GORE® Survey for Exploration
Amplified Geochemical Imaging^{SM} Service
FINAL REPORT

Exploration Permit EL58/2008
East Coast of Tasmania

Conducted for:
E&P INVESTMENTS AUSTRALIA PTY LTD
P.O. Box 340
Brighton, Victoria 3186
Australia

GORE Project #20228044
Final Report Date: 31 March 2011

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Amplified Geochemical Imaging^{SM} Technique
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Final Report Date: 31 March 2011

Conducted by:

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EXECUTIVE SUMMARY

A surface soil gas geochemical survey, the GORE® Survey for Exploration, has been completed for E&P INVESTMENTS AUSTRALIA PTY LTD (E&P INVESTMENTS), over portions of Exploration Permit EL58/2008 along the east coast of Tasmania. This "Final Report" presents the results of the analysis and interpretation of geochemical data through the survey area, as well as recommendations for further action. A description of this surface geochemical method is included in Appendix A, "GORE® Survey for Exploration".

The objectives of this geochemical survey are: (1) to detect hydrocarbon signatures related to oil or gas accumulations in the area; and (2) to identify regions of petroleum prospectivity within the survey area. Successful completion of these objectives will provide surface geochemical evidence for an active petroleum system or systems in the region.

The geochemical survey conducted over the Wombat field in Victoria will be discussed in a separate section of this report. The survey in Tasmania was located along sections of the east coast, and farther inland. The survey spanned sections of the coast from ~5 km north of the city of Four Mile Creek, to ~8 km north of the city of Bicheno, and extended inland of St. Marys by ~4 km (Figure 1). The survey in Tasmania included 219 samples in total, placed in semi-regular to irregular pattern with variable sample spacing (~500 – 1,000 meters in general). Approximate areal coverage for this component of the survey is ~64 km^2. Actual survey sample locations acquired by field personnel during the sampling program are shown in Figure 2.

All geochemical samplers were analyzed via automated thermal desorption, gas chromatographic separation, mass selective detection (ATD-GC/MS), at GORE's laboratory in Elkton, MD, USA. Sample analyses were accompanied by calibration samples for all compounds of the analytical list for this method. Several classes of quality control blank sample were included for analysis with the field samplers of this project. *Approximately one of three samples analyzed during the course of this project were quality control, added by GORE to the samples that were installed and retrieved from the field area.*

The interpretation of survey sample data is based on geochemical model results in map form (petroleum influence probability values), and mapped hydrocarbon compound mass response. Geochemical model results are presented in Figures 7 and 9, and the map of summed hydrocarbon mass is presented as Figure 10. Geochemical Model 1 and the sum of hydrocarbon mass maps show very similar feature definition, and Geochemical Model 3 supports many of the same anomalous locations although not all. Figure 11 shows the primary geochemical leads defined by this survey, against the map of Model 1 petroleum probability. Three specific leads are recommended for further examination: the southern coastal lead, the series of northern anomalies along the coast, and the northern inland series of leads. The northern leads are less well defined, since fewer samples are involved, and sample resolution is ~1,000 meters or more. The southern coastal lead is better resolved, and involves more samples. It is likely that the broad nature of the northern leads will change with greater sample resolution.

These findings provide reasonable evidence for an active petroleum system in the survey area. Hydrocarbon signatures in the region resemble in basic composition surface signatures measured in an active oil seepage area of the Tasman Shale (Lonnavale Quarry). Regional signatures do not show strong similarity to Wombat Field surface data.

These recommendations are based solely on the evaluation of geochemical results; no geological or geophysical data are available to GORE. The geochemical results of this report should be integrated fully with other geological and geophysical information, if available. E&P INVESTMENTS is in the best position to complete this integration effort. GORE is able and available to assist with the interpretation and evaluation of these geochemical results.

1.0 INTRODUCTION

A surface soil gas geochemical survey, the GORE® Survey for Exploration, has been completed for E&P INVESTMENTS AUSTRALIA PTY LTD (E&P INVESTMENTS), over portions of Exploration Permit EL58/2008 along the east coast of Tasmania. This “Final Report” presents the results of the analysis and interpretation of geochemical data through the survey area, as well as recommendations for further action.

The GORE® Survey for Exploration incorporates Amplified Geochemical Imaging℠ Service, to provide a valuable and unique geochemical sample analysis and interpretation method for organic compound data. The geochemical survey uses the GORE® Module, a passive adsorbent-based soil gas collector which is effective at retaining volatile and semi-volatile organic compounds from the subsurface environment. A description of this surface geochemical method is included in Appendix A, “GORE® Survey for Exploration”.

Geological information for the survey area was available to GORE during the interpretation of geochemical data, in the form of a study on regional petroleum systems potential (O’Brien *et al*, 2009). There is no petroleum production in the region, and the study advises potential for the Gondwanan petroleum system, although thermal maturity in the Permian section is marginal. Other potential source sections are thought to be over-mature (Ordovician-Silurian Larapintine petroleum system), or too thin for appreciable source potential (Mesozoic and Tertiary offshore sections). This report is included in Appendix B for reference purposes.

The objectives of this survey are to detect hydrocarbon signatures related to oil or gas accumulations in the survey area (thereby providing evidence of an active petroleum system in the region), and to identify regions of petroleum prospectivity within the survey area.

The geochemical survey was planned as several irregular to semi-regular grid pattern deployments along the east coast of Tasmania and farther inland, as well as a test area over a producing field in Victoria. A total of 270 samples were acquired for the survey, placed at intervals of from ~500 meters to 1,000 meters. Total area of coverage between the surveys in Tasmania and Victoria is 75 km^2. Geochemical calibration samples for petroleum influence were available from the test area in Victoria (Wombat field, gas with minor oil amounts). Calibration samples are used to determine the geochemical signatures of hydrocarbon reservoir and regional background. Field operations, including the acquisition of geochemical samples, were performed by personnel of E&P INVESTMENTS. All geochemical samplers for this method are analyzed using gas chromatography – mass spectrometry (GC/MS), for a range of hydrocarbon compounds from ethane (C_2) to octadecane (C_{18}), including pristane (C_{19}), phytane (C_{20}), and other compound types (aromatics, aldehydes, furans).

This report includes discussion of the statistical analyses of surface geochemical data, as well as the maps of hydrocarbon compound response. It is intended that E&P INVESTMENTS integrate the results of this geochemical survey with other exploration data (if and when available), in order to evaluate rigorously petroleum prospectivity for the survey area. GORE is available to assist with these integration efforts upon request.

1.1 Objective of Survey

The objectives of this geochemical survey are: (1) to detect hydrocarbon signatures related to oil or gas accumulations in the area; and (2) to identify regions of petroleum prospectivity within the survey area. Successful completion of these objectives will provide surface geochemical evidence for an active petroleum system or systems in the region.

To achieve these objectives, the following tasks were performed:

1. *Field sample acquisition* using the GORE® Module passive soil gas collector. Samples are placed at a depth of at least 60 centimeters, and left in place for a period of at least 17 days prior to retrieval, so that adsorbents within the module may equilibrate to ambient organic compound signatures.

2. *Calibration sample acquisition* using the GORE® Module passive soil gas collector. Samples are placed around known geochemical locations (usually petroleum production and dry well sites), in the same manner as with field samples. The data derived from calibration samples is used to classify field sample data.

3. *Laboratory analysis* using gas chromatography and mass selective detection (GC/MS), of all survey samples and quality assurance and quality control samples.

4. *Data pre-processing* to remove noise variables and compromised samples, and determination of data fitness for use with Canonical Variates Analysis and other statistical techniques.

5. *Data Processing and Interpretation*. The chemical data space is transformed to component space using Principal Components Analysis, helping to isolate geochemical patterns in the data set. Hierarchical Cluster Analysis may also be of use in identifying relevant geochemical patterns in the survey data. Transformed data are input into Linear Discriminant Analysis to determine the geochemical differences between the geochemical calibration signatures and to compare all survey sample results to the calibration signatures. The result of this comparison is a probability value indicating whether a given sample is similar to petroleum character (high probability value), or to geochemical background character (low probability value).

As indicated, several statistical data evaluation techniques are used to process and interpret the surface geochemical data, and identify the presence of thermogenic signatures (including cluster analysis and also compound response mapping). Where possible, such signatures are characterized and mapped across the survey area, indicating regions where further exploration effort is warranted. This report identifies and discusses the various statistical techniques used in the processing and interpretation of the geochemical data collected within the survey.

1.2 Structure of Report

This report is organized into five sections, including this introduction section. Section 2 includes key information on geochemical survey design and the conduct of field operations. Section 3 discusses the analysis of geochemical samples, the quality control and assurance efforts conducted during this process, and the generation of geochemical models (including the comparison between survey grid and calibration sample data, if available), and other interpretational techniques (such as compound response maps). Section 4 includes discussion and assessment of geochemical results, in the context of available geological and geophysical information for the survey area. Conclusions for this geochemical work and recommendations for further action are included in Section 5.

The appendices of this report include a variety of information concerning the geochemical survey and the survey area. Appendix A includes background information on the GORE® Survey for Exploration and the Amplified Geochemical Imaging℠ Service. Any information received from E&P INVESTMENTS during the survey is included in Appendix B. Appendix C includes information sent to E&P INVESTMENTS during the course of the survey (included for documentation purposes). Appendix D includes signature plots for all samples identified as outliers or potential outliers. A CD-ROM is included with this report, and contains additional survey information, such as information and daily reports from field personnel during the acquisition of samples, and signature plots for all survey and quality control samples, as well as documents related to vertical migration – microseepage.

Questions regarding this report, or any of the data processing techniques used by GORE in the evaluation of its geochemical data, or any aspect of the surface geochemical method, may be directed to the author of this report at the following address:

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Comments and discussion regarding this geochemical service are welcome and encouraged.

2.0 GEOCHEMICAL SURVEY INFORMATION

2.1 Survey Location and Design

The geochemical survey conducted over the Wombat field in Victoria will be discussed in a separate section of this report. The survey in Tasmania was located along sections of the east coast, and farther inland. The survey spanned sections of the coast from ~5 km north of the city of Four Mile Creek, to ~8 km north of the city of Bicheno, and extended inland of St. Marys by ~4 km (Figure 1).

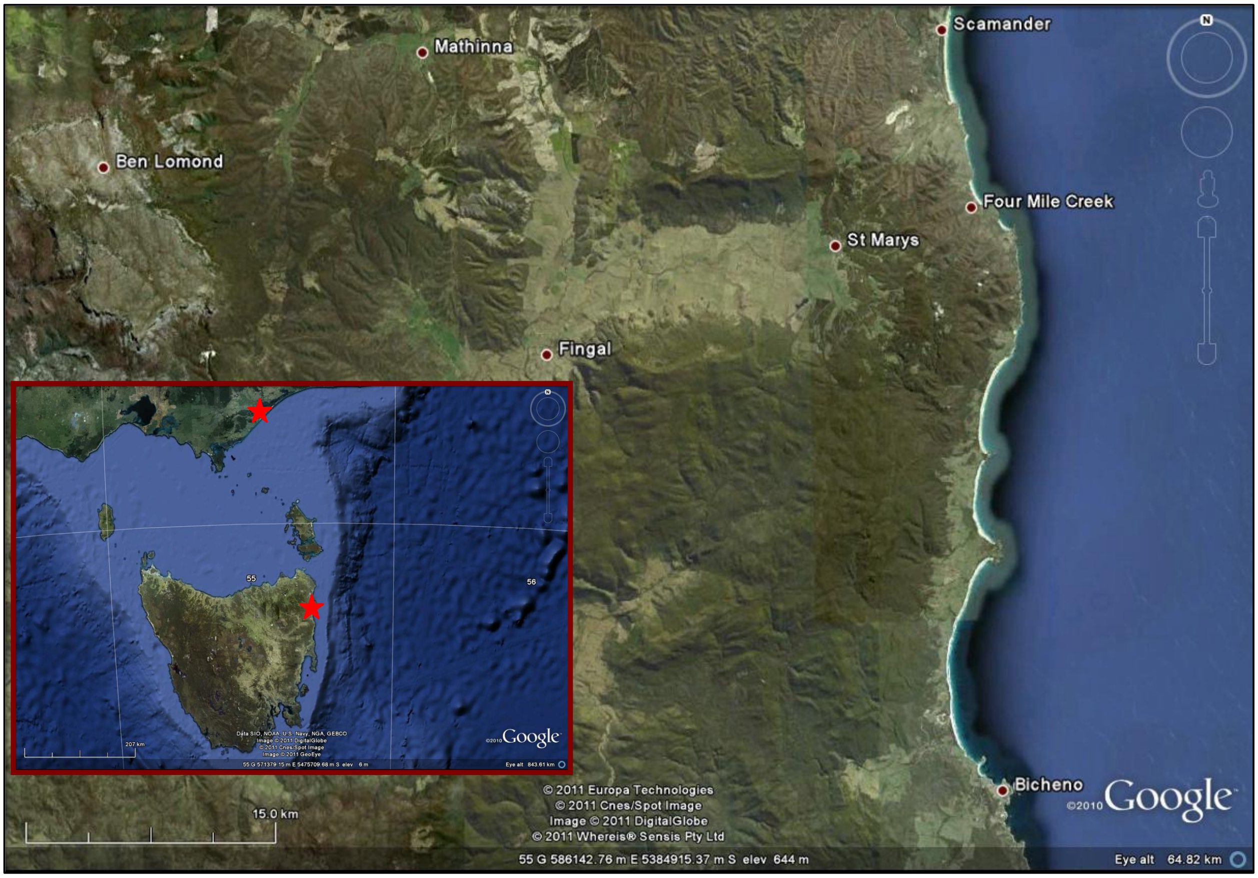


Figure 1. Main area of the GORE® Survey, along the coast of eastern Tasmania from Four Mile Creek to Bicheno, and west to St Marys. Calibration was acquired over the Wombat Field in Victoria. Both survey areas are indicated by star symbol on the inset regional map. Total area of coverage is 75 km^2.

