MkII Airborne Laser Fluorosensor Survey Reprocessing And Interpretation Report: Timor Gap, Timor Sea, Australia

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Contents

Summary

The Timor Gap airborne laser fluorosensor (ALF) MkII survey was flown in 1989 by BP over the northern Bonaparte Basin (Sahul Platform, Sahul Syncline and Malita Graben). The survey was designed to detect natural oil seepage over a region of the Timor Sea, Australia, in an effort to refine the petroleum prospectivity assessment.

The survey area spanned up to about 330km east to west and about 310km north to south. The line spacing was about 1,900m. A total of 1,860,650 fluorosensor spectra were recorded.

This report presents a re-interpretation of the BP data by Signalworks Pty Ltd using the *ALF Explorer™* software. A total of 5,441 confident fluors were interpreted out of the 1,860,650 recorded spectra. This is an average fluor density of 2.91 fluors per thousand spectra.

The fluorescence response over the survey area consisted mostly of relatively low confidence fluors (compared to the more reliable MkIII ALF survey data).

Some of the regions of increased fluor density correspond to regions having generally higher F/R values, probably caused by changing water properties. These areas may not necessarily have increased levels of hydrocarbon leakage.

1. Introduction

The Timor Gap airborne laser fluorosensor (ALF) MkII survey was flown in 1989 by BP over the northern Bonaparte Basin (Sahul Platform, Sahul Syncline and Malita Graben). The MkII system used a 308nm laser wavelength, which is longer than the 266nm used in the later MkIII system. The Raman peak wavelength is 344nm (293nm MkIII) and the fluorescence region is 370nm to 580nm (320nm to 580nm MkIII).

Each recorded spectrum is the average of ten detected spectra. The averaging was done by BP to reduce the data recording rate, which was limited by the available 1980's hardware. The MkIII system uses faster hardware and records all detected spectra without averaging.

This report presents a re-interpretation of the original BP data using the *ALF Explorer™* software, which consists of a database linked to a set of data processing, analysis and display modules. BP documented the original data processing and interpretation in a basic data report and interpretive data report (Walker, 1991a,b*).

208 lines were acquired at about 1,900m spacing in a NW-SE orientation and a flying height of 100m. A total of 1,860,650 spectra were collected at an average spacing of 16.9m to 28.5m. About 36,000 km of line data were acquired.

Some lines in an MkII ALF survey may use the same Line and Point values as other lines. The main ALF data table in the *ALF Explorer™* database (RawAlfData) uses the Line and Point fields as key fields, which cannot contain duplicates. Lines that contain duplicated Line and Point values are stored in separate tables (eg. RawAlfData2).

The main ALF data table contains 1,758,364 ALF spectra. A second table (RawAlfData2) contains 102,286 ALF spectra.

The survey area is shaded in red on the location map (Figure 1). Seven MkIII ALF surveys acquired between 1995 and 1998 in this region are shown with blue shading (Cowley, 2000a-g* and Cowley, 2001a). Other MkII ALF surveys are shaded in light green (Cowley, 2001b,c*).

A total of 5,441 confident fluors were interpreted out of the 1,860,650 recorded spectra. This is an average fluor density of 2.91 fluors per thousand spectra.

* Bibliographic references:

Walker, N.S., 1991a. 1991 Timor Sea Airborne Laser Fluorosensor Survey for BP Developments Australia Ltd. Basic Data Report. (Timor Gap Survey.) (unpubl. report).
Walker, N.S., 1991b. 1991 Timor Sea Airborne Laser Fluorosensor Survey for BP Developments Australia Ltd. Interpreted Data Report. (Timor Gap Survey.) (unpubl. report).
Cowley, R., 2000a. Comparison of AGSO – Geoscience Australia North-West Shelf Airborne Laser Fluorosensor Survey Interpretations. Record 2000/27.
Cowley, R., 2000b. 1996 Nancar Trough, Northern Bonaparte Basin (AC/P16) Airborne Laser Fluorosensor Survey Interpretation Report. Record 2000/28.
Cowley, R., 2000c. 1996 Laminaria High, Northern Bonaparte Basin (AC/P8) Airborne Laser Fluorosensor Interpretation Report. Record 2000/29.
Cowley. R., 2000d. 1998 Yampi Shelf, Browse Basin Airborne Laser Fluorosensor Survey Interpretation Report. Record 2000/30.
Cowley. R., 2000e. 1996 Yampi Shelf, Browse Basin Airborne Laser Fluorosensor Survey Interpretation Report. Record 2000/31.
Cowley. R., 2000f. 1996 Vulcan Sub-basin / Browse Basin Transition Airborne Laser Fluorosensor Survey Interpretation Report. Record 2000/32.
Cowley. R., 2000g. 1996 Vulcan Sub-basin Airborne Laser Fluorosensor Survey Interpretation Report. Record 2000/33.
Cowley. R., 2001a. Airborne Laser Fluorosensor (MkIII) Survey Reprocessing and Interpretation Report: WA-260-P, Timor Sea, Australia. Record 2001/17, AGSOCAT 35929.
Cowley. R., 2001b. MkII Airborne Laser Fluorosensor Survey Reprocessing and Interpretation Report: Bonaparte Basin, Timor Sea, Australia. Record 2001/24, AGSOCAT 35930.
Cowley. R., 2001c. MkII Airborne Laser Fluorosensor Survey Reprocessing and Interpretation Report: Timor Sea, Australia. Record 2001/23, AGSOCAT 34394.

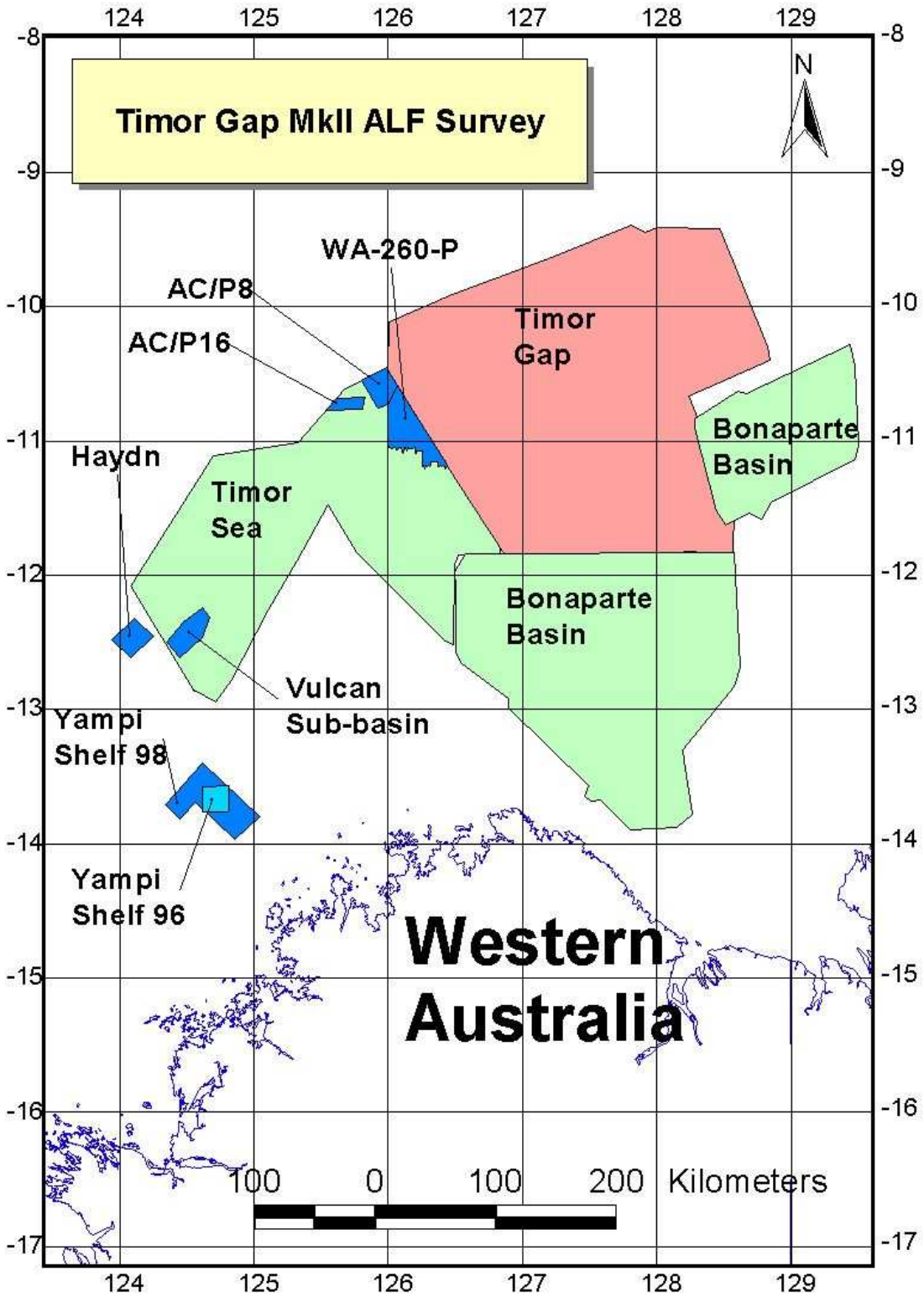


Figure 1. Timor Gap MkII ALF Survey Location Map.
(The Timor Gap survey is shaded in red.)
(Blue Areas are later MkIII ALF surveys.)
(Light green area are other MkII ALF surveys.)

