

**APPENDIX A  
LEISURE SHORES TEST PIT LOCATIONS AND DESCRIPTIONS  
B120 RELEASE  
BUZZARDS BAY, MASSACHUSETTS**

**Transect A**

GPS Coordinates for Start Point (0,0): 41.62870° N 70.82366°

Test Pit ID	Diameter (inches)	Depth (inches)	Field Team Observation - Test Pit	Field Team Observation - Spoils in Bucket	X Coordinate	Y Coordinate
A-30	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	0	30
A-40	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	0	40
A-50	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	0	50
A-60	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 40% coverage	Evidence of oil not observed in bucket	0	60
A-70	12	9	Approximately 80 particles of oil each less than 1 mm in diameter, 1 particle of oil 3 mm in diameter, and approximately 10% silver sheen coverage, fractured, breaks up, may be weathered	Approximately 6 particles of oil each less than 1 mm in diameter with approximately 15% coverage	0	70
A-80	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 40% coverage	Evidence of oil not observed in bucket	0	80
A-90	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	0	90
A-100	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	0	100
A-110	12	9	3 particles of oil each less than 1 mm in diameter and approximately 5% silver sheen coverage, breaks up when touched	2 particles of oil each less than 1 mm in diameter and approximately 10% silver sheen coverage, breaks up, may be from weathering	0	110
A-120	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	0	120
A-130	12	9	Evidence of oil not observed in test pit, orange/brown sediment observed on the bottom of the test pit	Evidence of oil not observed in bucket	0	130
A-140	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	0	140
A-150	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	0	150
A-160	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 80% coverage	Evidence of oil not observed in bucket	0	160
A-170	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 80% coverage	Evidence of oil not observed in bucket	0	170

Notes:

1. Test pits were excavated on September 20, 2006.
2. Depths are approximate values.
3. Coordinates are reported in feet.
4. Trenches were excavated at 10-foot intervals along the transect.
5. mm = millimeters
6. cm = centimeters
7. Observations:

	Evidence of oil not observed
	Sheen
	1 to 5 particles of oil
	6 to 10 particles of oil
	11 to 20 particles of oil
	21 to 100 particles of oil
	Greater than 100 particles of oil

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**Transect B**

Test Pit ID	Diameter (inches)	Depth (inches)	Field Team Observation - Test Pit	Field Team Observation - Spoils in Bucket	X Coordinate	Y Coordinate
B-30	12	9	Evidence of oil not observed in test pit	3 mm particle of oil observed on cobble sticking out above water line, approximately 20 particles of oil each less than 1 mm in diameter, approximately 5% sheen coverage with the sheen radiating from particles, largest sheen is approximately 1 cm in diameter	15	30
B-40	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	15	40
B-50	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 5% coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with approximately 20 % coverage	15	50
B-60	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	15	60
B-70	12	9	1 particle of oil less than 1 mm in diameter, 1 streamer approximately 13 cm long, less than 5% sheen and oil coverage, organic "scum" observed on surface of test pit with nearly 100% coverage	4 particles of oil each less than 1 mm in diameter, 1 particle of oil approximately 1 cm in diameter, less than 5% sheen coverage, organic "scum" observed on surface of water covering spoils with approximately 75% coverage	15	70
B-80	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	15	80
B-90	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	15	90
B-100	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 70% coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with approximately 70% coverage	15	100
B-110	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100% coverage	Evidence of oil not observed in bucket	15	110
B-120	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 80% coverage	Evidence of oil not observed in bucket	15	120
B-130	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 90% coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with approximately 50% coverage	15	130
B-140	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	15	140
B-150	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100% coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with nearly 100% coverage	15	150
B-160	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	15	160
B-170	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 90% coverage	Evidence of oil not observed in bucket	15	170
B-180	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 20% coverage	Evidence of oil not observed in bucket	15	180
B-190	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	15	190
B-200	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 90% coverage	Evidence of oil not observed in bucket	15	200

Notes:

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7. Observations:

	Evidence of oil not observed
	Sheen
	1 to 5 particles of oil
	6 to 10 particles of oil
	11 to 20 particles of oil
	21 to 100 particles of oil
	Greater than 100 particles of oil

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**Transect C**

Test Pit ID	Diameter (inches)	Depth (inches)	Field Team Observation - Test Pit	Field Team Observation - Spoils in Bucket	X Coordinate	Y Coordinate
C-20	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	10 particles of oil each 1 to 2 mm in diameter with sheen emanating from them, 1 particle of oil 3 mm long, approximately 25 % sheen coverage	30	20
C-30	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	30	30
C-40	12	9	Evidence of oil not observed in test pit	1 particle of oil with sheen emanating from it, sheen approximately 1.5 cm in diameter.	30	40
C-50	12	9	Evidence of oil not observed in test pit	1 silver sheen approximately 1.5 inches long, no particles of oil observed	30	50
C-60	12	9	Evidence of oil not observed in test pit	1 particle of oil approximately 1 mm in diameter.	30	60
C-70	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	30	70
C-80	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	30	80
C-90	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with approximately 10 % coverage	30	90
C-100	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 90 % coverage	Evidence of oil not observed in bucket	30	100
C-110	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	30	110
C-120	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 5 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with approximately 5 % coverage	30	120
C-130	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 5 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with approximately 10 % coverage	30	130
C-140	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	30	140
C-150	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	30	150
C-160	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	30	160
C-170	12	9	Evidence of oil not observed in test pit, black sand particles observed, organic "scum" observed on surface of test pit with approximately 80% coverage	3 particles of oil each less than 1 mm in diameter, less than 5 % sheen coverage with sheen radiating from particles up to 1 cm	30	170
C-180	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	30	180
C-190	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 5 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with less than 5 % coverage	30	190
C-200	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 80 % coverage	Evidence of oil not observed in bucket	30	200

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7. Observations:

	Evidence of oil not observed
	Sheen
	1 to 5 particles of oil
	6 to 10 particles of oil
	11 to 20 particles of oil
	21 to 100 particles of oil
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**Transect D**

Test Pit ID	Diameter (inches)	Depth (inches)	Field Team Observation - Test Pit	Field Team Observation - Spoils in Bucket	X Coordinate	Y Coordinate
D-30	12	9	Evidence of oil not observed in test pit, test pit was slightly underwater due to advancing tide	Evidence of oil not observed in bucket	45	30
D-40	12	9	Evidence of oil not observed in test pit, test pit was under less than 1 inch of water due to the advancing tide	Particles of oil not observed, less than 5 % silver sheen coverage	45	40
D-50	12	9	15 cm long streamer 1 to 2 cm wide	6 sheens 1.5 to 5 cm in diameter, 1 sheen 2 cm in diameter, 1 sheen 5 cm by 2.5 cm	45	50
D-60	12	9	1 particle of oil 2 mm in diameter, 2 sheens each 5 mm in diameter	25 particles of oil each less than 1 mm, 10 sheens some with slight rainbow each 5 mm in diameter, 5 silver streamers 3 to 5 cm long	45	60
D-70	12	9	Evidence of oil not observed in test pit	8 particles of oil each less than 1 mm with sheen radiating out 0.5 cm, 1 silver streamer 2.5 cm long and 3 mm wide	45	70
D-80	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with nearly 100% coverage	45	80
D-90	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with nearly 100% coverage.	45	90
D-100	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with nearly 100% coverage.	45	100
D-110	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with nearly 100% coverage.	45	110
D-120	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with nearly 100% coverage.	45	120
D-130	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with nearly 100% coverage.	45	130
D-140	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with nearly 100% coverage.	45	140
D-150	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with nearly 100% coverage.	45	150
D-160	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with nearly 100% coverage.	45	160
D-170	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with nearly 100% coverage.	45	170
D-180	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with nearly 100% coverage	45	180
D-190	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with nearly 100% coverage	45	190
D-200	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with nearly 100% coverage	45	200

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7. Observations:

	Evidence of oil not observed
	Sheen
	1 to 5 particles of oil
	6 to 10 particles of oil
	11 to 20 particles of oil
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**Transect E**

Test Pit ID	Diameter (inches)	Depth (inches)	Field Team Observation - Test Pit	Field Team Observation - Spoils in Bucket	X Coordinate	Y Coordinate
E-10	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	60	10
E-20	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	60	20
E-30	12	9	Approximately 100 particles of oil each less than 1 mm in diameter, 1 particle of oil approximately 3 mm in diameter, 1 stringer approximately 4 cm long, less than 5 % silver to dull rainbow sheen	5 % silver to dull rainbow sheen coverage, particles of oil not observed	60	30
E-40	12	9	1 particle of oil 3 mm in diameter, 7 particles of oil each 2 mm in diameter, approximately 200 particles of oil less than 1 mm in diameter, silver sheen surrounding particles, approximately 5 % total sheen coverage	7 particles of oil less than 1 mm in diameter, approximately 25 % dull rainbow sheen coverage	60	40
E-50	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	60	50
E-60	12	9	1 brown particle and sheen 1.5 cm	5% sheen coverage, 6 sheens 1 cm in diameter, 1 sheen 1.5 cm by 2 cm silver sheen, 1 silver streamer 5 cm long radiating from particles in center	60	60
E-70	12	9	2 silver streamers of sheen 3 cm long and 2 cm wide	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with nearly 100 % coverage	60	70
E-80	12	9	Evidence of oil not observed in test pit	1 particle of oil with sheen radiating around it 2 cm in diameter, 1 particle with sheen around it approximately 5 cm long and 2 cm wide	60	80
E-90	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	60	90
E-100	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	60	100
E-110	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	60	110
E-120	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	60	120
E-130	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	60	130
E-140	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	60	140
E-150	12	9	Evidence of oil not observed in test pit	2 particles of oil surrounded by sheen radiating 5 mm, 6 silver streamers, 2 5 mm sheens with brown middle, 5% sheen coverage	60	150
E-160	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	60	160
E-170	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	60	170
E-190	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	60	190
E-200	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	60	200

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7. Observations:

	Evidence of oil not observed
	Sheen
	1 to 5 particles of oil
	6 to 10 particles of oil
	11 to 20 particles of oil
	21 to 100 particles of oil
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**Transect F**

Test Pit ID	Diameter (inches)	Depth (inches)	Field Team Observation - Test Pit	Field Team Observation - Spoils in Bucket	X Coordinate	Y Coordinate
F-10	12	10.5	Evidence of oil not observed in test pit	1 sheen approximately 2 cm long surrounding <1 mm particle, 1 particle of oil with sheen 3 mm in diameter	75	10
F-20	12	10.5	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	75	20
F-30	12	10.5	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	75	30
F-40	12	10.5	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket	75	40
F-50	12	10.5	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket	75	50
F-60	12	10.5	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket	75	60
F-70	12	10.5	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket	75	70
F-80	12	10.5	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket	75	80
F-90	12	10.5	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket	75	90
F-100	12	10.5	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket	75	100
F-110	12	10.5	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket	75	110
F-120	12	10.5	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket	75	120
F-130	12	10.5	1 long streamer of sheen approximately 1 foot long and 0.5 inches wide	1 particle of oil 1 mm in diameter, sheen 2 cm long radiating out from particle	75	130
F-140	12	10.5	Evidence of oil not observed in test pit, only approximately 1 inch of water in test pit	8 sheen clumps approximately 1 cm in diameter with brown centers composed of particles of oil each less than 1 mm in diameter, approximately 5 % silver sheen coverage, sheen stringers also present	75	140
F-150	12	10.5	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 90 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with approximately 90 % coverage	75	150
F-160	12	10.5	Evidence of oil not observed in test pit, organic "scum" observed	Evidence of oil not observed in bucket, organic "scum" observed	75	160
F-170	12	10.5	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with approximately 50 % coverage	Evidence of oil not observed in bucket	75	170
F-190	12	10.5	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with 90 % coverage	Evidence of oil not observed in bucket	75	190
F-200	12	10.5	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with 90 % coverage	Evidence of oil not observed in bucket	75	200

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7. Observations:

	Evidence of oil not observed
	Sheen
	1 to 5 particles of oil
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**Transect G**

Test Pit ID	Diameter (inches)	Depth (inches)	Field Team Observation - Test Pit	Field Team Observation - Spoils in Bucket	X Coordinate	Y Coordinate
G-70	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket	90	70
G-80	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils with approximately 20 % coverage	90	80
G-90	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket	90	90
G-100	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	1 particle of oil with sheen 1 mm in diameter	90	100
G-110	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit with nearly 100 % coverage	Evidence of oil not observed in bucket	90	110
G-120	12	9	Silver sheen 3 cm wide and 8 inches long around the edges of the test pit	Evidence of oil not observed in bucket	90	120
G-130	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	90	130
G-140	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	90	140
G-160	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	90	160
G-170	12	9	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	90	170
G-180	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils	90	180
G-190	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils	90	190
G-200	12	9	Evidence of oil not observed in test pit, organic "scum" observed on surface of test pit	Evidence of oil not observed in bucket, organic "scum" observed on surface of water covering spoils	90	200