The survey in Tasmania included 219 samples in total, placed in semi-regular to irregular pattern with variable sample spacing (~500 – 1,000 meters in general). Approximate areal coverage for this component of the survey is ~64 km^2. The final survey design for this study was determined by E&P INVESTMENTS in cooperation with GORE. The survey design is adequate in its extent and number of samples to detect and characterize thermogenic hydrocarbon emanations in the section. Actual survey sample locations acquired by field personnel during the sampling program are shown in Figure 2.

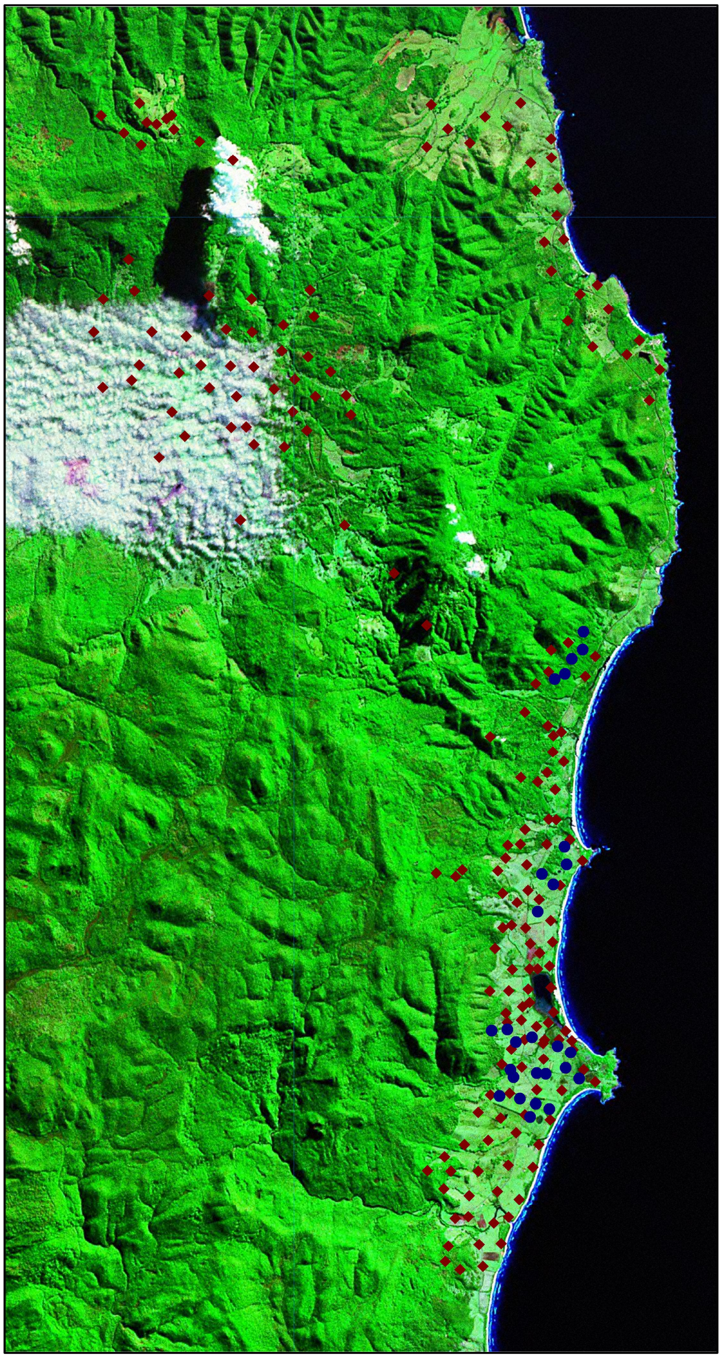


Figure 2. Location of geochemical samples in the Tasmanian survey area. Red map symbols represent the initial survey phase, and blue symbols show later infill sample phase. Not shown: samples located around the Lonnavale Quarry in southern Tasmania.

2.2 Field Sampling Operations

Field operations were conducted by personnel from E&P INVESTMENTS. GORE provided guidance in the use and handling of geochemical samplers prior to the conduct of field operations. The evaluation of GORE is that field operations were performed professionally and with appropriate attention to quality. Field reports and supporting information is included on CD-ROM as Attachment B (“Field Operations Information”).

Sample acquisition was done in two phases, with the initial phase providing the majority of sample coverage throughout the survey. A second phase of sample infill was conducted in Tasmania only, with the objective of augmenting sample resolution over geochemical leads defined by the initial interpretation. The two survey phases were separated in time by approximately 6 months. See Table 1 below for a list of samples by phase and area.

The GORE® Survey for Exploration features *passive* geochemical sampling, using engineered adsorbents to collect organic compounds, and equilibration to such compounds in the soil over a specified period of time. The nominal exposure period for this type of sampling is 17 days – a period evaluated as sufficient for the various compounds targeted by this geochemical method to have reached equilibrium with the sampler adsorbent system. Exposure times may fall below this duration by 2 – 3 days without concern (although not recommended). Longer exposure periods (>25 days) may also be acceptable.

The average exposure period for these samplers was 18.2 days (Initial Phase) and 20.5 days (Infill Phase), close to normal exposure specification. The modules of the first phase were shipped from the field on 19 July 2010, and were received at GORE’s Analytical Laboratory on 22 July 2010. Analysis of the samplers was initiated 18 August (sample analysis commenced after sample preparation and upon instrument availability), and was completed within approximately three weeks. Data processing and evaluation started a short while later, with initial results sent to E&P INVESTMENTS on 9 October 2010. Infill samples were shipped from Australia on 2 February 2011, and received by GORE a few days later. Analysis of these samples started on 15 February, with interpretation of the data completed a couple weeks later. Table 2 includes relevant field operations information.

Table 3 includes relevant field notations, received from E&P INVESTMENTS. In general, all modules were returned in good condition. Additional notation after sample preparation and analysis is given in Table 4.

Table 1: Survey Phases and Number of Samples

Initial Phase – Tasmania, along east coast and inland	187
Initial Phase – Victoria, over Wombat Field	51
Infill Phase – Tasmania only, including Lonnavale Quarry samples	32
TOTAL SAMPLES	270

Table 2: Field Operations Times and Module Exposure Durations

INITIAL PHASE	
Total number of survey samplers	238
Average module exposure (days)	18.2
Median module exposure (days)	18.0
Standard deviation exposure (days)	0.5
Minimum module exposure (days)	17.8
Maximum module exposure (days)	23.0
Deviation of module exposure (max – min, days)	5.2
Start of sample deployment	3 June 2010
Completion of sample deployment	28 June 2010
Duration of sample installation (days)	25.2
Start of sample retrieval	22 June 2010
Completion of sample retrieval	16 July 2010
Duration of sample retrieval (days)	24.2
Effective duration of field program (days)	43.2
INFILL PHASE	
Total number of survey samplers	32
Average module exposure (days)	20.5
Median module exposure (days)	20.0
Standard deviation exposure (days)	0.5
Minimum module exposure (days)	20.0
Maximum module exposure (days)	21.0
Deviation of module exposure (max – min, days)	1.0
Start of sample deployment	12 January 2011
Completion of sample deployment	13 January 2011
Duration of sample installation (days)	1.0
Start of sample retrieval	2 February 2011
Completion of sample retrieval	2 February 2011
Duration of sample retrieval (days)	<1
Effective duration of field program (days)	21.0

Table 3: Module Conditions Noted by Field Personnel

Lost samples during field exposure: 9				
627124 (#155)	627140 (#269)	627144 (#153)	627155 (#161)	627197 (#263)
627271 (none)	627279 (#IN009)	627303 (#346)	627318 (#382)	
Sample replaced during field exposure: 1				
627136 (#276)				
Sample not returned: 1				
627335 (none)				
Samples disturbed while in place: 10				
627154 (#151)	627222 (#356)	627245 (#364)	627259 (#381)	627270 (#359)
627276 (#376)	627278 (#246)	627338 (#392)	627376 (#397)	627397 (#204)

Note: Sample locations may be found in Attachment B, “Field Operations Information” (provided on CD)

Table 4: Module Conditions Noted by GORE

Trip blank samples (10)

627134	627149	627164	627208	627219
627269	627285	627301	627329	627379

Inventory blank samples (10)

627104	627117	627142	627147	627163
627179	627213	627214	627232	627260

Samples analyzed in duplicate (21)

627103 (#149)	627115 (#IN017)	627116 (#IN025)	627121 (#285)	627222 (#356)
627238 (#259)	627263 (#271)	27272 (#309)	627274 (#IN021)	627298 (#354)
627299 (#389)	627304 (#177)	627312 (#171)	627322 (#299)	627332 (#232)
627336 (#327)	627357 (#196)	627378 (#384)	627388 (#351)	627395 (#365)
627399 (#235)				

Samples lost during analysis due to instrument failure (2)

627202 (#272)	627331 (#375)

Note: Sample locations may be found in Attachment B, “Field Operations Information” (provided on CD)

The disposition of samples for the survey is given in Table 5. A total of 290 modules were shipped to the field area for survey usage, including 10 modules as trip blanks. All samplers allocated and shipped for this project are accounted. The 51 samples from Victoria (deployed over the Wombat field) are considered as calibration. A total of 10 samples were lost during field operations, for a loss rate of 3.6%. Adding the two samples lost during analysis, the effective lost sample rate is 4.3%. Typical loss rates for this service vary between 2 and 3%.

Table 5: Disposition of Geochemical Samplers

Sample Class	Sent to Field	Received from Field
Survey grid samples	270	219
Calibration samples	0	51
Extra samples	10	-
Trip Blanks	10	10
Not Returned / Lost Samples	-	10
Unused Samples	-	0
TOTAL	**290**	**290**

3.0 GEOCHEMICAL DATA EVALUATION

3.1 Analysis of Samplers

All geochemical samplers were analyzed via automated thermal desorption, gas chromatographic separation, mass selective detection (ATD-GC/MS), at the GORE laboratory in Elkton, Maryland, USA. Sample analyses are accompanied by analytical instrument calibration samples for all compounds on the analytical list of this method. In addition, several classes of quality control blank sample are included for analysis with the field samplers of this project. The types and numbers of quality control and instrument calibration samples for this project are listed in Table 6.

