58.48	-46.04	-36.74	-33.82	-31.94	-30.68	-29.47	-273	-212.1	-129.3	-117.9	-113.9	-104.5	-98.8		

USA	Julia / Walker Ridge	49.54	15.08	18.84	1.89	6.24	1.65	1.89	-15.33	-58.68	-46.01	-36.68	-33.66	-31.85	-30.52	-29.65	-268	-212.6	-129.5	-118.1	-113.3	-105.7	-99.9
USA	Genesis, Green Canyon	87	5.94	3.61	0.64	1.2	0.355	0.299	-13	-57.39	-32.05	-28.37	-29.14	-26.91	-27.42	-26.02	-204.2	-149.1	-122.1	-119.6	-116.8	-110.2	-106.5
USA	Genesis, Green Canyon	85.26	6.14	3.85	0.725	1.49	0.52	0.498	-10.85	-57.04	-31.89	-28.35	-29.1	-26.94	-27.37	-26.36	-207.2	-150.4	-122.3	-118.3	-118.3	-110.2	-109
USA	Genesis, Green Canyon	87.59	4.72	3.18	0.621	1.39	0.506	0.488	-9.31	-59.41	-32.45	-28.8	-29.53	-27.26	-27.56	-26.38	-202.4	-149.2	-124	-121.2	-117.6	-111.8	-109
USA	Genesis, Green Canyon	90.44	3.46	2.31	0.507	1.08	0.454	0.454	-13.8	-61.04	-31.82	-28.24	-29.12	-26.89	-27.41	-26.24	-201.4	-141.1	-120.3	-121.1	-116.3	-111.8	-110.2
USA	Genesis, Green Canyon	88.26	5.41	3.28	0.585	1.09	0.313	0.273	-12.39	-58.45	-31.84	-28.28	-29.01	-26.85	-27.29	-26.13	-202.9	-146.2	-123.5	-118	-115.4	-110.5	-108.7
USA	Genesis, Green Canyon	84.37	7.52	4.33	0.75	1.39	0.389	0.354	-17.04	-54.65	-31.59	-28.04	-28.82	-26.62	-27.07	-25.86	-209.1	-150	-122.7	-120	-116	-109.3	-107.3
USA	Genesis, Green Canyon	89.31	4.31	3.18	0.582	1.19	0.365	0.31	-22.44	-63.77	-32.71	-29.02	-29.64	-27.3	-27.85	-26.21	-201.7	-151.8	-124.6	-113.1	-116	-113.3	-108.3
USA	Genesis, Green Canyon	84.41	5.9	4.41	0.863	1.87	0.663	0.604	-19.9	-63.17	-33.32	-29.55	-29.96	-27.69	-28.18	-26.65	-204.9	-158.2	-128	-122.5	-120.4	-113.9	-109.1
USA	Genesis, Green Canyon	87.74	4.36	3.16	0.642	1.48	0.58	0.545	-20.64	-62.62	-32.65	-28.97	-29.59	-27.33	-27.88	-26.12	-203.7	-152.1	-124.5	-121.5	-118	-113.8	-107.2
USA	Galveston 209	94.4	3.14	0.894	0.322	0.199	0.116	0.0668	-8.06	-41.55	-26.85	-25.29	-26.15	-24.76	-24.31	-24.35	-163	-132.6	-118	-120.4	-111.8	-24.35	1072
USA	Galveston 209	95.25	2.58	0.597	0.176	0.125	0.0695	0.0435	-6.98	-40.35	-26.25	-24.93	-25.53	-24.56	-23.97		-159	-130.8	-123.1				1050
USA	Galveston 209	94.77	3.04	0.787	0.236	0.173	0.0991	0.0621	-6.99	-41.45	-26.4	-24.75	-25.55	-24.39	-23.99	-23.94	-161.8	-129.6	-119.6	-119.5		-23.94	1070
USA	Galveston 209	94.96	2.97	0.761	0.236	0.162	0.089	0.0533	-6.98	-41.75	-26.46	-24.72	-25.63	-24.33	-24.03	-24.08	-164.7	-128.9	-118	-121.4		-24.08	1063
Canada	Medicine Hat									-67.17							-245.96						
Canada	Medicine Hat	80.84	0.164	0.0101	0.0023	0.0006	0.0003	nd		-68.37	-58.77						-250						
USA	Sacate, SYU	85.37	7.53	4.23	0.62	1.14	0.24	0.21	-12.9	-38.3	-31.3	-28.4	-29	-26.5	-26.1	-26.6	-175						
