Comparison of AGSO North-West Shelf Airborne Laser Fluorosensor Survey Interpretations

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1. Introduction

This report compares the interpretation results of the six AGSO ALF surveys located in Northern Australia (Figure 1).

Much of the potential value in an airborne laser fluorosensor survey lies in assessing the oil generation risk of an unexplored region. To do this the interpretation results of an ALF survey should allow comparison between surveys. This comparison is made easier when consistent interpretation and display methods are used.

While an interpretation of a single airborne laser fluorosensor (ALF) survey will show the relative seepage variations and character over the survey area, it may not provide a good indication of absolute seepage levels and more regional seepage character variations. To address this problem, this report provides summaries of each AGSO ALF survey interpretation and brief discussion of their comparison.

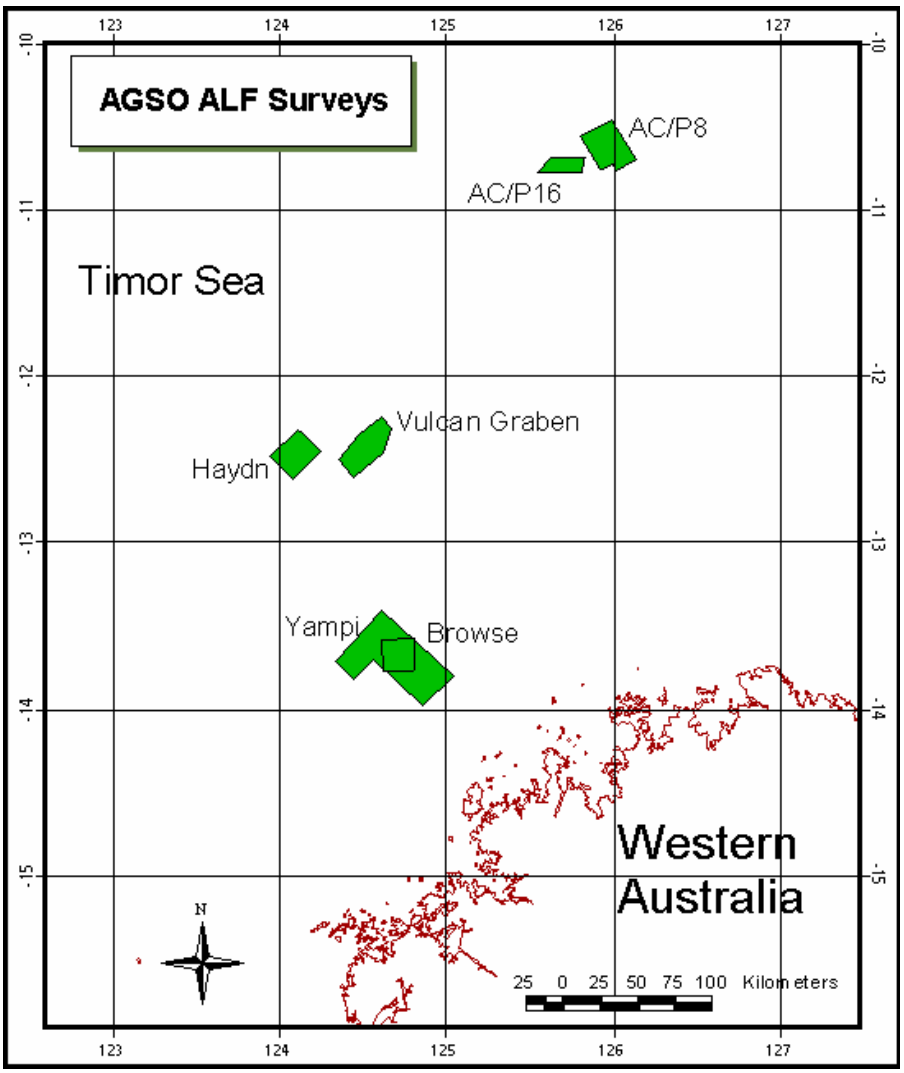


Figure 1 Location Map for the AGSO ALF Surveys.

2. AGSO ALF Survey Summary Pages

2.1. Summary Page Description

The AGSO ALF survey interpretation data is summarized on the following pages. Each page contains an interpreted fluor map and a fluor size histogram. A page of typical fluorescence responses is also shown for each survey.

The comparison of the overlapping Yampi and Browse surveys shows that interpretation bias and display scaling can distort the perceived seepage levels. It is also possible that the direction the surveys are flown with respect to the seepage and wind direction could affect the number and pattern of fluors detected.

The fluor histogram display can indicate the level of seepage and the effort taken to pick low amplitude fluors.

Survey Name	Km Flown	No. Spectra	No. Fluors Interpreted	Fluor Density (ppm)	Large Fluor Density (ppm)
AC/P8	1,490.1	1,040,856	249	239	43
AC/P16	412.9	290,337	111	382	176
Haydn	2,438.0	1,529,484	21	14	3
Yampi	3,148.4	2,149,037	132	61	20
Browse	488.7	343,563	57	165	3
Skua	2,419.2	1,569,513	183	117	107

Table 1. Selected ALF Survey Parameters.

Table 1 shows selected parameters for the ALF surveys analysed in the AGSO project. The fluor density value is the number of fluors picked from every million spectra (fluors per million spectra). This value should be used with caution as it is affected by the interpretation effort and data quality (ie laser intensity) as well as the actual number of fluors present at the time of the survey.

The large fluor density value is the number of fluors having F/R greater than 0.30 picked from every million spectra (large fluors per million spectra). This measure is much more reliable because the large fluors can be picked consistently.

The symbol scale used to display the standard maps is defined by the following parameters on the Symbol Settings form:
Field value 1 = 0, Symbol size 1 = 0, Field value 2 = 1.5, Symbol size 2 = 2268.
(Previously, before the scaling was updated in *ALF Explorer* software version 2.04, the settings were:
Field value 1 = 0, Symbol size 1 = 0, Field value 2 = 1.5, Symbol size 2 = 20.)

The symbol sizes are defined in map units (symbol diameter in metres). A 10km graticule is used on all maps in this report as a scale reference. Some variation in map scale was required for display purposes, which also affects the size of the fluor circles. The histogram plots provide the most consistent fluor size comparison.

2.2. AC/P8 ALF Survey Summary

Standard fluor map and F/R histogram displays.

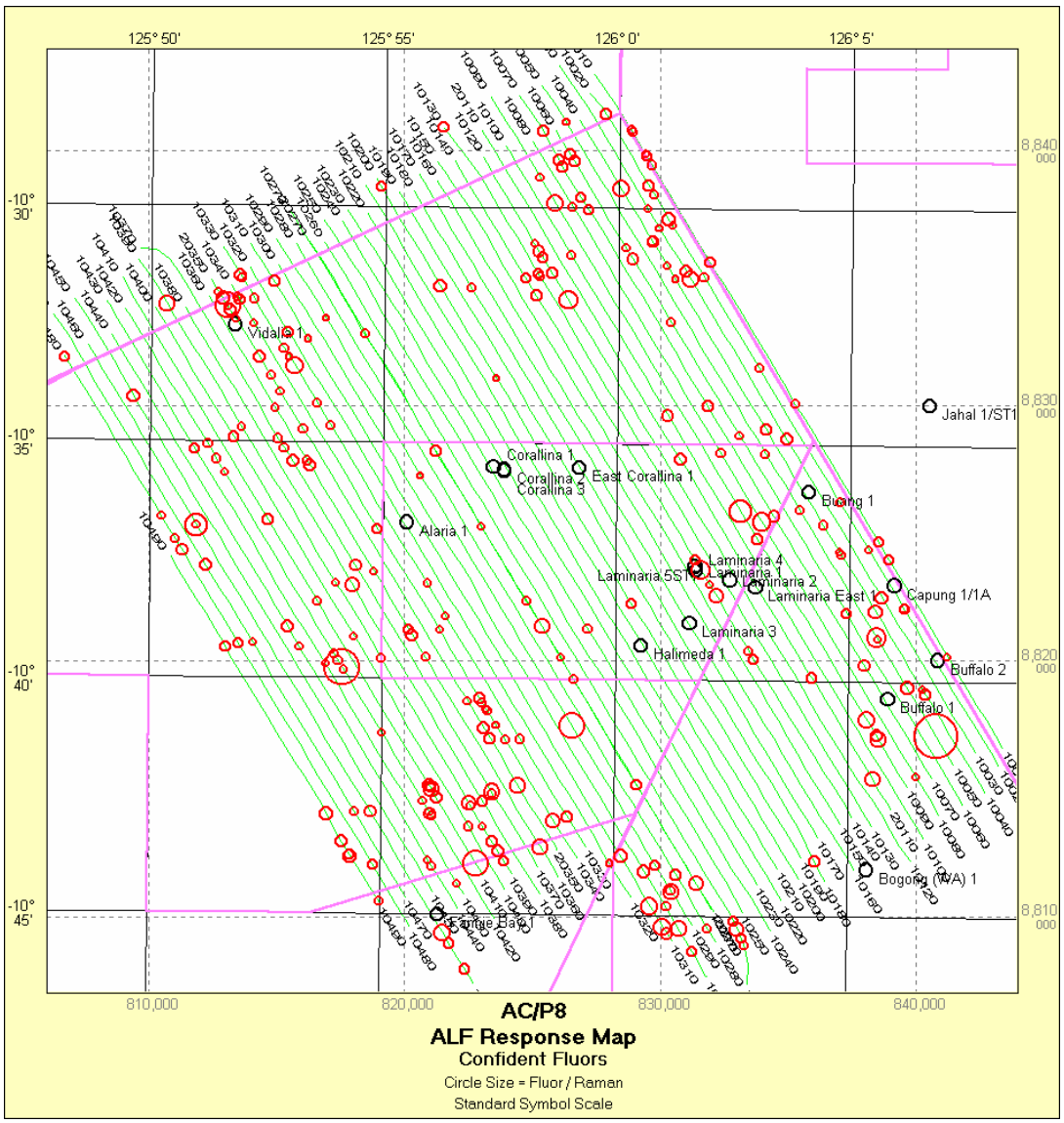


Figure 2. The AC/P8 ALF Survey Standard Fluor Map.

