Sockeye (2000)

Origin

California, U.S.A. (Via U.S. Dept. Int., M.M.S., OHMSETT, NJ)

Synonyms

Sockeye Sour

API Gravity

19.32 *(calc)*

Equation for Predicting Evaporation

$$\%Ev = (1.52 + 0.045\,T)\ln t$$

Where: %Ev = weight percent evaporated; T = surface temperature (°C); t = time (minutes)

Sulphur Content

Weathering (weight %)	Sulphur (weight %)	
0	4.51	*(n=3)*
6.9	4.95	*(n=3)*
13	5.19	*(n=3)*
19.8	5.47	*(n=3)*

Water Content

Weathering (weight %)	Water (volume%)	
0	0.8	*(n=3)*
6.9	0.1	*(n=3)*
13	0.1	*(n=3)*
19.8	<0.1	*(n=3)*

Copyright Environment Canada, Emergencies Science And Technology Division

Sockeye (2000)

Flash Point

Weathering (weight %)	Flash Point (°C)	
0	-4	*(n=4)*
6.9	35	*(n=3)*
13	72	*(n=3)*
19.8	>110	*(n=2)*

Density

Weathering (weight %)	Temperature (°C)	Density (g/mL)	
0	0	0.9465	*(n=3)*
	15	0.9354	*(n=3)*
6.9	0	0.9642	*(n=3)*
	15	0.9537	*(n=3)*
13	0	0.9798	*(n=3)*
	15	0.9692	*(n=3)*
19.8	0	0.9951	*(n=3)*
	15	0.9839	*(n=3)*

Pour Point

Weathering (weight %)	Pour Point (°C)	
0	-25	*(n=2)*
6.9	-18	*(n=2)*
13	2	*(n=2)*
19.8	13	*(n=2)*

Copyright Environment Canada, Emergencies Science And Technology Division

Sockeye (2000)

Dynamic Viscosity

Weathering (weight %)	Temperature (°C)	Viscosity (cP)	
0	0	3220	*(n=3)*
	15	761	*(n=3)*
6.9	0	13600	*(n=3)*
	15	2720	*(n=3)*
13	0	143000*	*(n=3)*
	15	15100	*(n=3)*
19.8	0	5300000*	*(n=3)*
	15	274000**	*(n=3)*

** Measured at a shear rate of 1 s^{-1} with a 60mm a cone and plate sensor.*
*** Measured under static conditions with a 60mm cone and plate sensor, applied shear stress of 100 Pa .*

Chemical Dispersibility

Weathering (weight %)	Chemical Dispersibility using Corexit 9500 (%)	
0	11.8	*(n=6)*
6.9	9.6	*(n=6)*
13	10.1	*(n=6)*
19.8	8.9	*(n=6)*

Adhesion

Weathering (weight %)	Adhesion (g/m^2)	
0	70	*(n=4)*
6.9	70	*(n=4)*
13	90	*(n=4)*
19.8	350	*(n=4)*

Copyright Environment Canada, Emergencies Science And Technology Division

Sockeye (2000)

Surface and Interfacial Tensions

Surface Tension (Oil/Air Interfacial Tension)

Weathering (weight %)	Temperature (°C)	Surface Tension (mN/m)	
0	0	30.1	*(n=4)*
	15	28.8	*(n=4)*
6.9	0	NM	
	15	31.3	*(n=3)*
13	0	NM	
	15	32.2	*(n=3)*
19.8	0	NM	
	15	NM	

NM: Not Measurable

Oil/Brine (33‰) Interfacial Tension

Weathering (weight %)	Temperature (°C)	Surface Tension (mN/m)	
0	0	23	*(n=3)*
	15	21.9	*(n=3)*
6.9	0	NM	
	15	23.1	*(n=3)*
13	0	NM	
	15	NM	
19.8	0	NM	
	15	NM	

NM: Not Measurable

Copyright Environment Canada, Emergencies Science And Technology Division

Sockeye (2000)

Oil/Fresh Water Interfacial Tension

Weathering (weight %)	Temperature (°C)	Surface Tension (mN/m)	
0	0	23.7	*(n=3)*
	15	21.4	*(n=3)*
6.9	0	NM	
	15	24.9	*(n=3)*
13	0	NM	
	15	NM	
19.8	0	NM	
	15	NM	