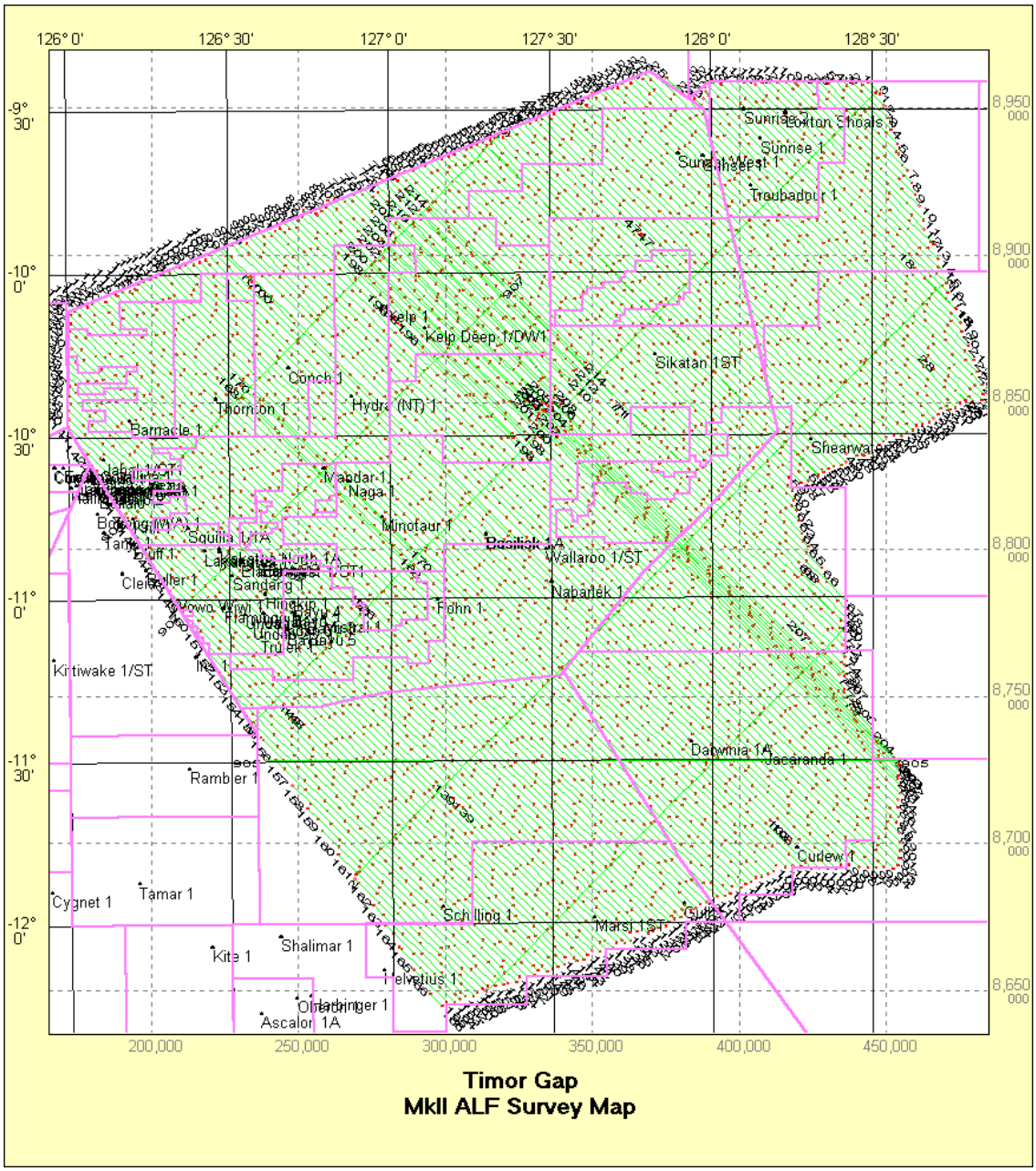


Figure 2. The Timor Gap MkII ALF Survey.

Figure 2 shows a map of the Timor Gap MkII ALF survey, with point symbols annotated in red at a spacing of 500 points.

Mapping Specifications:
The geodetic coordinates of the supplied ALF data used the AGD66 geodetic datum. Because of inconsistencies in the AGD66 datum, there is no single set of transformation parameters that can accurately transform the coordinates into the WGS84 or AGD84 datums. The AGD66 datum coordinates were assumed to be approximately equal to the AGD84 coordinates for the accuracy of mapping required in this report.

Projection: Southern UTM Zone 52 (Central Meridian 129 degrees east)

Min Easting:	165,000
Max Easting:	485,000
Min Northing:	8,635,000
Max Northing:	8,970,000

2. ALF Survey Analysis

2.1. Fluor Mapping

A fluorescence anomaly (fluor) is detected by an increase in the area of the fluorescence response region of the ALF spectrum. For a variety of reasons the magnitude of each ALF spectrum can vary significantly from shot to shot. The fluorescence area value is usually normalized using the Raman area to produce a more consistent measure of fluorescence intensity. The ratio is called the fluorescence on Raman area ratio, usually denoted as F/R.

In this analysis, the Raman area is calculated between the wavelengths 330.77nm and 360.13nm (channels 26 to 54). The fluorescence area is calculated between the wavelengths 360.13nm to 600.83nm (channels 54 to 154). Oil fluorescence usually extends over the Raman region but the Raman response distorts the value if it is calculated over this region.

The F/R ratio typically shows varying intensity trends over a survey area, probably because of changing water properties. A map of the averaged F/R ratio over the Timor Sea survey is shown in Figure 13 (Appendix 1). The F/R ratio generally increases to the south and east. Localized increases in the ratio are usually seen consistently over several lines.

Figure 3 shows the F/R plot for line 21. The values are low to the NW, grading to high to the SE.

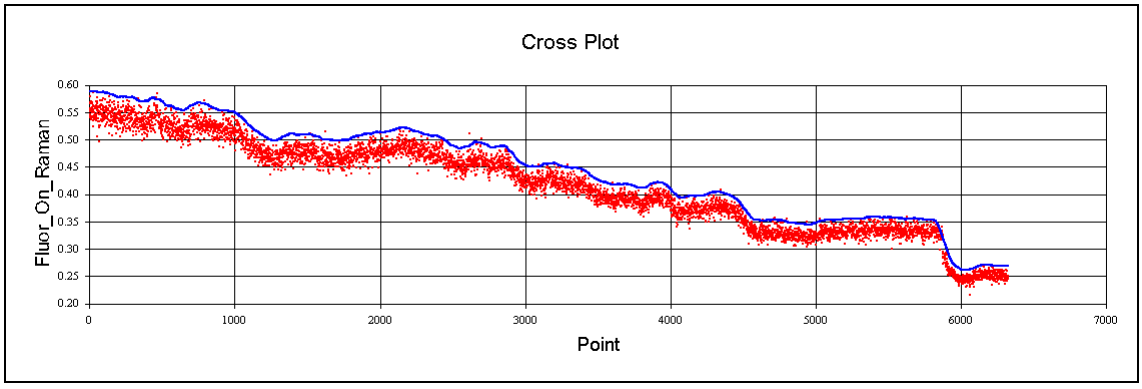


Figure 3. The F/R Plot for Line 21.

Because of the changing F/R trends, a constant F/R cutoff level cannot be used to detect fluorescence anomalies (fluors). An average of the F/R ratio is used as an estimate of the background F/R level at any point. Only spectra having an F/R value significantly above the background level are selected as possible fluors.

The blue line shown in Figure 3 is the (101 point) average F/R rescaled by a factor of 1.07. The rescaling moves the averaged curve above the F/R values of most of the spectra. Only spectra having an F/R value above the blue curve

are selected as possible fluors. The scaling factor is usually selected between values of 1.05 and 1.5 for each line depending on the amount of scatter in the F/R plot.

13,261 possible fluors were selected from the raw ALF data tables. (12,744 from RawAlfData and 517 from RawAlfData2.) Figure 4 shows a map of the possible fluors.

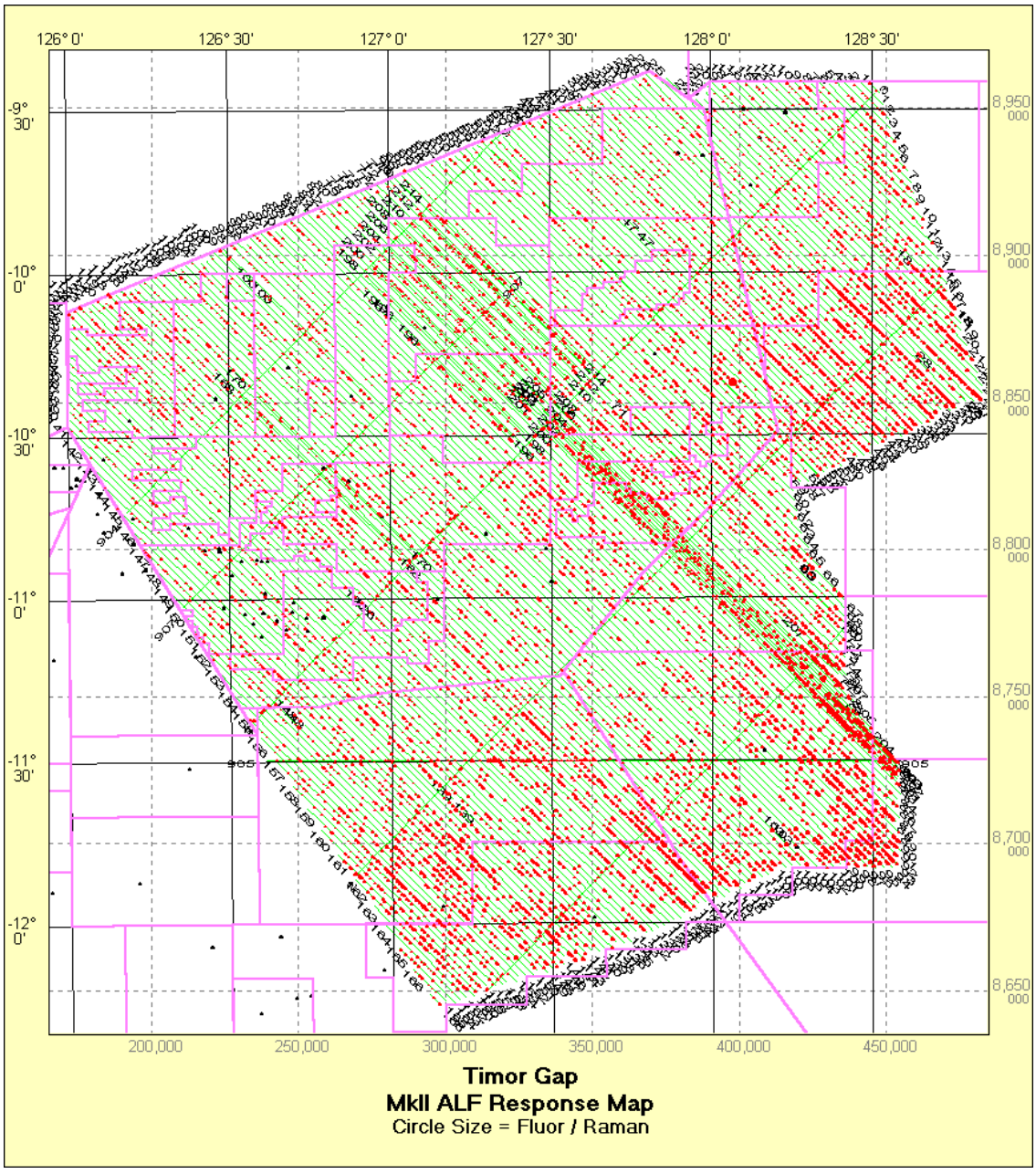


Figure 4. Timor Gap MkII ALF Survey First Pass Fluor Map.