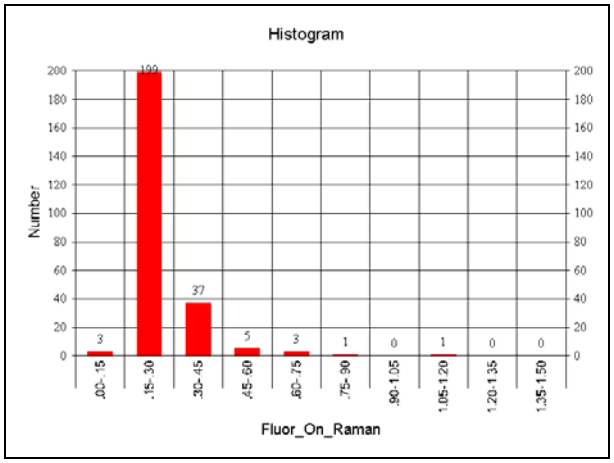
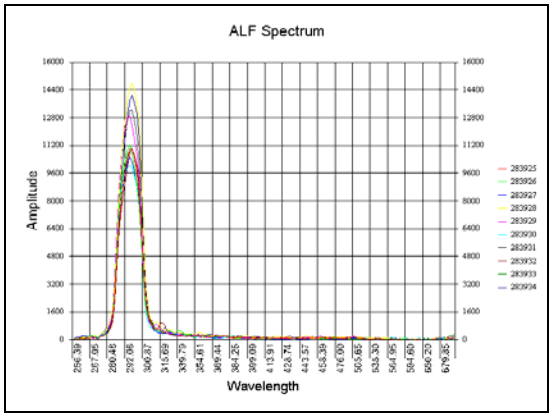
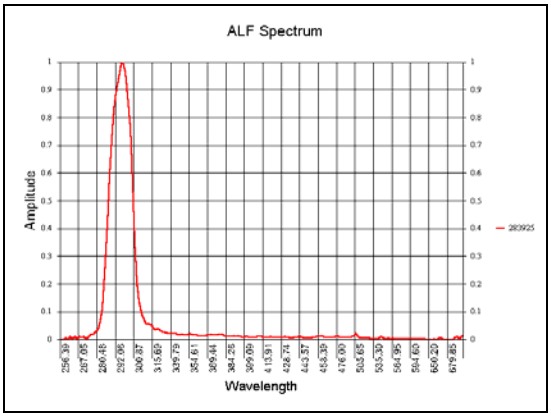


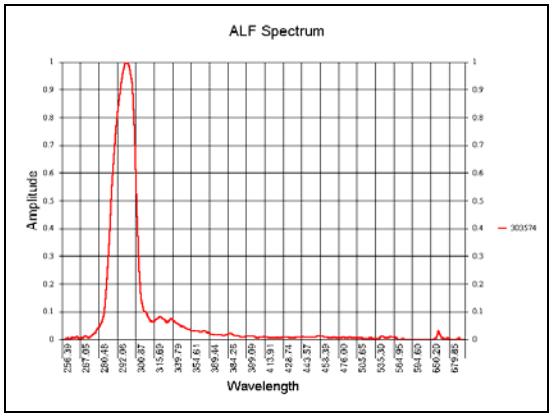
Figure 3. The AC/P8 ALF Survey F/R Area Histogram.



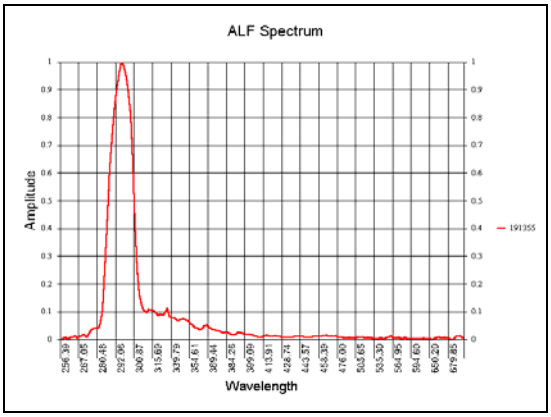
3 a) Line 10010 Ten Adjacent ALF Spectra.



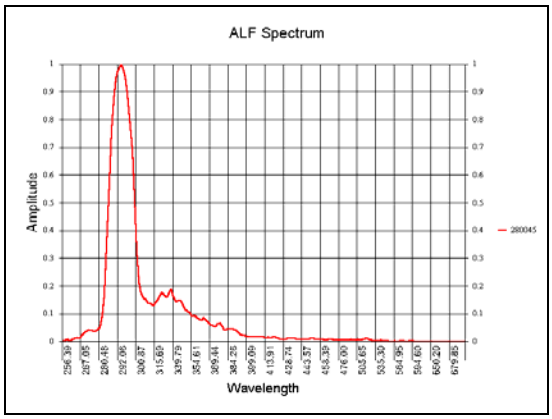
3 b) Line 10010 No Fluor.



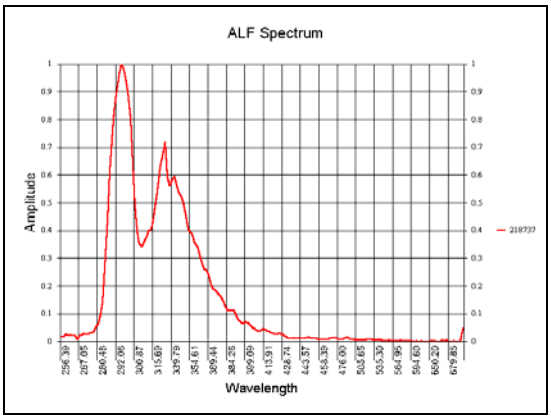
3 c) Line 10330 Low Amplitude Fluor.



3 d) Line 10060 Small to Medium Fluor.



3 e) Line 10020 Medium to Large Fluor.



3 f) Line 10050 Largest Amplitude Fluor.

Figure 4. AC/P8 ALF Survey Selected Spectra.

2.3. AC/P16 ALF Survey Summary

Standard fluor map and F/R histogram displays.

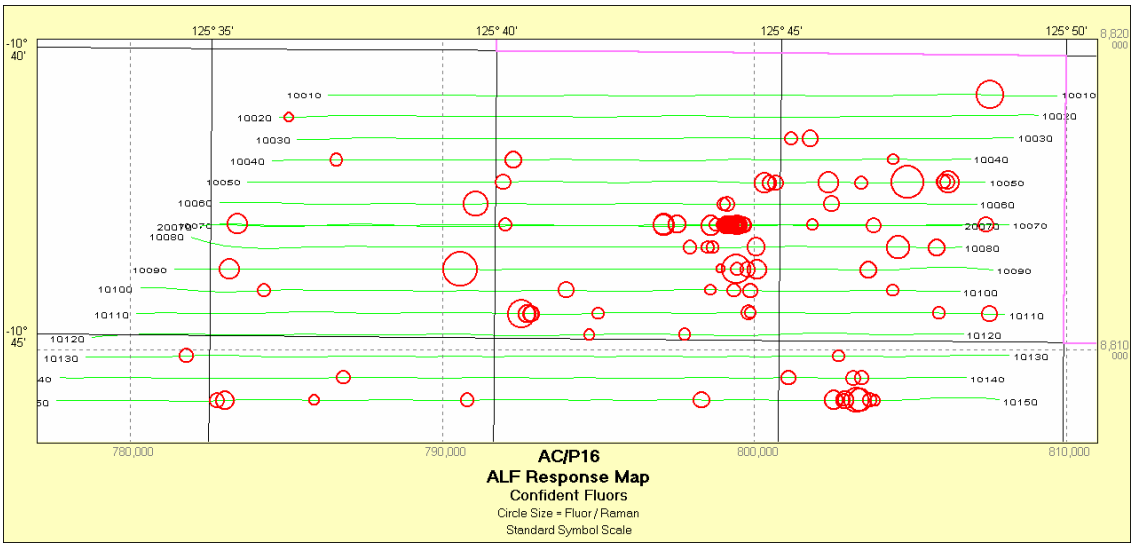


Figure 5. The AC/P16 ALF Survey Standard Fluor Map.

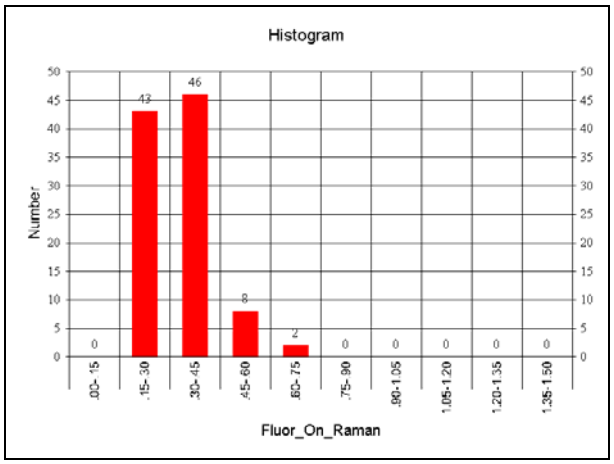
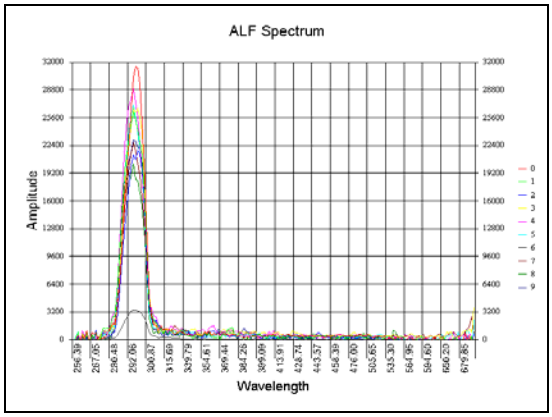
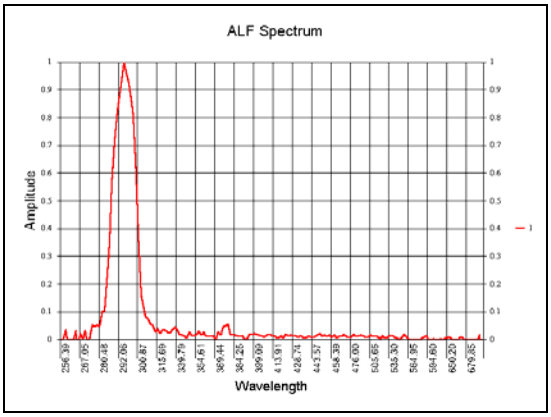


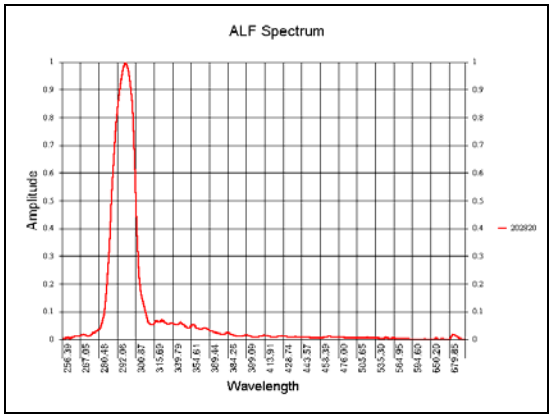
Figure 6. The AC/P16 ALF Survey F/R Area Histogram.