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7. Observations:

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**Vertical Distribution**

Test Pit ID	Diameter (inches)	Depth (inches)	Field Team Observation - Test Pit	Field Team Observation - Spoils in Bucket	X Coordinate	Y Coordinate
A-70	12	2	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	0	70
A-70	12	4	1 dull rainbow sheen approximately 7 cm long and 5 cm wide seeping out of the sidewall and 1 sheen 2 cm long and 8 mm wide, approximately 15 % total sheen coverage	2 sheens, 1 sheen 1 cm diameter, 1 sheen 12 cm long and 1.5 cm wide, less than 5 % total sheen coverage	0	70
A-70	12	6	Evidence of oil not observed in test pit	Evidence of oil not observed in bucket	0	70
A-110	12	2	10 particles of oil 2 mm in diameter, 4 cm streamer, 1 sheen 2 cm in diameter, 1 sheen 4 cm in diameter, less than 5 % total sheen coverage	Evidence of oil not observed in bucket	0	110
A-110	12	4	4 cm rainbow streamer, 2 - 2cm rainbow streamers, 3 - 1 cm streamers, less than 5 % total sheen coverage	4 cm rainbow streamer, 9 sheens 0.5 in diameter, 1 sheen 1 cm in diameter, less than 5 % total sheen coverage	0	110
A-110	12	6	7 sheens 0.5 to 1 cm in diameter, less than 5 % total sheen coverage	10 small sheens 3 mm to 1 cm in diameter	0	110
E-40	12	2	7 particles of oil each less than 1 mm, less than 5 % total sheen coverage	Evidence of oil not observed in bucket	60	40
E-40	12	4	20 particles of oil, less than 5 % total sheen coverage	Evidence of oil not observed in bucket	60	40
E-40	12	6	6 particles of oil, less than 5 % total sheen coverage.	Evidence of oil not observed in bucket	60	40

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7. Observations:

	Evidence of oil not observed
	Sheen
	1 to 5 particles of oil
	6 to 10 particles of oil
	11 to 20 particles of oil
	21 to 100 particles of oil
	Greater than 100 particles of oil



**APPENDIX B  
LEISURE SHORES TEST PIT EVALUATION  
SEPTEMBER 20, 2006  
B120 RELEASE  
BUZZARD'S BAY, MASSACHUSETTS**



1. Test pit excavation.



2. Oiled cobble removed from the intertidal zone.

**APPENDIX B  
LEISURE SHORES TEST PIT EVALUATION  
SEPTEMBER 20, 2006  
B120 RELEASE  
BUZZARD'S BAY, MASSACHUSETTS**

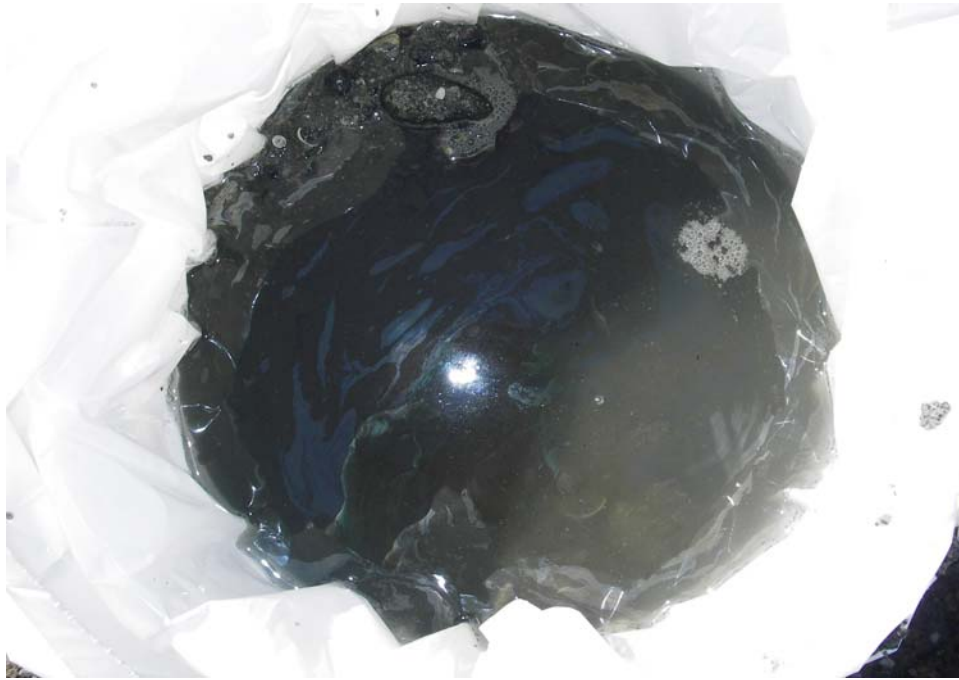


3. View of test pit excavation activities from Howard's Beach.



4. View of test pit excavation activities from southwest corner of Leisure Shores Beach.

**APPENDIX B  
LEISURE SHORES TEST PIT EVALUATION  
SEPTEMBER 20, 2006  
B120 RELEASE  
BUZZARD'S BAY, MASSACHUSETTS**



5. Sheen observed in bucket containing excavated sediment.



6. Test pits excavated for vertical distribution delineation.

## **Comparison of September 20, 2006 Teflon<sup>®</sup> Net Samples with B120 Oil**

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This report summarizes the evaluation of three hydrocarbon samples collected in test pits at Leisure Shores Beach in Mattapoisett, Massachusetts on September 20, 2006. On occasion, test pits at Leisure Shores show small flecks that come to the surface when the pits fill with water. This memo describes the chemical nature of these flecks in relation to the B120 oil. The analytical results for these samples are compared to the analytical results for the fresh oil product from the Barge B120.

On April 27, 2003, an undetermined amount of Number 6 fuel oil was released from the Barge B120 into Buzzards Bay, Massachusetts. Detailed discussions of the chemical composition of the original (fresh) B120 product and environmental samples of the B120 oil are provided in the August 3, 2006 Phase II Comprehensive Site Assessment Report. The composition of polycyclic aromatic hydrocarbon (PAH) compounds is regularly used to identify the presence/absence and source of oils as well as assess the degree of environmental weathering. The original B120 product was dominated by the following PAH compounds, which together comprise over 80% of the total PAH content:

- Naphthalenes (2-ringed PAH compounds) with carbon side-chains comprise almost one-third of the total PAH content. Naphthalenes with two carbon side-chains (C2-naphthalenes) are the most abundant, present at concentrations over 0.7%.
- Phenanthrenes (3-ringed PAH compounds) with carbon side-chains comprise 25% of the total PAH content. C2-Phenanthrenes are the most abundant of these PAHs, with concentrations exceeding 0.5%.
- Fluoranthenes/Pyrenes (4-ringed PAH compounds) with carbon side-chains comprise 13% of the total PAH content. Again, compounds with two carbon side-chains are the most abundant.
- Chrysenes (also 4-ringed PAH compounds) with carbon side-chains are the fourth dominant PAH. Chrysenes with either one or two carbon side-chains are similar in concentration.

Absent or relatively insignificant concentrations of the following PAHs also characterize the fresh B120 product:

- Acenaphthylene (not detected);
- PAHs without side-chains (often referred to as 'parent' PAHs);
- PAHs with five or six rings (e.g., benzo[a]pyrene or benzo[g,h,i]perylene); and
- Dibenzothiophenes (sulfur-containing PAH).

### ***Teflon<sup>®</sup> Net Samples***

Field sampling methods are described in Section 3.1.1.2 of the IRA Status and Closure Report. Three samples were collected from surface water in test pits dug in the sandy

substrate of Leisure Shores Beach in Mattapoisett, Massachusetts. The quantity, dimensions, and color of any sheens and/or particles were noted. In three test pits that had relatively greater sheening, samples were collected using a Teflon<sup>®</sup> net to skim the majority of the sheen and particles from the water surface using multiple passes of the net. The samples were identified by the test pit in which they were collected (e.g., sample A-70 was collected from test pit A-70). Refer to Figure 1 for the test pit locations. Figure 2 is a photograph of one of the test pits (G-120 ) excavated during this investigation.

Table 1 summarizes the hydrocarbon characteristics of the three samples (A-70, B-30, and B-70) relative to B120 oil. Figure 3 illustrates the PAH distribution in these samples relative to B120 oil. The lightest PAH compounds appear on the far left side of the graph and the heaviest PAH compounds are on the far right side.

### Forensics Evaluation

The dominant pattern in the three samples is that of B120 oil, although all of the PAH distributions in Figure 3 exhibit weathering (loss of 2-ring and some 3-ring PAH compounds). That conclusion is confirmed by an assessment of biomarker compounds as depicted in Figures 4 and 5, which show the similarities of the sterane and pentacyclic triterpane biomarker distributions of the B120 oil and Teflon<sup>®</sup> net samples A-70, B-30, and B-70.

Figure 3 depicts the PAH distribution in these net samples compared to B120 oil. The lightest PAH compounds appear on the far left and heaviest on the far right of the figure. The bar height is proportional to concentration, which in Figure 3 is displayed as a percentage of the total PAH concentration. That concentration ranged from approximately 7,000 to 105,000 nanograms (ng) of total PAH/net for samples A-70, B-70, and B-30. These values represent the total mass of PAH collected by Teflon<sup>®</sup> net from test pits.

In addition to containing B120 oil, the Teflon<sup>®</sup> net samples also contain other source materials based on the following features:

1. An alternative fossil fuel source contributes to at least samples A-70 and B-30 because they contain 18 $\alpha$ -oleanane, a triterpane biomarker than is not present in B120 oil. That alternative fuel source may also exist in sample B-70 but is not detectable, possibly because the total PAH concentration of this sample is 5 to 15 times lower than that of the other two samples.
2. The presence of weathered B120 and an alternative fuel source is also indicated by the *n*-alkane distribution for Teflon<sup>®</sup> net sample B-30 in Figure 6. That sample, as well as the other two samples, has a low concentration of *n*-alkanes in the *n*-C<sub>20</sub> to *n*-C<sub>25</sub> range relative to those in the *n*-C<sub>10</sub> to *n*-C<sub>18</sub> range compared with those in the B120 oil. Only volatilization and solubilization of the original B120 source (accounting for a loss of *n*-C<sub>10</sub> to *n*-C<sub>25</sub> hydrocarbons), coupled with a fresh contribution of *n*-C<sub>10</sub> to *n*-C<sub>18</sub> compounds by an additional hydrocarbon source (e.g., diesel No. 2) could account for the observed distribution from *n*-C<sub>10</sub> to *n*-C<sub>25</sub>.
3. The *n*-alkane distribution in Figure 6 shows the presence of natural plant waxes in addition to hydrocarbons from fossil fuels in Teflon<sup>®</sup> net sample B-30. This source has increased the relative concentrations of odd-numbered *n*-alkanes in the *n*-C<sub>25</sub> to

September 2006 Teflon<sup>®</sup> Net Oil Samples  
April 2, 2007

*n*-C<sub>31</sub> range compared with even-numbered *n*-alkanes in the *n*-C<sub>24</sub> to *n*-C<sub>32</sub> range. Therefore, spilled fuels comprise only a portion of the “oils” detected in the Teflon<sup>®</sup> net samples. There are sufficient hydrocarbons from natural background sources to visibly alter the overall fingerprint of these samples.

***Summary***

The three Teflon<sup>®</sup> net samples collected on September 20, 2006 predominantly contain weathered B120 oil. The B120 fingerprint is distinct in all three samples. There also is evidence of a minor contribution by another fossil fuel containing a triterpane biomarker not present in B120, as well as natural biogenic oils from terrestrial plant waxes.

Table 1. Comparison of hydrocarbon characteristics of Teflon<sup>®</sup> net samples B-70, A-70, and B-30 with B120 product.

Parameter	A-70	B-30	B-70	B120 Product
Total Alkanes (ng/test pit)	33,800	11,100	21,400	N/A
Ratio Alkanes:UCM <sup>a</sup>	0.037	0.066	7.90 <sup>b</sup>	0.067
Odd:Even Predominance <sup>c</sup>	1.3	1.1	0.92	1.1
Total PAH (ng/test pit)	105,058	37,225	6,980	N/A
Ratio Total Alkanes:PAH	0.32	0.30	3.07 <sup>b</sup>	0.29
Oleanane Present <sup>d</sup>	Yes	Yes	No	No
PAH Signature <sup>e</sup>	B120+ trace <sup>e</sup>	B120+ trace <sup>e</sup>	B120	[B120]
Comment	Degraded with trace of alternative oil, plus plant detritus	Relatively fresh alkanes from alternative source plus plant detritus	Degraded with background alkane hydrocarbon source	

<sup>a</sup> Ratio of normal alkanes to unresolved complex mixture.