USA	Pescado, SYU	84.25	4.6	2.88	0.29	0.6	0.17	0.15	-10.7	-48.2	-35.4	-31.4	-29.2	-28.2	-26.4	-27.5	-205						
Germany	Rotliegend	90.14	1.37	0.07	0.01	0.01	0	0	-8.4	-27	-21.6	-20.6	-22.4	-21.3			-129						
Germany	Rotliegend	90.05	1.36	0.07	0.01	0.01	0	0	-7.8	-27.1	-23	-20.5	-22.6	-21.3			-128						
Germany	Rotliegend	87.38	1.22	0.06	0.02	0.01	0.01	0	-7	-26.1	-22.6	-20.9	-22.6	-21.7			-130						
Germany	Rotliegend	84.59	1.56	0.06	0.01	0.01	0	0	-8	-26.5	-23.2	-20.7	-21.2	-21.9			-128						
Germany	Rotliegend	84.6	1.52	0.05	0.01	0.01	0	0	-7.8	-26.6	-22.7	-20.4	-21.2	-21.1			-130						
Germany	Rotliegend	87.92	1.28	0.06	0.01	0.01	0	0	-8.8	-26.6	-23.1	-20.7	-22.9	-21.6			-130						
Germany	Rotliegend	88.02	1.32	0.06	0.01	0.01	0	0	-7.3	-26.3	-22.9	-20.7	-22.7	-21.5			-129						
Germany	Rotliegend	84.86	1.44	0.05	0.01	0.01	0	0	-7.3	-25.9	-23.4	-21.2	-22.2	-22.1			-127						
Germany	Rotliegend	81.81	1.49	0.05	0.01	0.01	0	0	-6.4	-26.2	-23.5	-20.5	-22.4	-21.6			-127						
Germany	Rotliegend	84.54	1.51	0.06	0.01	0.01	0	0	-8.4	-26.7	-23.1	-20.7	-21.4	-22.2			-129						
Norway	Sleitner Vest	69	8.28	4.26	0.53	0.82	0.18	0.16	-7.1	-40.9	-29.1	-27.3	-26.9	-28.6	-26.9	-27.5	-231						

Norway	Sleipner Vest	80.39	7.86	3.65	0.48	0.82	0.21	0.2	-8.3	-38	-28.5	-27.1	-26.2	-27.5	-26.6	-27.8	-209						
Norway	Sleipner Vest	74.7	8.24	4.27	0.61	1.01	0.28	0.26	-7.4	-39.8	-28.7	-27.1	-26.2	-27.6	-26.5	-27.7	-221						
Norway	Sleipner Vest	73.05	8.48	4.64	0.67	1.07	0.27	0.23	-6.7	-39.9	-28	-27	-26.6	-27.7	-26.7	-27.6	-217						
Norway	Sleipner Vest	75.14	8.29	4.2	0.55	0.86	0.2	0.17	-7.5	-39.4	-28.9	-27.2	-26.5	-27.6	-26.6	-27.8	-215						
USA	Eagleford	73.66	13.86	6.72	0.75	1.61	0.33	0.33	-1.2	-45.9	-32.5	-29.3	-30.3	-28.4	-27.7	-28.1	-237						
USA	Eagleford	77.86	11.88	4.94	0.45	0.98	0.19	0.2	-3.6	-45.6	-33.6	-29.3	-31.6	-28.7	-28.4	-28.3	-240						
USA	Eagleford																						
USA	Eagleford	77.8	12.62	5.32	0.58	1.28	0.27	0.3	-3.8	-47.4	-32.2	-29.3	-31.2	-30	-27.5	-28.5	-260						
USA	Eagleford																						
USA	Eagleford	78.09	12.59	5.1	0.56	1.25	0.25	0.27	-3.8	-47.5	-32.1	-29.4	-31.3	-30.7	-28	-28.3	-261						
USA	Eagleford	80.27	11.17	4.05	1.01	1.31	21	0.36	-0.6	-40.7	-24.6	-22.7	-25.8	-23.3	-22.9	-22	-181						
USA	Eagleford																						
USA	Eagleford	80.7	10.64	3.83	0.99	1.27	0.53	0.38	-0.5	-39.8	-24.2	-22.5	-26	-23	-23	-21.7	-181						
USA	Eagleford																						
USA	Eagleford	91.49	3.42	0.44	0.14	0.08	0.04	0.02	1.8	-39.2	-18.5	-15.2	-15.2	-16.7	-15.9	-17.3	-164						
USA	Eagleford	82.99	9.19	2.06	0.71	0.56	0.28	0.17	2.2	-40.2	-23.3	-20.1	-22	-20.4	-19.4	-18.9	-174						