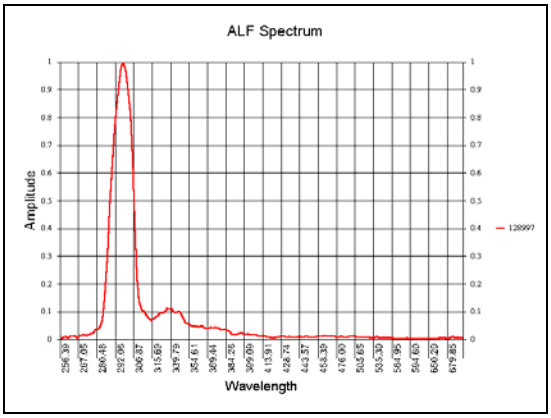
6 a) Line 10010 Ten Adjacent ALF Spectra.



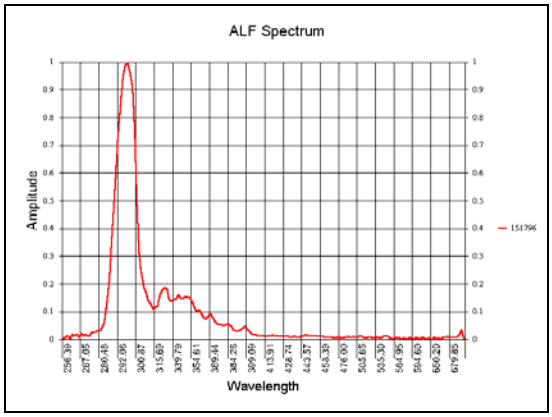
6 b) Line 10010 No Fluor.



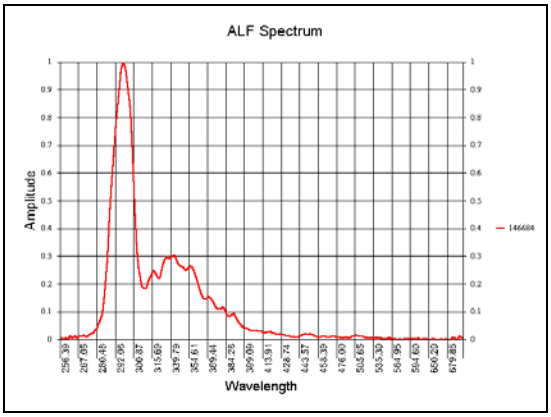
6 c) Line 10120 Smallest Fluor.



6 d) Line 10080 Small Fluor.



6 e) Line 10090 Medium Fluor.



6 f) Line 10090 Largest Fluor.

Figure 7. AC/P16 ALF Survey Selected Spectra.

2.4. Haydn ALF Survey Summary

Standard fluor map and F/R histogram displays.

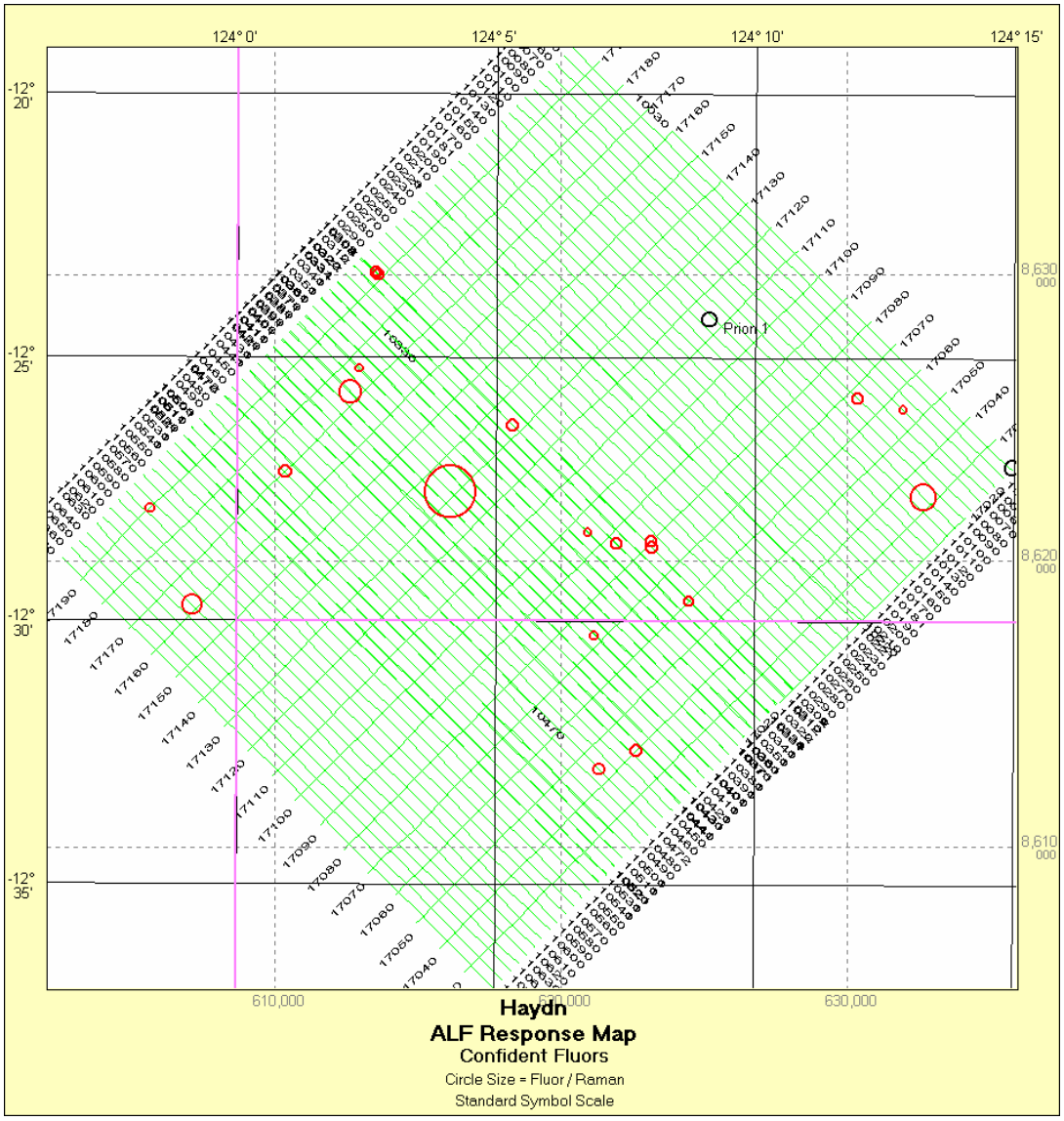


Figure 8. The Haydn ALF Survey Standard Fluor Map.

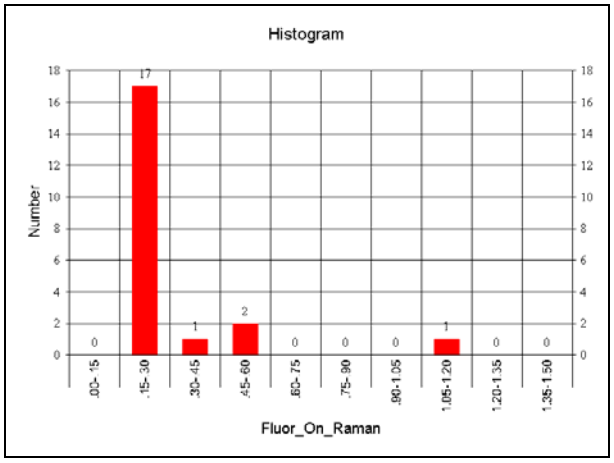
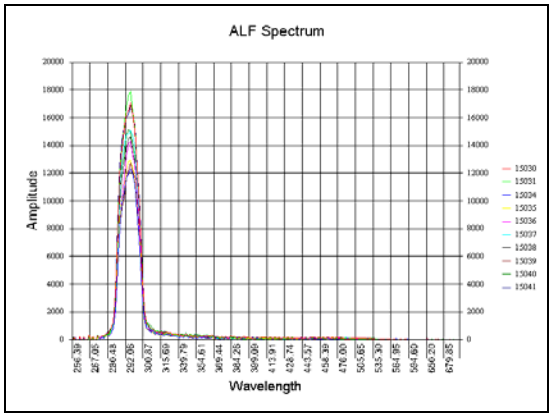
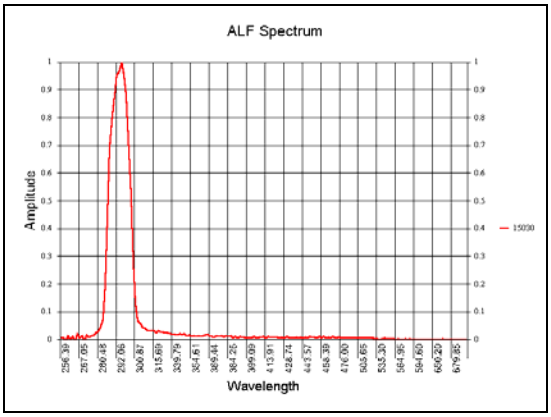
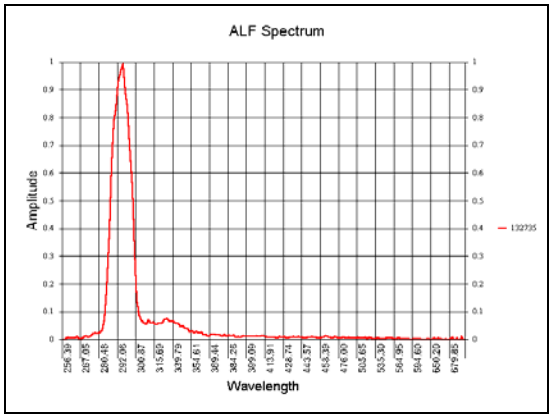


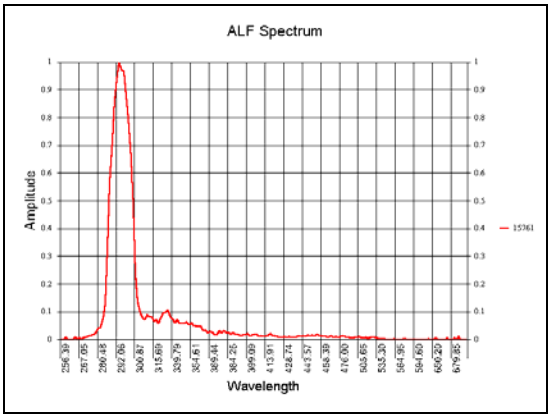
Figure 9. The Haydn ALF Survey F/R Area Histogram.