NM: Not Measurable

Emulsion Formation

Weathering (weight %)	Visual Stability	Complex Modulus (Pa)	Emulsion Water Content (%)
0	Meso-stable	183	75.6
6.9	Meso-stable	251	73.3
13	Entrained Water	391	53.4
19.8	Entrained Water	1298	17.7

Copyright Environment Canada, Emergencies Science And Technology Division

Sockeye (2000)

Boiling Point Distribution

	Cumulative Weight Fraction (%)			
Boiling Point (°C)	0% weathered	6.9% weathered	13.0% weathered	19.8% weathered
40	0.4			
60	0.4			
80	1.5	0.1		
100	3.3	0.7		
120	5.1	1.6		
140	7.1	3.1	0.2	
160	9.2	5	0.9	
180	11.3	7.1	2.3	
200	13.2	9.2	4.1	0.4
250	18.9	15.4	10.5	4.6
300	24.7	21.6	17.1	11.3
350	30.9	28.3	24.2	19
400	36.8	34.6	30.9	26.3
450	43.3	41.7	28.5	34.6
500	50.1	49	46.4	43.4
550	57.3	56.6	54.9	52.9
600	63.5	63.2	62.1	60.9
650	69.2	69.1	68.5	68

Copyright Environment Canada, Emergencies Science And Technology Division

Sockeye (2000)

Hydrocarbon Groups

Component	Concentration (weight %) 0% weathered	6.9% weathered	13.0% weathered	19.8% weathered
Saturates	49.2	46.2	44.4	40.3
Aromatics	17.2	17.6	18	18
Resins	15.1	16.4	17.1	17.2
Asphaltenes	18.5	19.8	20.5	24.5
Waxes	1.6	1.7	1.8	2.1

Volatile Organic Compounds

Component	Concentration (µg/g oil) 0% weathered	19.8% weathered
Benzene	1343	9
Toluene	2031	12
Ethylbenzene	974	0
Xylenes†	3880	1
C_3-Benzenes‡	5810	70
Total BTEX	8230	20
Total BTEX and C_3-Benzenes‡	14040	90

†"Xylenes" include o-, m-, and p-xylene isomers.
††"C_3-Benzenes" include eight isomers.

Copyright Environment Canada, Emergencies Science And Technology Division

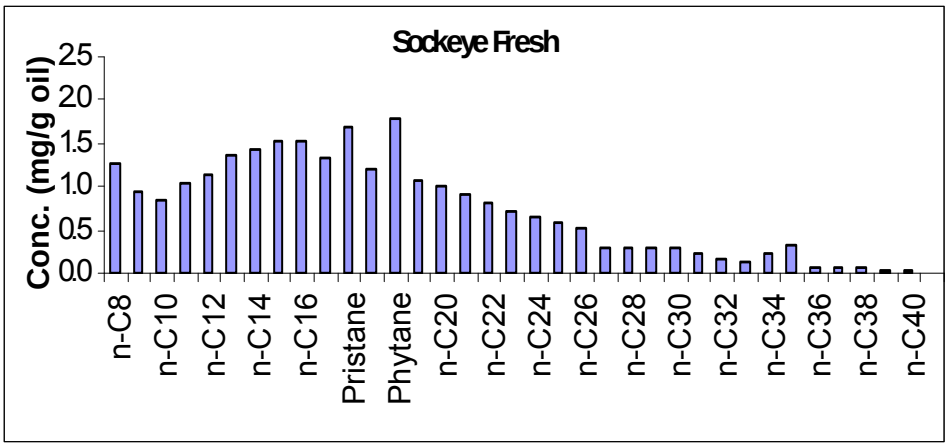
Sockeye (2000)

