Supporting Information

Estimate of Saturation Pressures of Crude Oil by Using Ensemble-Smoother-Assisted Equation of State

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Table S1 Properties and saturation pressures of 130 light oil samples[9]

no.	composition										specific gravity of C7+	molecular weight of C7+	temp, K	measured p_s, kPa	estimated p_s by SRK EOS, kPa	estimated p_s by PR EOS, kPa
	N_2	CO_2	H_2S	C1	C2	C3	C4	C5	C6	C7+						
1	0.4	0.2	0.0	27.2	8.9	8.6	6.1	3.7	2.6	42.4	0.9	271	327.6	9411.3	11045.4	9866.4
2	0.3	0.5	0.0	28.4	8.3	7.4	5.1	3.4	4.4	42.3	0.9	252	329.3	11252.2	11528.0	10183.6
3	0.3	0.2	0.0	25.6	6.9	6.4	5.6	4.7	4.3	46.0	0.9	222	329.3	10997.1	9935.3	8632.2
4	0.4	0.5	0.0	26.5	7.7	6.1	4.0	4.1	4.2	46.6	0.9	253	330.4	10342.1	11121.2	9514.8
5	0.1	0.5	0.0	28.8	7.9	6.5	3.2	2.1	3.3	47.7	0.9	250	329.8	11135.0	11479.8	10176.7
6	0.2	0.3	0.0	24.7	7.5	6.9	4.8	2.7	3.4	49.6	0.9	239	329.8	9652.7	9459.6	8370.2
7	0.2	0.2	0.0	27.8	7.7	6.2	3.4	1.8	2.8	49.9	0.9	228	329.8	10962.7	10562.8	9494.1
8	0.1	0.3	0.0	27.5	6.9	5.9	4.4	2.5	3.5	48.9	0.9	245	330.4	10617.9	10762.7	9452.7
9	0.8	0.1	0.0	24.8	6.8	6.5	5.4	4.1	3.7	47.9	0.9	227	329.8	9645.8	10404.2	8887.3
10	0.0	0.2	0.0	31.2	6.5	4.8	2.5	1.7	2.6	50.5	0.9	264	330.4	11652.1	12913.9	11073.0
11	0.0	0.2	0.0	28.6	8.6	7.4	3.8	2.6	4.1	44.7	0.9	249	329.8	10673.1	10693.8	9852.6
12	0.5	0.1	0.0	29.4	7.9	7.3	6.0	4.8	4.5	39.6	0.9	227	329.8	11755.6	11369.5	10300.8
13	0.6	0.1	0.0	29.9	7.8	7.0	6.1	2.8	2.7	43.1	0.9	242	329.3	11397.0	12465.7	10962.7
14	0.0	0.3	0.0	27.8	8.3	6.7	3.7	4.1	4.2	44.9	0.9	254	329.8	11341.9	10914.4	9652.7
15	0.1	0.8	0.0	31.3	7.4	5.7	2.8	1.6	2.6	47.6	0.9	270	328.7	12072.7	13396.5	11424.6
16	0.0	0.2	0.0	19.5	8.2	8.4	6.0	2.9	3.6	51.2	0.8	225	328.7	7067.1	6646.5	6198.4
17	0.5	0.4	0.0	33.3	7.6	6.2	4.1	2.2	2.9	42.9	0.9	236	330.9	11307.4	14485.9	12520.9
18	0.2	0.2	0.0	31.2	8.9	7.4	4.1	3.5	4.3	40.3	0.8	221	330.4	11376.4	11603.9	10804.1
19	0.5	0.9	0.0	29.9	7.3	6.0	3.5	2.0	4.3	46.2	0.9	271	329.8	11266.0	12617.4	11128.1
20	0.7	1.0	0.0	25.5	6.4	6.5	5.2	4.9	3.8	46.0	0.9	264	329.8	10569.7	11341.9	9514.8
21	0.2	1.4	0.0	27.9	6.5	5.2	2.5	1.6	2.6	52.1	0.9	255	330.4	10673.1	11914.1	10080.1
22	0.2	2.5	0.0	31.9	7.5	6.6	4.8	3.5	3.3	39.7	0.9	324	329.8	12582.9	16071.7	12844.9