<sup>b</sup> The high alkane:UCM and alkane:PAH ratios for the B-70 sample result from a relatively low concentration of oil relative to background contributions of hydrocarbons from other sources. Therefore, the UCM and PAH levels are low relative to the total alkane concentration, yielding high ratios.

<sup>c</sup> Ratio of [C<sub>23</sub>+C<sub>25</sub>+C<sub>27</sub>+C<sub>29</sub>] to [C<sub>24</sub>+C<sub>26</sub>+C<sub>28</sub>+C<sub>30</sub>]. Oils have ratios approximately somewhat less than or equal to one; terrestrial plant waxes have ratios substantially higher than one.

<sup>d</sup> 18 $\alpha$ -Oleanane is a triterpane biomarker characteristic of some fossil fuels but not detected in B120. Its presence in two sample suggests a mixture of a second oil besides B120 but the contribution is minor because the PAH and biomarker signature is dominated by B120 characteristics.

<sup>e</sup> The dominant PAH signature in all three Teflon net samples is B120 oil, however, the detectable oil in the B-70 sample appears to be exclusively B120 oil and the B-30 and A-70 samples appear also to contain a small quantity of another fuel oil. The oil concentration in B-70 is 5-15 times lower than in the other two samples, which may account for the difference in detected oils. Alkanes in the B-70 sample have been substantially degraded relative to other hydrocarbons, including PAH.

Figure 1. Location of Test Pit Grid at Leisure Shores

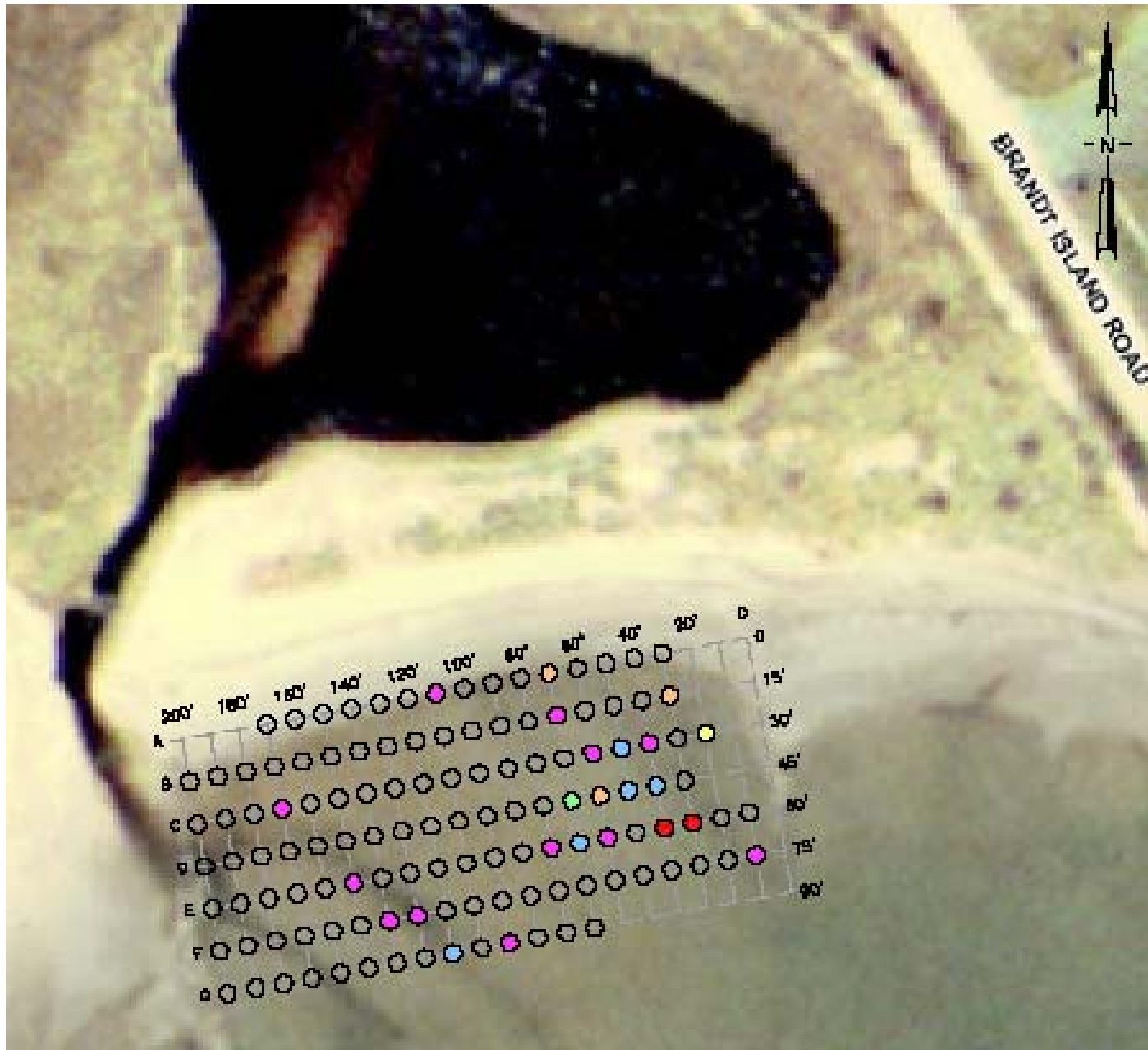




Figure 2. Example Test Pit (G120)



Figure 3. Comparison of PAH Distribution in Teflon Net Samples and B120 Oil

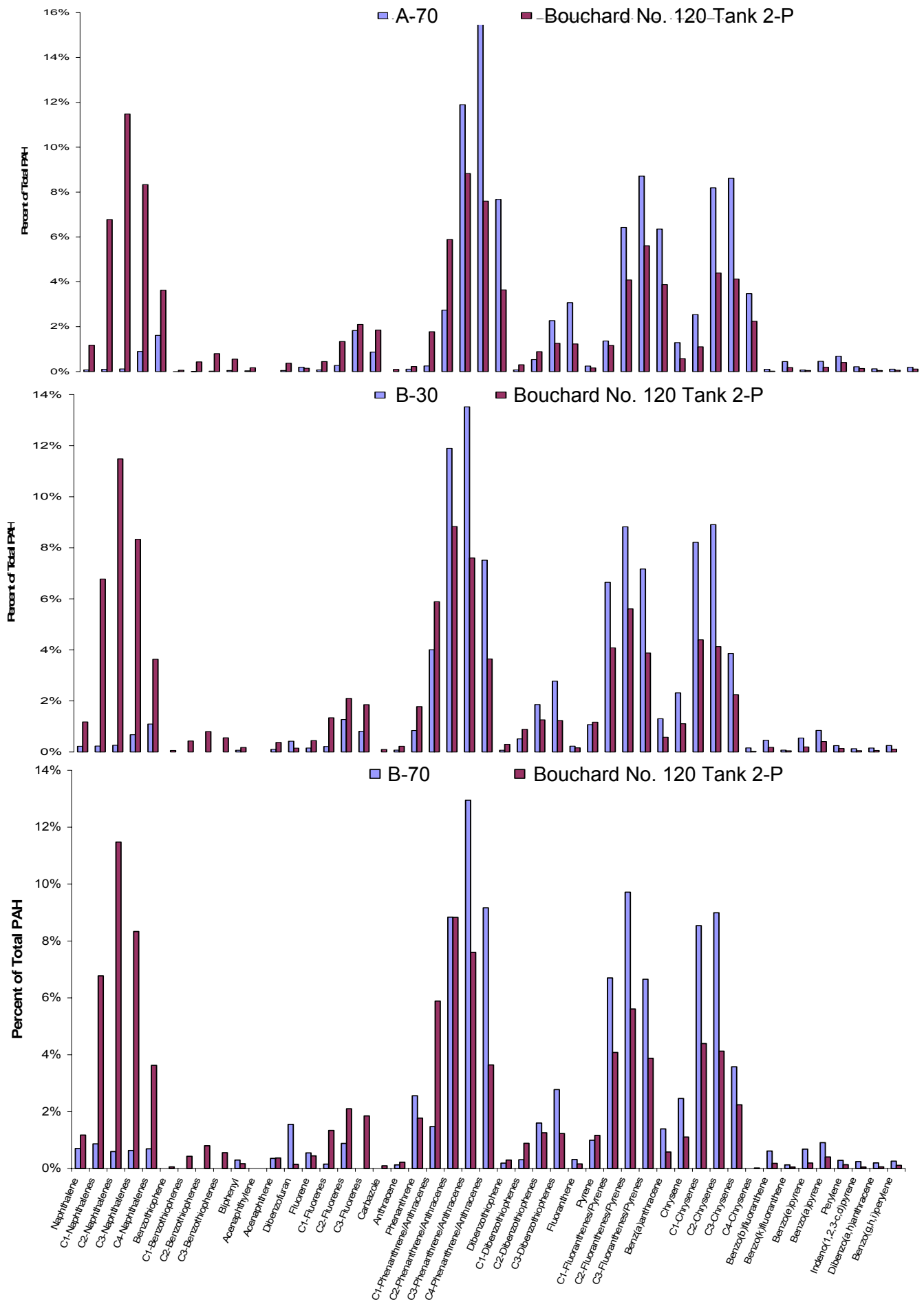


Figure 4. Comparison of Triterpane ( $m/z$  191) Biomarker Distribution in B120 Oil and Teflon Net Samples A70, B30, and B70.

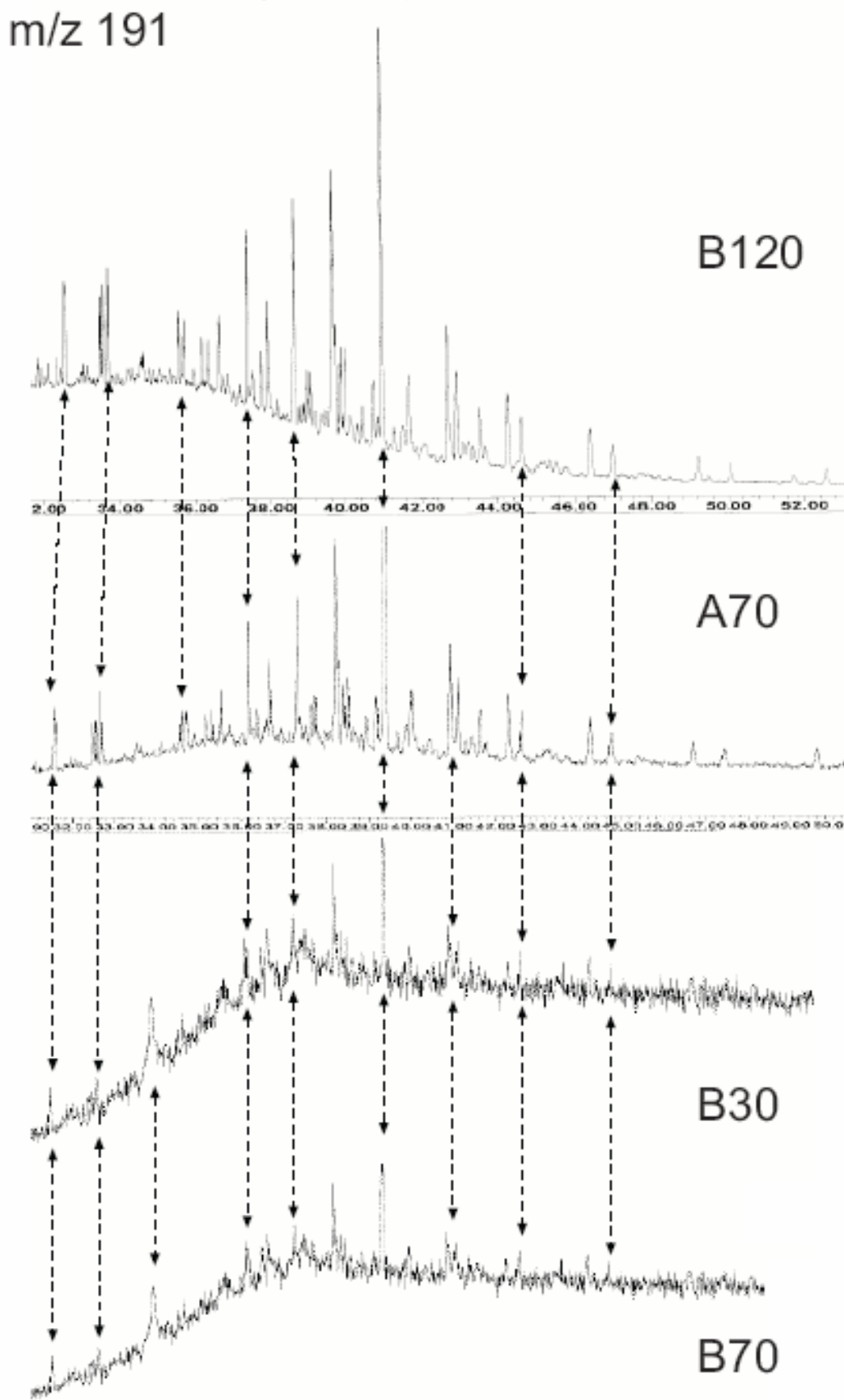


Figure 5. Comparison of Sterane ( $m/z$  217) Biomarker Distribution in Teflon Net Samples A70 and B30, and B120 Oil