As an aggregate, quality control and instrument calibration samples constitute 33% of the samplers analyzed in the course of this project (132 total quality control samples and 268 field samples comprising the geochemical survey). As a percentage of samples analyzed for a project, the quality control measures of the GORE® Survey for Exploration represent a significant effort, and are demonstrative of GORE's commitment to quality control. *Approximately one of every three samples analyzed during the course of this project were quality control, added by GORE to the samples that were installed and retrieved from the field area.*

Compounds included in the GORE® Survey for Exploration method are listed in Table 7. There are a total of 86 organic compounds specified for this method. This includes several distinct types of organic compounds, including several hydrocarbon types (the aliphatics – alkanes, alkenes, cycloalkanes, aromatics and polyaromatics). The diversity of compounds is intended to better characterize the geochemical environment, and provide an unbiased data set for studying petroleum emanation and related changes in the soil zone. Many of the compounds included in the analytical list for this method are minor constituents of typical oils, or simply not found in oils (aldehydes, for example). Such compounds help to better discriminate between petroleum emanation and geochemical background influences, and thus help to delineate prospective regions more reliably. <u>The inclusion of such compounds is one of the features that distinguish this surface geochemical method from others.</u>

Table 6: Disposition of Quality Control Samplers

Geochemical Sample Class	**Count**
Trip Blank	10
Inventory Blank	10
Method Blank	23
Instrument Blank	22
Instrument Calibration	46
Duplicate Sample Analysis (field samples only)	18
Subtotal Quality Control Sample Classes	**132**
Survey Samples Analyzed	**268**
TOTAL Samples Analyzed for Project	**400**
Quality Sample % = Quality Control Samples / Total Samples *100	33%

3.2 Data Quality

Several steps have been taken during the processing of the geochemical data to ensure proper data quality. These include steps to evaluate the chemical compound data in order to eliminate noise, and to evaluate sample point data in order to remove statistical outlier samples. Not all organic compounds included in this method are significant to the petroleum system or systems under consideration in the survey area. In a sense, data noise includes compound data not related to the petroleum system. GORE has developed methodology to identify and remove such compound data. Similarly, certain samples are found occasionally to be spurious, and are removed prior to further processing and interpretation. The end result of this quality control effort is a data set which is most suited to the statistical processing techniques developed by GORE for use with this geochemical data.

Table 7: Analytical Compound List by Compound Class

GORE™ Survey for Exploration Organic Compound Target Analytical List
Version 4 (2006) 86 compounds total

Typical Petroleum Constituents
Carbon number in ( )

Normal Alkane: 17 compounds	**Iso-alkane: 11**	**Cyclic Alkane: 15**	**Aromatic and PAH: 17**
Ethane (2)	2-Methylbutane (5)	Cyclopentane (5)	Benzene (6)
Propane (3)	2-Methylpentane (6)	Methylcyclopentane (6)	Toluene (7)
Butane (4)	3-Methylpentane (6)	Cyclohexane (6)	Ethylbenzene (8)
Pentane (5)	2,4-Dimethylpentane (7)	cis-1,3-Dimethylcyclopentane (7)	m,p-Xylenes (8)
Hexane (6)	2-Methylhexane (7)	trans-1,3-Dimethylcyclopentane (7)	o-Xylene (8)
Heptane (7)	3-Methylhexane (7)	trans-1,2-Dimethylcyclopentane (7)	Propylbenzene (9)
Octane (8)	2,5-Dimethylhexane (8)	Methylcyclohexane (7)	1-Ethyl-2/3-methylbenzene (9)
Nonane (9)	3-Methylheptane (8)	Cycloheptane (7)	1,3,5-Trimethylbenzene (9)
Decane (10)	2,6-Dimethylheptane (9)	cis-1,3/1,4-Dimethylcyclohexane (8)	1-Ethyl-4-methylbenzene (9)
Undecane (11)	Pristane (19)	cis-1,2-Dimethylcyclohexane (8)	1,2,4-Trimethylbenzene (9)
Dodecane (12)	Phytane (20)	trans-1,3/1,4-Dimethylcyclohexane (8)	Indane (9)
Tridecane (13)		trans-1,2-Dimethylcyclohexane (8)	Indene (9)
Tetradecane (14)		Ethylcyclohexane (8)	Butylbenzene (10)
Pentadecane (15)		Cyclooctane (8)	1,2,4,5-Tetramethylbenzene (10)
Hexadecane (16)		Propylcyclohexane (9)	Naphthalene (10)
Heptadecane (17)			2-Methylnaphthalene (11)
Octadecane (18)			Acenaphthylene (12)

Byproduct and Alteration Compounds
Included in this method to provide a comprehensive inventory of the geochemical system in the surface soil zone

Alkene: 10	**Alteration/Byproduct: 3**	**Biogenic: 4**	**Nitrogen/Sulfur/Oxygen Compounds: 9**
Ethene (2)	Octanal (8)	alpha-Pinene	Furan
Propene (3)	Nonanal (9)	beta-Pinene	2-Methylfuran
1-Butene (4)	Decanal (10)	Camphor	Carbon Disulfide
1-Pentene (5)		Caryophyllene	Benzofuran
1-Hexene (6)			Benzothiazole
1-Heptene (7)			Carbon Dioxide
1-Octene (8)			Carbonyl Sulfide
1-Nonene (9)			Dimethylsulfide
1-Decene (10)			Dimethyldisulfide
1-Undecene (11)			

NOTE: PAH = polyaromatic hydrocarbons (example: naphthalene)

Modules are sent to the field in randomized condition (constructed from components in random order), to avoid potential system bias due to material lot differences in the manufacture of geochemical samples (standard good operating practice). Samples are also placed in randomized order prior to analysis, to avoid loss of sequences of samples due to potential instrumental mishap.

Data quality steps taken during data processing include canonical variates analysis, model signature evaluation, principal components transformation and evaluation of the sample data, and signal-to-noise comparison of field data with quality control blank data added into the survey at analysis time. This quality control effort follows in step with the stringent quality procedures instituted by GORE's laboratory staff, during preparation and analysis of the samples.

3.2.1 Signal-to-Noise Processing of the Data

Average field sample compound response levels are compared to average quality control blank response levels, for all compounds of this analytical method (see Table 7). Any compound for which the average field sample response was not distinctly greater than the quality control response was flagged as a "low signal-to-noise" compound, and considered for removal prior to further data processing and interpretation. Instrument blank and method blank data are meant to show the inherent organic compound response levels of the analytical instrument and lab environment, and should show low levels of compounds (if any are detected). Therefore, these data form an appropriate baseline for comparison to field acquired signal. If field acquired signal does not differ significantly from these quality control data, for any given compound, that compound should be removed from the survey data prior to further processing.

A total of 29 compounds were evaluated as low signal-to-noise, and these compounds were removed from the survey data (see Table 8). This represents 34% of the analytical compounds included in the method, within the typical compound noise deletion percentage (up to 40%). The light hydrocarbon compound ethane was disqualified, and there were other normal, branched and cyclic alkane compounds removed as potential noise variables (propane, cyclopentane, hexane, cyclooctane, dimethylcyclopentane, propylcyclohexane). Other disqualified compound types include carbon dioxide, dimethyldisulfide, indane, indene, and terpenoid compounds (pinenes, camphor and caryophyllene). There were no unusual characteristics or conditions suggested by the content of the low signal-to-noise compound list. The remaining signal-to-noise qualified compound data are sufficient to characterize regional petroleum systems, and to classify survey samples according to their potential prospectivity.

Table 8: List of Low Signal-to-Noise Compounds

CarbonDioxide	2Methylfuran	Indane
DimethylDisulfide	t13Dimethylcyclopentane	Indene
EtheneEthane	Cyclooctane	Butylbenzene
Ethane	Propylcyclohexane	1245Tetramethylbenzene
Propane	alphaPinene	Camphor
Furan	Propylbenzene	Naphthalene
CarbonDisulfide	135Trimethylbenzene	2Methylnaphthalene
Cyclopentane	betaPinene	Caryophyllene
1Hexene	1Ethyl4methylbenzene	Acenaphthylene
Hexane	Benzofuran	

3.2.2 Sample Outlier Evaluation

Upon completion of the organic compound signal-to-noise evaluation, and removal of disqualified compounds from the data, field sample data were processed statistically to determine the potential for outlier samples. Field sampler data were transformed from chemical response values to component scores using Principal Component Analysis (PCA). Component score data are later used in data interpretation exercises.

Sample data were evaluated statistically in order to determine if spurious data points exist. Techniques for outlier evaluation include sample component plots and Mahalanobis distance plots. These techniques involve plotting sample data points according to their inherent chemical data space distance from some reference point (usually the multivariate data centroid). Spurious samples plot at a distance from the majority of survey sample data on various plots. Outlier samples are removed from the data to avoid corruption of sample classifications. However, the classification of samples as outliers remains somewhat subjective, particularly with heterogeneous data such as surface geochemical sampling (heterogeneous in the sense that more than one source of organic compounds exists in the typical survey area). The location of any given sample in data space does not entirely determine whether the sample is an outlier; rather, the pattern of organic compound responses is the primary factor in this assessment.

For example, the plot of jackknifed Mahalanobis distances for survey samples is shown as Figure 3. The Mahalanobis distance is the multivariate data space distance between the sample and the survey data centroid of all measured organic compounds. This distance is a function of the mean, standard deviation and correlation of the survey data as a whole, and as such, takes into account the shape of survey data variance in the data space. The calculation is “jackknifed”, so that sample Mahalonobis distance is calculated without sample inclusion in mean and standard deviation calculations for the survey data (therefore, outlier samples will not distort the multivariate shape of the data, prior to then calculating distances). Distal sample points were identified from the various outlier samples plots. The signature of each distal sample was then examined for uniqueness of chemical signature. Unique signatures are taken as likely indication of outlier character. The signatures of all distal data space sample points are included in Appendix D, “Potential Outlier Sample Signatures”.

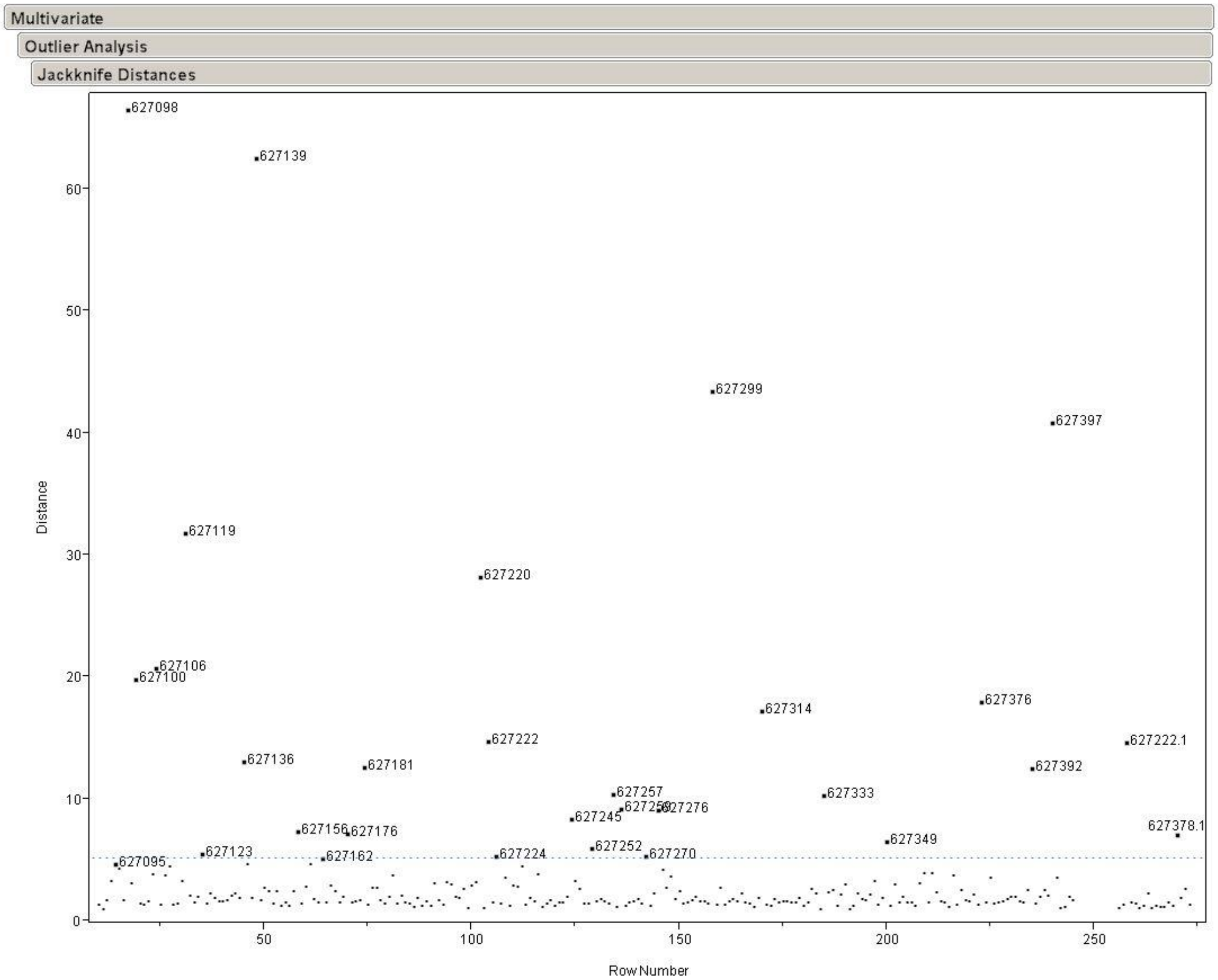


Figure 3. Mahalanobis plot of survey samples based on distance from data centroid. Plot indicates potential outlier samples as defined by unique composition in geochemical data space. Module numbers of select outliers shown on plot (example: 627098, in the upper left of the plot).