23	0.2	2.5	0.0	30.3	7.3	6.4	4.6	3.5	3.2	42.1	0.9	299	329.8	12582.9	14492.8	11817.6
24	0.2	1.2	0.0	26.5	6.6	5.5	4.2	3.1	3.3	49.2	0.9	290	328.7	11010.9	11224.7	9521.7
25	0.4	0.8	0.0	27.8	7.5	6.9	4.6	3.1	3.1	45.7	0.9	272	329.3	10790.3	12403.7	10376.6
26	0.1	0.5	0.0	29.4	8.0	6.2	4.0	3.3	3.8	44.7	0.9	290	329.8	10893.7	12824.3	10838.6

27	0.2	0.4	0.0	27.6	7.9	6.3	3.6	2.6	3.7	47.9	0.9	152	328.7	9514.8	12010.7	8742.6
28	0.3	1.3	0.0	28.3	6.0	4.9	3.6	4.0	4.3	47.5	0.9	274	329.8	11583.2	12465.7	10280.1
29	0.2	0.8	0.0	31.4	7.6	7.2	4.9	2.0	1.0	44.9	0.9	251	328.7	11983.1	13644.7	11610.8
30	0.5	0.5	0.0	27.8	6.9	6.3	4.5	3.3	3.5	46.7	0.9	214	329.3	11410.8	11755.6	9804.3
31	0.4	0.7	0.0	30.2	6.9	6.6	5.9	4.6	4.3	40.5	0.9	247	330.4	12962.1	12245.1	10935.1
32	0.2	1.2	0.0	32.3	7.6	6.0	3.9	3.2	3.6	42.2	0.9	134	329.3	12327.8	14113.6	10252.5
33	0.1	1.2	0.0	32.9	7.8	6.1	3.7	2.9	3.7	41.6	0.9	279	329.3	12445.0	13775.7	12307.1
34	0.2	0.5	0.0	29.5	8.5	6.6	4.0	3.4	3.8	43.6	0.9	145.8	330.4	10342.1	13327.6	9556.1
35	0.2	0.5	0.0	28.5	8.2	6.4	4.2	3.7	3.9	44.6	0.9	141.9	330.4	10342.1	12624.3	9052.8
36	0.5	0.5	0.0	31.6	8.7	7.9	5.5	3.5	4.5	37.5	0.9	289	329.3	11824.5	14747.9	12355.4
37	0.2	0.7	0.0	30.5	7.3	5.2	2.0	2.0	2.8	49.5	0.9	239	327.6	11514.2	11769.4	10555.9
38	0.5	0.5	0.0	30.6	7.3	7.3	5.2	3.8	3.9	41.1	0.9	268	330.4	11962.4	13355.2	11500.5
39	0.2	1.1	0.0	24.8	6.8	6.8	6.0	4.4	3.9	46.1	0.9	256	329.8	10549.0	10542.1	8783.9
40	0.2	0.1	0.0	28.6	8.7	6.5	4.8	2.7	3.6	44.8	0.9	274	330.4	12176.1	13679.2	10700.7
41	0.2	0.7	0.0	33.1	7.4	6.1	3.2	1.8	3.1	44.4	0.9	271	333.2	11927.9	15389.1	12858.7
42	0.1	1.4	0.7	36.0	8.7	5.9	3.0	1.5	3.1	39.7	0.9	274	348.7	17271.4	18684.8	15982.1
43	0.1	1.5	0.8	36.0	8.8	6.1	4.1	2.8	2.5	37.3	0.9	230.1	347.6	19808.6	18388.3	15416.7
44	0.0	1.1	0.2	27.0	10.8	9.2	5.0	2.6	3.3	40.8	0.9	249	370.9	12941.5	13368.9	12369.2
45	0.0	1.3	0.0	33.4	9.2	6.1	2.4	1.6	2.8	43.3	0.9	252	383.2	14547.9	15947.6	15706.3
46	0.0	0.7	0.0	48.8	10.6	6.2	3.5	4.6	2.8	24.8	0.8	218	383.2	18822.7	24972.8	24331.6
47	0.1	0.9	0.0	41.1	11.1	7.1	4.8	2.9	3.2	29.0	0.8	198	389.3	22994.0	20622.2	19588.0
48	0.1	0.9	0.0	44.4	10.8	6.2	4.0	2.6	2.6	28.4	0.8	195	388.7	25028.0	22635.5	21442.7
49	0.0	0.8	0.0	40.9	10.7	6.6	4.4	2.6	2.5	31.3	0.8	202	389.3	21511.7	23076.8	22035.7