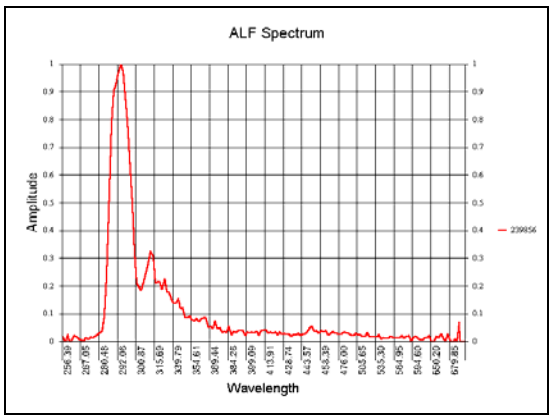


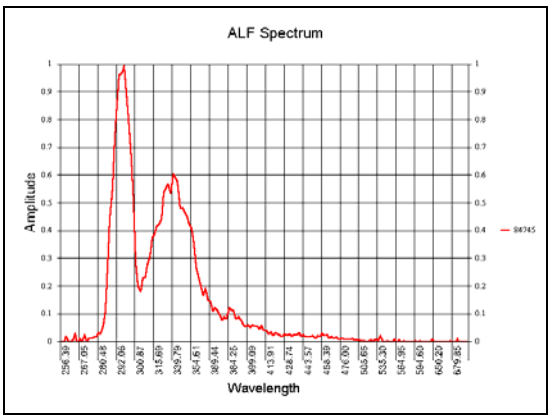
9 a) Line 10020 Ten Adjacent ALF Spectra. **9 b) Line 10020 No Fluor.**





9 c) Line 10060 Lowest Amplitude Fluor. **9 d) Line 10302 Small Fluor.**





9 e) Line 10620 Medium Fluor. **9 f) Line 10391 Largest Fluor.**

Figure 10. Haydn ALF Survey Selected ALF Spectra.

2.5. Yampi ALF Survey Summary

Standard fluor map and F/R histogram displays.

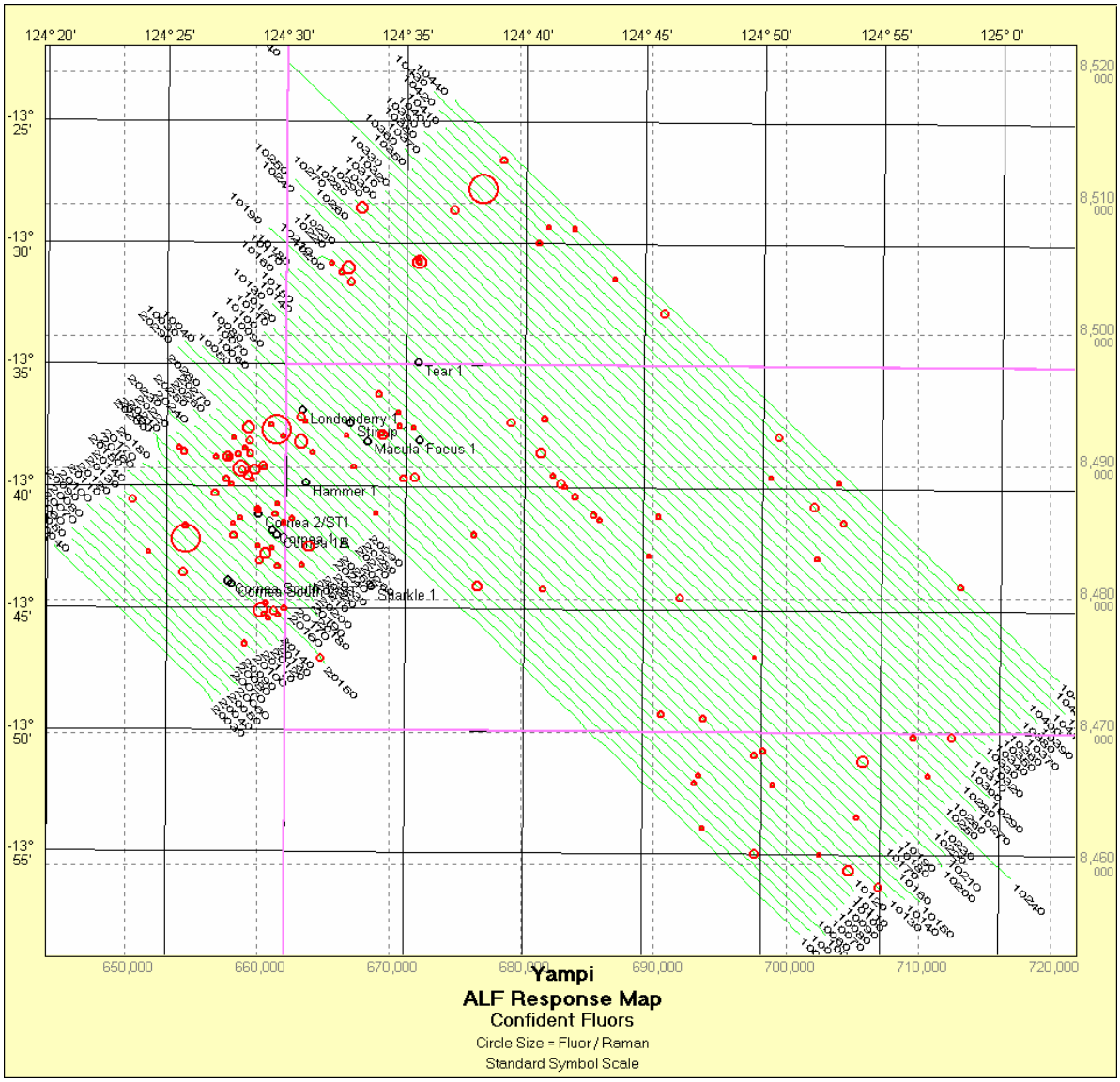


Figure 11. The Yampi ALF Survey Fluor Map.

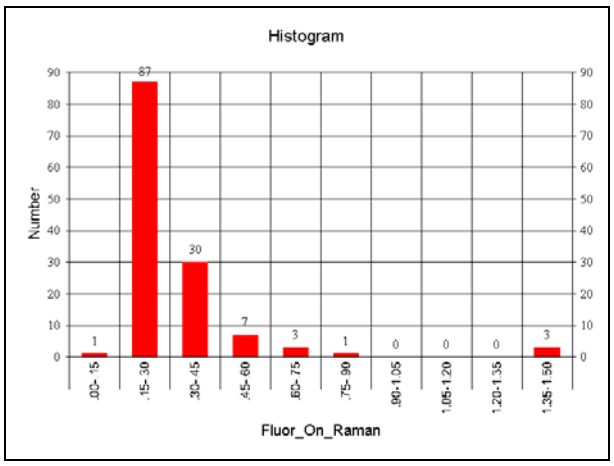
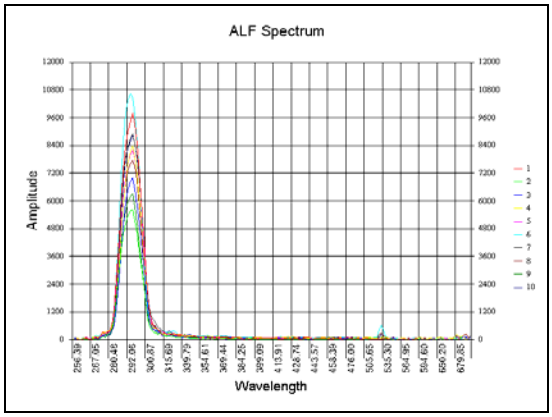
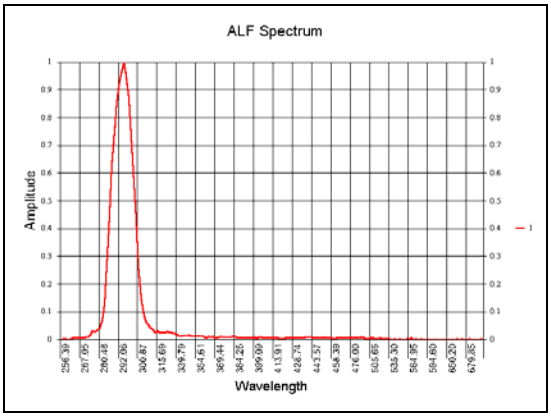
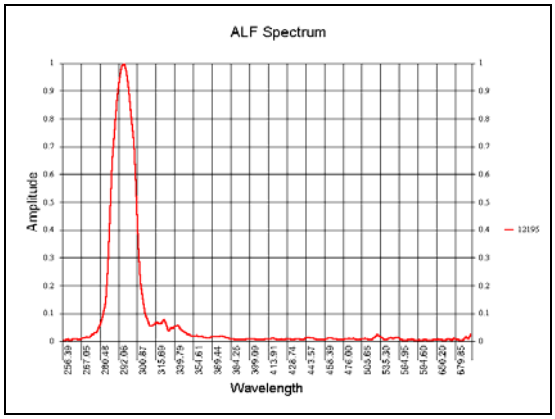


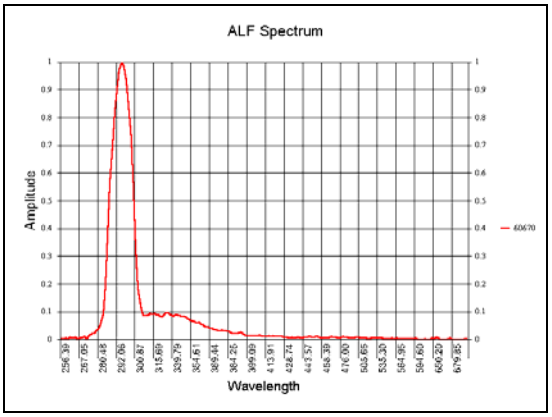
Figure 12. The Yampi ALF Survey F/R Area Histogram.