The following queries was used to remove some of the noisy spectra from the picked fluors:

SELECT * FROM [Sel Fluors1 Spectra Params] WHERE Fluor_Jitter_On_Area > 0 AND Fluor_Jitter_On_Area < .0015

SELECT * FROM [Selected Fluors 2 Spectra Params] WHERE Fluor_Jitter_On_Area > 0 AND Fluor_Jitter_On_Area < .0015

These select 5,072 and 369 (5,441 total) confident fluors from the two sets of possible fluors. These are plotted in Figure 5.

Adding an F/R cutoff value of 0.4 to the queries reduced the number of selected fluors to 3,318 and 283, but this tended to preserve fluors only in the high F/R regions.

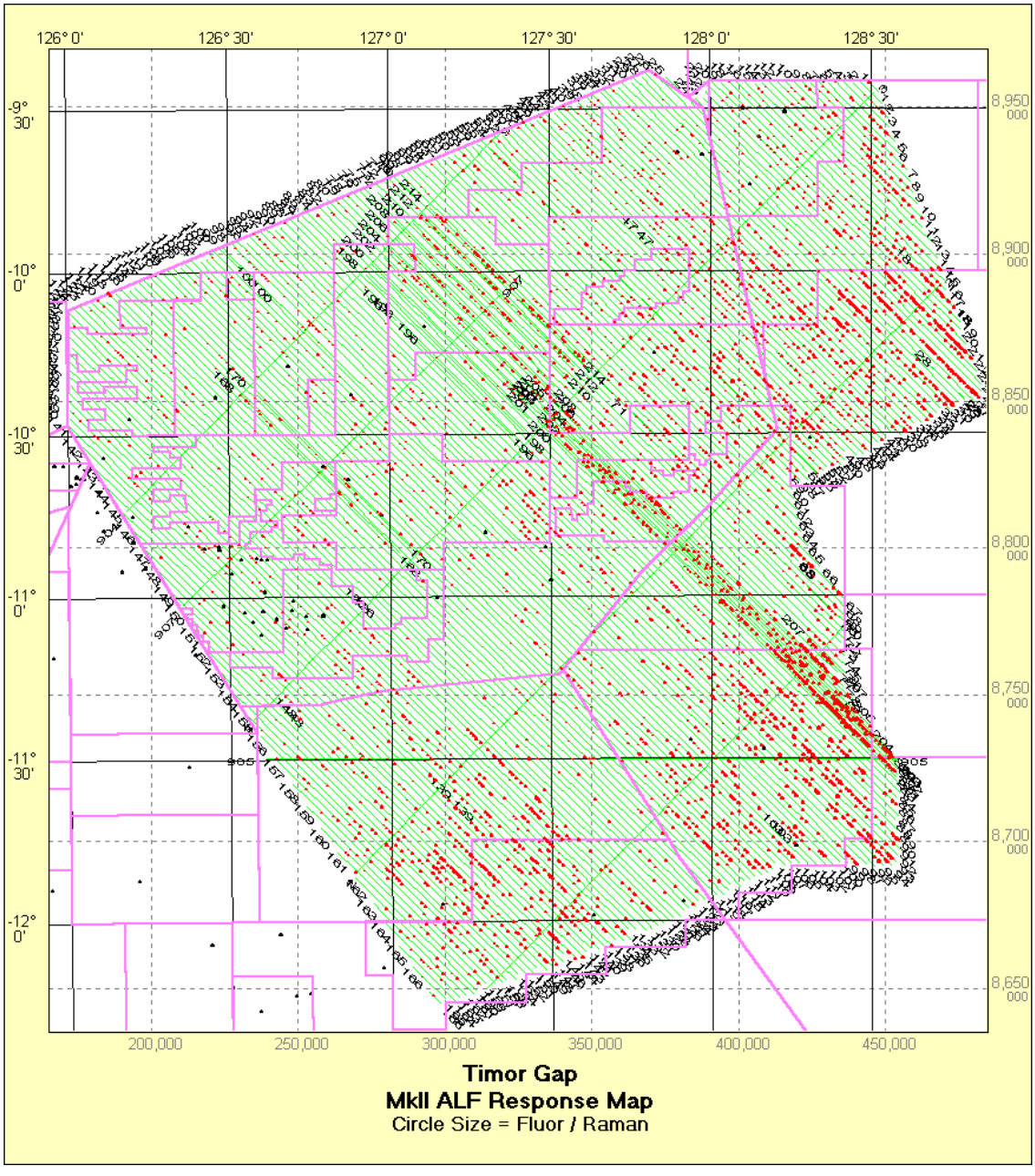


Figure 5. Timor Gap MkII ALF Survey Confident Fluor Map.

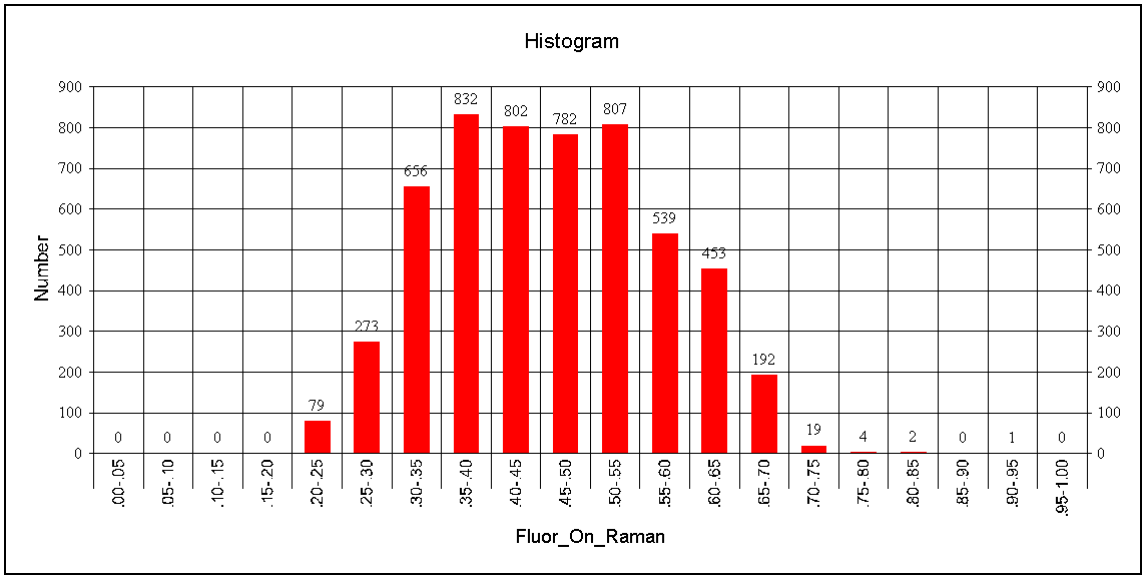
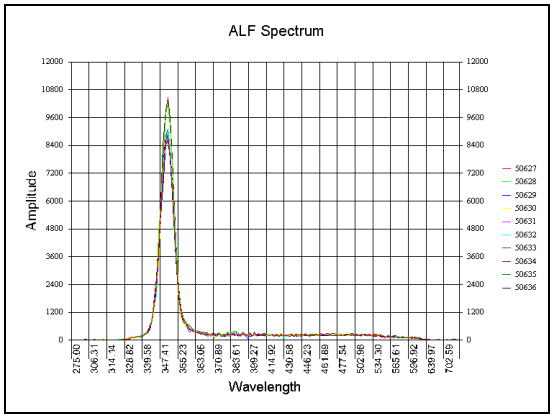
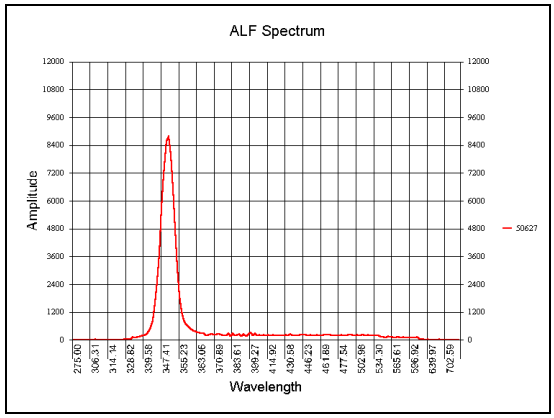


Figure 6. The F/R Histogram for the Confident Fluors.

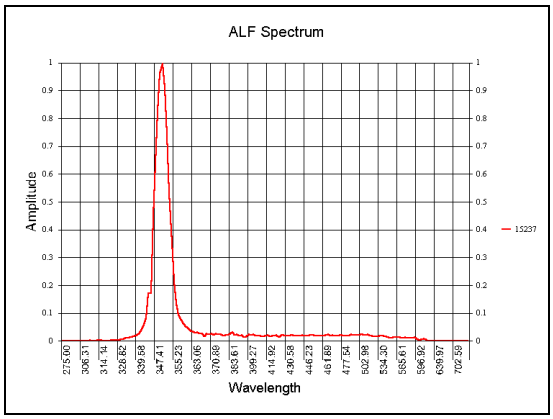
Figure 6 shows the fluors intensity (F/R) histogram for the edited fluor picks. Because a varying fluor intensity cutoff level is used to select likely fluors, the histogram bars gradually reduce in size towards the low F/R end of the graph.