50	0.0	0.9	0.3	39.7	10.4	7.2	4.5	3.1	2.8	31.5	0.9	197	390.4	21104.9	25696.8	19808.6
51	0.1	0.9	0.0	40.7	10.5	6.6	4.4	2.7	2.8	31.4	0.8	195	390.4	21925.3	20256.8	19160.5
52	0.0	1.0	0.0	41.6	10.8	7.5	4.5	3.0	2.4	29.1	0.9	208	389.3	21160.0	21435.8	20539.5
53	0.1	1.1	0.0	43.1	10.5	7.2	4.6	2.8	2.3	28.3	0.9	214	389.3	22187.3	25138.3	22352.8
54	0.0	1.0	0.0	41.9	10.6	7.0	4.3	3.2	2.9	29.1	0.8	200	385.9	22297.7	21008.3	19953.4
55	0.0	1.0	0.0	38.8	10.1	6.9	4.2	2.9	2.8	33.4	0.8	210	388.7	20815.3	19257.1	17078.3
56	0.3	0.9	0.0	53.5	11.5	8.8	4.6	2.1	1.5	12.7	0.9	143	353.2	30750.6	30833.4	26138.0
57	0.1	2.4	0.0	35.2	6.7	6.2	5.1	5.2	4.1	35.0	0.8	213	394.3	17561.0	16630.2	16395.7

58	0.6	1.0	0.0	36.5	9.3	8.9	6.0	3.8	3.6	30.4	0.8	200	385.4	18933.0	17505.8	17050.7
59	1.6	0.1	0.0	28.4	7.2	10.5	8.4	3.8	4.1	36.0	0.8	252	328.2	11679.7	11541.8	11155.7
60	0.2	0.4	0.0	5.8	0.8	0.4	1.1	3.0	4.9	83.2	0.9	304	344.3	2158.1	2599.3	2006.4
61	0.1	5.0	2.7	23.0	8.5	8.3	5.4	4.4	3.9	38.8	0.9	254	365.4	11934.8	12010.7	11176.4
62	0.1	1.3	0.3	8.9	4.1	5.4	3.9	3.5	3.8	68.7	0.9	243	354.3	4667.8	4495.4	3571.5
63	0.2	0.9	0.0	36.5	9.7	7.0	5.4	2.9	4.3	33.3	0.9	218	377.6	18064.3	17464.4	16726.7
64	0.9	1.5	0.0	51.5	6.6	4.8	3.1	2.4	2.2	27.1	0.8	265	363.7	31481.5	27096.4	27972.0
65	0.0	0.0	0.0	57.5	10.2	5.8	3.3	2.7	1.4	19.1	0.8	203	373.2	34922.0	28303.0	29337.2
66	0.6	3.6	0.0	45.3	5.5	3.7	2.4	1.6	1.3	36.1	0.8	253	365.9	26786.1	22490.7	22752.7
67	1.6	0.1	0.0	28.4	7.2	10.5	8.4	3.8	4.1	36.0	0.8	252	328.2	11776.3	11541.8	11155.7
68	0.5	0.4	0.0	35.1	4.6	2.5	7.7	1.6	5.5	48.2	0.8	225	355.4	17374.8	12941.5	12603.6
69	0.0	0.0	0.0	42.0	8.0	6.0	2.0	1.0	4.0	37.0	0.8	255	341.5	22408.0	16506.1	16954.2
70	0.6	3.6	0.0	45.3	5.5	3.7	2.4	1.6	1.3	36.1	0.8	255	365.9	26786.1	21125.5	22435.5
71	0.4	1.0	0.0	45.4	4.2	0.9	1.1	0.9	1.0	45.1	0.9	250	344.3	23897.2	23697.3	20029.3
72	0.7	2.1	0.0	34.9	7.0	7.8	5.5	3.8	3.0	35.2	0.9	230	387.6	18781.3	17878.1	17299.0
73	0.3	0.8	0.0	49.2	6.3	4.5	3.0	2.3	2.1	31.5	0.9	230	366.5	27448.0	26455.2	24304.0
74	0.4	0.4	0.0	49.1	7.6	6.1	3.8	2.5	2.0	28.0	0.8	231	365.9	25779.5	24283.3	24179.9
75	0.9	0.2	0.0	47.1	6.0	4.6	3.5	2.6	2.2	33.0	0.9	217	347.6	23400.8	22573.4	20939.4
76	0.4	1.1	0.0	50.5	4.5	0.9	1.2	0.9	1.6	39.0	0.9	291	342.0	25441.7	30143.9	24676.3