A total of 28 samples were classified as potential outliers to be retained in the survey data, and eleven samples were classified as true outliers to be removed from the data (Table 9). That is, examination of the signatures of the various outliers led to eleven samples being disqualified as invalid or suggestive of some interference or contamination which could compromise the interpretation of the survey data. These samples were deleted from the survey data prior to further processing and evaluation.

3.2.3 Canonical Variates Evaluation of Data

The relationship between field sampler (survey samples and model samples, if any) and quality control blank data is evaluated using Canonical Variates Analysis (CVA). CVA is a procedure for evaluating the relationship between sets of variable measurements, such as the physical measurements made on two or more genetic groups of items. The purpose of this evaluation is to determine whether there are obvious geochemical differences between the field sampler data and quality control blank data, with respect to the measured organic compounds of this method. Differences between field sample data and quality control data indicate equilibration of field samplers to *in situ* geochemical signatures, and signify that field data interpretations are not biased by inherent sampler signatures.

Table 9: Potential and Classified Outlier Samples

Potential outlier modules, retained in the statistical analysis (28)				
627095 (#395)	627098 (#152)	627105 (#215)	627106 (#150)	627136 (#276)
627137 (#367)	627145 (#195)	627156 (#170)	627159 (#229)	627162 (#360)
627176 (#331)	627181 (#205)	627220 (#213)	627224 (#208)	627229 (#210)
627231 (#167)	627237 (#260)	627245 (#364)	627252 (#158)	627257 (#333)
627276 (#376)	627314 (#180)	627333 (#190)	627349 (#303)	627361 (#261)
627378.1 (dupl)	627392 (#249)	627397 (#204)		
Confirmed outlier modules, removed from further statistical analysis (11)				
627100 (#221)	627119 (#383)	627123 (#318)	627139 (#315)	627222 (#356)
627222.1 (dupl)	627259 (#381)	627270 (#359)	627299 (#389)	627299.1 (dupl)
627376 (#397)				

Note: Sample locations may be found in Attachment B, "Field Operations Information" (provided on CD)

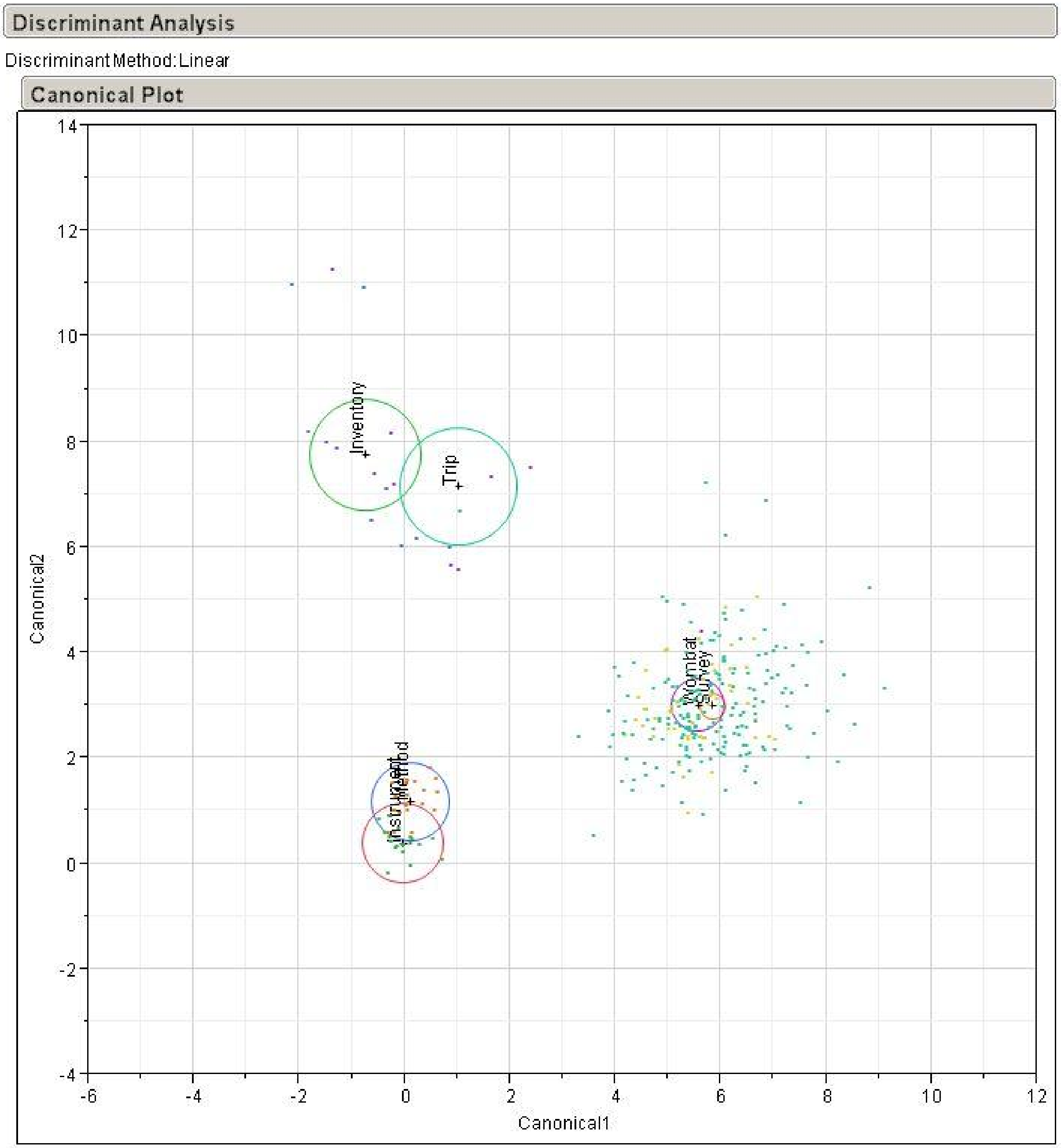
Canonical scores are linear combinations of the measured compound response values, and are relative to a coordinate system of "variates" which span the survey data space. The variates are calculated as orientations which maximize the separation of defined sample classes (such as the various blank classes). While the weights of the measured chemical responses to each of the scores are useful information, the analysis of canonical scores is not the purpose of this exercise; hence, the composition of the scores is not discussed. The objective of this exercise is to demonstrate chemical differences between the various sampler classes, as verification that field sampler data are not a product of any manufacturing or analytical process effect. Chemical differences are apparent whenever subsets of samples are distinct in the canonical variates plot.

Four types of quality control blank sample are included in this exercise: instrument blank, method blank, trip blank, and inventory blank. The instrument blank class data represents analytical data recorded with no sample inserted in the GC/MS instrument, and should show the inherent instrument condition. The method blank class records the analysis of clean, isolated GORE® Modules, and should demonstrate analytical process conditions. Instrument and method blanks should be similar in signature, plotting in the same region of canonical score space. The inventory blank class presents data for isolated "unused" samplers (retained in inventory at the laboratory but assigned to the project) from the same sample lot as those sent to the field. The trip blank class records the transit conditions to and from the field, and should be similar to the inventory sample class if no ambient contamination occurred during shipping or field activities.

In all, six classes of samples were included in the CVA evaluation of the project data: survey samples (Tasmania), Wombat Field samples, and the four system blank sample classes defined in the previous paragraph. Only initial phase geochemical survey data was evaluated in this exercise. The survey sample class was compared to the various quality control blank sample classes. Figure 4 shows plots of the survey data in canonical variate space. From the distribution of sample classes in data space, as seen in the canonical scores plot of Figure 4, it is concluded that:

1. Instrument and method blank sample classes are sufficiently distinct from the survey sample class, so that there is no evidence of instrumental or laboratory contamination.
2. Proximity of the instrument and method blank classes confirms the lack of organic compound contamination in the laboratory.
3. Samples of the trip blank class are separate from the cluster of survey samples, indicating low probability of trip related effects on the field data. Trip blank samples plot near inventory blank samples in data space, reinforcing the likelihood of minimal transit affect.
4. Survey samples are separate from inventory blank samples, indicating a change in the state of the samples once placed in the ground.
5. Canonical variates are defined and ordered by the amount of survey sample data variance represented. Variates 1 and 2 account for 61.8% and 23.0% respectively of the total variance (~85% combined variance). Variate 1 defines the separation between the quality control blank samples and survey samples, and Variate 2 defines the separation between “system” blanks and “analytical” blanks.

The canonical scores plot of Figure 4 is indicative of differences in signatures of survey *versus* blank sample data. The purpose of this exercise was to determine if reasonable geochemical separation exists between quality control sample classes and survey sample classes. Appropriate separation was noted between these sample classes, sufficient to demonstrate that survey sample data is not a product of the sampler manufacturing process, shipping and field activities, or of the analysis of the samplers. As a result of this analysis, the sample data were evaluated as fundamentally fit for use in further processing and geochemical model development.



Discriminant Analysis

Discriminant Method: Linear

Canonical Plot

Figure 4. Canonical variate scores plot showing survey data on variate 1 *versus* variate 2. Field and quality control sample classes shown. See text for definition of blank sample classes. Canonical variates relate to distinct mixtures of organic compounds detected by the analytical method. Separation between field sample class and various blank sample classes indicates acquisition of *in situ* geochemical signatures and hence data validity. Outer circle drawn around sample classes indicates 50% confidence interval.

3.3 Development of Geochemical Results

3.3.1 Geochemical Model Development

Geochemical modeling is the general term for sample classification against organic compound signatures which are taken to be representative of regional petroleum and background influences, and which have been developed from specified calibration samples. Calibration samples are usually acquired near ideal petroleum production and dry well sites, if available. Geochemical modeling relies on the quality of the calibration data, hence the need for information regarding selected well sites for calibration. Where production or dry well sites do not exist, calibration samples may be selected from among the samples of a survey using data cluster analysis techniques. Cluster analysis may also be required in cases where calibration data from well sites are found to be inadequate for proper classification.

Limited geochemical calibration data for petroleum influence are available for this survey from the Wombat Field, and these have been used in the classification of survey sample data in Tasmania. However, the main modeling effort involved cluster analysis of all survey samples, and development of petroleum influence and background character signatures directly from selected sample clusters. The cluster model result is labeled Geochemical Model 1, and the Wombat data model is labeled Geochemical Model 3. Classification of survey sample data against geochemical model signatures results in a calculated probability of petroleum influence for each survey sample. Petroleum probability values are then mapped in the evaluation of prospectivity in the survey area.

Figure 5 presents the cluster dendrogram for the survey sample data. Various sample clusters are shown against relative organic compound response, and the petroleum influence and background character sample clusters selected for modeling are indicated. Note the high relative response for the methylated aromatics range of the dendrogram plot; these compounds appear not to relate to subsurface thermogenic sourcing. This cluster is not selected for geochemical modeling. The geochemical signature developed from this cluster interpretation (Geochemical Model 1), is shown in Figure 6. The model signature involves moderate distinction (10 – 15 ng mass difference) between petroleum and background samples, primarily over light to light-midrange (C4 – C6) hydrocarbons.

Geochemical Model 1 was applied to all data of the Tasmanian survey area, including later infill samples. The projection of this model signature onto the survey data resulted in petroleum influence probability values, which are presented in map form in Figure 7. The model shows several moderate size geochemical features in the survey area, including one feature in the southern portion of the survey along the coast. This geochemical feature is defined by several sample locations, including both initial and infill samples. Geochemical features to the north, along the coast and inland, are of good size, but defined by fewer sample locations (owing to lower sample resolution in the northern portion of the survey). The trend of surface lineaments is shown on the map in this figure, and good correspondence with geochemical features is noted in the southern part of the survey. Lineament data is taken from O’Brien *et al* (2009).