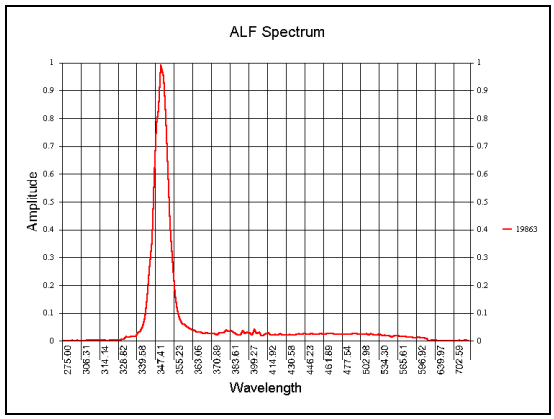
a) Line 70 Ten Adjacent Spectra.



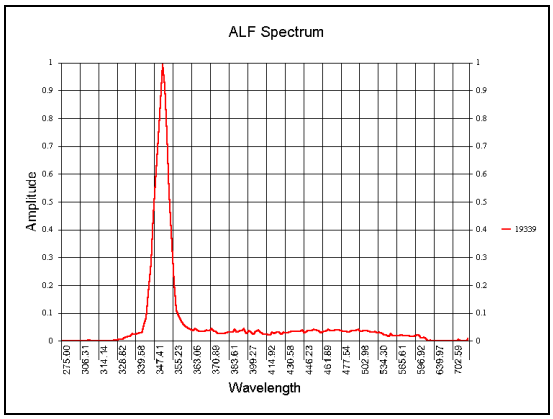
b) Line70 No Fluor



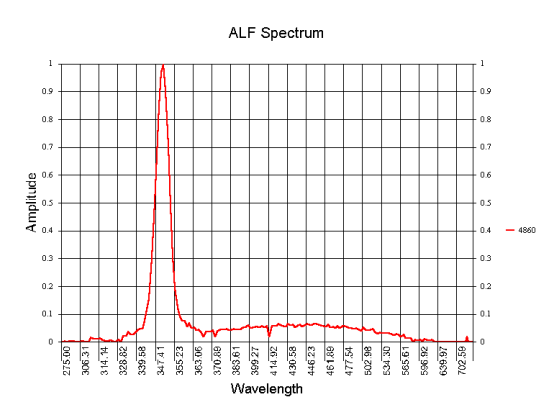
c) Line 94 Small Fluor



d) Line 25 Small to Medium Fluor



e) Line 58 Medium Fluor.



f) Line 153 Large Fluor.

Figure 7. Timor Gap MkII ALF Survey, Selected Spectra.

3. Conclusions and Recommendations

The fluorescence response over the survey area consisted mostly of relatively low confidence fluors (compared to the more reliable MkIII ALF survey data).

The 10 spectra averaging method used to record the MkII data tends to filter out the isolated fluorescence response and enhance anomalous water responses.

The ~2km line spacing is not sufficiently close to detect most fluor clusters. For example, the line spacing of 300m used on the nearby MkIII ALF survey over the Skua field, Timor Sea (Cowley, 2000*), was only just sufficient to detect the fluor cluster lying near that accumulation.

Some of the regions of increased fluor density correspond to regions having generally higher F/R values, probably caused by changing water properties. These areas may not necessarily have increased levels of hydrocarbon leakage.

The Timor Gap ALF MkII data is probably not suitable for identifying the isolated, low intensity fluors that are usually detectable on ALF MkIII surveys in the region.

*Bibliographic reference:
Cowley. R., 2000. 1996 Vulcan Sub-basin Airborne Laser Fluorosensor Survey Interpretation Report. Record 2000/33.

Appendix 1. Data Acquisition QC

Line	Sections	Clipped	Avg Raman Peak	Avg Raman Variance
1	83	0	4	2
2	4	0	5	2
2	154	0	4	3
3	144	0	5	8
4	9	0	3	2
6	19	0	6	5
8	25	0	3	0
10	29	0	6	7
12	33	0	3	0
14	46	0	7	8
16	51	0	3	1
18	53	0	9	7
18	9	0	8	8
20	55	0	3	1
21	62	0	6	5
22	67	0	9	8
23	68	0	9	12
24	73	0	3	2
25	75	0	17	21
26	76	0	9	9
27	82	0	20	25
28	76	0	7	13
28	6	0	3	1
29	76	0	20	28
30	81	0	9	11
31	81	0	19	30
32	90	0	6	10
33	77	0	5	0
34	77	0	10	14
35	87	0	5	1
36	75	0	3	0
37	78	0	6	1
38	81	0	10	16
39	86	0	7	1
40	87	0	3	1
41	77	0	7	2
42	76	0	12	21

Table 1a. Timor Gap MkII ALF Survey Data Acquisition Summary.

Line	Sections	Clipped	Avg Raman Peak	Avg Raman Variance
43	86	0	7	2
44	80	0	3	1
45	79	0	8	2
46	82	0	14	23
47	28	0	10	2
47	60	0	10	3
48	100	0	3	2
49	78	0	11	3
50	80	0	10	6
51	88	0	12	4
52	77	0	4	1
53	79	0	7	4
54	88	0	11	7
55	93	0	5	3
56	93	0	3	1
58	81	0	15	16
60	88	0	3	1
62	93	0	17	20
64	85	0	4	1
66	97	0	20	25
67	103	0	5	1
68	115	0	4	1
69	105	0	11	12
70	101	0	7	4
70	118	0	19	18
71	119	0	14	19
72	105	0	3	2
73	110	0	14	24
74	119	0	9	9
75	122	0	17	33
76	126	0	5	7
77	113	0	5	3
78	120	0	5	28
79	131	0	7	8
80	133	0	4	1
81	130	0	10	25
82	143	0	7	22

Table 1b. Timor Gap MkII ALF Survey Data Acquisition Summary (cont).

Line	Sections	Clipped	Avg Raman Peak	Avg Raman Variance
83	149	0	10	26
84	153	0	4	1
85	139	0	9	8
86	142	0	14	27
87	151	0	13	17
88	142	0	4	4
89	143	0	13	18
90	154	0	15	22
91	156	0	13	19
92	150	0	3	1
93	155	0	6	4
94	151	0	14	14
95	159	0	10	13
96	160	0	4	3
97	150	0	13	18
98	154	0	18	13
99	157	0	15	20
100	133	0	5	9
100	6	0	10	24
101	147	0	7	5
102	148	0	21	13
103	153	0	12	12
104	154	0	8	22
105	142	0	19	19
106	146	0	14	6
107	148	0	19	22
108	138	0	4	2
109	149	0	6	6
110	155	0	21	12
111	147	0	15	31
112	153	0	4	6
113	148	0	4	3
114	145	0	27	18
115	153	0	10	28
116	144	0	9	12
117	146	0	19	67
118	153	0	27	20

Table 1c. Timor Gap MkII ALF Survey Data Acquisition Summary (cont).

Line	Sections	Clipped	Avg Raman Peak	Avg Raman Variance
119	152	0	19	77
120	152	0	11	32
121	147	0	3	0
122	143	0	5	7
123	155	0	3	1
124	144	0	17	116
125	146	0	7	3
126	151	0	10	41
127	153	0	7	5
128	150	0	21	191
129	147	0	5	1
130	150	0	22	24
131	151	0	7	1
132	133	0	3	3
133	137	0	7	2
134	134	0	20	25
135	144	0	9	2
136	140	0	4	5
137	129	0	2	1
138	139	0	10	15
139	98	0	4	3
139	36	0	7	9
140	126	0	8	8
141	120	0	9	11
142	120	0	5	3
143	120	0	9	13
144	112	0	9	11
145	101	0	3	2
146	103	0	6	14
147	100	0	3	0
148	90	0	9	15
149	100	0	3	1
150	79	0	7	12
151	78	0	25	4007
152	75	0	10	20
153	67	0	21	1495
154	65	0	5	4

Table 1d. Timor Gap MkII ALF Survey Data Acquisition Summary (cont).

Line	Sections	Clipped	Avg Raman Peak	Avg Raman Variance
155	59	0	6	6
156	54	0	8	17
157	48	0	8	12
158	40	0	4	2
159	39	0	12	28
160	33	0	3	4
161	28	0	12	34
162	23	0	4	1
163	18	0	17	353
164	13	0	3	4
165	6	0	17	60
166	1	0	5	1
168	37	0	1	0
170	40	0	1	0
196	23	0	10	3
196	0	0	0	0
196	0	0	0	0
196	0	0	0	0
196	0	0	0	0
196	0	0	0	0
196	0	0	0	0
196	0	0	0	0
196	0	0	0	0
196	0	0	0	0
196	0	0	0	0
198	41	0	11	3
200	36	0	12	3
201	95	0	10	4
202	83	0	10	2
203	84	0	14	5
203	84	0	14	5
204	80	0	9	2
204	36	0	12	3
206	43	0	11	3
208	37	0	10	3
210	42	0	10	3
212	36	0	7	3

Table 1e. Timor Gap MkII ALF Survey Data Acquisition Summary (cont).

Line	Sections	Clipped	Avg Raman Peak	Avg Raman Variance
214	42	0	6	2
904	96	0	3	1
905	111	0	10	22
907	78	0	10	17
1	1	0	5	2
3	9	0	5	3
5	14	0	6	5
7	23	0	6	5
9	26	0	6	6
11	35	0	8	9
13	36	0	10	14
15	49	0	11	17
17	47	0	14	22
19	62	0	14	21
55	79	0	4	2
57	91	0	3	2
59	78	0	6	5
61	94	0	8	8
63	86	0	6	8
65	102	0	7	9
203	84	0	7	6
205	81	0	6	8
207	5	0	7	11

Table 1f. Timor Gap MkII ALF Survey Data Acquisition Summary (cont).

The average Raman peak levels (averaged over each line) ranged from 0 to 27. This parameter is mapped over the survey in Figure 8.

The Raman variance, calculated over 100 point windows and averaged over each line, ranged from 0 to 4000. This parameter is mapped over the survey in Figure 9. Lines 151 and 153 are extremely noisy and have very high Raman variances.