77	0.3	0.2	0.0	35.4	3.4	0.9	1.0	0.4	0.7	57.7	0.9	255	343.7	15906.2	17912.6	13920.5
78	0.4	0.4	0.0	40.5	7.7	8.2	5.5	3.6	2.8	31.4	0.8	210	370.9	19898.3	18815.8	18009.1
79	0.0	0.0	0.0	52.0	3.8	2.4	1.7	1.2	2.1	36.8	0.8	199	366.5	26469.0	24290.2	22656.2
80	0.5	0.4	0.0	35.1	4.6	2.5	1.7	1.6	5.5	48.2	0.9	225	355.4	17374.8	17257.6	14217.0
81	0.1	2.4	0.0	35.2	6.7	6.2	5.1	5.2	4.1	35.0	0.8	213	394.3	17561.0	16630.2	16395.7
82	0.6	1.0	0.0	36.5	9.9	8.9	6.0	3.8	3.6	30.4	0.8	200	385.4	18933.0	17492.0	17043.8
83	1.6	0.1	0.0	28.4	7.2	10.5	8.4	3.8	4.1	36.0	0.8	252	328.2	11679.7	11541.8	11155.7
84	0.3	2.2	1.2	16.3	6.3	7.5	6.1	4.4	3.6	52.3	0.9	249	374.8	8694.3	8170.3	7529.1
85	0.2	1.5	0.6	13.2	6.4	7.6	6.8	5.7	6.4	51.7	0.9	275	360.9	7860.0	6081.2	5674.4
86	0.2	0.7	1.9	12.6	6.1	6.5	4.3	4.5	1.1	62.2	0.9	230	388.2	10273.2	6357.0	5853.7
87	0.3	3.7	0.7	21.6	8.6	7.7	6.4	5.1	2.6	43.4	0.9	243	388.2	10969.6	11686.6	11135.0
88	0.4	3.5	3.7	19.5	8.3	6.9	4.3	4.2	2.4	46.9	0.9	246	383.2	6846.5	10983.4	10266.3

89	0.2	0.3	0.0	20.0	7.9	8.0	6.6	5.9	5.1	45.9	0.9	230	385.9	6205.3	9328.6	8894.2
90	0.8	2.0	1.4	17.4	6.4	7.6	5.6	4.5	5.1	49.1	0.9	267	385.4	8204.8	9831.9	8983.9
91	0.2	0.8	0.5	6.1	2.6	5.8	7.7	6.1	5.4	64.8	0.9	231	337.6	2427.0	2378.7	2213.2
92	0.9	1.3	0.0	5.6	2.5	4.6	7.3	6.0	4.7	67.0	0.9	224	326.5	2592.4	2702.7	2468.3
93	0.3	0.0	0.0	7.1	1.5	3.7	7.3	6.7	6.2	67.2	0.9	233	333.2	2578.6	2489.0	2282.2
94	0.4	0.6	1.4	10.0	1.5	1.9	3.6	4.5	5.2	71.0	0.9	258	337.6	3488.7	3661.1	3316.4
95	0.3	0.3	0.0	6.8	2.0	4.0	6.6	6.6	6.7	66.8	0.9	237	335.4	2578.6	2482.1	2296.0
96	0.3	0.5	0.5	10.8	1.1	1.6	3.7	4.0	4.8	72.9	0.9	261	335.9	3578.4	3612.9	3350.9
97	0.3	0.4	0.0	6.7	2.2	4.0	5.5	5.3	4.5	71.1	0.9	225	332.0	2482.1	2468.3	2247.7
98	0.4	0.3	0.0	6.1	2.4	4.7	6.3	5.6	4.7	69.5	0.9	225	329.8	2385.6	2371.8	2151.2
99	0.5	0.1	0.0	22.8	6.5	8.5	6.6	4.7	4.2	46.0	0.9	242	342.0	9135.6	9121.8	8425.4
100	0.8	0.1	0.0	20.6	5.8	7.1	6.9	6.0	5.1	47.7	0.9	237	342.6	8335.8	8197.9	7653.2
101	0.6	0.1	0.0	23.7	7.2	8.7	6.9	5.2	2.9	44.8	0.9	238	342.0	9556.1	9831.9	8963.2
102	1.1	0.1	0.0	25.5	7.0	9.6	7.9	5.9	1.9	41.0	0.9	237	342.6	9969.8	10686.9	10135.3
103	0.4	0.0	0.0	17.3	6.1	8.2	5.5	3.8	4.0	54.8	0.9	242	342.0	3702.5	6467.3	6122.5