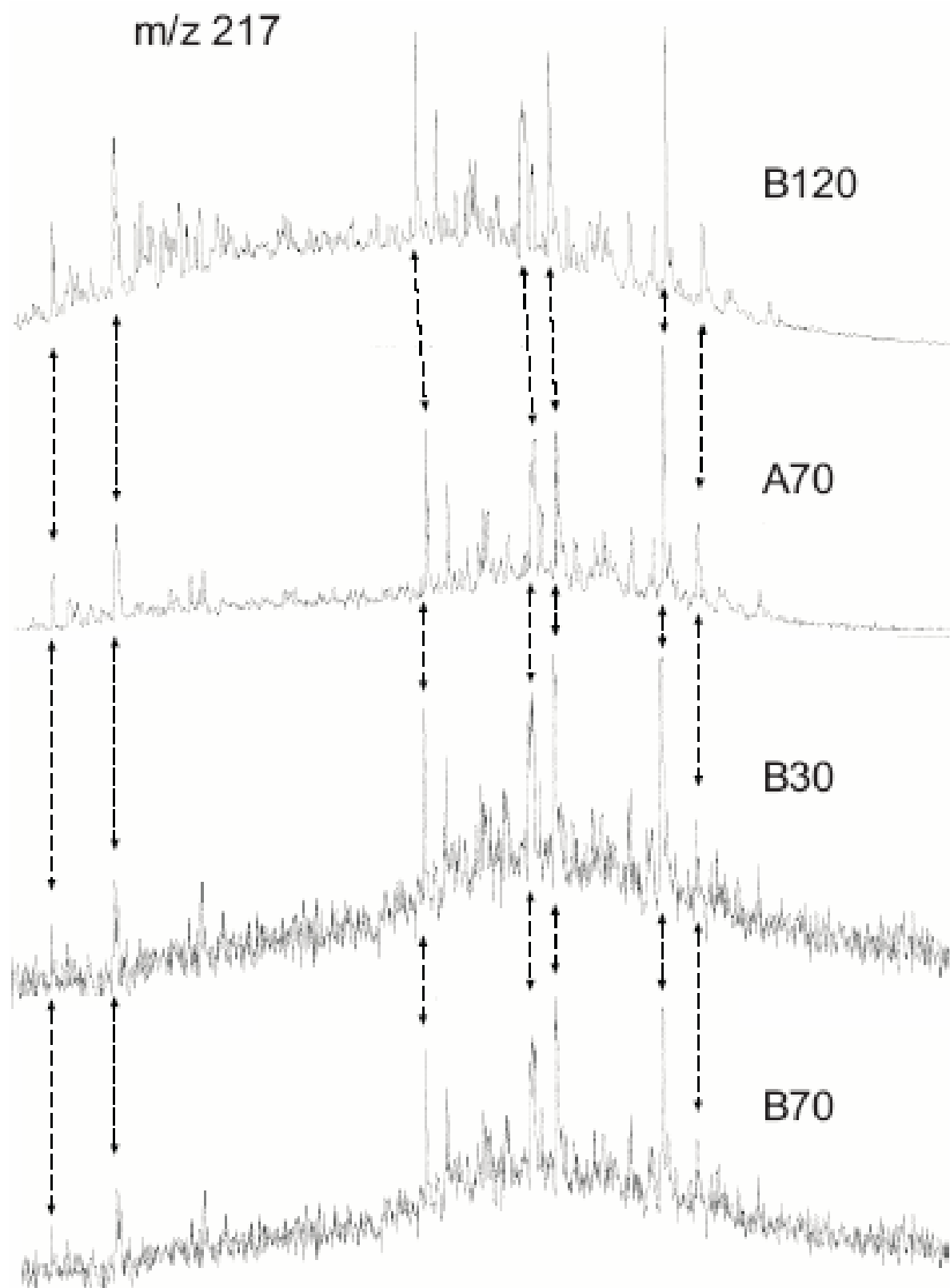
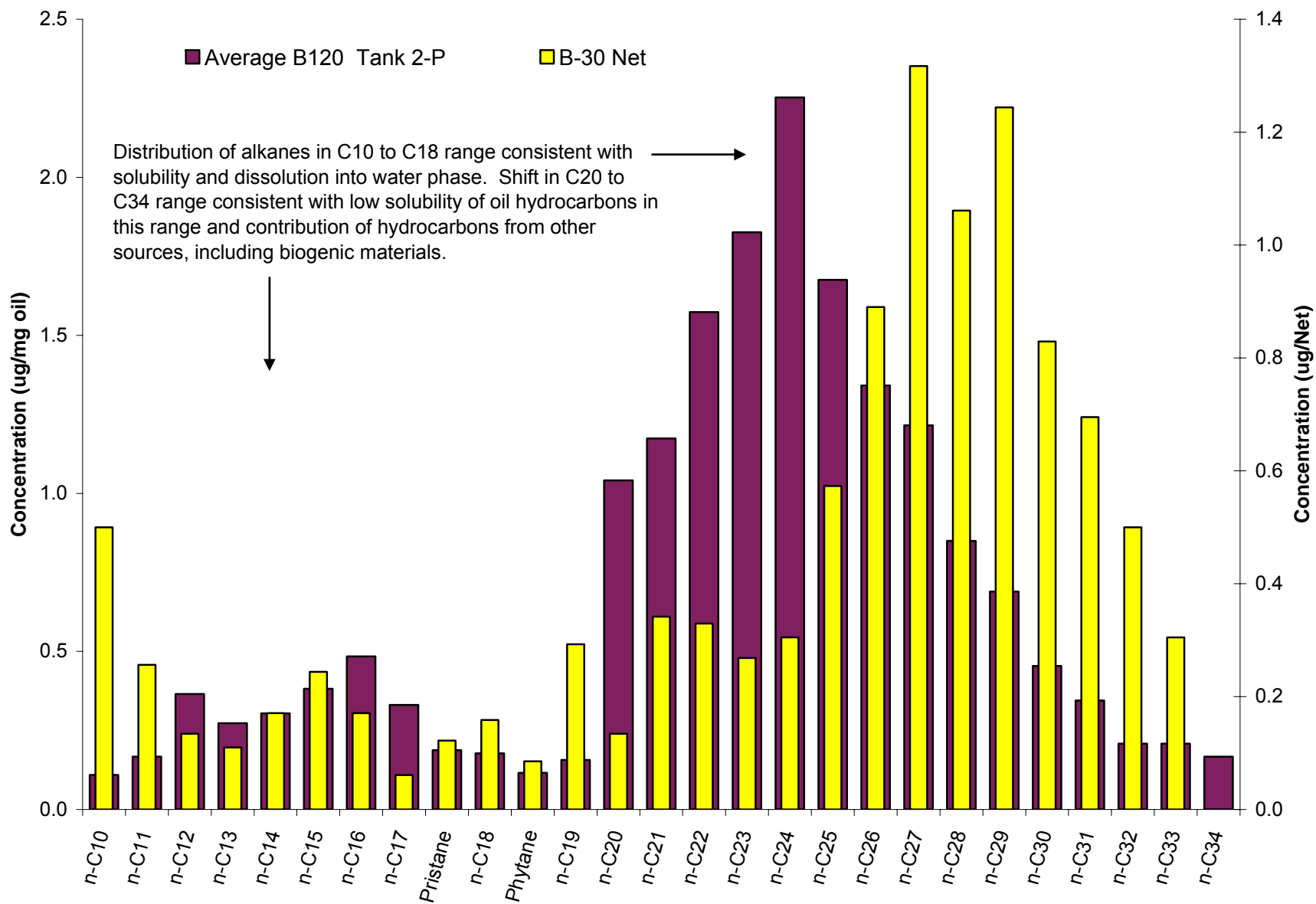
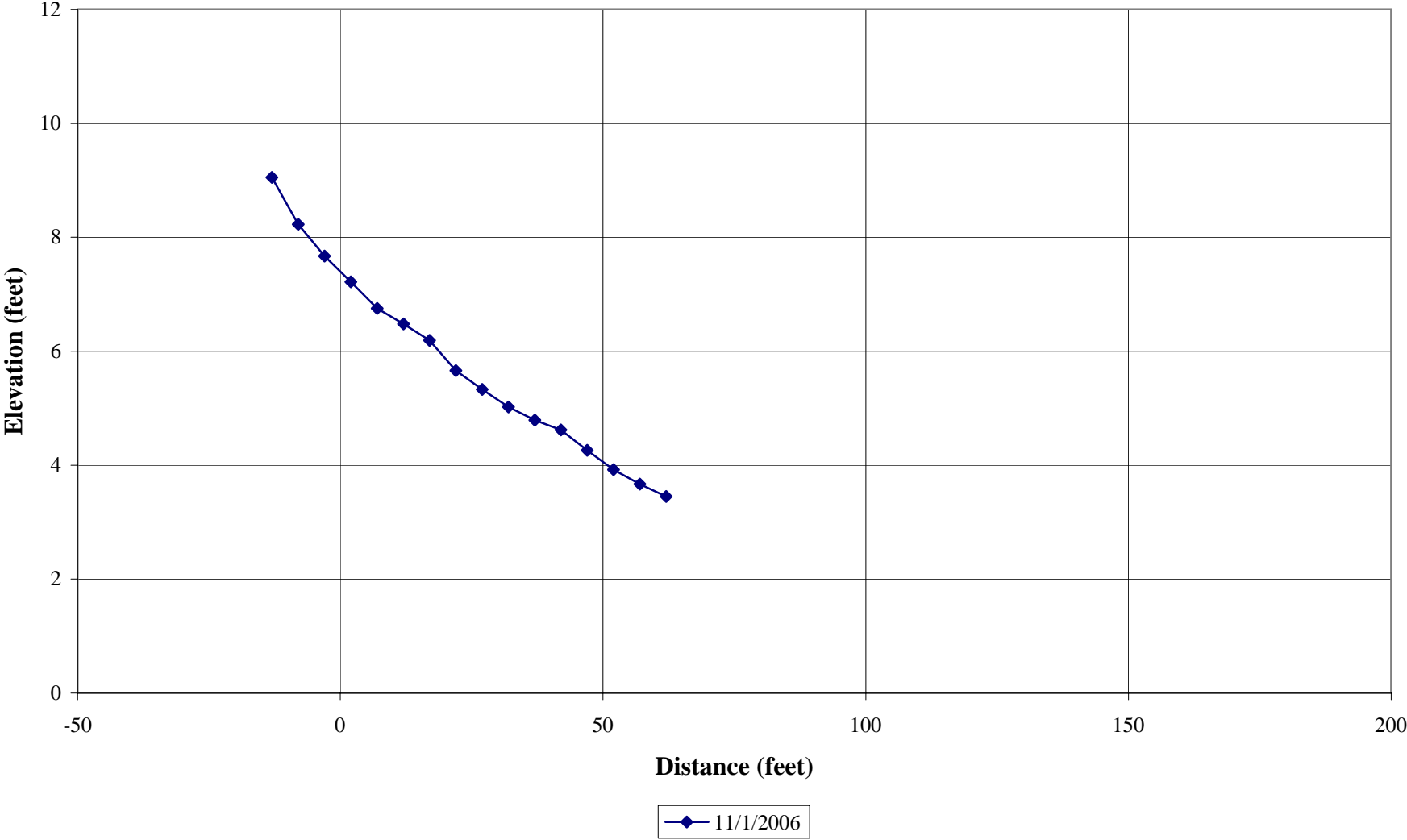