Single-point anomalies are noted in places throughout the survey, but are downgraded as either of higher risk or too small for consideration. Note that minimum curvature contouring has been applied to the petroleum probability data surface, which has the effect of enhancing single-point anomalies.

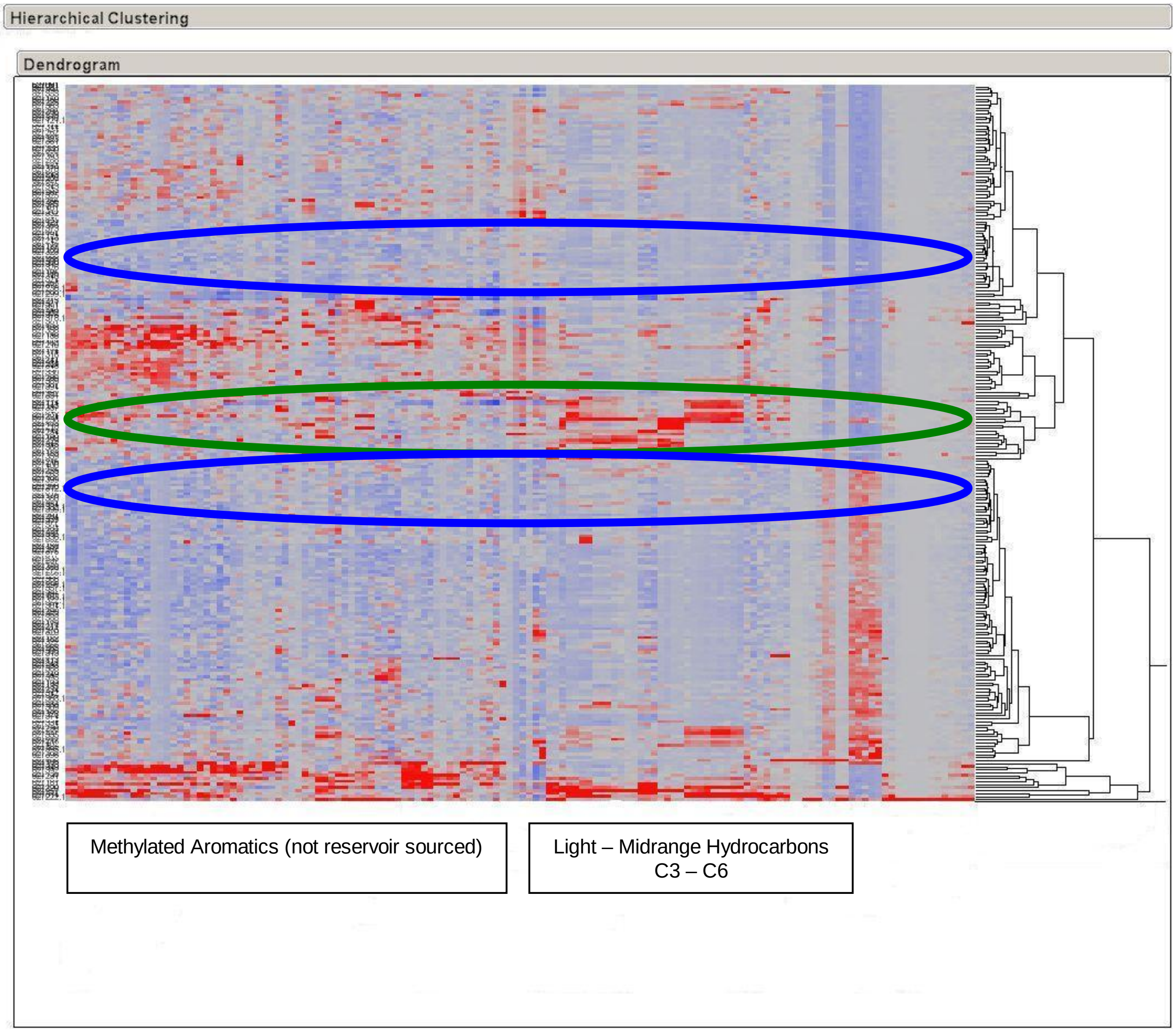


Figure 5. Cluster dendrogram for survey data. Samples are shown on the left vertical axis in cluster order. Cluster linkage is shown on right side of plot in dendrogram form. Middle of plot shows relative compound response, with red colors for high relative response and blue colors low relative response. The blue ellipses indicate samples selected as background influence (low signature levels) in the cluster modeling exercise; the green ellipse shows samples selected as petroleum influence (high relative response for suites of hydrocarbon compounds) for the cluster modeling.

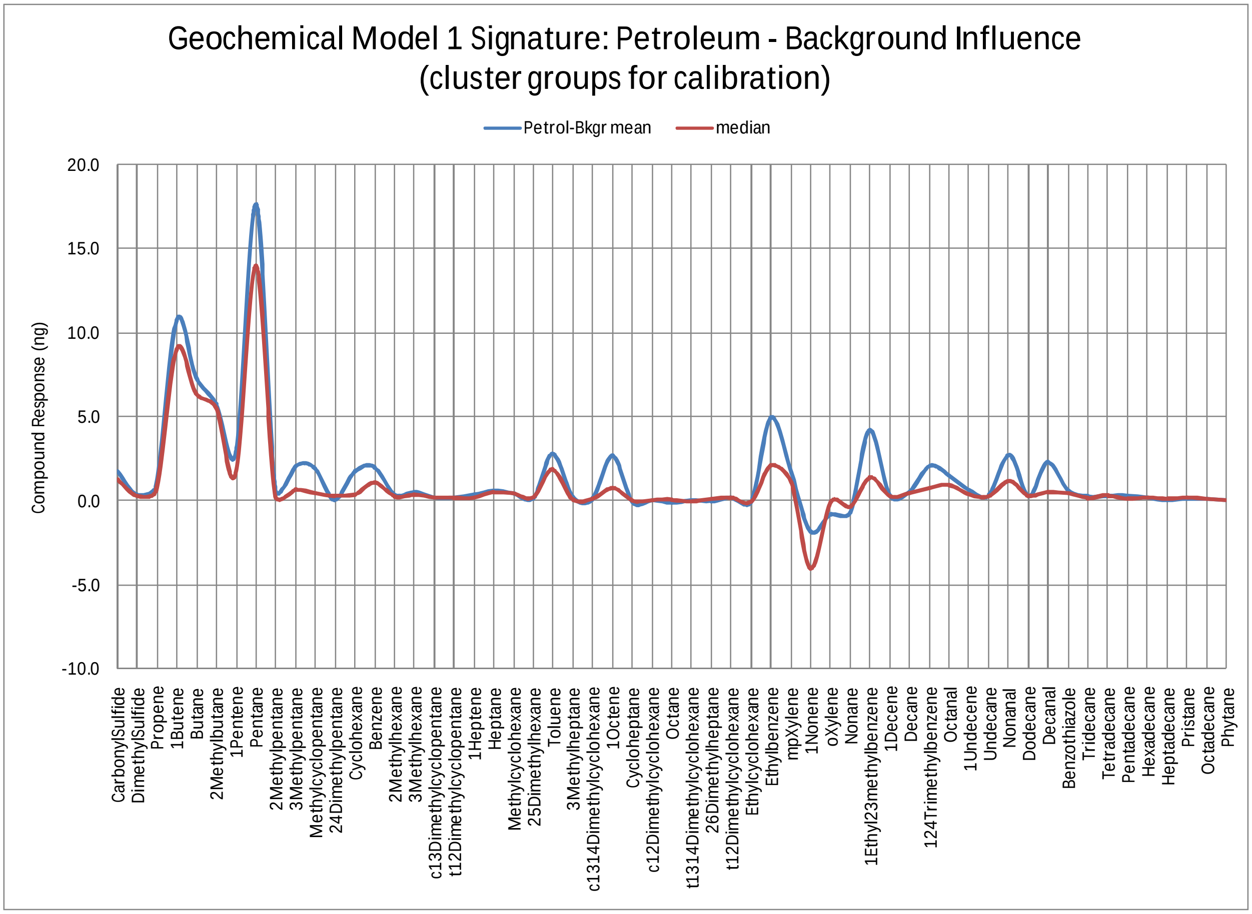


Figure 6. Signature of Geochemical Model 1 for petroleum influence. Signature involves mostly light hydrocarbon compounds in the C4 – C6 range, with minor contribution from heavier components. Signature is calculated as the difference between average and median signatures of samples selected from the petroleum influence and background clusters indicated in Figure 5.

Wombat Field sample data was also used to develop an alternate geochemical model, since these samples were placed over the extent of the reservoir in production. The Wombat Field sample data is discussed in more detail below. The signature of the geochemical model produced from Wombat sample data is shown in Figure 8. This signature is not very robust, in terms of compounds correlated with petroleum influence or in mass level contrast with background. It may be that Wombat is somewhat lower in reservoir pressure – a factor which degrades the quality of the surface hydrocarbon signature through microseepage. Wombat may not be a good analog for the east coast of Tasmania either.

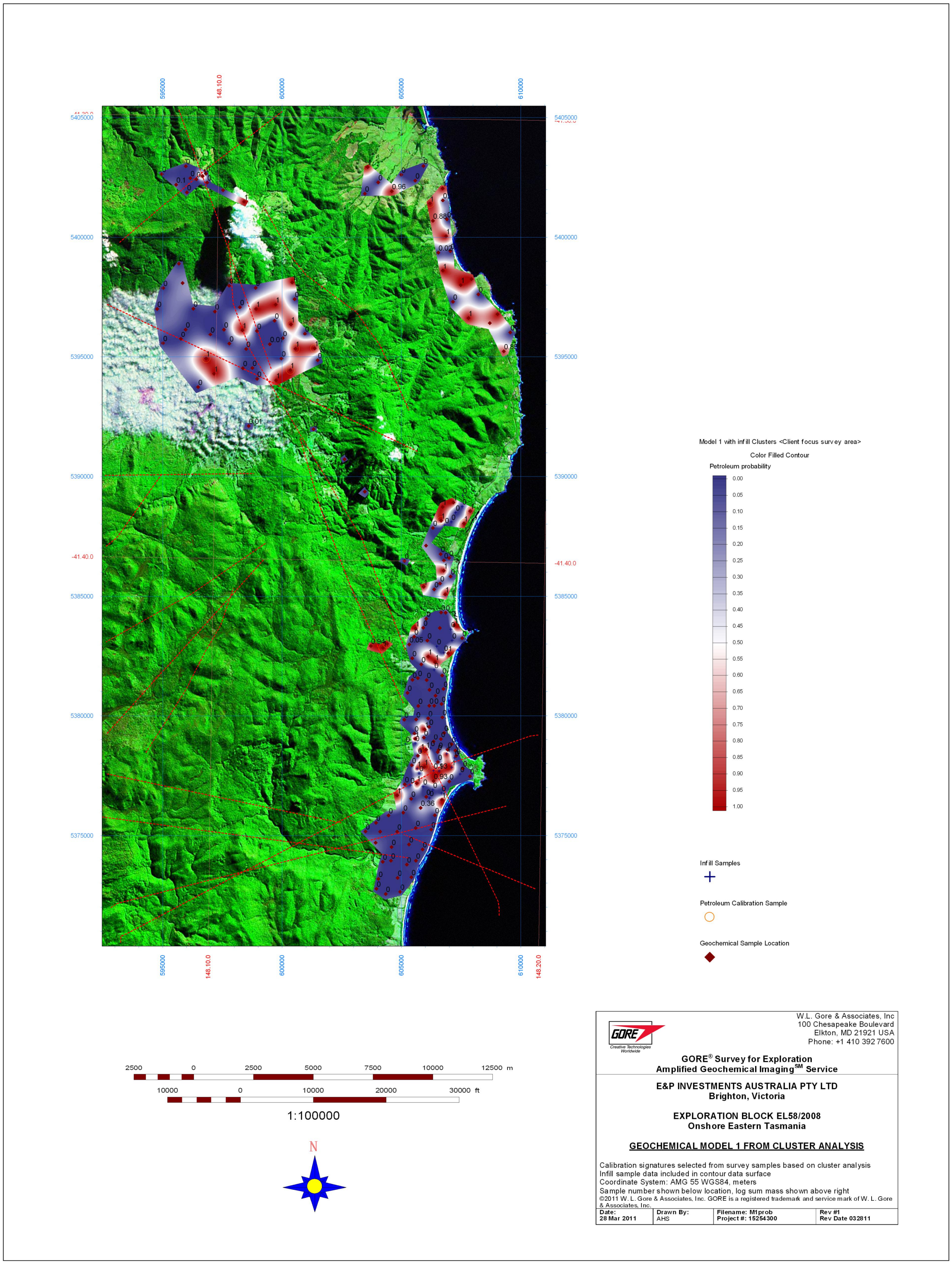
This model is applied to the survey data in Tasmania, with the resultant petroleum influence probability map shown in Figure 9. The model defines fewer geochemical leads in the survey area, compared to Model 1. However, there is consistency in the anomalous sample locations of Model 3 and Model 1. The geochemical lead in the southern part of the survey near the coast is also prominent with Model 3, although of slightly different configuration. Also, the northern inland anomalous sample locations are consistent to large degree. While the signature of Model 3 is unimpressive, it appears that enough critical distinction in hydrocarbon response and pattern exists with this model to define prominent features consistent with Model 1. Interestingly, Model 3 is very effective at mapping potential hydrocarbon charge through the Wombat Field, as is discussed in Section 5 of this report.