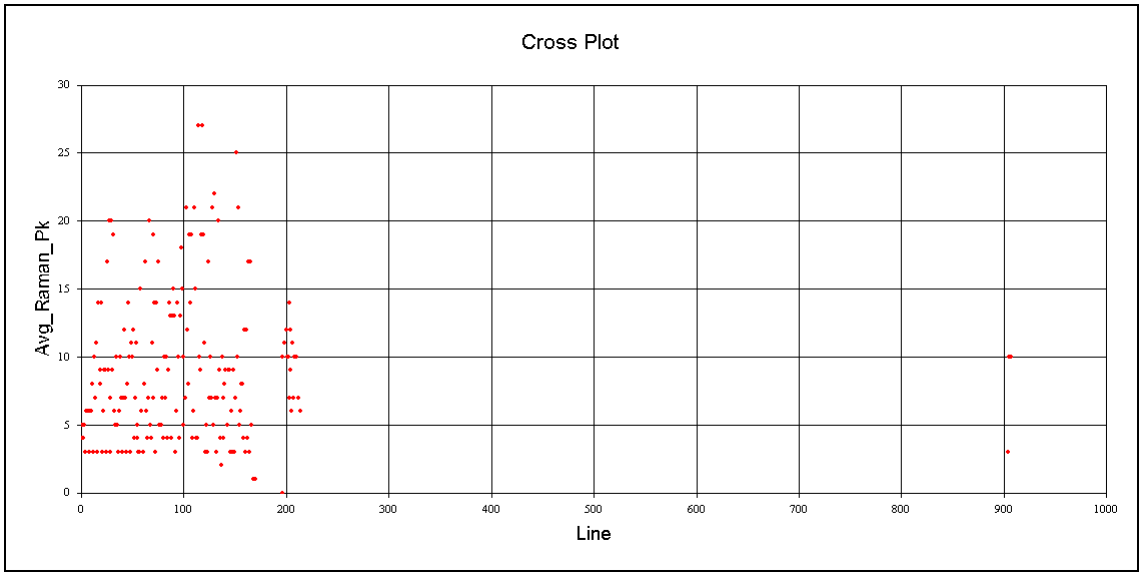


Figure 8. The Average Raman Peak Plotted for All Lines.

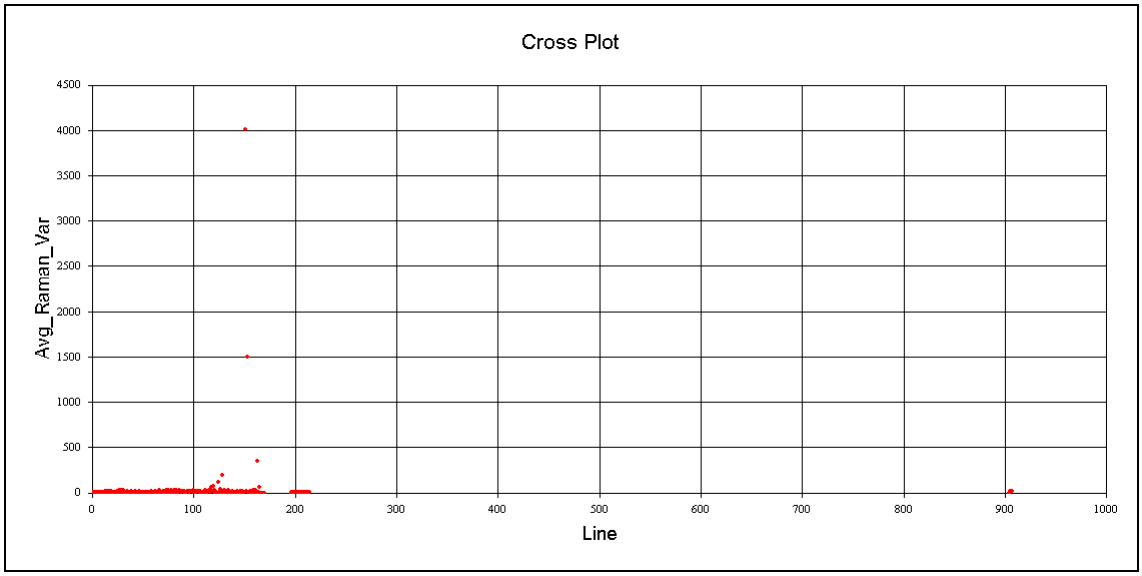


Figure 9. The Average Raman Variance Plotted for All Lines.

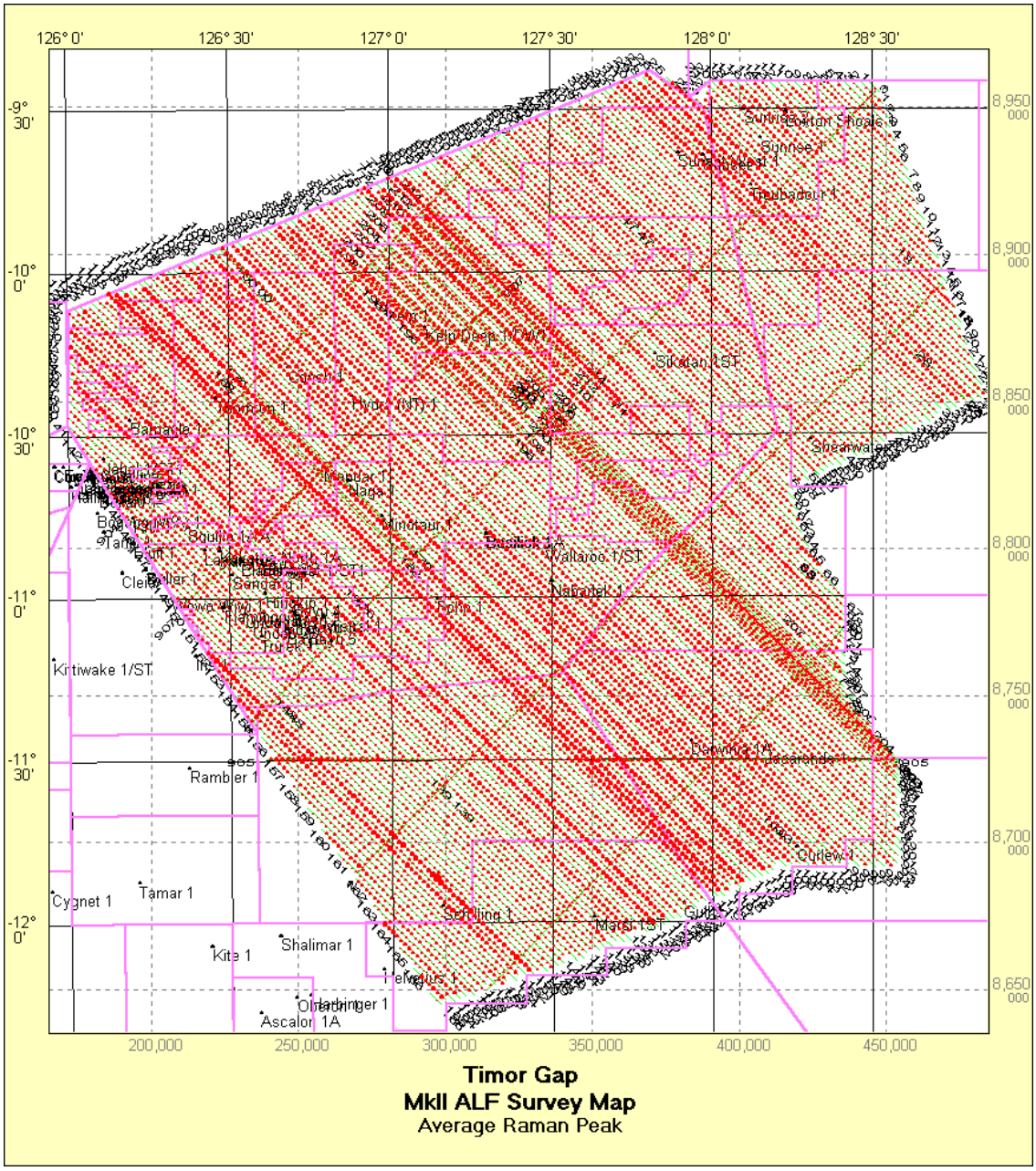


Figure 10. Average Raman Peak Map.

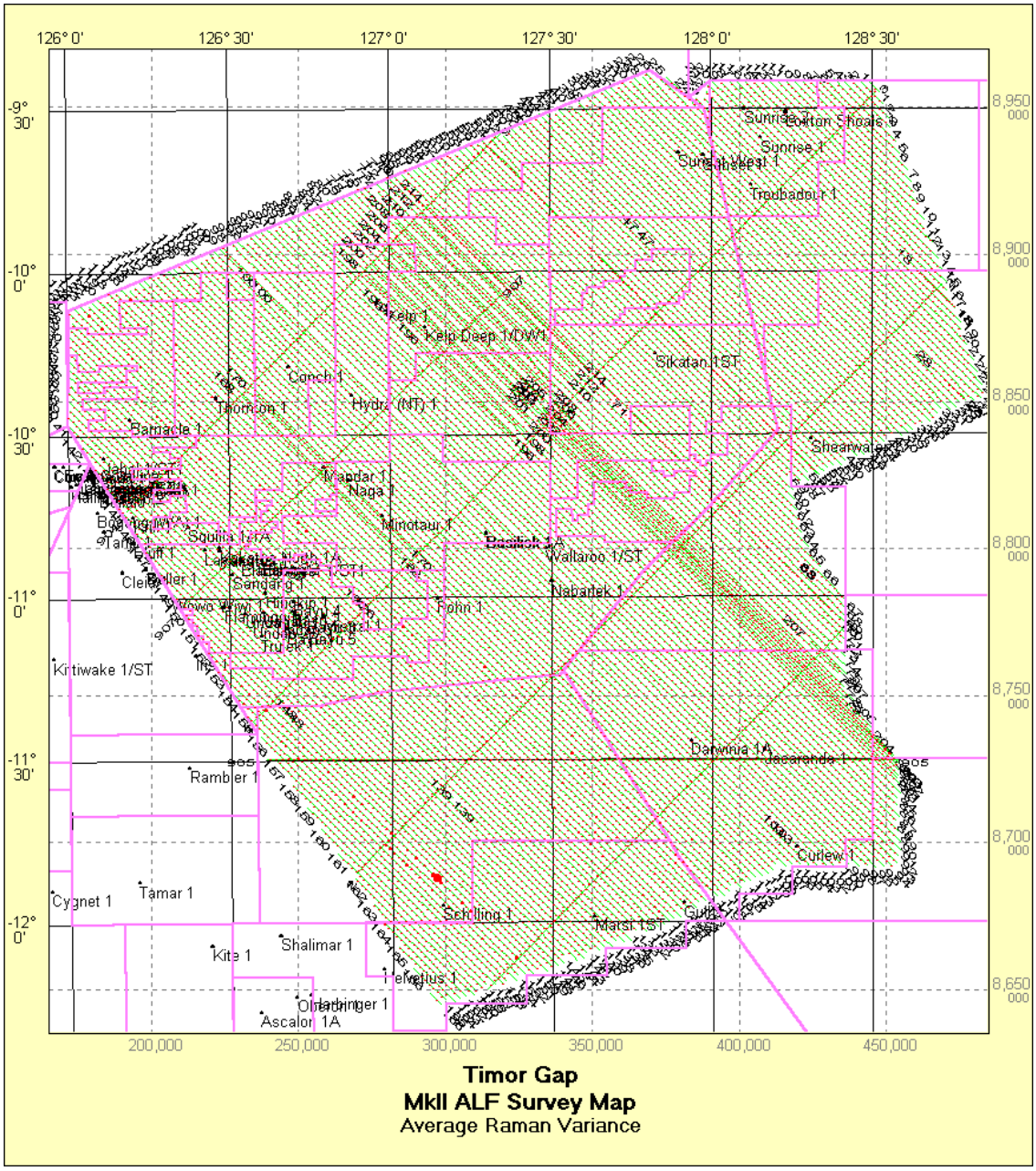


Figure 11. Raman Variance Map.