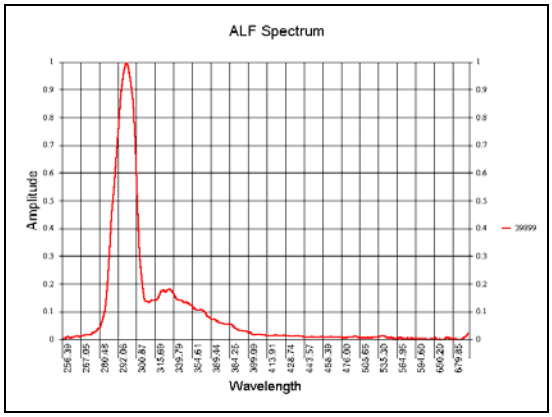


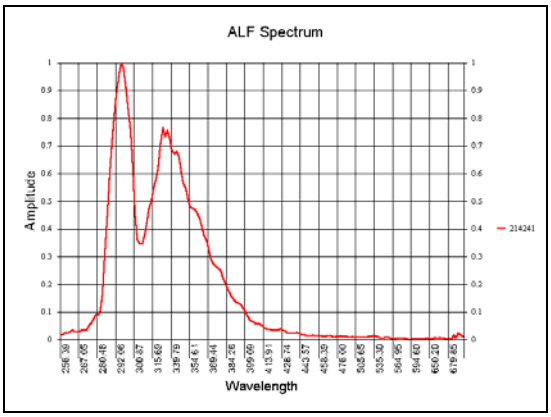
12 a) Line 10030 Ten Adjacent ALF Spectra. **12 b) Line 10030 No Fluor.**





12 c) Line 10220 Low Amplitude Fluor. **12 d) Line 20230 Medium Amplitude Fluor.**





12 e) Line 10350 Medium Amplitude Fluor. **12 f) Line 10390 High Amplitude Fluor.**

Figure 13. Yampi ALF Survey Selected Spectra.

2.6. Browse ALF Survey Standard Summary

Standard fluor map and F/R histogram displays.

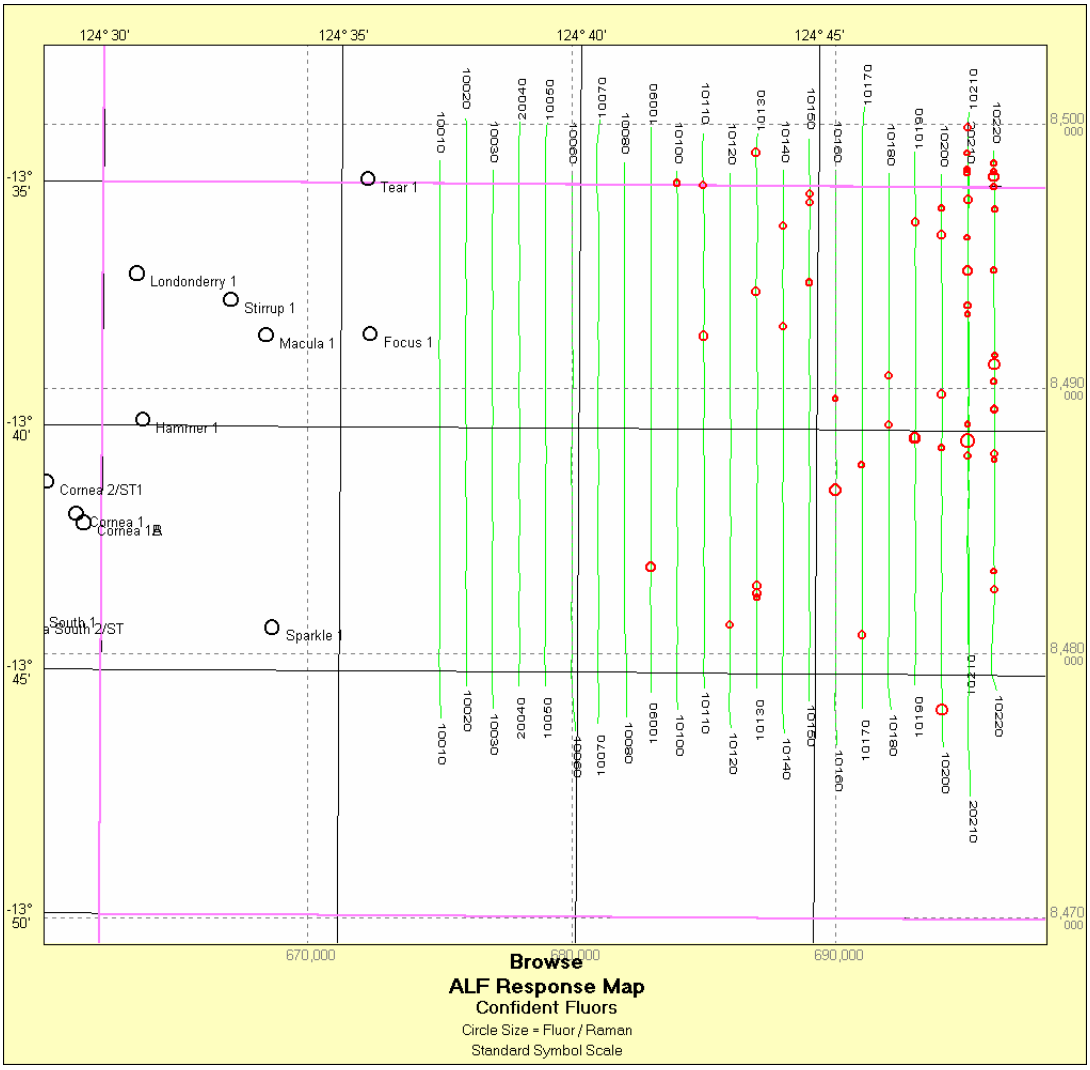


Figure 14. The Browse ALF Survey Standard Fluor Map.

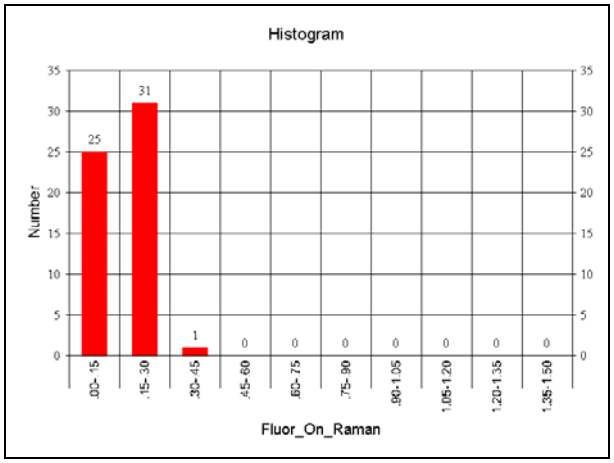
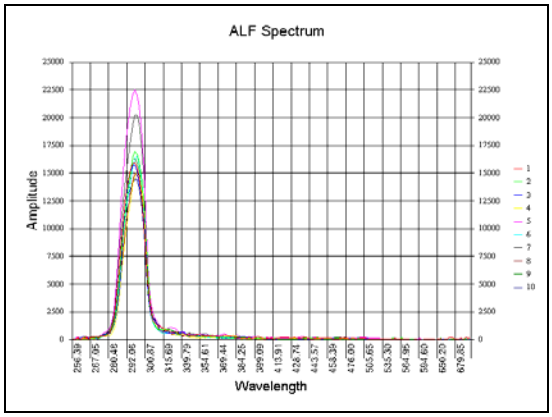
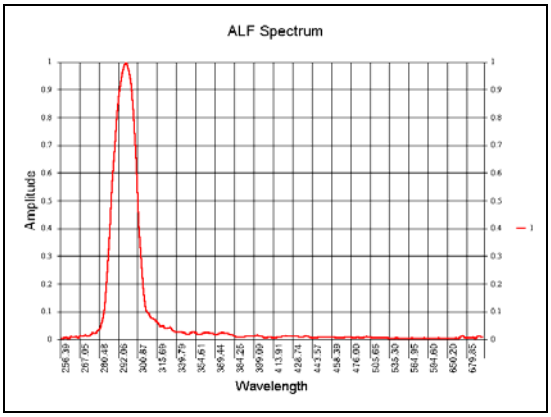


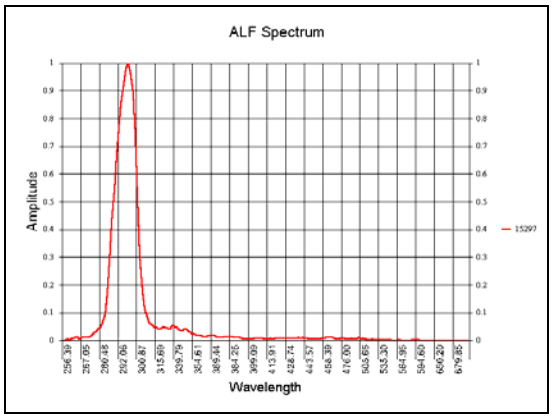
Figure 15. The Browse ALF Survey F/R Area Histogram.



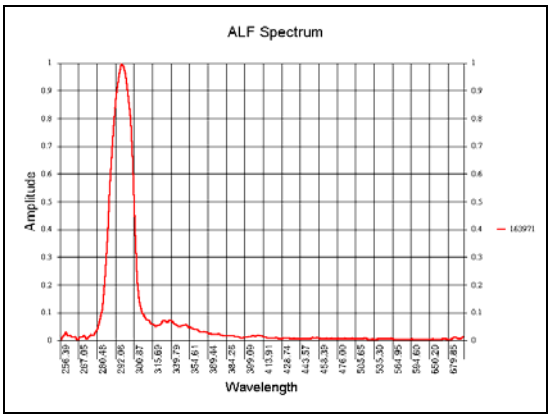
15 a) Line 10220 Ten Adjacent ALF Spectra.