3.3.2 Hydrocarbon Compound Map

A map of summed organic compound mass has been prepared for the survey data (Figure 7). This result includes the C4 – C18 alkanes and cyclic alkanes, with the mass sum log transformed (base 10) to smooth the resultant data surface. The map of summed compound mass is meant to show the variation in overall mass response through the survey area (particularly against the distribution of geochemical model anomalies, defined by the geochemical models).

This result shows locations of elevated compound response in the survey area, presumably related to microseepage from subsurface sources. Geochemical features are defined in the southern part of the survey along the coast, coinciding with features imaged by both geochemical model versions. Anomalous sample locations are also noted in two other places along the southern coastal survey area, as well as the northern inland area of the survey. In fact, the anomalies defined in the northern inland area correspond with prominent features defined by Model 1 (but not Model 3).

The distribution of hydrocarbon compound mass seems to support the definition of geochemical features by Geochemical Model 1, highlighting sample areas with both elevated hydrocarbon emanation and particular pattern of light to midrange hydrocarbon compounds.



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Brighton, Victoria

EXPLORATION BLOCK EL58/2008
Onshore Eastern Tasmania

GEOCHEMICAL MODEL 1 FROM CLUSTER ANALYSIS

Calibration signatures selected from survey samples based on cluster analysis
Infill sample data included in contour data surface
Coordinate System: AMG 55 WGS84, meters
Sample number shown below location, log sum mass shown above right

Date: **28 Mar 2011**	**Drawn By:** AHS	**Filename: M1prob** **Project #: 15254300**	**Rev #1** **Rev Date 032811**

Figure 7. Map of Geochemical Model 1 petroleum influence probability values for the Tasmanian survey area. Red contour colors indicate similarity to the signature for petroleum influence, and define geochemical leads in the survey area. Blue colors indicate lack of correspondence to petroleum influence.

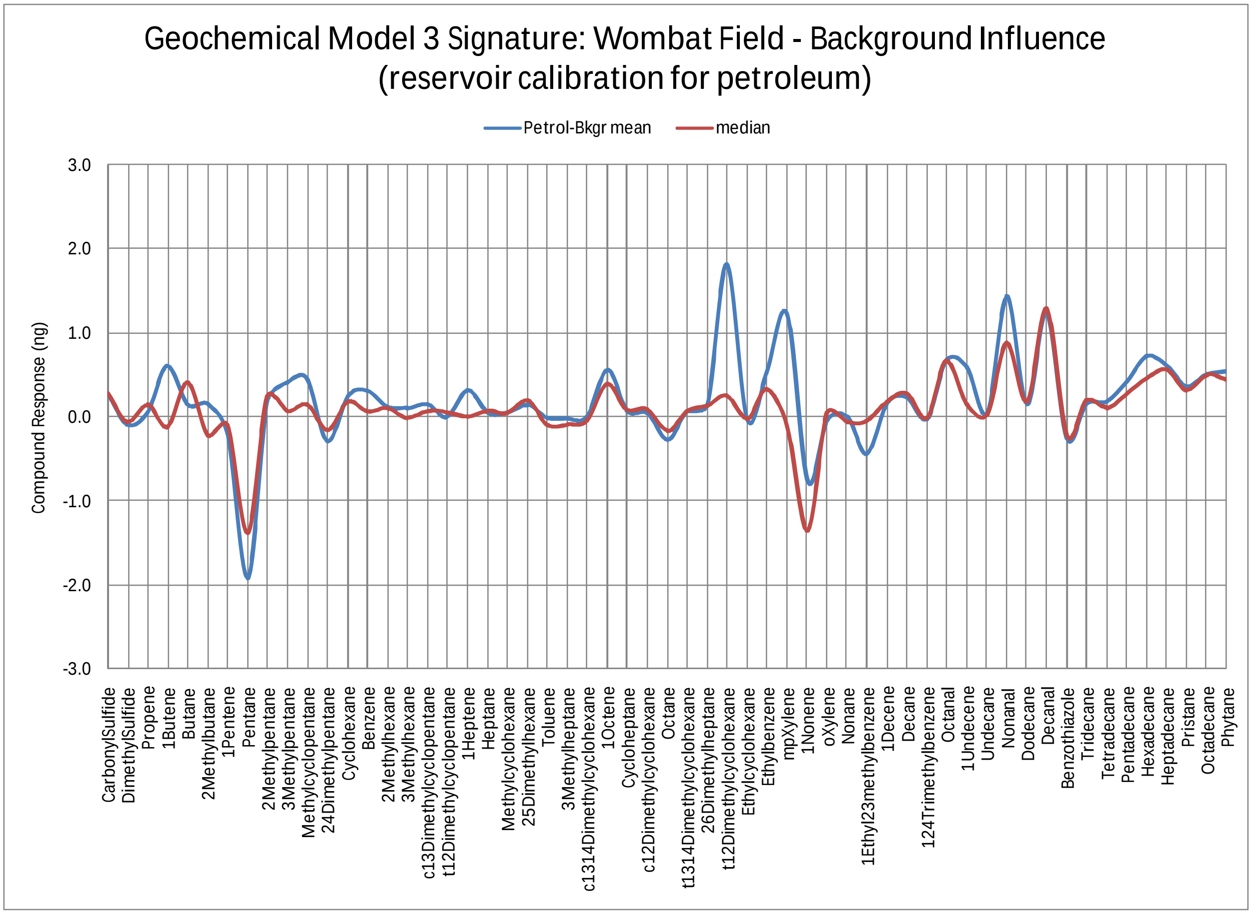
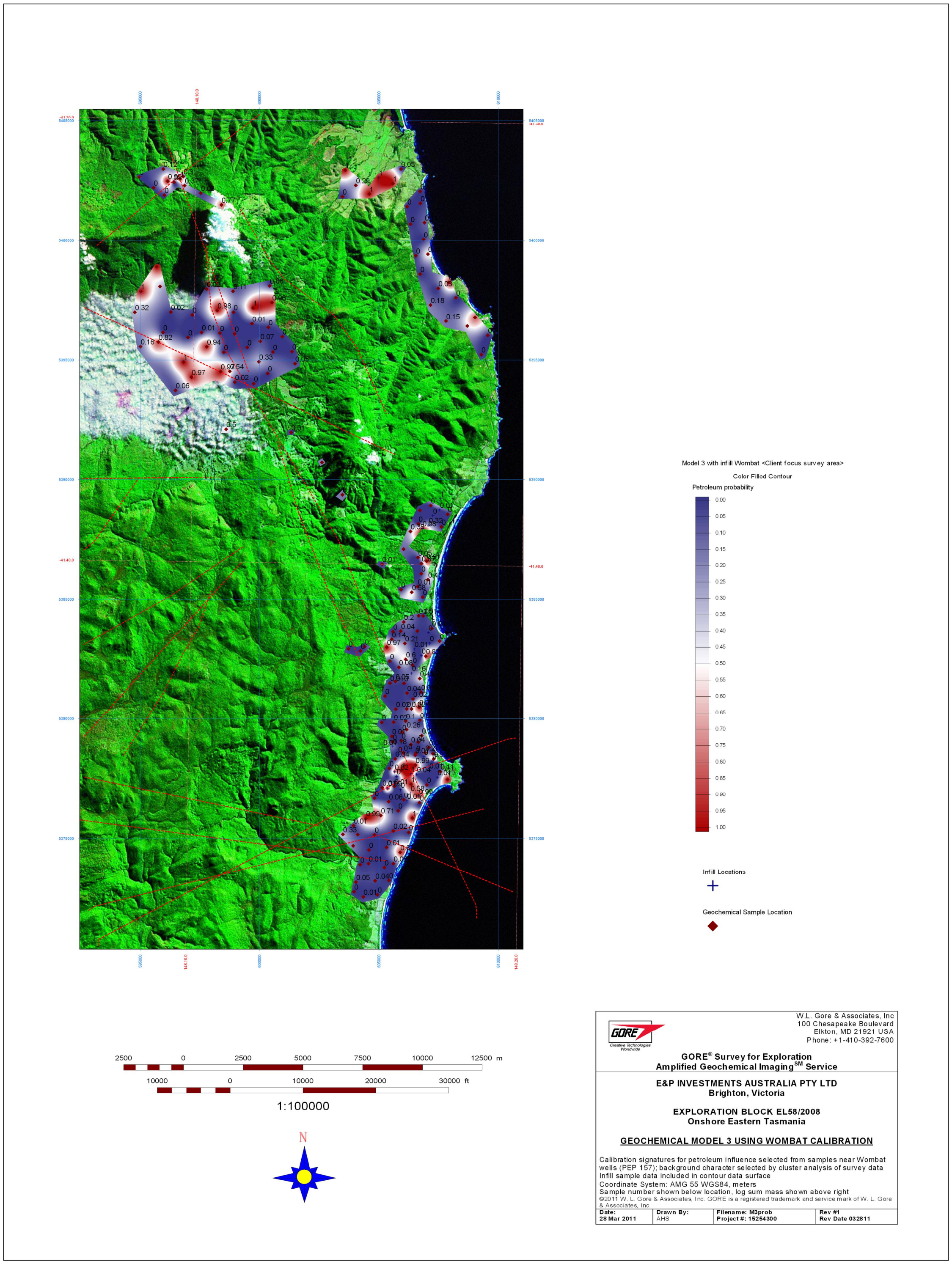


Figure 8. Signature of Geochemical Model 3 for petroleum influence. Signature involves mostly light hydrocarbon compounds in the C4 – C6 range, with minor contribution from heavier components. Signature is calculated as the difference between average and median signatures of samples selected from the the Wombat Field in Victoria, and background clusters indicated in Figure 5.