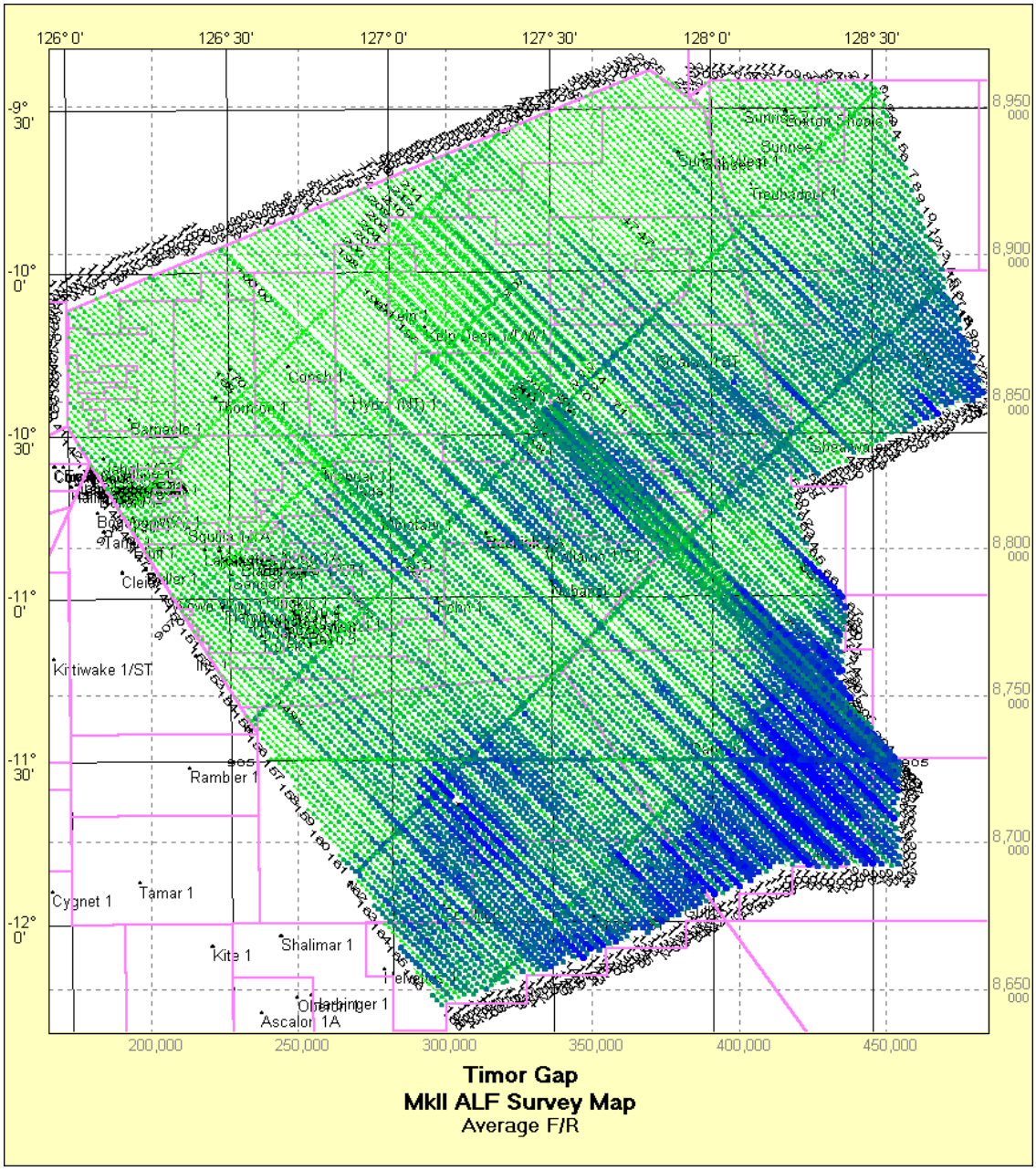


Figure 12. Smoothed F/R Map.

Figure 12 shows the smoothed F/R value over the survey area. The map shows F/R variations that can be correlated between lines.

Appendix 2. Data Navigation QC

Line	Heading (Deg)	Straight Line Distance (m)	Acquisition Time (seconds)	Avg Straight Line Velocity (km/hr)	Points	Flight Distance (m)	Avg Flying Velocity	Avg Point Spacing (m)
1	224.63	172436	0	0	8385	172454.7	0	20.57
2	314.18	11886.5	0	0	590	11887.7	0	20.22
2	44.81	282584.9	0	0	15584	282720	0	18.14
3	224.68	301239.6	0	0	14461	301260.5	0	20.84
4	316.04	23100.56	0	0	1070	23180.77	0	21.7
6	134.9	33869.14	0	0	1976	33870.24	0	17.16
8	134.91	48247.6	0	0	2625	48258.43	0	18.4
10	314.76	59446.4	0	0	3000	59494.2	0	19.84
12	315.13	70901.65	0	0	3320	70947.56	0	21.38
14	135.01	84659.98	0	0	4715	84662.72	0	17.96
16	134.85	96855.9	0	0	5248	96871.92	0	18.47
18	314.92	109875.7	0	0	5413	109904.1	0	20.31
18	314.63	19501.96	0	0	965	19503.73	0	20.25
20	314.95	119746.2	0	0	5570	119768.2	0	21.51
21	314.93	126686.6	0	0	6324	126753.8	0	20.05
22	135.03	129123.2	0	0	6809	129182.7	0	18.98
23	134.93	131598.5	0	0	6971	131621.5	0	18.89
24	134.88	138025	0	0	7450	138130.5	0	18.55
25	314.91	152147	0	0	7560	152276.5	0	20.15
26	314.85	157387.9	0	0	7775	157424.4	0	20.25
27	134.91	157582.7	0	0	8255	157629.2	0	19.1
28	314.96	155324.5	0	0	7770	155413.9	0	20.01
28	314.35	14992.89	0	0	695	14997.74	0	21.64
29	314.89	157127.4	0	0	7775	157181.7	0	20.22
30	134.95	156054.4	0	0	8201	156199	0	19.05
31	134.87	157370.3	0	0	8200	157377.2	0	19.2
32	134.82	154738.3	0	0	9110	154828.9	0	17
33	314.87	156989.5	0	0	7831	157057	0	20.06
34	314.85	157911.8	0	0	7775	157937.9	0	20.32
35	135.04	158614.5	0	0	8850	158687.5	0	17.93
36	314.98	159065	0	0	7555	159131.8	0	21.07
37	314.86	158091	0	0	7835	158117.7	0	20.19
38	134.87	156794.8	0	0	8191	156894.1	0	19.16
39	134.96	158247.5	0	0	8740	158283.4	0	18.11
40	134.76	159061.3	0	0	8895	159116.3	0	17.89
41	314.82	158021.4	0	0	7775	158116.3	0	20.34
42	314.89	157931.1	0	0	7715	157996.4	0	20.48

Table 2a. Timor Gap MkII ALF Survey Line Navigation Summary.

Line	Heading (Deg)	Straight Line Distance (m)	Acquisition Time (seconds)	Avg Straight Line Velocity (km/hr)	Points	Flight Distance (m)	Avg Flying Velocity	Avg Point Spacing (m)
43	134.86	157974.1	0	0	8686	158075.5	0	18.2
44	314.65	159986.5	0	0	8100	160127.7	0	19.77
45	314.71	159600.1	0	0	8088	159609.5	0	19.74
46	134.92	159948.4	0	0	8300	160037.9	0	19.29
47	134.84	51603.7	0	0	2882	51616.37	0	17.92
47	134.78	106760.8	0	0	6065	106860.8	0	17.63
48	134.97	160109.2	0	0	10130	160154.7	0	15.81
49	314.85	158063.6	0	0	7874	158071.2	0	20.08
50	314.78	160944	0	0	8149	161037.5	0	19.77
51	134.84	160803	0	0	8945	160869.5	0	17.99
52	314.83	158670.3	0	0	7830	158768.4	0	20.28
53	314.82	160340.2	0	0	8040	160413.8	0	19.96
54	134.85	160019.5	0	0	8900	160090.3	0	17.99
55	134.82	160902.3	0	0	9434	161120.2	0	17.08
56	134.76	158349.3	0	0	9390	158372.3	0	16.87
58	314.82	160833.5	0	0	8250	160859.7	0	19.5
60	134.78	162155.3	0	0	8915	162257.9	0	18.2
62	134.73	169761.4	0	0	9324	169780.8	0	18.21
64	314.87	178740.2	0	0	8690	178803.7	0	20.58
66	314.76	193327.6	0	0	9870	193407.4	0	19.6
67	314.78	207703.8	0	0	10439	207713.6	0	19.9
68	134.81	211459.3	0	0	11534	211477.8	0	18.34
69	314.83	213998.7	0	0	10674	214041.9	0	20.06
70	314.75	213441	0	0	10256	213482.7	0	20.82
70	134.64	214356.7	0	0	11850	214478.6	0	18.1
71	134.77	219499.9	0	0	11960	219529.3	0	18.36
72	314.79	221350	0	0	10675	221467.7	0	20.75
73	314.67	222876.1	0	0	11160	222955.7	0	19.98
74	134.86	224033.5	0	0	12044	224148.6	0	18.61
75	134.76	229919	0	0	12285	229978.4	0	18.72
76	134.76	233260.4	0	0	12660	233365.7	0	18.44
77	314.72	232247	0	0	11422	232387.4	0	20.35
78	314.76	238215.4	0	0	12125	238248.7	0	19.65
79	134.76	240767	0	0	13246	240990.7	0	18.2
80	314.91	268910.1	0	0	13464	268963.8	0	19.98
81	314.78	273210.8	0	0	13033	273267.2	0	20.97
82	134.78	274321.2	0	0	14380	274479.4	0	19.09

Table 2b. Timor Gap MkII ALF Survey Line Navigation Summary.