USA	Eagleford																						
USA	Eagleford	91.79	3.63	0.38	0.1	0.04	0.02	0.01	2.4	-37.8	-17.4	-14	-10.5	-13.6	-9.3	-11.4	-167						
USA	La Barge - Tip Top	90.24	5.58	1.95	0.298	0.441	0.122	0.106	-7.93	-38.85	-28.02	-27.05	-26.42	-26.1	-25.4	-25.15	-187.7	-165.3	-156.7	-143.2	-154.1		
USA	La Barge - Tip Top	90.55	5.43	1.03	0.0231	0.0541	0.0451	0.0216	-7.66	-42.35	-27.92	-23.99					-198	-175.4	-116.4				
USA	La Barge - Tip Top	89.39	5.74	2.36	0.317	0.578	0.181	0.21		-38.72	-28.9	-28.04	-28.28	-27.11	-27.06	-26.89	-190.3	-172.8	-167.5	-149.3	-166.3	-145.6	-155
USA	La Barge - Hogs Back	81.44	9.37	4.73	0.828	0.953	0.313	0.268		-41.22	-28.31	-26.9	-26.61	-26.12	-25.57	-25.41	-201.1	-173.4	-160	-147.1	-155.4	-137.7	-146.4
USA	La Barge - Hogs Back	87.43	6.38	3.12	0.494	0.813	0.186	0.167		-36.91	-30.95	-28.66	-28.21	-26.93	-26.98	-26.58	-185.7	-178.9	-166.9	-157.7	-156.6	-144	-146.4
USA	Santa Barbara channel	84.16	0.758	0.824	0.227	0.266	0.178	0.0291	21.83	-49.13	-33.25	-27.66	-27.43	-23.78	-24.04		-209.5	-189.9	-133.8	-130	-111.9	-115	
USA	Santa Barbara channel																						
USA	Santa Barbara channel	82.5	0.68	0.988	0.261	0.528	0.274	0.164	24.48	-46.96	-34.06	-28.52	-28.02	-25.49	-24.69	-23.79	-204.6	-203.8	-149	-133.8	-134	-122.9	-120.4
USA	Santa Barbara channel	80.57	0.882	1.15	0.243	0.511	0.211	0.143	22.54	-47.84	-33.81	-28.83	-27.84	-25.45	-24.6	-24.2	-199.9	-200.1	-148.4	-129.1	-131.2	-117.3	
USA	Briggs	86.95	5.83	1.68	0.529	0.634	0.305	0.286	-10.39	-40.53	-25.68	-23.64		-23.35		-24.24	-158.4	-108.9	-99.4		-88.9		-92.2
USA	Briggs	85.48	6.75	2.05	0.504	0.657	0.301	0.223	-13.18	-41.46	-26.24	-24.26		-23.82		-24.28	-166.8	-110.9	-99.8		-93.8		-95.6

USA	Briggs	87.91	5.61	1.58	0.485	0.562	0.251	0.238	-10.29	-40.33	-25.23	-23.13		-23.06		-23.96	-160.6	-110.4	-100.3		-88.9		-87.4
USA	Briggs	83.93	8.84	3.04	0.547	0.773	0.346	0.299	-4.42	-44.1	-28.36	-26.09		-25.61		-26.1	-182.5	-125.7	-111.4		-109.5		-108.1
USA	Briggs	82.03	8.88	3.62	0.879	1.2	0.62	0.383	-3.02	-43.96	-27.92	-25.69		-24.59		-24.56	-181.8	-121	-113.1		-107.2		-104.3
USA	Bethany	88.63	4.68	1.42	0.361	0.507	0.243	0.225	-10.15	-39.2	-25.43	-23.68		-24		-24.77	-158.5	-110.6	-102.6		-94.6		-98.9
USA	Bethany	83.07	8.3	3.17	0.676	1.03	0.451	0.371	-2.85	-43.71	-28.19	-26.24		-25.77		-26.11	-178.7	-129.4	-117.2		-111.9		-108.9
USA	Bethany	72.58	12.56	6.91	1.3	2.55	0.839	0.648	-3.91	-45.28	-31.47	-28.69		-27.53		-26.96	-188.9	-137.5	-118.1		-109.5		-102.2
USA	Bethany																						
USA	Bethany	92.73	3.54	0.656	0.155	0.171	0.0849	0.0586	-11.78	-39.07	-24.87	-22.72		-22.76		-24.05	-159.7	-105.2	-94.7				