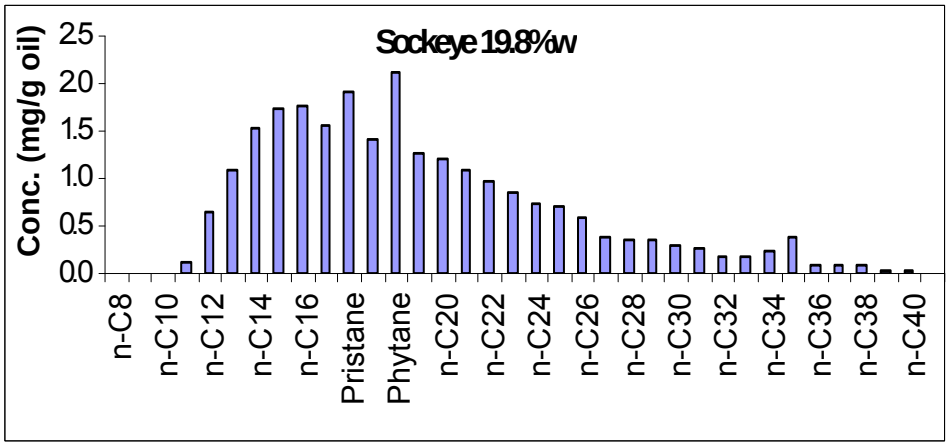
n-Alkane Distribution

n-Alkane Component	Concentration (mg/g oil) 0% weathered	19.8% weathered
n-C8	1.27	
n-C9	0.95	
n-C10	0.85	
n-C11	1.02	0.13
n-C12	1.14	0.63
n-C13	1.37	1.08
n-C14	1.43	1.52
n-C15	1.54	1.73
n-C16	1.52	1.76
n-C17	1.32	1.55
Pristane	1.68	1.9
n-C18	1.19	1.41
Phytane	1.79	2.11
n-C19	1.08	1.25
n-C20	1.02	1.2
n-C21	0.91	1.09
n-C22	0.81	0.97
n-C23	0.71	0.85
n-C24	0.65	0.75
n-C25	0.59	0.71
n-C26	0.51	0.6
n-C27	0.3	0.37
n-C28	0.3	0.36
n-C29	0.3	0.36
n-C30	0.28	0.29
n-C31	0.23	0.28
n-C32	0.15	0.17
n-C33	0.14	0.17
n-C34	0.23	0.24
n-C35	0.33	0.39
n-C36	0.07	0.1
n-C37	0.08	0.1
n-C38	0.07	0.08
n-C39	0.03	0.04
n-C40	0.02	0.02
n-C41		
TOTAL	25.9	24.2
C17/PRISTANE	0.78	0.82
C18/PHYTANE	0.66	0.67
PRISTANE/PHYTANE	0.94	0.9
CPI	0.95	1

Copyright Environment Canada, Emergencies Science And Technology Division

Sockeye (2000)





n-Alkane Distribution for Sockeye Crude Oil (mg/g oil)

Copyright Environment Canada, Emergencies Science And Technology Division

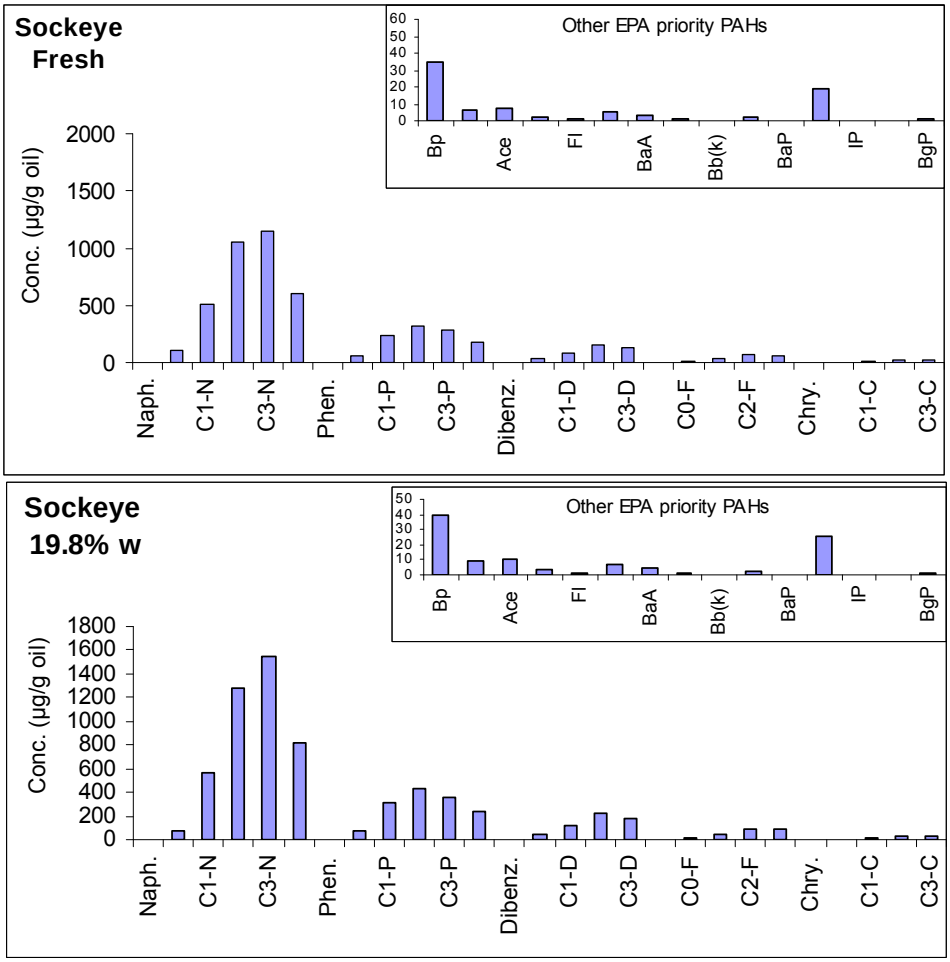
Sockeye (2000)