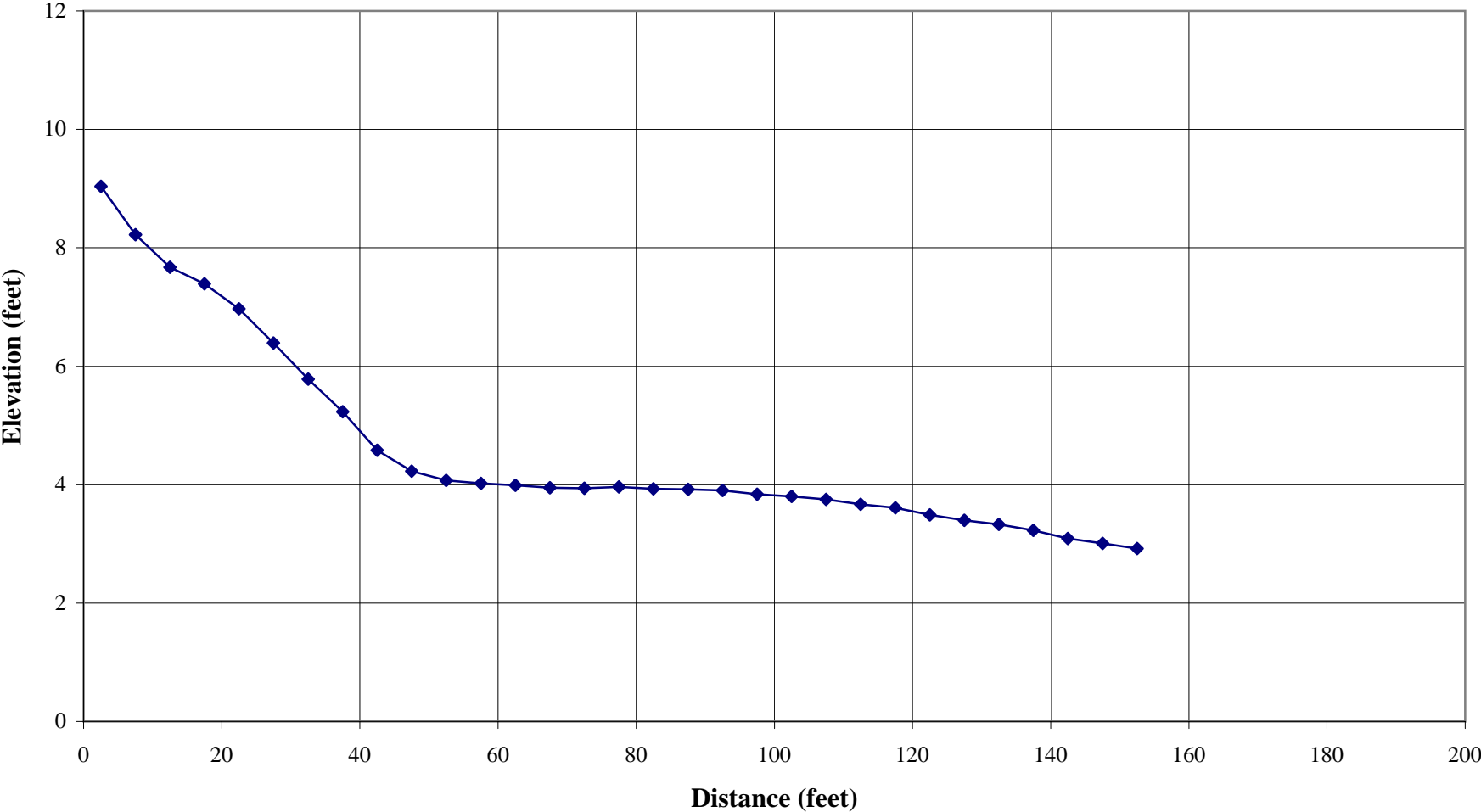
Figure 6. Comparison of *n*-Alkane Distribution in B-30 Teflon Net Sample and B120 Oil



**Leisure Shores Post-Storm Survey Profile  
Transect H-2**

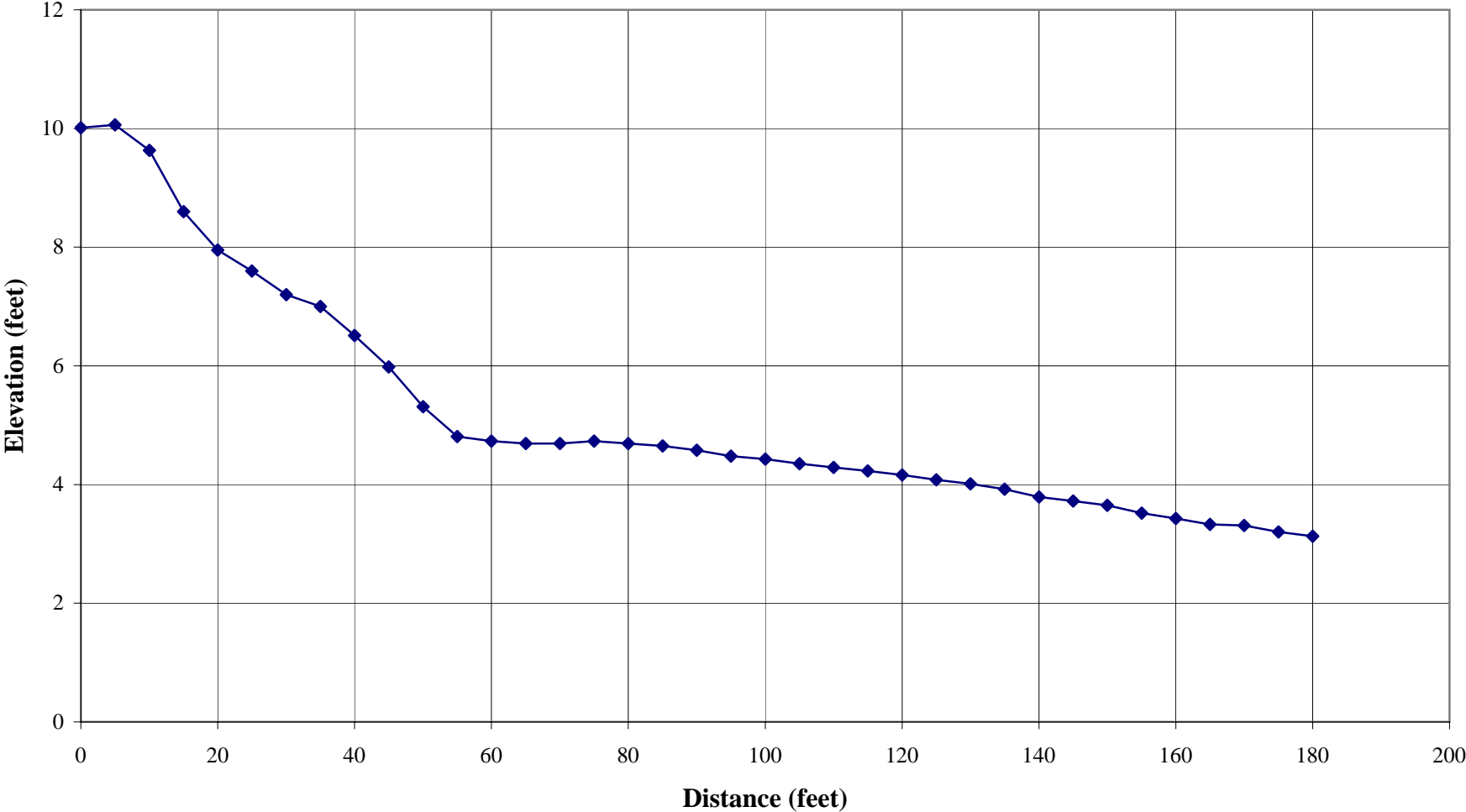


**Leisure Shores Post-Storm Survey Profile  
Transect H-3**



—◆— 11/1/2006

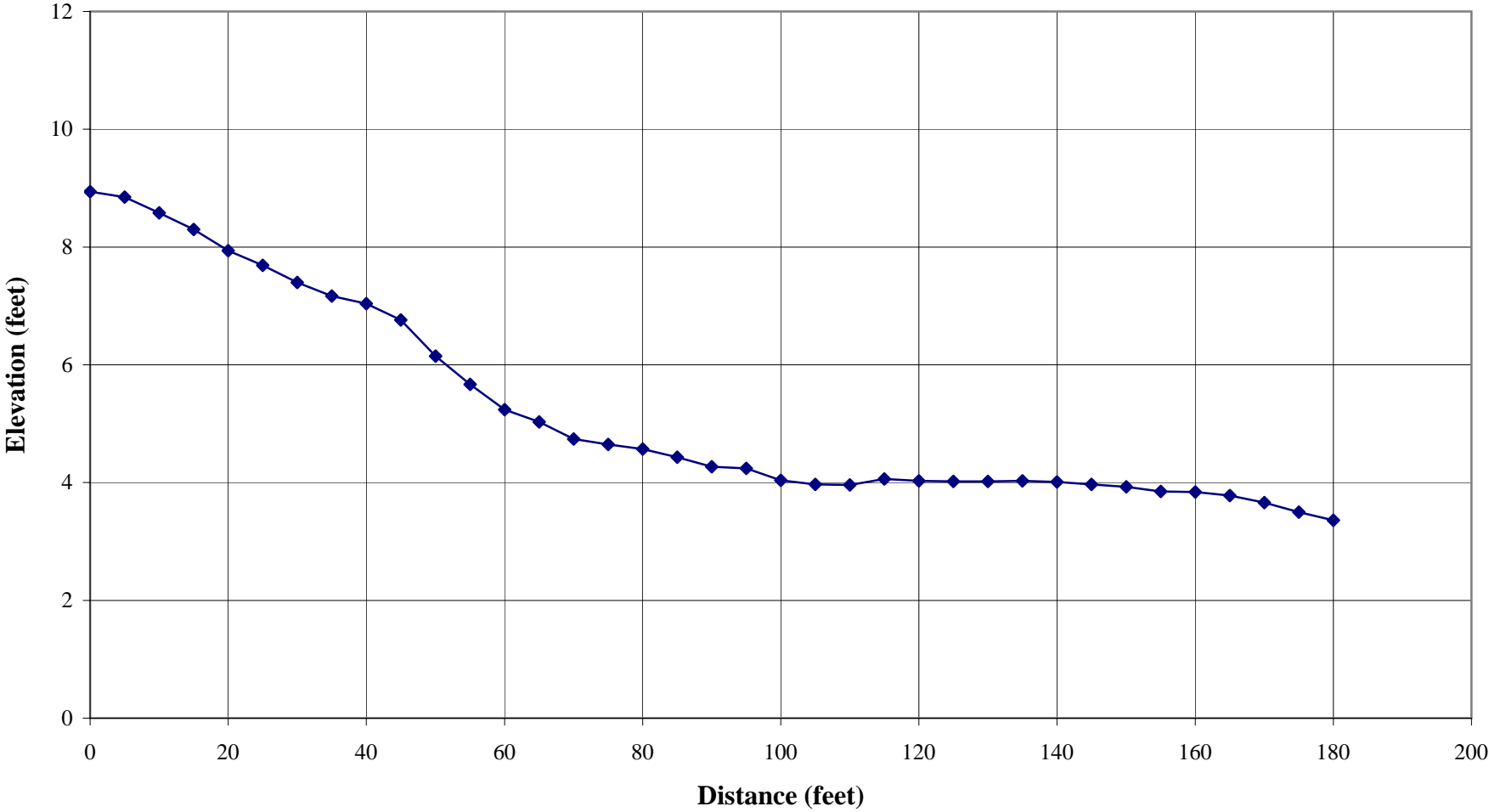
**Leisure Shores Post-Storm Survey Profile  
Transect H-4**