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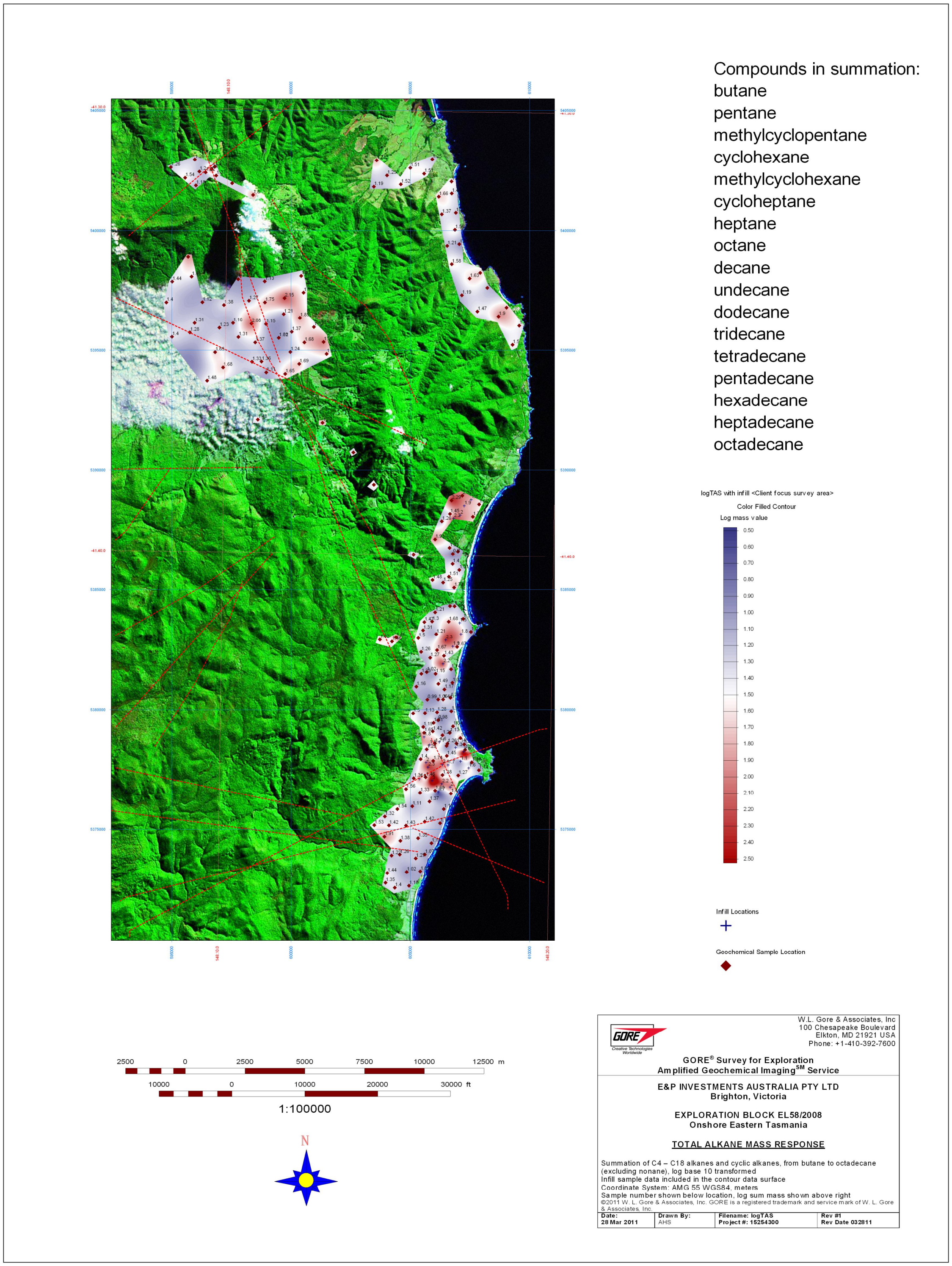
Onshore Eastern Tasmania

GEOCHEMICAL MODEL 3 USING WOMBAT CALIBRATION

Calibration signatures for petroleum influence selected from samples near Wombat wells (PEP 157); background character selected by cluster analysis of survey data
Infill sample data included in contour data surface
Coordinate System: AMG 55 WGS84, meters
Sample number shown below location, log sum mass shown above right

Date: **28 Mar 2011**	**Drawn By:** AHS	**Filename: M3prob** **Project #: 15254300**	**Rev #1** **Rev Date 032811**

Figure 9. Map of Geochemical Model 3 petroleum influence probability values for the Tasmanian survey area. This model is based on sample data from the Wombat Field, for petroleum influence. Red contour colors indicate similarity to the signature for petroleum influence, and define geochemical leads in the survey area. Blue colors indicate lack of correspondence to petroleum influence.



Compounds in summation:
butane
pentane
methylcyclopentane
cyclohexane
methylcyclohexane
cycloheptane
heptane
octane
decane
undecane
dodecane
tridecane
tetradecane
pentadecane
hexadecane
heptadecane
octadecane

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Onshore Eastern Tasmania

TOTAL ALKANE MASS RESPONSE

Summation of C4 – C18 alkanes and cyclic alkanes, from butane to octadecane (excluding nonane), log base 10 transformed
Infill sample data included in the contour data surface
Coordinate System: AMG 55 WGS84, meters
Sample number shown below location, log sum mass shown above right

Date: **28 Mar 2011**	**Drawn By:** AHS	**Filename: logTAS** **Project #: 15254300**	**Rev #1** **Rev Date 032811**

Figure 10. Summed hydrocarbon compound mass, including compounds in the C4 – C18 range. Summed mass response is log base 10 transformed to normalize the data distribution, and smooth the mapped surface.

3.3.3 Reproducibility of Geochemical Data

GORE analytical procedures specify ‘duplicate sample’ analyses for all projects, to evaluate the reproducibility of geochemical survey data. All GORE® Modules include two geochemical samplers. Usually only one sampler is analyzed for a given module, but both may be analyzed to provide a duplicate data point. This data allows method precision study, as the samples are acquired from precisely the same location (in the same hole in the ground). Samples are selected at random for duplicate analysis.

There were 21 duplicate samples available for this survey (Table 10). Normal reproducibility is in the range 65% - 85% for this surface geochemical method, based on duplicate sample comparisons of numerous surveys. The reproducibility of this survey data varies from 86 to 95%, depending on the specific geochemical parameter in question. In general, values of the same order of magnitude are considered equivalent when considering hydrocarbon summations, and probabilities are considered equivalent when above or below the 0.5 level. The overall reproducibilities of models and compound summations for the duplicates of this survey exceed the normal precision range for this method. Note that analysis date does not affect reproducibility.

Table 10: Duplicate Sample Information

Module (sample#)	Easting (1)	Northing	Analysis Date	Model 1 Probability (2)	Model 3 Probability (2)	Compound Mass Sum (3)
627103 149	594772.0	5397012.0	1-Sep-10	0.00	0.32	75.4
			1-Sep-10	0.00	0.02	65.6
627115 IN017	606173.0	5376556.0	16-Feb-11	0.00	0.01	32.3
			16-Feb-11	0.00	0.04	35.7
627116 IN025	607262.0	5388495.0	16-Feb-11	0.00	0.00	82.0
			16-Feb-11	0.02	0.16	99.1
627121 285	607260.0	5378541.0	*24-Aug-10*	0.00	0.04	61.8
			31-Aug-10	0.00	0.01	56.2
627222 356	511236.0	5753955.0	31-Aug-10	1.00	0.00	114.0
			1-Sep-10	1.00	0.00	90.6
627238 259	606789.0	5379285.0	31-Aug-10	0.00	0.29	48.6
			1-Sep-10	0.00	0.01	36.6
627263 271	605120.0	5379835.0	31-Aug-10	0.00	0.00	89.9
			1-Sep-10	0.00	0.00	66.5
627272 309	604841.0	5373212.0	1-Sep-10	0.00	0.04	41.5
			1-Sep-10	0.00	0.04	49.7
627274 IN021	606373.0	5381904.0	16-Feb-11	*0.00*	0.16	406.5
			16-Feb-11	*1.00*	0.17	405.1
627298 354	510668.0	5752866.0	1-Sep-10	0.00	*0.94*	72.9
			1-Sep-10	0.00	*0.28*	61.8

627299 389	513042.0	5754560.0	19-Aug-10	*1.00*	0.00	*278.5*
			18-Aug-10	*0.00*	0.02	*11.0*
627304 177	599976.0	5394934.0	1-Sep-10	0.00	0.33	62.1
			1-Sep-10	0.00	0.01	56.3
627312 171	598499.0	5395332.0	1-Sep-10	0.00	0.00	69.1
			1-Sep-10	0.00	0.00	68.4
627322 299	605600.0	5375305.0	31-Aug-10	0.00	0.02	70.4
			1-Sep-10	0.00	0.01	51.8
627332 232	606041.0	5384048.0	1-Sep-10	0.00	0.20	57.1
			1-Sep-10	0.00	0.00	52.9
627336 327	601488.0	5394857.0	1-Sep-10	0.00	0.05	83.5
			1-Sep-10	0.00	0.03	58.9
627357 196	607053.0	5399429.0	31-Aug-10	0.00	*0.51*	49.5
			1-Sep-10	0.00	*0.17*	47.0
627378 384	512345.0	5754003.0	*20-Aug-10*	1.00	1.00	65.8
			31-Aug-10	0.88	1.00	98.2
627388 351	510988.0	5753237.0	31-Aug-10	0.00	*1.00*	50.6
			1-Sep-10	0.00	*0.09*	83.3
627395 365	511149.0	5756149.0	1-Sep-10	0.00	0.99	54.2
			1-Sep-10	0.00	1.00	82.7
627399 235	605536.0	5383304.0	1-Sep-10	0.00	0.14	74.5
			1-Sep-10	0.00	0.01	60.5
REPRODUCIBILITY (%)				**91**	**86**	**95**

(1) coordinates in meters, AMG55
(2) model probabilities from 0 (background) to 1 (petroleum influence)
(3) sum of mass response for C4 –C18 normal and cyclic alkanes

4.0 DISCUSSION OF GEOCHEMICAL RESULTS

The interpretation of survey sample data is based on geochemical model results in map form (petroleum influence probability values), and mapped hydrocarbon compound mass response. Geochemical model results are presented in Figures 7 and 9, and the map of summed hydrocarbon mass is presented as Figure 10. Geochemical Model 1 and the sum of hydrocarbon mass maps show very similar feature definition, and Geochemical Model 3 supports many of the same anomalous locations although not all. Figure 11 shows the primary geochemical leads defined by this survey, against the map of Model 1 petroleum probability. Three specific leads are recommended for further examination: the southern coastal lead, the series of northern anomalies along the coast, and the northern inland series of leads. The northern leads are less well defined, since fewer samples are involved, and sample resolution is ~1,000 meters or more. The southern coastal lead is better resolved, and involves more samples. It is likely that the broad nature of the northern leads will change with greater sample resolution.

The disparity between Model 1 and 3 probably indicates that the Wombat production type is only weakly or moderately relevant to the Tasmanian survey area. The similarity between Model 1 and the total hydrocarbon summation shows that geochemical features are defined by both hydrocarbon pattern (as determined by the geochemical model signature), and intensity of hydrocarbon mass. The light to midrange hydrocarbon signature of Model 1 is reasonably taken to be of thermogenic origin, particularly with cyclic alkanes included.

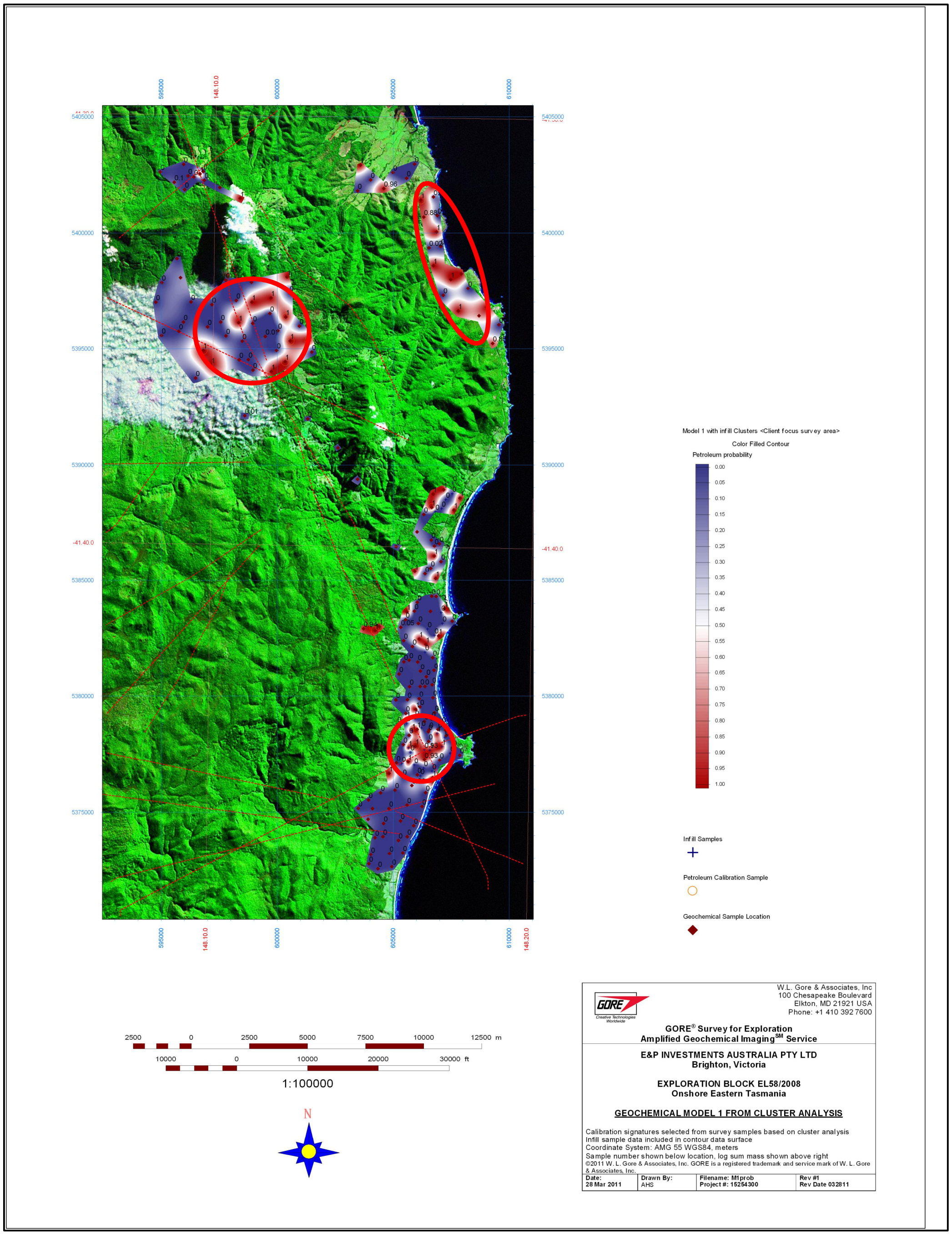

Figure 11. Geochemical features on the map of petroleum influence probability values from Geochemical Model 1. Features or regions incorporating features are indicated by red ellipses.