Line	Heading (Deg)	Straight Line Distance (m)	Acquisition Time (seconds)	Avg Straight Line Velocity (km/hr)	Points	Flight Distance (m)	Avg Flying Velocity	Avg Point Spacing (m)
83	134.83	278285.8	0	0	15014	278389.3	0	18.54
84	134.76	279878	0	0	15393	279934.9	0	18.19
85	314.75	284615	0	0	14052	284624.5	0	20.26
86	314.74	285463.2	0	0	14381	285497.6	0	19.86
87	134.77	287782.3	0	0	15181	287813.5	0	18.96
88	314.74	290656.2	0	0	14324	290822.2	0	20.31
89	314.73	295076.3	0	0	14430	295176.5	0	20.46
90	134.72	296793.4	0	0	15455	297021.3	0	19.22
91	134.76	299327.8	0	0	15718	299560.3	0	19.06
92	314.76	303235.3	0	0	15135	303254.8	0	20.04
93	314.73	305914	0	0	15614	305982.1	0	19.6
94	314.74	306068.1	0	0	15185	306077.9	0	20.16
95	134.74	304234.9	0	0	16034	304319.8	0	18.98
96	134.75	301544.5	0	0	16145	301572.4	0	18.68
97	314.74	302083.4	0	0	15124	302189.1	0	19.98
98	134.71	300421.8	0	0	15560	300494.3	0	19.31
99	134.52	298932.8	0	0	15744	298948	0	18.99
100	314.69	275729.1	0	0	13398	275796.3	0	20.59
100	314.39	15288.23	0	0	736	15289.2	0	20.83
101	314.69	298013.3	0	0	14864	298064.3	0	20.06
102	314.73	296610.3	0	0	14916	296666.9	0	19.89
103	134.73	293587.7	0	0	15340	293748.3	0	19.15
104	134.7	292598.5	0	0	15505	292679.1	0	18.88
105	314.69	292278.8	0	0	14380	292449.2	0	20.34
106	314.66	290530.9	0	0	14755	290668.5	0	19.7
107	134.68	289699	0	0	14905	289776.8	0	19.44
108	314.65	288544.7	0	0	13955	288616.7	0	20.68
109	314.69	289432.6	0	0	15040	289667.1	0	19.26
110	134.69	289653.1	0	0	15561	289740.9	0	18.62
111	134.67	289687.2	0	0	14825	289770.2	0	19.55
112	134.68	289801	0	0	15368	289890	0	18.87
113	314.66	290439.1	0	0	14963	290471.2	0	19.42
114	314.65	290220.7	0	0	14641	290339.6	0	19.83
115	134.67	289745.7	0	0	15345	289824.8	0	18.89
116	314.64	287709.7	0	0	14545	287728.6	0	19.78
117	314.66	291690	0	0	14755	291803.9	0	19.78
118	134.63	291029.4	0	0	15398	291142.7	0	18.91

Table 2c. Timor Gap MkII ALF Survey Line Navigation Summary.

Line	Heading (Deg)	Straight Line Distance (m)	Acquisition Time (seconds)	Avg Straight Line Velocity (km/hr)	Points	Flight Distance (m)	Avg Flying Velocity	Avg Point Spacing (m)
119	134.68	291423.7	0	0	15290	291434	0	19.06
120	134.58	286353.3	0	0	15304	286420.2	0	18.72
121	314.63	291667.7	0	0	14805	291705.2	0	19.71
122	314.61	290699.5	0	0	14494	290713.3	0	20.06
123	134.61	290895.9	0	0	15620	290920.7	0	18.63
124	314.63	292101	0	0	14488	292128.8	0	20.17
125	314.59	291637.9	0	0	14699	291656.7	0	19.84
126	134.61	291715.6	0	0	15145	291729.8	0	19.26
127	134.61	288149.7	0	0	15450	288252.5	0	18.66
128	134.6	286273.3	0	0	15106	286440.7	0	18.96
129	314.58	285134.3	0	0	14801	285169.8	0	19.27
130	134.61	280464.3	0	0	15021	280508.6	0	18.68
131	134.52	278750.4	0	0	15230	278830.4	0	18.31
132	314.58	276923.6	0	0	13465	277048.4	0	20.58
133	314.6	271907.9	0	0	13789	272097	0	19.74
134	314.62	268590.3	0	0	13520	268738.2	0	19.88
135	134.66	268226	0	0	14539	268308.2	0	18.46
136	134.59	265537.4	0	0	14110	265693.8	0	18.83
137	314.58	262469.3	0	0	13090	262580.1	0	20.06
138	134.6	259924.8	0	0	14050	260062.3	0	18.51
139	134.61	183353.8	0	0	9828	183379.5	0	18.66
139	134.49	70054.8	0	0	3756	70056.89	0	18.66
140	314.61	254178	0	0	12765	254276.4	0	19.92
141	314.57	245571.3	0	0	12065	245706.3	0	20.37
142	314.58	236810.5	0	0	12125	237031.8	0	19.55
143	134.6	228422.9	0	0	12074	228477.6	0	18.93
144	134.53	219064.2	0	0	11310	219069.2	0	19.37
145	314.59	206953.5	0	0	10194	206965.4	0	20.31
146	134.55	200388.4	0	0	10391	200455.8	0	19.3
147	134.6	190862.9	0	0	10136	190916.2	0	18.84
148	314.56	182700	0	0	9115	182767.6	0	20.06
149	134.55	173864.5	0	0	10145	173876.4	0	17.14
150	314.57	164349.4	0	0	7930	164355.3	0	20.73
151	134.62	155754.6	0	0	7830	155758.5	0	19.9
152	134.6	147228.5	0	0	7608	147242.2	0	19.36
153	314.6	136836.6	0	0	6865	136842.8	0	19.94
154	134.56	128980.9	0	0	6645	128987	0	19.42

Table 2d. Timor Gap MkII ALF Survey Line Navigation Summary.

Line	Heading (Deg)	Straight Line Distance (m)	Acquisition Time (seconds)	Avg Straight Line Velocity (km/hr)	Points	Flight Distance (m)	Avg Flying Velocity	Avg Point Spacing (m)
155	314.82	118194.3	0	0	6057	118220.5	0	19.52
156	314.56	108661	0	0	5407	108662.7	0	20.1
157	134.57	96889.82	0	0	4934	96891.65	0	19.65
158	314.63	85974.44	0	0	4129	86052.75	0	20.85
159	314.57	76728.83	0	0	3915	76733.41	0	19.61
160	314.78	66683.68	0	0	3375	66689.22	0	19.77
161	134.62	56720.91	0	0	2895	56722.04	0	19.61
162	134.87	43997.35	0	0	2355	44000.9	0	18.7
163	134.65	35833.47	0	0	1820	35835.94	0	19.71
164	134.82	26686.55	0	0	1445	26687.02	0	18.49
165	314.74	15536.06	0	0	795	15536.65	0	19.59
166	314.95	5680.37	0	0	265	5680.49	0	21.6
168	314.74	75673.02	0	0	3855	75739.63	0	19.66
170	134.62	74552.47	0	0	4070	74555.56	0	18.33
196	315.13	54089.06	0	0	2403	54098.93	0	22.53
196	327.12	119.42	0	0	5	0	0	0
196	270	0	0	0	1	0	0	0
196	296.11	863.2	0	0	36	882.88	0	25.97
196	314.92	3136.1	0	0	112	3136.1	0	28.51
196	314.65	1818.24	0	0	68	1818.24	0	27.55
196	314.46	60.36	0	0	3	0	0	0
196	314.17	487.97	0	0	17	0	0	0
196	314.21	277.99	0	0	9	0	0	0
196	314.64	102.95	0	0	6	0	0	0
196	314.9	911.01	0	0	31	0	0	0
198	134.67	75751.94	0	0	4213	75756.16	0	17.99
200	314.52	75466.89	0	0	3750	75487.41	0	20.14
201	134.77	173010.3	0	0	9586	173101.9	0	18.06
202	314.76	172744.1	0	0	8405	172841.6	0	20.57
202	135.01	74796.72	0	0	4225	74886.84	0	17.73
203	314.84	170865.1	0	0	8525	170941.9	0	20.06
204	134.89	155783.9	0	0	8099	155872.9	0	19.25
204	314.68	74925.07	0	0	3699	74941.08	0	20.27
206	134.95	76242.02	0	0	4340	76315.67	0	17.59
208	316.06	78205.95	0	0	3864	78379.7	0	20.3
210	134.68	75128.94	0	0	4290	75206.35	0	17.54
212	314.82	74573.01	0	0	3688	74574.68	0	20.23

Table 2e. Timor Gap MkII ALF Survey Line Navigation Summary.