104	0.5	0.2	0.0	21.6	6.0	8.4	7.1	4.8	3.9	47.5	0.9	236	342.0	8666.7	8590.9	7915.2
105	1.4	0.3	0.0	21.3	6.2	8.1	6.4	3.8	5.5	47.0	0.9	257	342.0	8411.6	9576.8	8597.8
106	0.7	0.2	0.0	22.8	6.3	7.8	6.2	4.6	3.4	47.9	0.9	226	342.0	9700.9	9301.0	8466.8
107	0.4	0.1	0.0	21.4	6.4	7.4	5.1	4.3	4.5	50.4	0.8	245	338.2	7749.7	7708.3	7446.3
108	1.0	0.1	0.0	19.8	5.5	6.9	4.9	4.5	2.7	54.7	0.9	247	344.5	7942.8	8025.5	7653.2
109	0.3	0.9	0.0	53.5	11.5	8.8	4.6	2.1	1.5	16.9	0.8	173	353.2	30750.6	26303.5	23945.5
110	1.7	1.4	0.0	26.7	9.3	10.2	6.4	4.0	0.0	40.4	0.9	217	372.0	13472.4	14203.2	13362.0
111	0.7	0.0	0.0	45.0	12.5	8.9	6.0	3.0	1.4	22.4	0.8	184	333.2	20698.1	18091.9	17567.8
112	0.3	0.2	0.0	40.9	10.4	9.0	5.1	3.3	2.2	28.6	0.8	182	422.0	20980.8	18815.8	19436.3
113	0.2	0.3	0.0	66.8	8.3	5.2	3.3	2.0	1.9	12.0	0.8	182	374.8	33163.8	33556.8	34522.1
114	0.0	0.0	0.0	52.0	3.8	2.4	1.7	1.2	2.0	36.8	0.8	199	367.0	26393.1	24310.9	22676.9
115	0.0	0.0	0.0	46.8	8.8	7.4	4.0	2.6	4.0	26.4	0.8	158	373.2	20277.5	17581.6	17885.0
116	0.0	0.0	0.0	36.2	12.2	8.1	5.8	4.8	5.2	27.8	0.8	191	373.2	15430.5	13658.5	14596.2
117	0.0	0.0	0.0	74.2	5.3	4.7	2.6	1.0	1.6	10.7	0.8	159	373.2	32770.8	32660.5	33667.1
118	0.0	0.0	0.0	73.4	5.4	4.7	2.6	1.0	1.6	11.2	0.8	161	373.2	32695.0	32439.8	33522.3
119	0.0	0.0	0.0	31.0	10.4	11.9	7.3	4.4	2.6	32.4	0.7	199	327.6	11169.5	8777.0	9700.9

120	1.0	0.4	0.0	54.6	11.5	7.3	4.0	2.0	1.4	17.8	0.8	218	346.5	26889.6	26834.4	28365.0
121	0.3	3.0	0.0	41.3	8.9	6.0	4.1	2.7	0.0	33.7	0.8	200	366.5	22063.2	20773.9	19388.1
122	0.7	3.8	1.2	59.5	5.6	4.1	3.1	1.6	1.3	19.3	0.8	297	343.2	47435.9	28730.5	34839.2
123	0.0	0.0	0.0	60.9	7.4	5.0	2.8	2.0	1.8	20.1	0.8	191	360.9	34473.8	31619.4	29661.3
124	0.0	9.1	0.0	45.6	5.1	3.0	2.2	1.9	1.5	31.5	0.9	270	360.9	26475.9	28840.8	23669.7
125	0.3	0.7	0.0	47.7	6.6	4.6	2.6	1.2	1.7	34.6	0.9	234	384.3	26200.1	26579.3	24600.5
126	0.0	8.4	0.0	47.4	10.3	6.1	4.2	2.9	2.1	18.6	0.8	180	419.3	27579.0	27117.1	26744.8
127	0.5	6.5	0.0	39.6	10.7	7.3	5.3	3.7	2.9	23.7	0.9	176	427.6	25007.3	23566.3	22049.4
128	0.3	7.1	0.0	48.4	9.2	5.8	4.4	3.2	2.3	19.2	0.8	183	429.8	28144.4	25807.1	26903.4
129	0.4	7.0	0.0	48.7	8.9	5.5	4.1	3.0	2.1	20.3	0.8	181	427.0	28654.6	25786.4	26689.6
130	1.7	2.2	0.0	60.5	7.5	4.7	4.1	3.0	0.0	16.3	0.8	181	392.0	33253.4	31116.1	32667.4