PAH Distribution

Alkylated PAH	Concentration (µg/g oil) 0% weathered	19.8% weathered
Naphthalene		
C0-N	111	72
C1-N	511	560
C2-N	1057	1272
C3-N	1144	1541
C4-N	599	824
Sum	3424	4269
Phenanthrene		
C0-P	60	76
C1-P	237	314
C2-P	319	424
C3-P	283	362
C4-P	179	241
Sum	1078	1417
Dibenzothiophene		
C0-D	34	45
C1-D	86	117
C2-D	155	216
C3-D	128	171
Sum	404	550
Fluorene		
C0-F	13	17
C1-F	39	50
C2-F	68	89
C3-F	64	84
Sum	183	239
Chrysene		
C0-C	5	7
C1-C	11	15
C2-C	22	29
C3-C	22	29
Sum	61	81
TOTAL	5149	6556
2-m-N/1-m-N	1.35	1.33
(3+2-m/phen)/(4-/9-+1m-phen)	1.09	1.1
4-m:2/3m:1-m-DBT	1 : 0.89 :0.36	1 : 0.89 :0.35
Other PAHs		
Biphenyl	34.23	38.98
Acenaphthylene	6.72	8.99
Acenaphthene	7.7	10.37
Anthracene	2.2	3.12
Fluoranthene	1.22	1.62
Pyrene	5.01	6.75
Benz(a)anthracene	3.18	4.25
Benzo(b)fluoranthene	0.98	1.12
Benzo(k)fluoranthene	0.4	0.5
Benzo(e)pyrene	1.59	2.5
Benzo(a)pyrene	0.49	0.5
Perylene	19.32	25.98
Indeno(1,2,3cd)pyrene	0	0
Dibenz(a,h)anthracene	0.12	0.2
Benzo(ghi)perylene	0.86	1
TOTAL	84	106

Copyright Environment Canada, Emergencies Science And Technology Division

Sockeye (2000)



PAH Distribution for Sockeye crude oil (µg/g oil)

Copyright Environment Canada, Emergencies Science And Technology Division

Sockeye (2000)

Biomarker Concentrations

Biomarker	Concentration (µg/g oil) 0% weathered	19.8% weathered
C23	46.2	57.7
C24	31.3	38.9
C29	61.2	78.2
C30	99.5	126.5
C31(S)	38.7	52.3
C31(R)	40.6	54.4
C32(S)	27.5	36.9
C32(R)	18.9	25.3
C33(S)	18.8	26.3
C33(R)	12.8	18.1
C34(S)	8.4	11.9
C34(R)	5.7	8
Ts	6.9	8.7
Tm	35.4	42.9
C27αββ steranes	207.8	262.1
C29αββ steranes	151.7	191.4
TOTAL	811	1039
Diagnostic Ratios		
C23/C24	1.48	1.48
C23/C30	0.46	0.46
C24/C30	0.31	0.31
C29/C30	0.62	0.62
C31(S)/C31(R)	0.95	0.96
C32(S)/C32(R)	1.45	1.46
C33(S)/C33(R)	1.47	1.46
C34(S)/C34(R)	1.47	1.48
Ts/Tm	0.19	0.2
C27αββ/C29αββ	1.37	1.37

Copyright Environment Canada, Emergencies Science And Technology Division