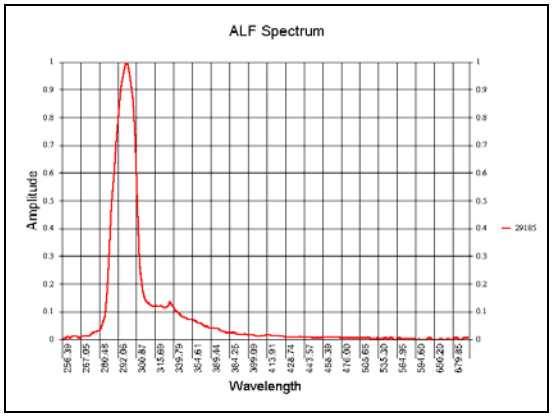
15 b) Line 10220 No Fluor.



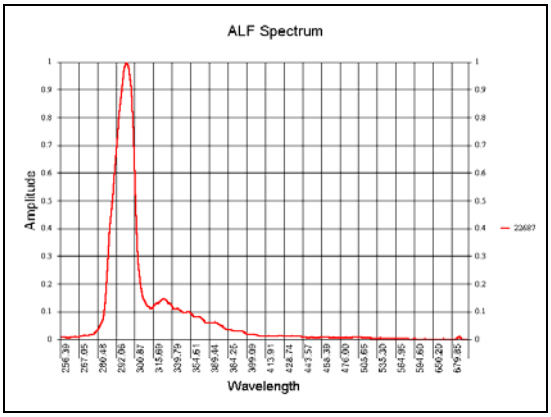
15 c) Line 10210 Lowest Amplitude Fluor.



15 d) Line 10110 Small Amplitude Fluor.



15 e) Line 10200 Large Amplitude Fluor.



15 f) Line 10210 Largest Amplitude Fluor.

Figure 16. Browse ALF Survey Selected Spectra.

2.7. Yampi and Browse ALF Surveys -- Combined Mapping

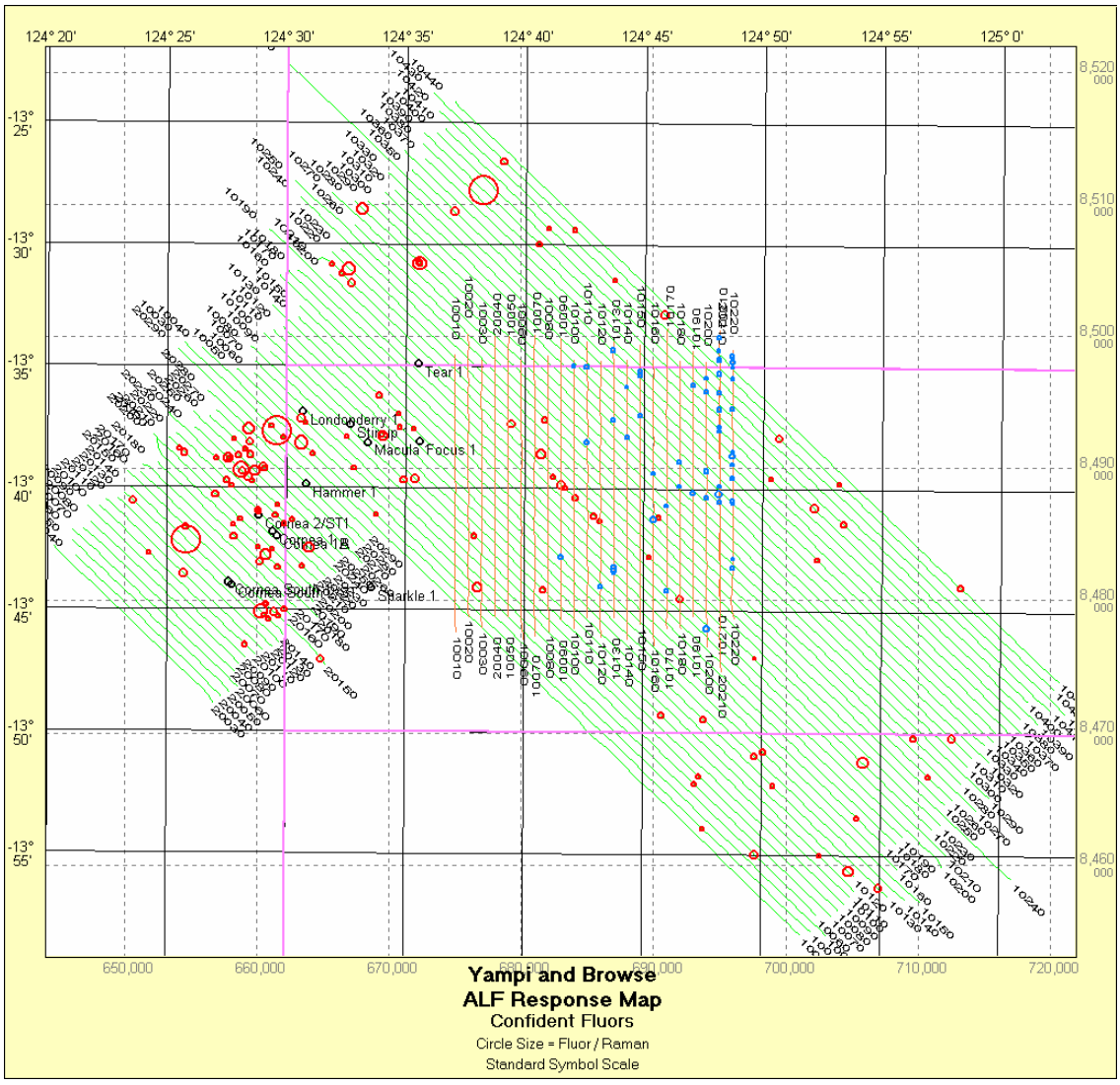
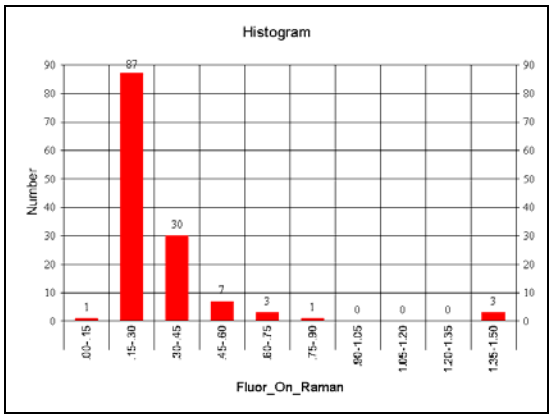
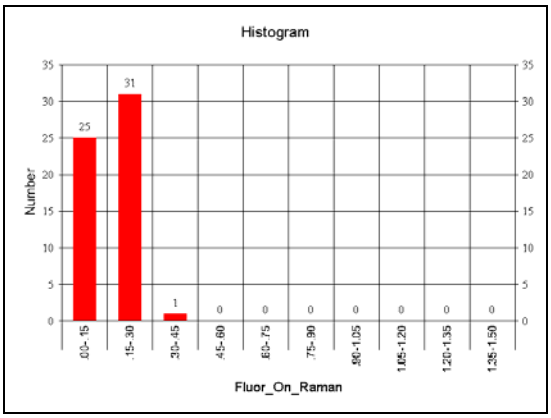


Figure 17. Combined Yampi and Browse ALF Survey Standard Fluor Map. (Yampi Fluors are Red, Browse Fluors are Blue.)



a) Yampi Fluor Histogram.



b) Browse Fluor Histogram.

Figure 18. Yampi and Browse F/R Area Histograms.

2.8. Skua ALF Survey Summary

Standard fluor map and F/R histogram displays.

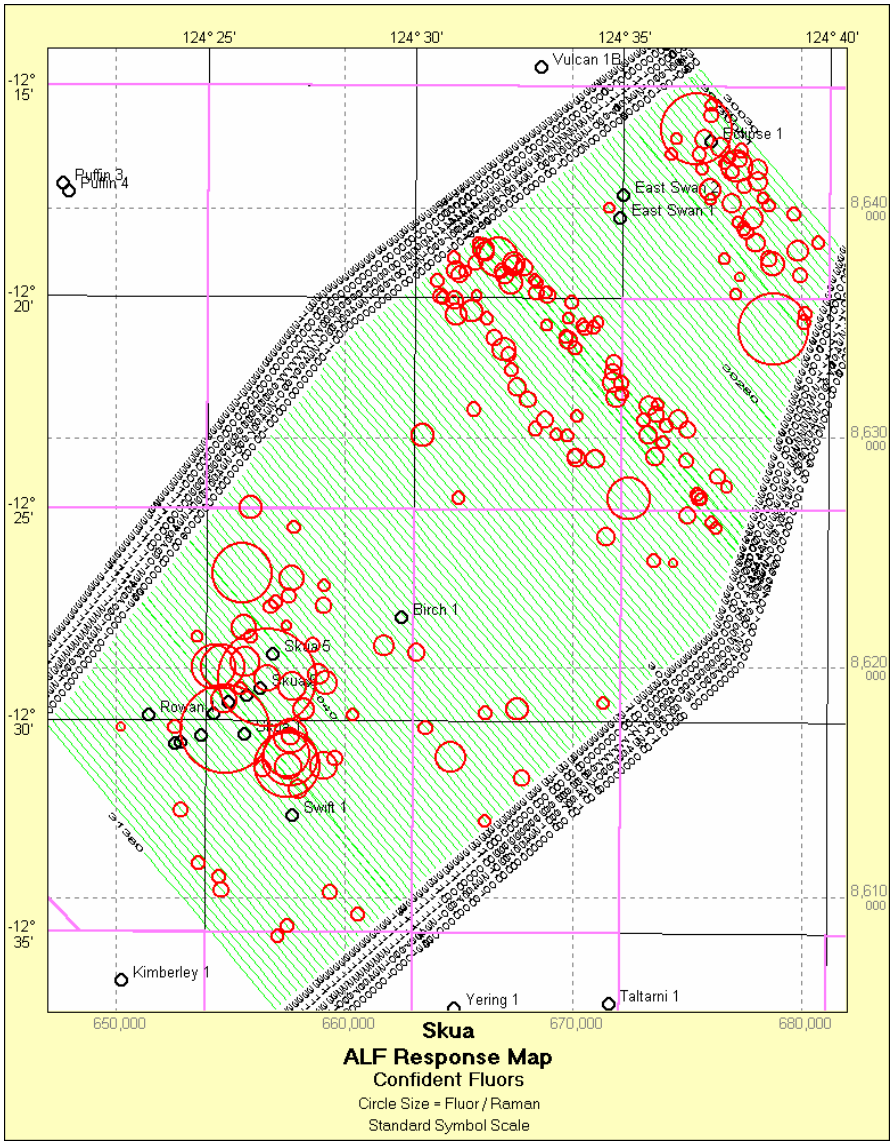


Figure 19. The Skua ALF Survey Standard Fluor Map.