—◆— 11/1/2006

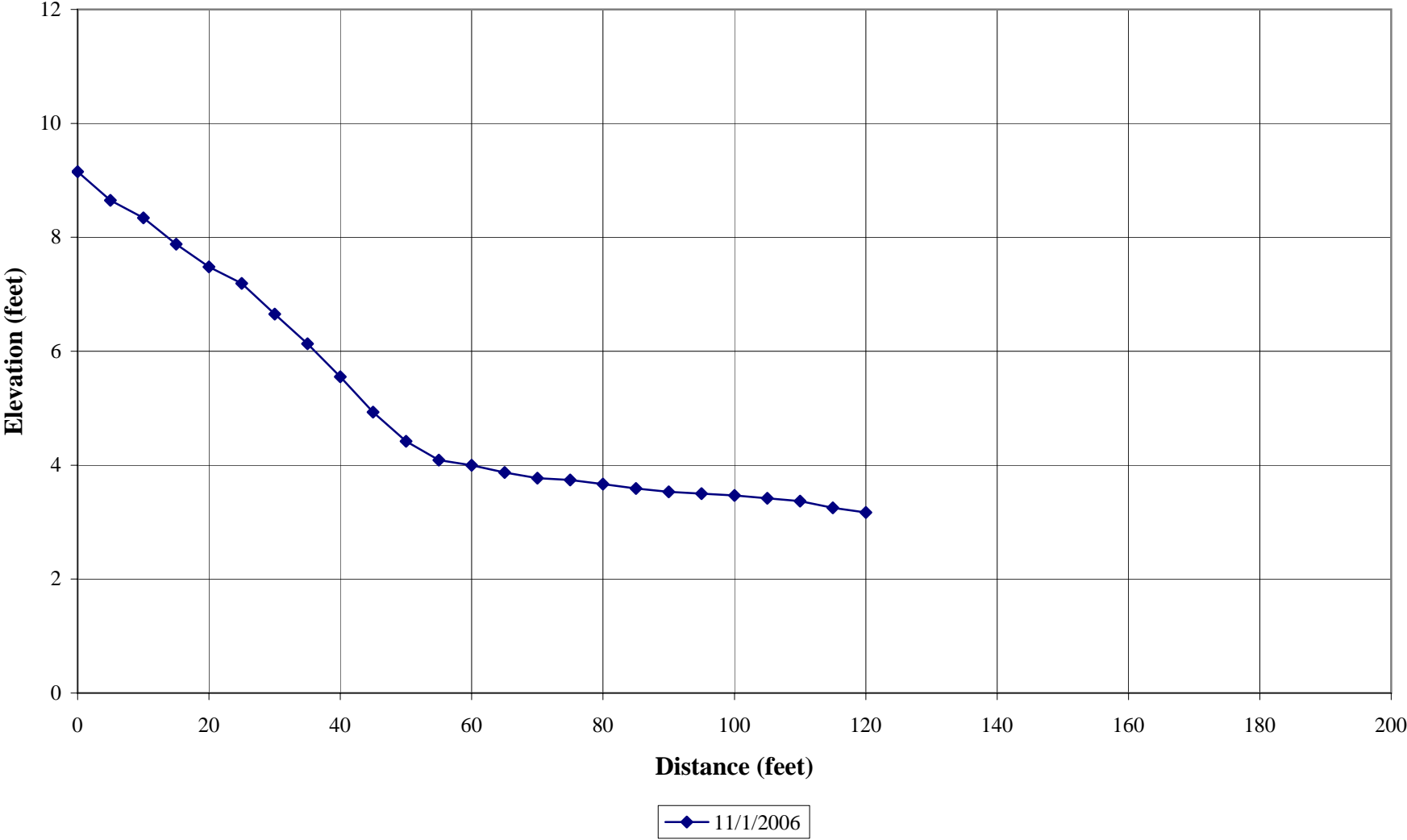


**Leisure Shores Post-Storm Survey Profile  
Transect H-5**



—◆— 11/1/2006

**Leisure Shores Post-Storm Survey Profile  
Transect H-7**



**APPENDIX F**  
**FINGERPRINT EVALUATION REPORT**  
**Comparison of October 25, 2006 Tar Balls**  
**with B120 Oil**

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This report summarizes the evaluation of four tar ball samples, identified as “W2B-03-S2,” “Exhibit 31,” “Exhibit A,” and “Exhibit B,” relative to No. 6 fuel oil released from Bouchard Barge B120. Samples W2B-03-S2 and Exhibit 31 were collected by GeoInsight, Inc. (GeoInsight) on October 25, 2006 at Mosher’s Point in Dartmouth, Massachusetts, which is part of the Clark’s Cove East shoreline segment (segment W2B-03). The other samples were given to GeoInsight on October 26, 2006 by Jason Adkins, an attorney representing plaintiffs in a class-action lawsuit associated with the release. This evaluation was conducted to identify if the chemical signature of the individual samples was: 1) consistent with B120 oil, 2) indicative of a non-B120 hydrocarbon, or 3) a mixture of potential B120 oil with non-B120 hydrocarbons.

On April 27, 2003, an undetermined amount of Number 6 fuel oil was released from Barge B120 into Buzzards Bay, Massachusetts. A small portion of that oil formed tar balls, which are small, sticky pieces left after wind and waves have mixed an oil slick with water, stripping it of “lighter” components that had made the oil fluid. Additional mixing with sediment and other changes to the tar ball occur over time, some physical such as exposure to wind and sunlight, and some biological such as exposure to microbes. The chemical composition of the original oil changes through these processes, called weathering. In addition, the tar balls can incorporate material from other carbon sources, especially particles that contain soot from combustion of a variety of substances, pyrolyzed (heat treated) materials such as coal tars and creosotes, and other organic debris.

*Chemical Composition of B120 Oil*

Detailed discussions of the chemical composition of the original (fresh) B120 product and environmental samples of the B120 oil are provided in the August 3, 2006 Phase II Comprehensive Site Assessment Report. The composition of polycyclic aromatic hydrocarbon (PAH) compounds is regularly used to identify the presence/absence and source of oils as well as assess the degree of environmental weathering. The original B120 product is dominated by the following PAH compounds, which together comprise over 80% of the total PAH content:

- Naphthalenes (2-ringed PAH compounds) with carbon side-chains comprise almost one-third of the total PAH content. Naphthalenes with two carbon side-chains (C2-naphthalenes) are the most abundant, present at concentrations over 0.7%.
- Phenanthrenes (3-ringed PAH compounds) with carbon side-chains comprise 25% of the total PAH content. C2-Phenanthrenes are the most abundant of these PAHs, with concentrations exceeding 0.5%.

- Fluoranthenes/Pyrenes (4-ringed PAH compounds) with carbon side-chains comprise 13% of the total PAH content. Again, compounds with two carbon side-chains are the most abundant.
- Chrysenes (also 4-ringed PAH compounds) with carbon side-chains are the fourth dominant PAH. Chrysenes with either one or two carbon side-chains are similar in concentration.

Absent or relatively insignificant concentrations of the following PAHs also characterize the fresh B120 product:

- Acenaphthylene (not detected);
- PAHs without side-chains (often referred to as ‘parent’ PAHs);
- PAHs with five or six rings (e.g., benzo[a]pyrene or benzo[g,h,i]perylene); and
- Dibenzothiophenes (sulfur-containing PAH).

The tar ball samples (W2B-03-S2, Exhibit A, Exhibit B, and Exhibit 31) were compared to a representative source oil tar ball sample to determine if B120 oil was present in these samples. NTB-1 tar ball sample was collected by ENTRIX, Inc. on May 13, 2003 (within approximately 3 weeks of the spill) from Nargansett Town Beach in Nargansett, Rhode Island and was used for this comparison.

For this report, initial evaluation of the samples indicated that three of the four tar ball samples (those with the “Exhibit” prefix) were similar in composition and therefore these samples are described together. Sample W2B-03-S2 had a different signature and is described separately. Copies of the laboratory reports for these samples are included in the GeoInsight Immediate Response Action Status and Completion report.

#### *Exhibit A, B, and 31 Tar Balls*

Figure 1 shows the PAH pattern for the three “Exhibit” tar ball samples. The lightest PAH compounds appear on the far left side of the figure and the heaviest PAH compounds are on the far right side. The bar height is proportional to concentration, which did not exceed approximately 500 parts per billion (ppb) for tar balls Exhibit A, B, and 31. The low PAH concentrations (less than 500 ppb) are indicative of comparatively low oil concentrations in these tar ball samples. Table 1 summarizes characteristics of these tar balls in comparison with B120 oil.

Although the PAH distribution in these tar balls differs substantially from the spilled B120 product and tar ball sample NTB-1 collected within approximately 3 weeks of the spill, many of those differences can largely be accounted for by the changes that would be expected upon further environmental weathering, such as:

1. Substantial weathering and degradation processes that have caused losses of 2-ring and 3-ring PAH compounds. These losses could account for the low 0.03% to 0.5% PAH content in tar balls Exhibit A, B, and 31.
2. Mixture of carbon material from other sources, which in particular have resulted in an increase in the relative concentration of 5-ring and 6-ring PAH compounds

characteristic of combustion sources, as well as a change in the dibenzothiophene distribution. Dibenzothiophene is a sulfur-containing aromatic compound that co-occurs in varying amounts with PAH compounds in crude oils, fuels, asphalts, and combustion products.

However, tar ball Exhibit 31 also contains oleanane, an oil biomarker not contained in B120. Oleanane is a terpane<sup>1</sup> biomarker for angiosperms, or flowering plants (ten Haven and Rulkötter 1988), and occurs in fossil fuels formed from Cretaceous source rocks or younger, in mixed terrestrial/marine environments (Moldowan et al., 1994, Murray et al., 1997). Its presence indicates that another oil besides B120 is present in this tar ball. The lack of detected oleanane in Exhibits A and 31 could be affected by the relatively low total PAH concentration in those samples relative to that in Exhibit B (i.e., oleanane is present, but at a concentration below the detection limit). However, the overall hydrocarbon composition of the three “Exhibit” tar balls is consistent with the same mixture of oils present in all three samples.

Figures 2a and 2b show the similarity between the B120 product, tar ball NTB-1 collected shortly after the oil spill in 2003, and the Exhibit B tar ball. The Exhibit B tar ball was used for illustrative purposes because it had the highest PAH concentrations of the three “Exhibit” tar ball samples, and the composition is considered to be representative of those three samples (see Figure 1). The results shown in Figure 2a indicate that there has been substantial weathering of the 2- and 3-ring PAH compounds relative to either the original B120 oil product or tar ball collected in 2003.

Figure 2b illustrates the similarity between the 2003 tar ball and the Exhibit B tar ball with consideration of the expected reduction of 2- and 3-ring PAH due to continued weathering. In particular, once the 2- and 3-ring PAH compounds that are most susceptible to weathering have been excluded from the evaluation, the remaining distribution of 4- to 6-ring PAH compounds is similar between the NTB-1 and Exhibit B samples, and characteristic of weathered B120 oil. B120 oil is likely to be a component of samples Exhibit A, B, and 31 based on the overall PAH distribution shown in Figure 1 and Figure 2. Elevated concentrations of 5- and 6-ring PAH (benzofluorathenes through benzo[g,h,i]perylene) in the “Exhibit” samples relative to NTB-1 in Figure 2b are consistent with a mixture of petrogenic and combustion-derived PAH in those samples.

#### *W2B-03-S2 Tar Ball*

Figure 3 shows the PAH pattern for an additional tar ball collected on October 25, 2006 from Mosher’s Point (Dartmouth). Individual PAH concentrations in this tar ball ranged up to 47,000 ppb. Table 1 summarizes distinguishing characteristics of this tar ball in comparison with B120 oil, the “Exhibit” tar ball samples, and the NTB-1 sample.

This tar ball exhibits weathering and degradation that have caused losses of 2- and 3-ring PAH compounds, and an increase in the relative concentration of 5- and 6-ring PAH

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<sup>1</sup> Terpanes derive from the breakdown of organic material in higher order, terrestrial plants, like trees and shrubs.

compounds. However, the following characteristics confirm that tar ball W2B-03-S2 does not derive from the B120 spill:

1. Tar ball W2B-03-S2 contains approximately 30% PAH by weight, which is approximately 10x the PAH content of either B120 product or tar ball NTB-1 collected within 2 weeks of the spill. Such a PAH content is abnormally high for an oil but is consistent with pyrogenic products such as creosote, which in its pure state can contain up to 85% to 90% PAH by weight.
2. The series of naphthalenes and phenanthrenes present in tar ball W2B-03-S2 does not display the characteristic “bell-shaped” distribution of parent and alkylated PAH found in oils (e.g., B120 in Figure 3) but it shows high concentrations of parent PAH with decreasing concentrations of alkylated PAH, which is characteristic of a pyrogenic source such as creosote and coals tars. In those materials, the parent naphthalene and phenanthrene (as well as parent fluoranthene/pyrene and chrysene compounds) are present in highest concentration with a generally decreasing concentration with increasing alkylation for the C1-, C2-, C3-, and C4- analogs. That distribution, the relatively high concentration of PAH in the tar ball is consistent with a creosote, coal tar, or similar origin for this sample.
3. The (FL+Py)/C<sub>30</sub>-hopane ratio is three orders of magnitude higher for the tar ball W2B-03-S2 than for B120. The near absence of C<sub>30</sub>-hopane relative to the two 4-ring PAH compounds cannot be explained by weathering processes and provides further evidence that this tar ball derives from an alternative source than B120.