Line	Heading (Deg)	Straight Line Distance (m)	Acquisition Time (seconds)	Avg Straight Line Velocity (km/hr)	Points	Flight Distance (m)	Avg Flying Velocity	Avg Point Spacing (m)
214	134.67	74419.13	0	0	4285	74431.77	0	17.38
904	44.59	181278.1	0	0	9719	181310.3	0	18.66
905	90.01	214804.6	0	0	11258	214811.4	0	19.08
907	45.54	151794.5	0	0	7880	151820.3	0	19.27
1	315.54	5472.05	0	0	265	5472.34	0	20.81
3	134.46	16847.32	0	0	965	16847.87	0	17.5
5	315.46	30774.87	0	0	1500	30801.16	0	20.56
7	134.9	42524.68	0	0	2408	42525.13	0	17.67
9	314.87	54959	0	0	2669	54960.47	0	20.61
11	135.07	66222.22	0	0	3640	66224.08	0	18.2
13	314.67	78089.39	0	0	3745	78100.65	0	20.87
15	134.91	90118.8	0	0	4920	90120.66	0	18.32
17	314.9	101808.9	0	0	4870	101824	0	20.92
19	134.95	115053.6	0	0	6260	115133.9	0	18.4
55	314.79	160977.6	0	0	8094	161136.8	0	19.91
57	134.76	161308.9	0	0	9168	161345.8	0	17.6
59	314.74	157746.3	0	0	7875	157804	0	20.04
61	134.81	165453.5	0	0	9554	167359.5	0	17.52
63	314.74	174733.5	0	0	8621	174777.2	0	20.28
65	134.77	183780.5	0	0	10340	183946.4	0	17.79
203	314.83	170448.5	0	0	8530	170507.9	0	19.99
205	134.7	143458.6	0	0	8202	143500.8	0	17.5
207	314.87	16077.88	0	0	660	16078.05	0	24.43
TOTAL		**35,923,849.06**			**1,860,650**	**35,935,960.25**		

Table 2f. Timor Gap MkII ALF Survey Line Navigation Summary.

A total of 1,860,650 ALF spectra were recorded on 208 lines. A total of nearly 36,000 km of lines were flown during the survey.

Figure 13 shows the average point spacing plotted for all lines. The spacing typically lies between 17 and 29m. Several short line segments have a calculated average point spacing of 0 because the navigation QC module requires at least 100 points for its calculations.

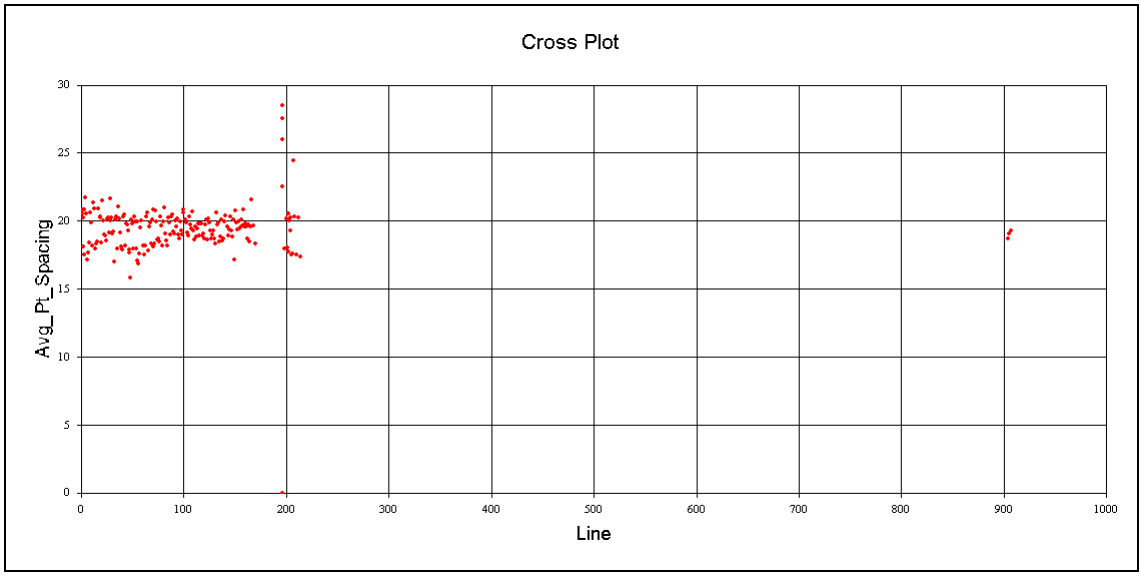
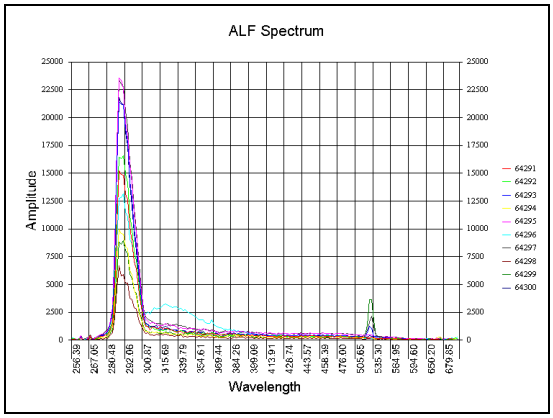


Figure 13. The Average Point Spacing Plotted for All Lines.

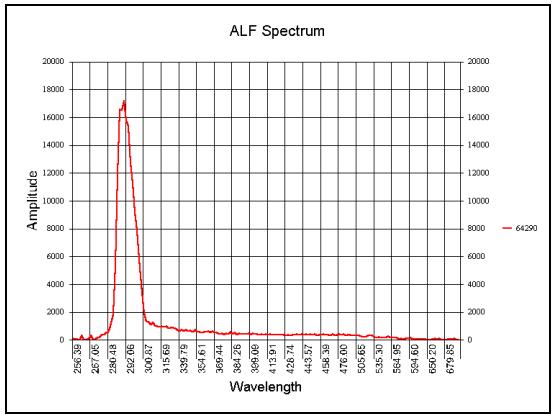
Appendix 3. **Comparison of MkII and MkIII ALF Survey Data**

Figure 14 shows a comparison of ALF MkIII survey data from the Skua region with the Timor ALF MkII data. Figure 14a shows a typical isolated MkIII fluor within ten adjacent spectra. Figure 14b shows a typical non-fluorescing spectrum. A medium intensity fluor is shown in Figure 14c. When the fluor is averaged with the surrounding non-fluor spectra (Figure 14d), the response is difficult to distinguish from the non-fluor spectra. The averaging process has tended to filter out the fluorescence response and enhance the more consistent water response.

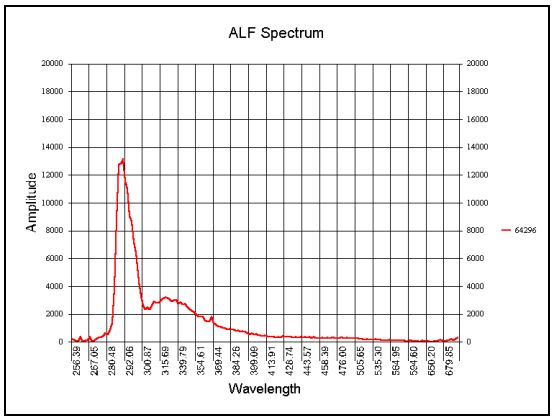
Figures 14e and 14f show a typical non-fluor and interpreted medium intensity fluor from the Timor MkII ALF survey. The refined interpretation method is required to distinguish the more subtle MkII fluors.



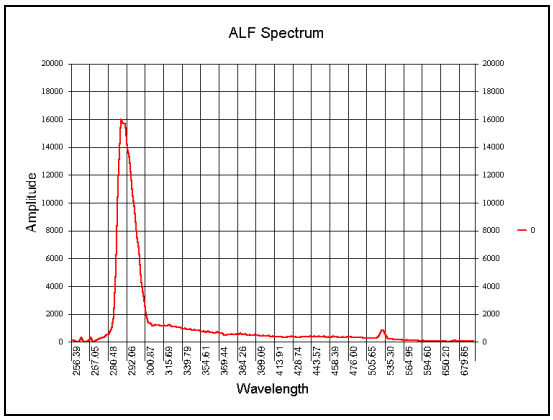
a) Skua ALF MkIII Ten Adjacent Spectra



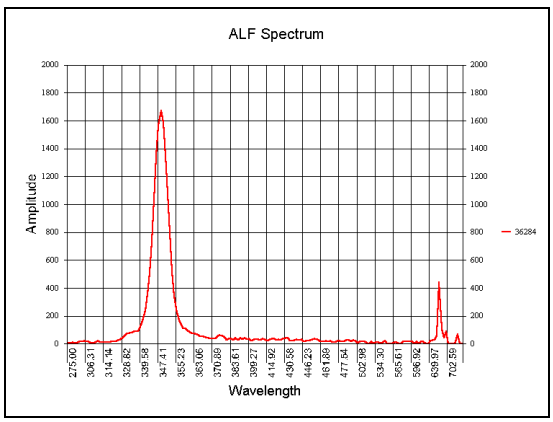
b) Skua Line 30130 No Fluor



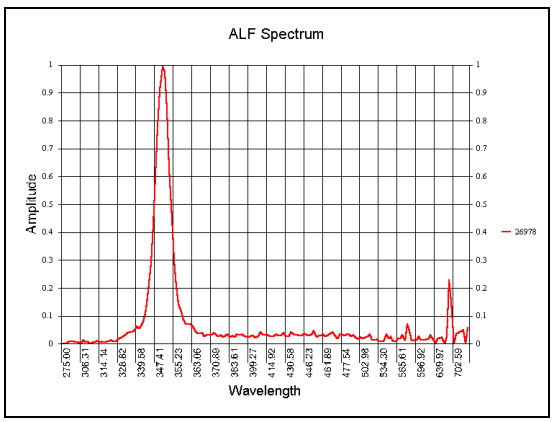
c) Skua Line 30130 Medium Fluor



d) Skua Line 30130 Ten Spectra Averaged



e) Timor MkII Line 15 No Fluor



f) Timor MkII Line 21 Medium Fluor.

Figure 14. Comparison of Skua MkIII and Timor Sea MkII ALF Data.

Appendix 4. CD Contents

The CD contains the following files:

Timor Gap MkII ALF Project.zip
: the *ALF Explorer™* project

Timor Gap MkII ALF Survey Interpretation Report.doc
: the interpretation report document file

Timor Gap MkII ALF Survey Picked Fluors.txt
: an ASCII data file of the fluors selected during the interpretation

Timor Gap MkII ALF Survey Summary.xls
: Excel spreadsheet containing the survey acquisition and navigation QC summaries

Figures
: Directory containing figures used in the interpretation report