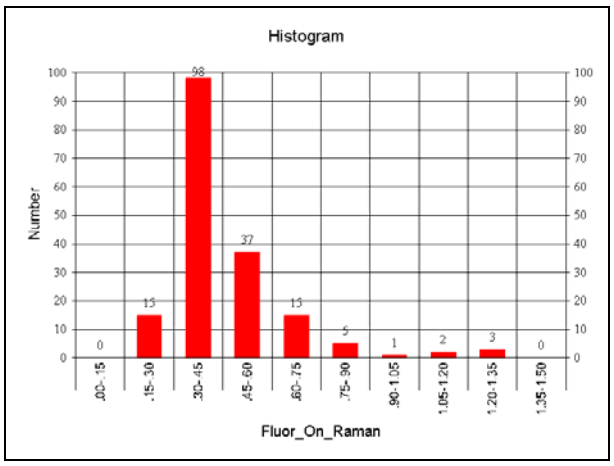


Figure 20. The Skua ALF Survey F/R Area Histogram.

The Skua ALF survey has fluors with the highest F/R area ratio. The standard 0 to 1.5 range used to compare the other surveys does not extend far enough to show all of the high F/R fluors in the Skua survey. Figure 21 extends up to 3.00 and shows the complete Skua histogram.

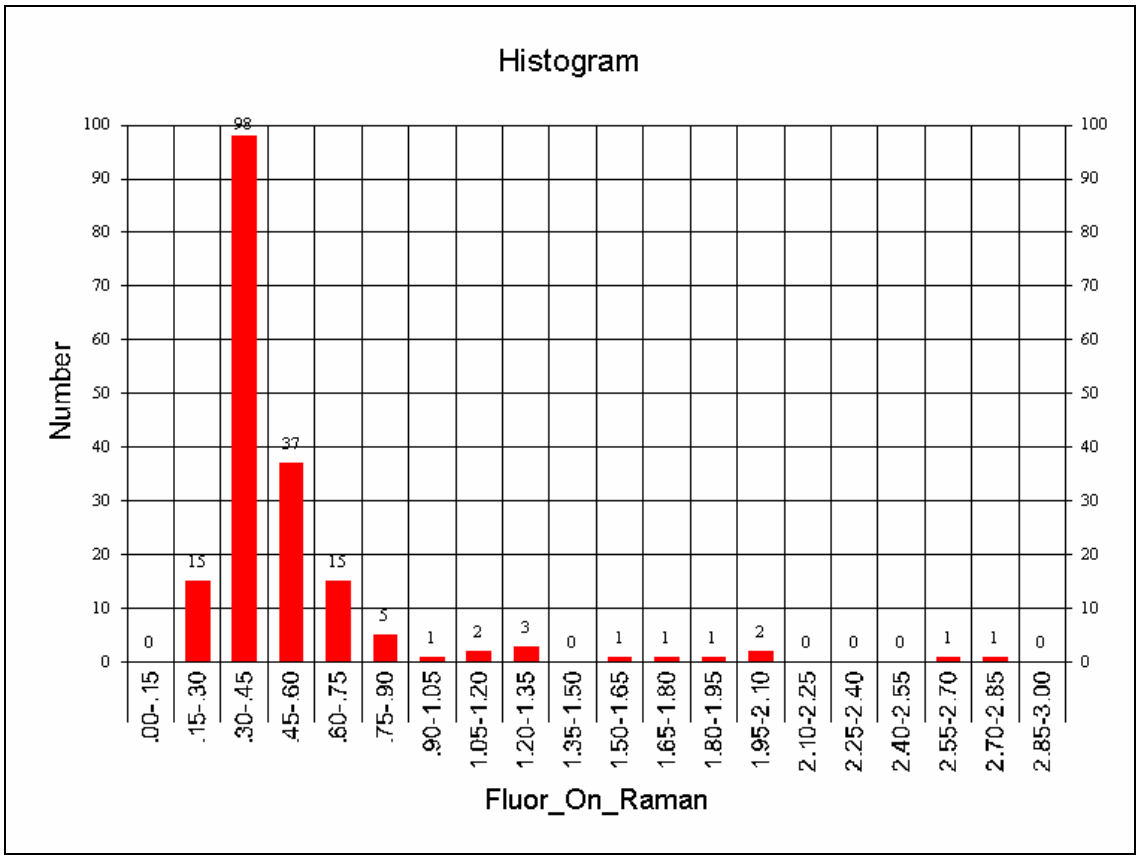
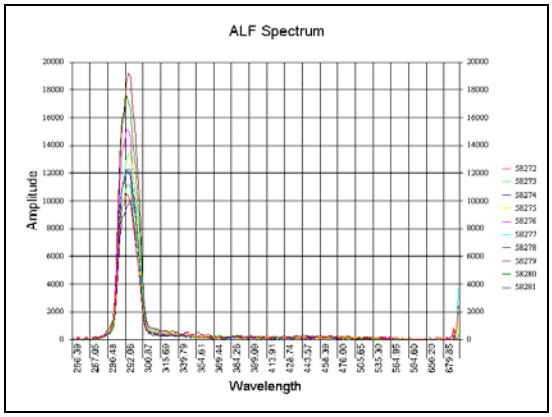
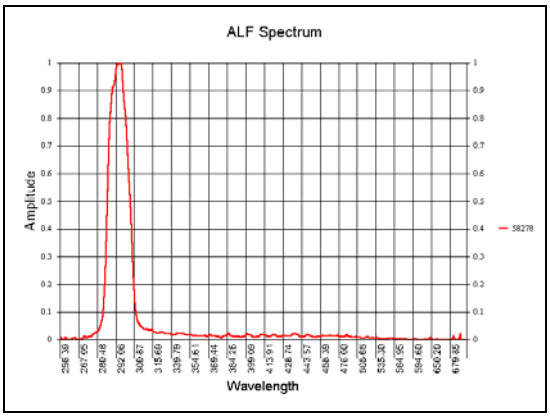


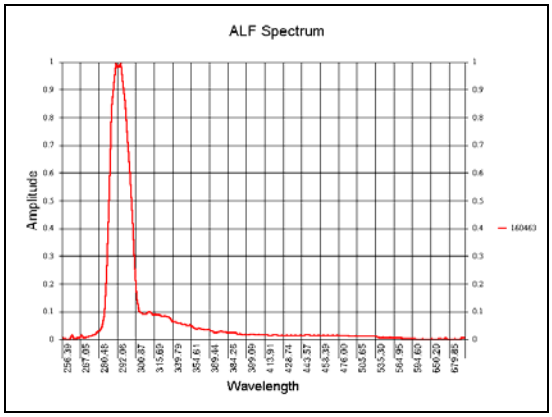
Figure 21. The Skua ALF Survey F/R Area Histogram (F/R 0 to 3.0).



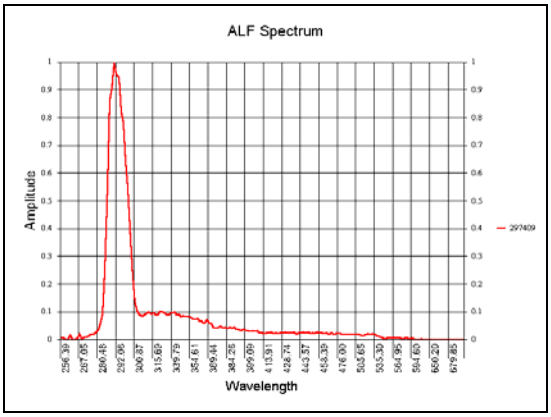
21 a) Line 10413 Ten Adjacent Fluors.



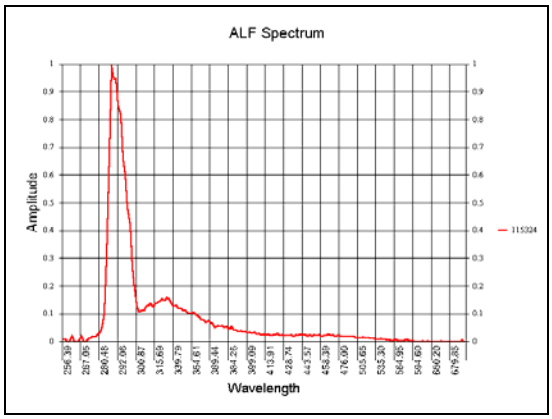
21 b) Line 10413 No Fluor.



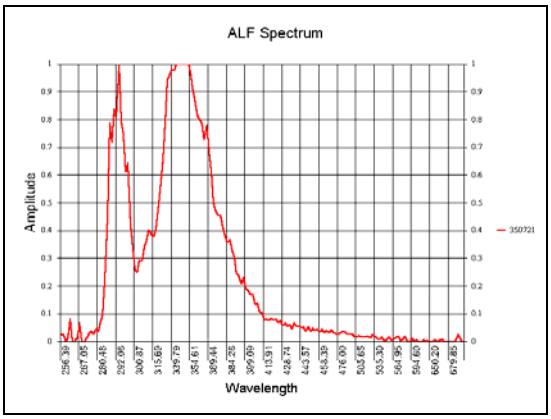
21 c) Line 31290 Small Fluor.



21 d) Line 31060 Small to Medium Fluor.



21 e) Line 30890 Medium Fluor.



21 f) Line 31080 Largest Fluor.

Figure 22. Skua ALF Survey Selected Spectra.

3. Conclusions and Recommendations

ALF survey interpretation maps can be misleading if inconsistent display parameters are used between surveys. This is important if the surveys are used to rank different regions for prospectivity. In this report a comparison of different surveys is made using consistent display scales and fluor size histogram plots.