### *Source Assessment*

Figures 4 and 5 display “double ratio” plots of some of the ratios summarized in Table 1. For example, the graph in Figure 4 plots the Chr2:DBT2 ratios on the x-axis and the Chr3:DBT3 ratios on the y-axis. This double ratio plot can be used to interpret potential hydrocarbon source relationships among samples. Ratios of different homologues (or “families”) of chrysene and dibenzothiophene (i.e., C2-chrysene and C2-dibenzothiophenes vs. C3-chrysene and C3-dibenzothiophenes) can be characteristic of the particular source rocks in which the oils developed. Changes in these ratios, for example, especially when compared as double ratio plots (or cross plots) highlight differences among samples that have different proportions of material from multiple sources. The differences require careful interpretation, however, because some changes are the result of environmental weathering processes. These differences can be identified in related samples because environmental processes produce predictable changes.

### *Samples Exhibit A, B, and 31*

Using additional sets of double ratio plots helps identify the influence of weathering and source mixtures on the source assessment. For example, a double ratio plot of C2-dibenzothiophenes and C2-phenanthrenes compared with C3-dibenzothiophenes and C3-phenanthrenes highlights a linear relationship among samples Exhibit A, B, and 31, the relatively fresh tar ball NTB-1, and the source sample B120. A source link between

B120, tar ball NTB-1, and Exhibit B was indicated in Figure 2a. The presence of a second oil in sample Exhibit B was also indicated because of the detection of the biomarker oleanane. In Figure 4, there is an approximate straight-line relationship among those samples that continues to include samples Exhibit 31, and A. The unifying characteristic of the samples along that line is an increasing proportion of high molecular weight PAH (HPAH) compounds in samples Exhibit B, 31, and A compared with B120 and the tar ball NTB-1. This characteristic is consistent with the weathering of low molecular weight PAH (LPAH) compounds and an increasing contribution of HPAH compounds from a combustion source. The offset of the Exhibit B, 31, and A samples from the B120 and tar ball NTB-1 samples on the y-axis in Figure 5 indicates the influence of the alternative sources of hydrocarbons to these samples (second oil and combustion PAH), while the separation along the x-axis for the samples is consistent with changes in composition due to weathering processes.

Therefore, the information depicted in Figure 2a, Figure 4, and Figure 5 and the relatively high proportion of HPAH in the three “Exhibit” samples confirm that they contain a mixture of carbon sources that likely include B120 oil, another fossil fuel oil, and combustion products.

#### Tar Ball W2B-03-S2

In contrast, the PAH composition in Figure 3 indicated that tar ball W2B-03-S2 was from a distinct source other than B120. This conclusion was illustrated using the cross plots in Figure 4, which showed that the composition of dibenzothiophenes and phenanthrenes was unlikely to have derived from B120 because it had a higher HPAH content yet lower dibenzothiophene proportion relative to phenanthrene than any of the samples that did correspond to B120. That compositional difference can be explained by source differences, not by environmental processes.

Figure 5 also showed how tar ball W2B-03-S2 was distinctive with a disproportionately high concentration of HPAH, and in particular chrysenes relative to B120. This characteristic could not be explained simply by relatively high concentrations of combustion PAH because tar ball W2B-03-S2 also had a disproportionately high concentration of chrysene relative to the “Exhibit” samples, which contained substantial combustion PAH contributions.

Therefore, the substantially low concentration of C<sub>30</sub>-hopane relative to fluoranthene and pyrene, the overall differing PAH compositions depicted in Figure 2, and distinctive dibenzothiophene and chrysene proportions in Figures 4 and 5 confirm that tar ball W2B-03-S2 does not contain B120 oil. This tar ball is dominated by pyrogenic sources that include both pyrolyzed (e.g., creosote or coal tar) and combusted materials.

### *Summary*

All of the tar ball samples collected in October 2006 contain combustion-derived PAH compounds in addition to the following petrogenic or pyrogenic materials:

#### 1) Exhibit A, B, and 31 Tar Balls

- These three tar balls contain B120 oil based on a comparison of their fingerprints after accounting for substantial weathering and degradation of naphthalenes and phenanthrenes.
- Exhibit B tar ball contains an additional fossil fuel that contains the biomarker oleanane, which is absent in B120 oil. Tar balls Exhibit A and 31 may also contain this oil but at levels below detection limits based on relatively low overall hydrocarbon concentrations.
- The specific source material enriched with C3-dibenzothiophenes (Figure 3b) in the three "Exhibit" tar ball samples is unknown but is inconsistent with the highly weathered B120 oil present in those samples. An alternative, non-B120, source of hydrocarbon accounts for this distribution.

#### 2) Tar ball W2B-03-S2

- The PAH and biomarker fingerprint, as well as the total PAH content of this tar ball has no relationship with B120 oil but is consistent with creosote or similar pyrogenic material (e.g. coal tar).

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**Table 1.** Summary of distinguishing hydrocarbon ratios in tar balls and B120 oil.

	Tar Ball W2B-03-S2	Tar Ball Exhibit A	Tar Ball Exhibit B	Tar Ball Exhibit 31	Tar Ball (2003) NTB-1	B120 Product
<b>Percent "Parent" PAH<sup>1</sup></b>						
Phenanthrene	66%	1%	N/A	2%	7%	7%
Fluoranthene + Pyrene	79%	7%	11%	13%	8%	9%
Chrysene	59%	7%	8%	10%	9%	9%
Four-, Five-, and Six-Ring PAH <sup>2</sup>	81%	17%	18%	23%	14%	14%
<b>Percent HPAH/(HPAH+LPAH)<sup>3</sup></b>	68%	98%	85%	95%	55%	50%
<b>(FI+Py)/C<sub>30</sub>-hopane Ratio<sup>4</sup></b>	9,000 <sup>5</sup>	0.03	0.46	0.07	N/A	8.9
<b>Percent DBT2/(DBT2+Ph2)<sup>6</sup></b>	7%	56%	36%	41%	15%	13%
<b>Percent DBT3/(DBT3+Ph3)<sup>6</sup></b>	12%	57%	41%	48%	12%	14%
<b>Percent Chr2/(Chr2+DBT2)<sup>7</sup></b>	83%	74%	77%	75%	71%	76%
<b>Percent Chr3/(Chr3+DBT3)<sup>7</sup></b>	59%	49%	37%	38%	69%	63%

<sup>1</sup> The percentages shown are calculated by dividing the concentration of the parent PAH (i.e., no carbon side-chains) by the sum of the concentration of that parent PAH and all of associated PAH with carbon side-chains. For example, the percentage for chrysene is the concentration of chrysene divided by the sum of the concentrations of chrysene, C1-chrysenes, C2-chrysenes, C3-chrysenes, and C4-chrysenes.

<sup>2</sup> Fluoranthene, pyrene, benz[a]anthracene, chrysene, benzofluoranthenes, benzo[e]pyrene, benzo[a]pyrene, Indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.

<sup>3</sup> Proportion of the 10 high molecular weight parent PAH (HPAH) listed in footnote (2) to all sixteen HPAH and low molecular weight PAH (LPAH; naphthalene, acenaphthalene, acenaphthene, fluorene, anthracene, phenanthrene).

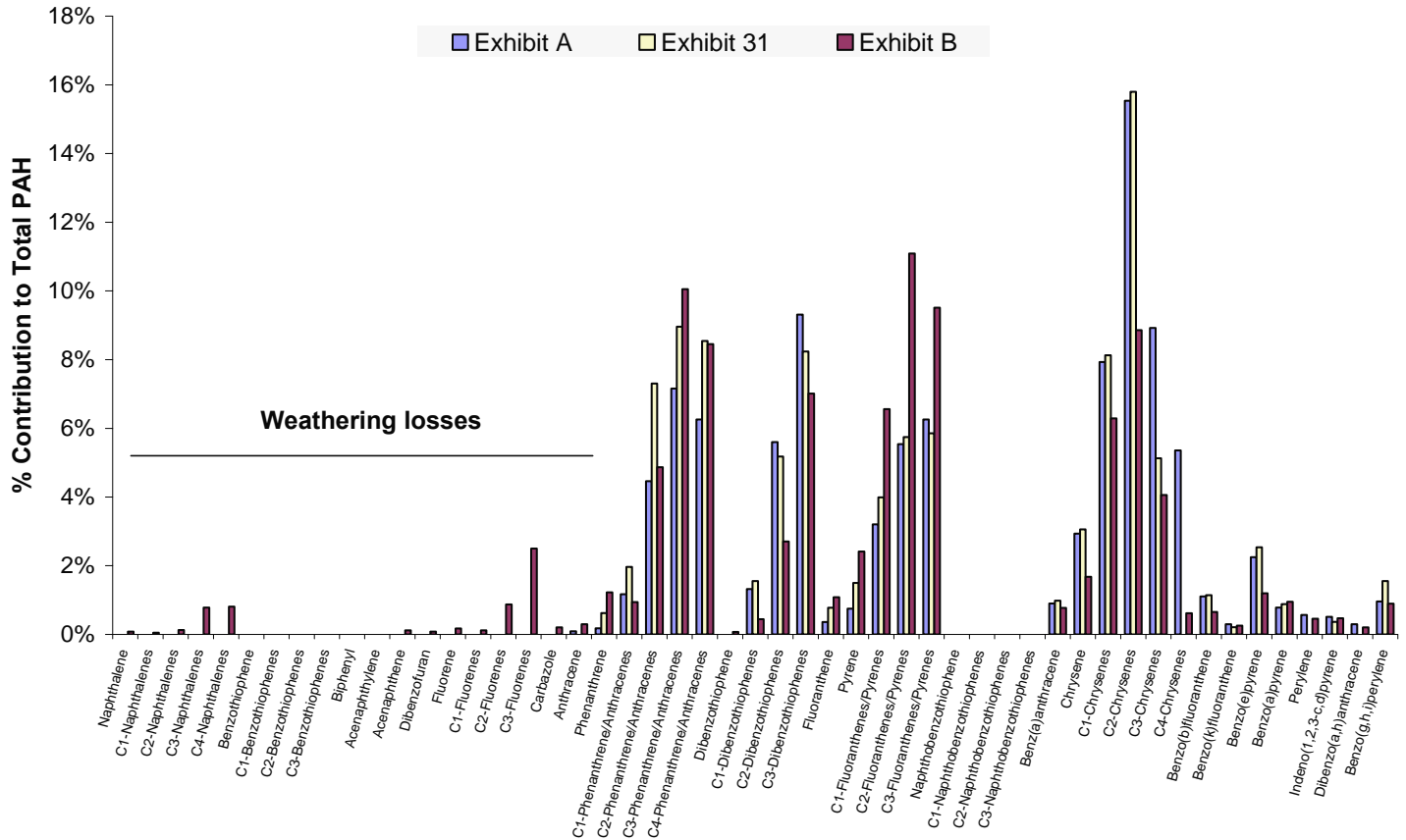
<sup>4</sup> Ratio of the sum of the 4-ring PAH compounds fluoranthene (FI) plus pyrene (Py) to the substantially more stable C<sub>30</sub>-hopane.

<sup>5</sup> The high (FI+Py)/C<sub>30</sub>-hopane ratio for Sample W2B-03-S2 is uncharacteristic of oils and suggests a dominant pyrogenic material.

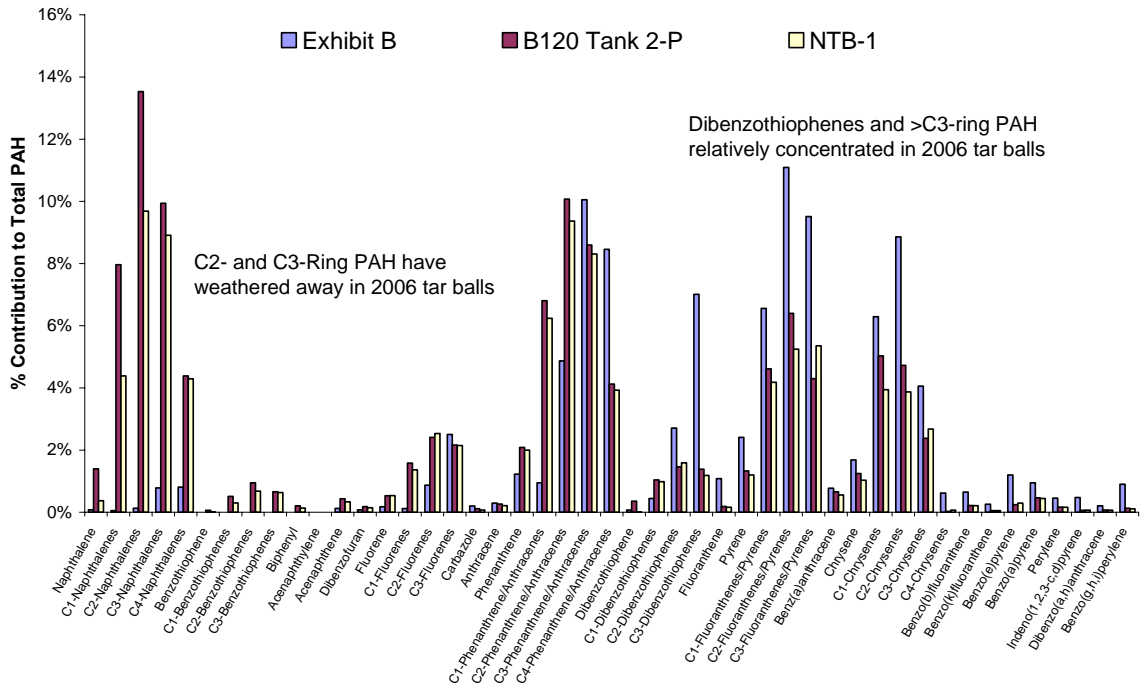
<sup>6</sup> Proportion of C2-dibenzothiophenes to total (C2-dibenzothiophenes plus C2-phenanthrenes) and proportion of C3-dibenzothiophenes to total (C3-dibenzothiophenes plus C3-phenanthrenes). A comparison of these proportions (Figure 4) can be indicative of hydrocarbon sources.