USA	Bethany	88.44	4.72	1.38	0.414	0.532	0.265	0.223	-11.04	-39.19	-25.48	-23.84		-23.62		-24.22	-159.5	-104.9	-94.8		-87.7		-92
USA	Bethany																						
USA	Huxley	97.51	0.741	0.144	0.0361	0.0532	0.0253	0.0224	-0.03	-34.59	-24.11	-25.1					-146.3						
USA	Huxley	97.37	1.03	0.0383	0.0093	0.0076	0.0038	0.0034	-6.81	-35.87	-18.8						-140						
USA	Huxley	97.48	0.742	0.145	0.0376	0.0567	0.0278	0.0249	-0.14	-34.78	-23.95	-23.72					-141.8						
USA	Huxley	96.93	0.193	0.0074	0.0006	0.0013	0.0002	0.0002	0.4	-35.55	-29.43						-145						
USA	Huxley	97.81	0.566	0.135	0.0329	0.042	0.0211	0.0152	0.12	-34.39	-25.9	-25.32					-141.6						
USA	Nebo Hemphill	97.46	0.448	0.0988	0.151	0.0872	0.118	0.067	-0.93	-58.86							-197.5						
USA	Nebo Hemphill	83.02	0.841	2.26	2.22	2.69	2.03	1.54															
USA	Olla	83.83	2.91	0.0789	0.0483	0.03	0.0222	0.0166															
USA	Olla	33.2	2.05	0.195	0.107	0.0664	0.0269	0.0169															
USA	Olla	45.96	1.82	0.0807	0.0393	0.0199	0.0135	0.0064															
USA	Olla	85.5	1.92	0.239	0.23	0.166	0.181	0.0752	15.1	-48.92	-27.3	-17.74	-26.3	-22.54			-186.8	-115.8	-79.9	-112.8			
USA	Nebo Hemphill	97.5	0.185	0.0059	0.0025	0.003	0.0037	0.0034	7.1	-60.99							-191.4						
USA	Nebo Hemphill	0.0235	0.0004	0.0012	0.0027	0.0015	0.0024	0.001															
USA	Nebo Hemphill	75.77	1.51	5.47	4.41	5.14	2.44	1.69	3.08	-56.79	-36.96	-28.08	-29.43	-27.58			-197.5	-177	-152.1	-124.7	-130.6		
USA	Nebo Hemphill	95.89	0.535	0.532	0.722	0.382	0.335	0.176	0.33	-49.58	-24.19	-25.87	-28.08	-26			-195	-115.2	-129.2	-114.2	-122.3		
USA	Nebo Hemphill	96.92	0.921	0.0613	0.245	0.281	0.274	0.198	3.31	-56.05							-193.8						
USA	Nebo Hemphill	93.6	0.778	0.869	0.801	0.795	0.474	0.311	9.4	-54.09	-35.37	-26.52	-28.45	-26.62			-203.4	-148.5	-136.5	-123.2	-130.1		
USA	Searcy	96.62	1.12	0.0363	0.0054	0.0165	0.0206	0.0227	1.43	-55.48							-195.3						

USA	Searcy	97.25	0.506	0.012	0.0016	0.0047	0.006	0.007	2.26	-55.44							-192.2							
USA	Olla	66.45	3.71	0.437	0.257	0.153	0.119	0.0744	13.34	-44.67	-28.14	-20.22	-24.83	-21.58			-185.9	-126.6	-74	-99.9	-83.7			
USA	Olla	71.49	6.5	0.45	0.35	0.258	0.185	0.123																
Canada	Scotian Basin	86.94	6.86	1.95	0.346	0.439	0.195	0.139	NaN	-40.72	-29.04	-25.22	-25.37	-24.23	-24.84	-23.95	-168.8	-128.4	-110.7	-111.8	-107	-104.4	NaN	
Canada	Scotian Basin	86.77	7.10	2.65	0.360	0.563	0.147	0.115	NaN	-41.27	-29.91	-27	-26.4	-26.17	-25.66	-25.4	-173.7	-137.6	-122.3	-110	-121.6	NaN	NaN	
Canada	Scotian Basin	91.07	4.16	1.40	0.167	0.280	0.0846	0.0713	NaN	-38.03	-28.61	-26.09	-25.34	-25.08	-24.94	-24.58	-166.3	-138.7	-124	NaN	-117.4	NaN	NaN	