In this report it is assumed that the fluorescence area / Raman area ratio is a relatively consistent measure of fluorescence intensity, largely independent of acquisition parameters. It has been necessary to modify the fluorescence region used in the calculations to exclude the laser “backscatter” region. (See Appendix 2.)

While some analysts favour fluorescence density as a good prospectivity indicator, fluorescence size may also be significant. Some regions having dense but very low amplitude fluors do not appear to relate to prospective areas.

Noisy data acquisition is a problem with some surveys leading to reduced interpretation confidence. Low amplitude fluors become more difficult to pick as the noise levels increase. Care must be taken when the acquisition parameters vary across the survey to avoid this affecting the picked fluor distribution.

Low intensity fluors cannot currently be picked consistently. Statistics based on these are much less reliable than those based only on higher intensity fluors. A F/R area ratio greater than 0.30 is used in this report to define a confident higher intensity fluor. The Skua interpretation has relatively few low intensity fluors because noise problems make it difficult to separate them from the noisy records. The Browse survey has many low intensity fluors picked because extra effort was made so that the data could be compared with the overlapping Yampi survey.

Dense, high amplitude fluor regions may be taken as a good sign for exploration. In some areas such as Skua and Cornea, the fluor clusters are located near to the fields. There is a notable absence of a cluster over the Laminaria Field, but the size and density of fluors in the surrounding areas may indicate a working source and migration system.

Using the large fluor density values listed in Table 1, the six surveys would be ranked, in order of confidence in the presence of an active petroleum system with a level of seepage: 1) AC/P16, 2) Skua, 3) AC/P8, 4) Yampi, 5) Haydn and 6) Browse. Areas within each survey can also be ranked depending on the fluor distribution and geological models of the region.

The consistent interpretation and display methods that have been developed are essential for comparing the oil potential of different regions. More ALF surveys should be analysed to improve our understanding of the relationship between fluor patterns and prospectivity.

Appendix 1. Browse ALF Survey Summary -- Default Scaling

Figures 23 and 24 show the fluor map and F/R histogram for the Browse ALF survey displayed with the default scaling parameters. In this case the scaling exaggerates the fluor intensity when compared to the standard scales used in Figures 14 and 15. Standard scales should be used when comparing different surveys.

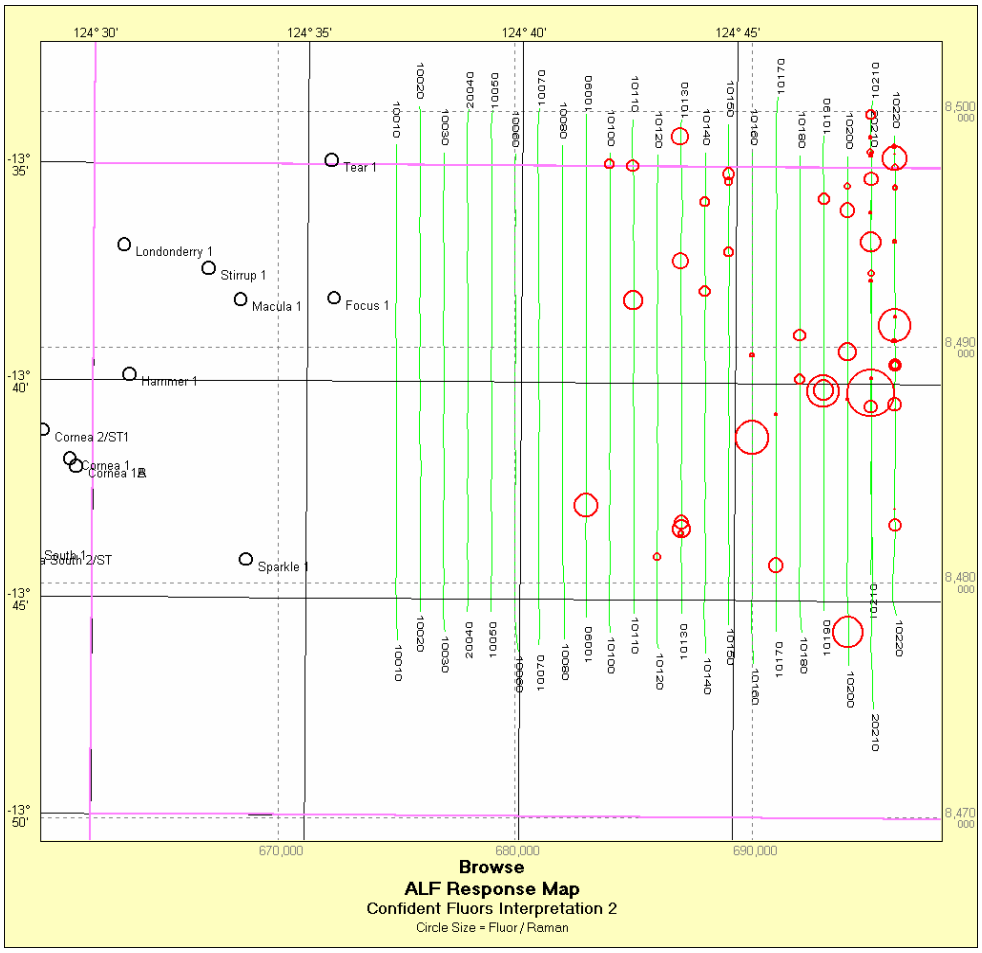


Figure 23. The Browse ALF Survey Fluor Map (Automatic Fluor Scaling).

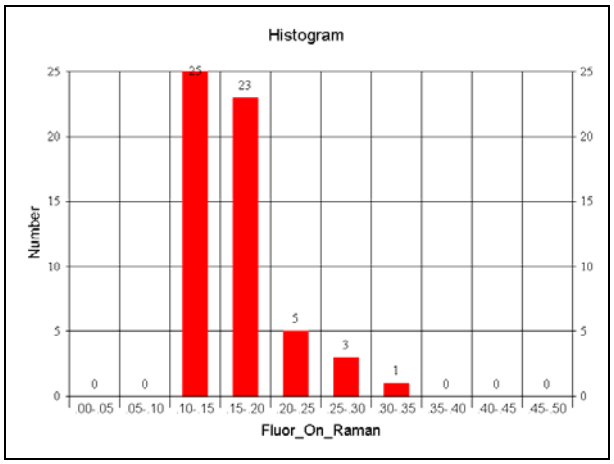


Figure 24. The Browse ALF Survey F/R Area Histogram (Automatic Range).

Appendix 2. The Effect of Laser “Backscatter” on the Fluorescence / Raman Area Ratio

The fluorescence area is usually calculated between the wavelengths 320nm and 580nm. Figure 25 shows an example of a fluor picked on the Yampi ALF survey that has a very large laser “backscatter” response near 535nm. The fluorescence area of this response between 320 and 580nm is 28,822. Most of this value lies in the laser “backscatter” region (18,137 between 505.65 and 564.95nm). A revised fluorescence region from 320nm to 480nm was used for most F/R calculations to avoid this error.

This modification may not be possible in regions having heavier oils and fluorescence extending over the laser “backscatter” wavelengths.

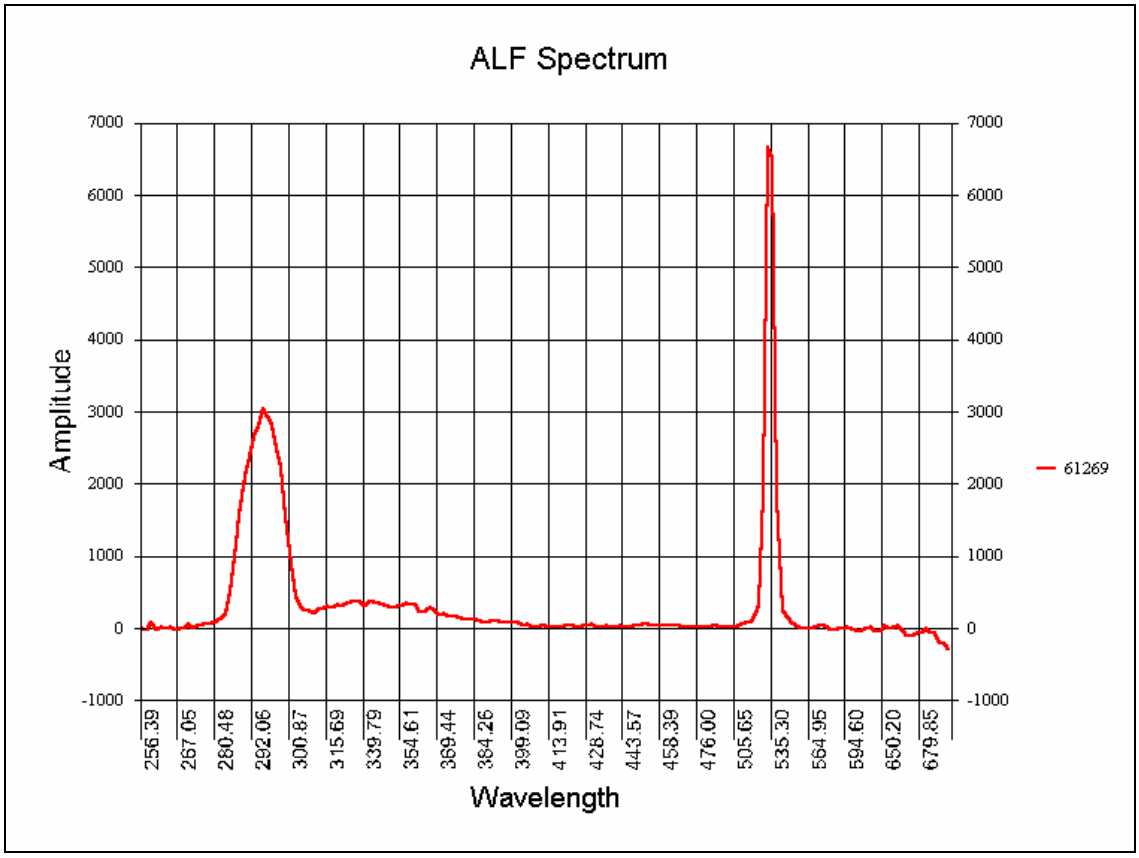


Figure 25. Line 20110 Large Laser “Backscatter” Example.