<sup>7</sup> Proportion of C2-chrysenes to total (C2-chrysenes plus C2-dibenzothiophenes) and proportion of C3-chrysenes to total (C3-chrysenes plus C3-dibenzothiophenes). A comparison of these proportions (Figure 5) can be indicative of differences in weathering/degradation among samples.

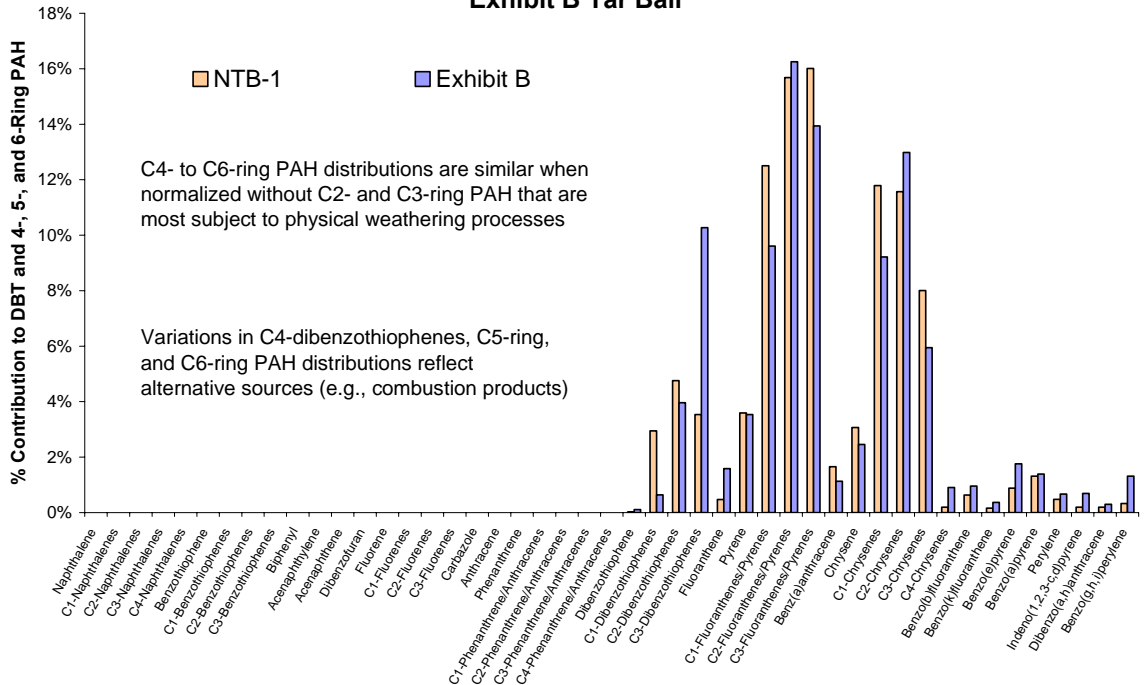
**Figure 1. Comparison of PAH Distribution in Tarball Samples Exhibits A, B, and 31 (GEO0048, 49, 50)**



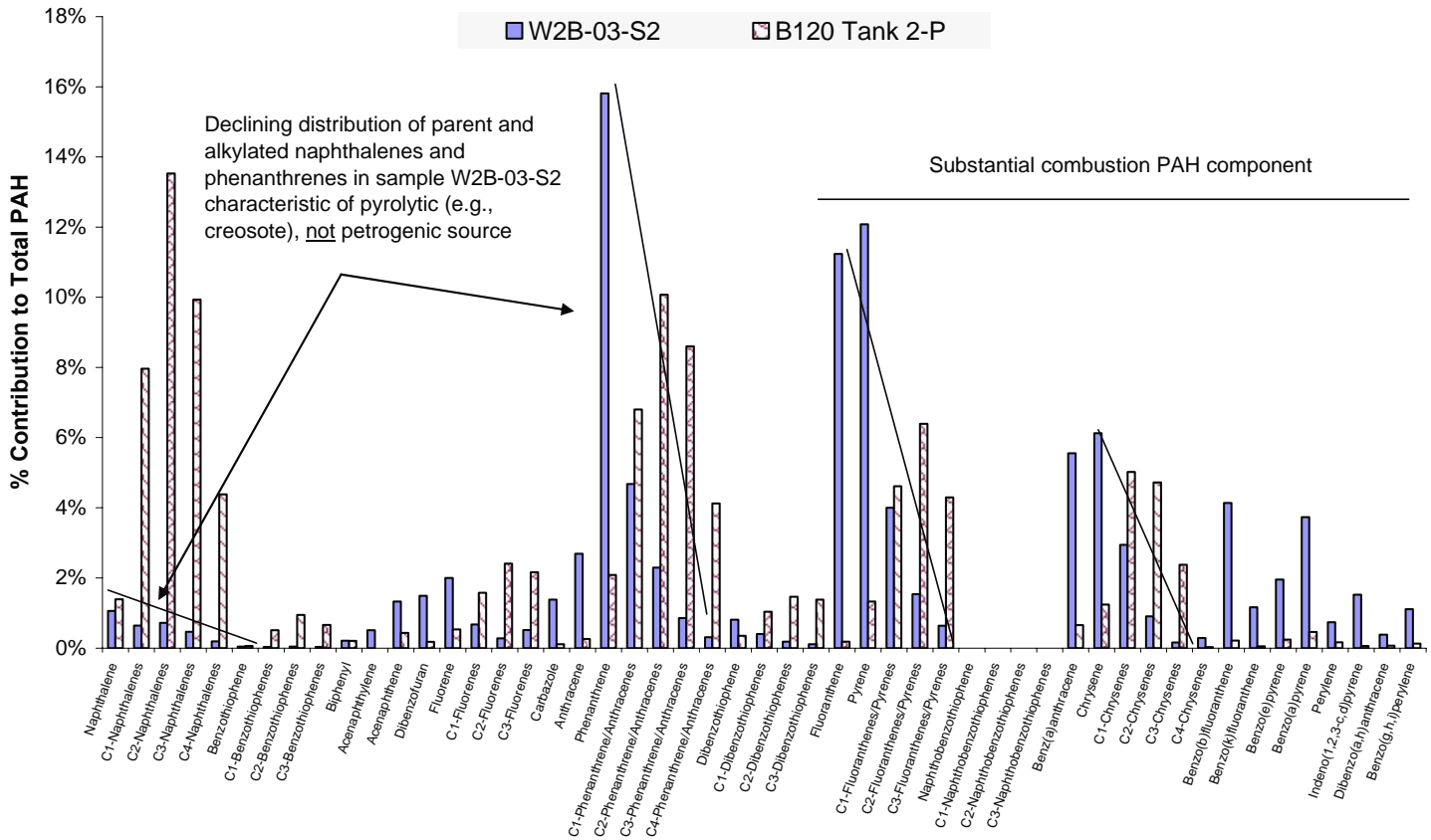
**Figure 2a. PAH Proportions in Exhibit B Tar Ball with B120 Product and B120 Tar Ball Collected in June 2003**



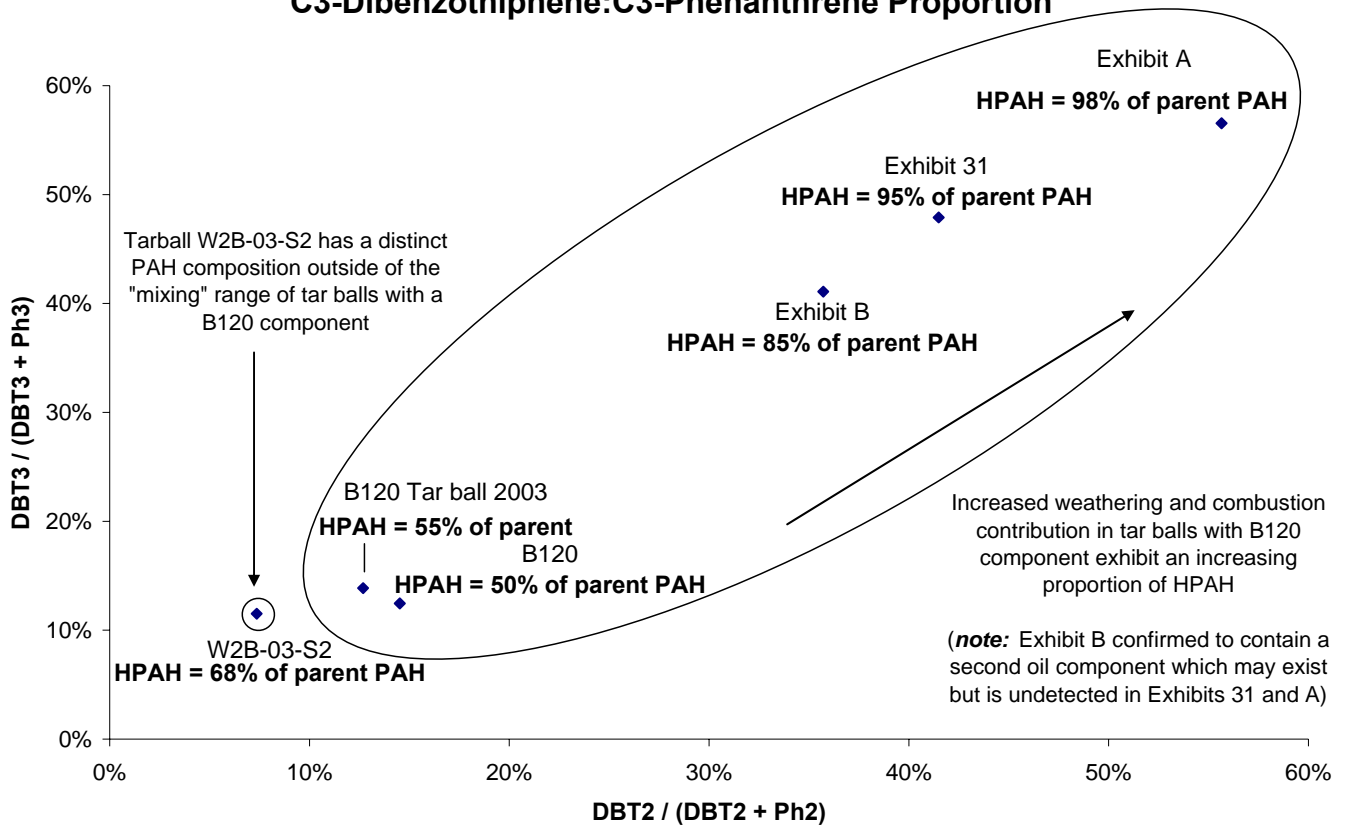
**Figure 2b. Comparison of PAH Proportions Solely in Dibenzothiophene and ≥4-Ring PAH Range in B120 Tar Ball Collected in June 2003, and Exhibit B Tar Ball**



**Figure 3. Comparison of Dissimilar PAH Distribution in Tar Ball Sample W2B-03-S2 and B120 Tank 2-P Oil**



**Figure 4. C2-Dibenzothiophene:C2-Phenanthrene Proportion vs. C3-Dibenzothiophene:C3-Phenanthrene Proportion**



**Figure 5. C2-Chrysenes:C2-Dibenzothiophene Proportion vs. C3-Chrysenes:C3-Dibenzothiophenes Proportion**