The infill sample phase included five samples placed within the Lonnavale Quarry in southeastern Tasmania. This site is distant from the survey area, but was included as an outcrop site for the Tasman Shale, a potential mature source section for Tasmania. In addition, there are known oil seeps in the vicinity, which have been sampled and analyzed (see report included in Appendix B).

Geochemical calibration usually entails more than five samples for reasons of stability of statistical prediction (the geochemical modeling process is more effective and reliable with more samples per model set). Rather than use the Lonnavale samples as a calibration set in the modeling discriminant process, the sample signatures were compared to the signatures of Geochemical Model 1 and 3, to determine the extent of similarity. This was done by subtracting the background signature of Model 1 (same as Model 3) from the average Lonnavale signature, and plotting this contrast signature against the two model signatures. The result of this comparison was that the Lonnavale signature is a good match to the signature of Model 1. Lonnavale does not however fit with the Model 3 signature of Wombat. See Appendix B, for a presentation of the Lonnavale sample signatures, and the comparison to the geochemical model signatures.

There are certain differences between Lonnavale and Model 1: the compounds carbonyl sulfide, 2,4-dimethylpentane, toluene, and 1-undecene are prominent for Lonnavale but not Model 1; 1-octene, ethylbenzene, ethylmethylbenzene, and nonanal are among the compounds prominent for Model 1 and not Lonnavale. These differences may relate to the difference in geochemical environments between the east coast survey area and Lonnavale, or may reflect the sparse Lonnavale sample data.

To the extent that similar shale sequences are present along the east coast region, the similarity between Model 1 and Lonnavale implies thermogenic source for hydrocarbons in the survey area.

5.0 DISCUSSION OF WOMBAT FIELD SAMPLES

A set of 51 samples were placed over the Wombat Field in southeastern Victoria, near the coast and the city of Sale. The purpose of this data acquisition was to provide for petroleum influence calibration over a producing gas field (Wombat produces gas with minor oil), for use with the Tasmanian survey (having no regional production).

Geochemical Model 3 was determined using selected samples from the field against the cluster analysis background samples of the Tasmanian survey. This model was then applied to the Wombat samples themselves, in order to map petroleum influence over the field area. Figure 12 shows the result of this mapping.

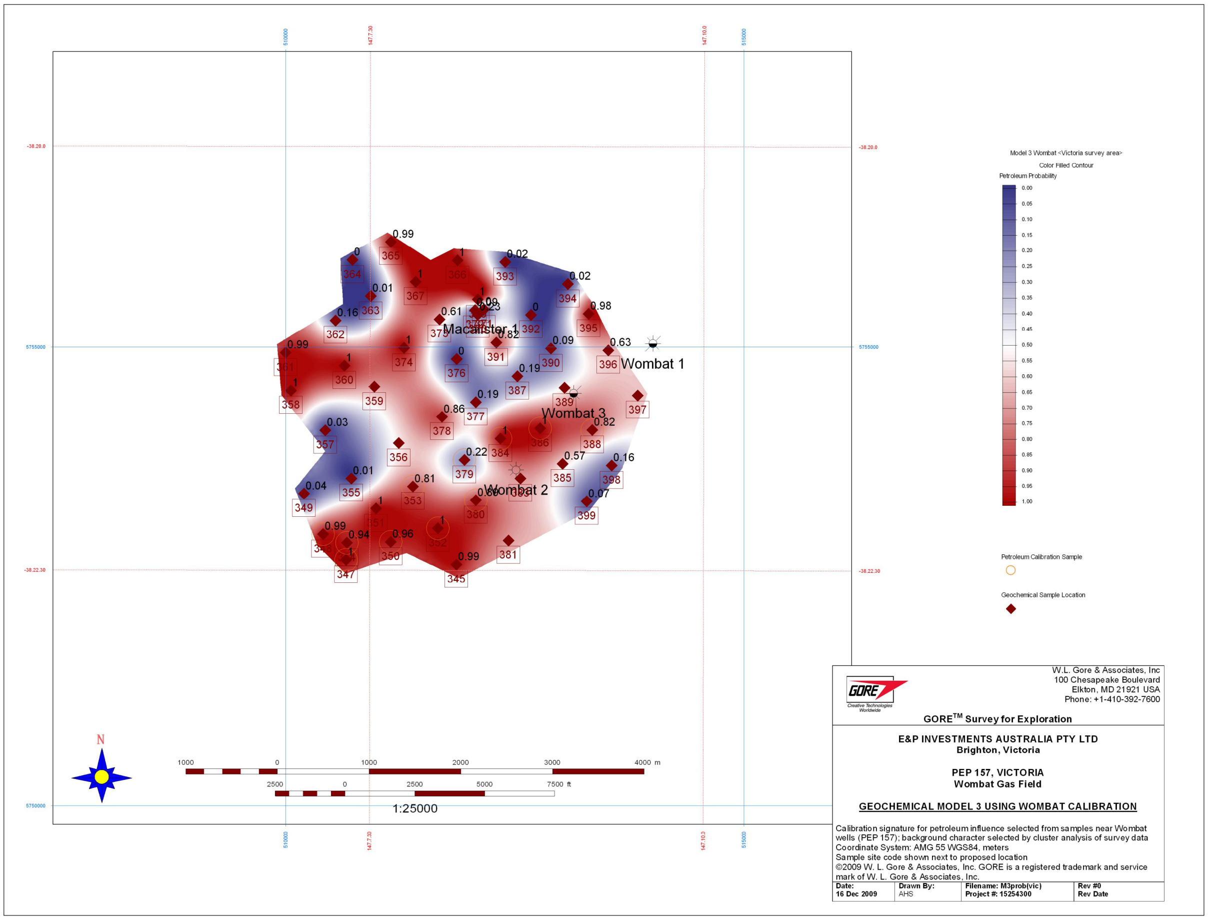

Figure 12. Map of Geochemical Model 3 petroleum probability values for the Wombat survey area. The model is comprised of the samples over the field itself. Red contour colors indicate similarity to the signature for petroleum influence, and blue colors indicate lack of correspondence to petroleum influence.

The Wombat Field is well-imaged by this model, showing strong SW – NE trend of hydrocarbon accumulation through the field. The fit of this model is more impressive against the faulting at reservoir level (information from the Lakes Oil website, operator of the field). The strong SW – NE trend through the field may be related to faulting of the reservoir section, as shown in Figure 13. The application of Model 3 to the Wombat samples indicates portions or compartments of the reservoir which may be positive for additional exploitation.

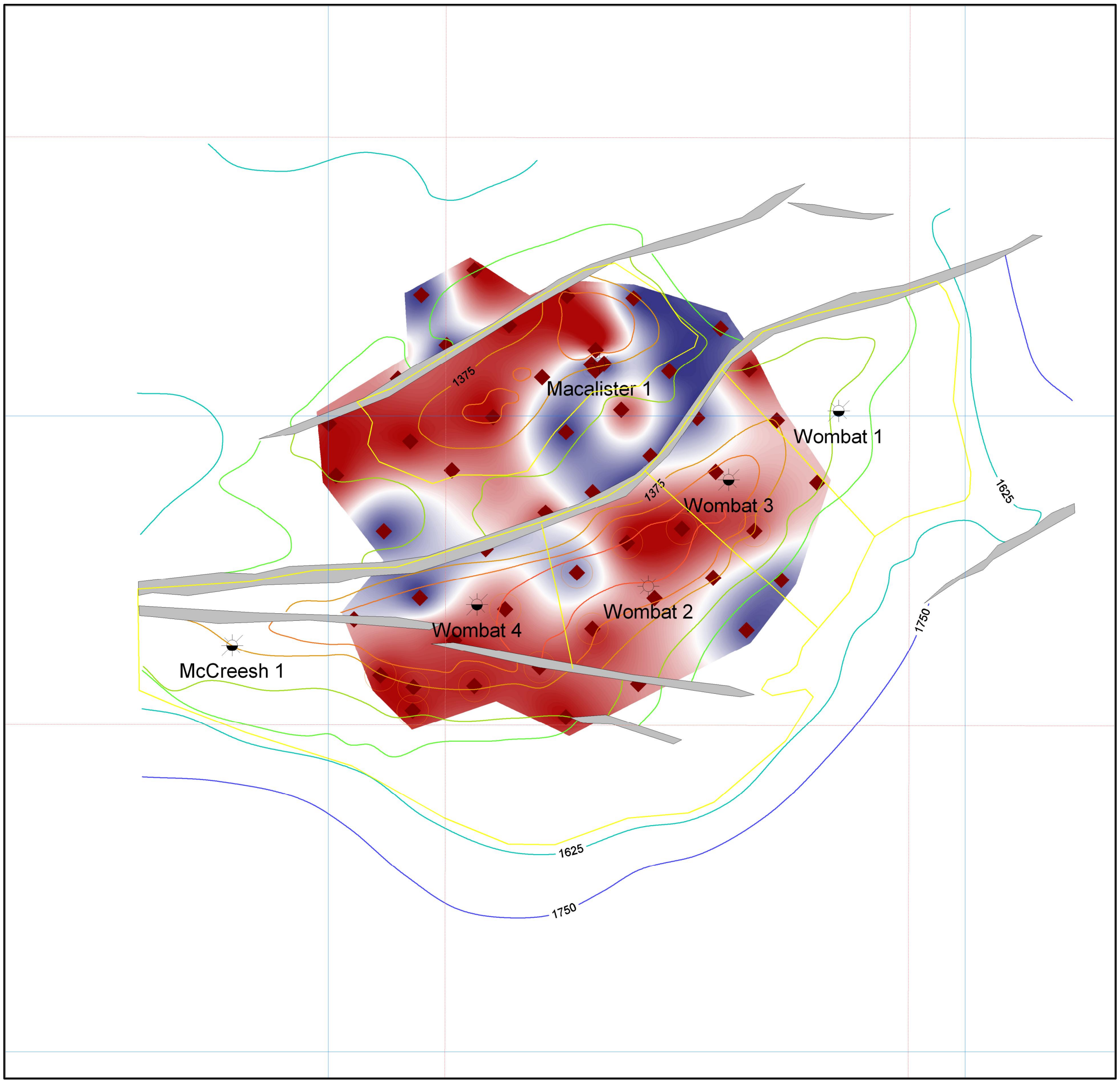

Figure 13. Model 3 petroleum probability values against faulting at reservoir depth. Structural information obtained from the Lakes Oil website. Note that Macalister #1 is a dry well, on the edge of low probability values through the field area.

The map of summed hydrocarbon compound response is shown in Figure 14. This result shows zones of most intense hydrocarbon emanation in the field. Note that the vicinity of Macalister #1 dry well is low in both model probability and hydrocarbon mass level. Wombat #2 shows good response for both model and compound mass. Integrating the model map with the compound mass map shows that a portion of the field west of Wombat #2 and southwest of Macalister #1 may represent a compartment of the reservoir.

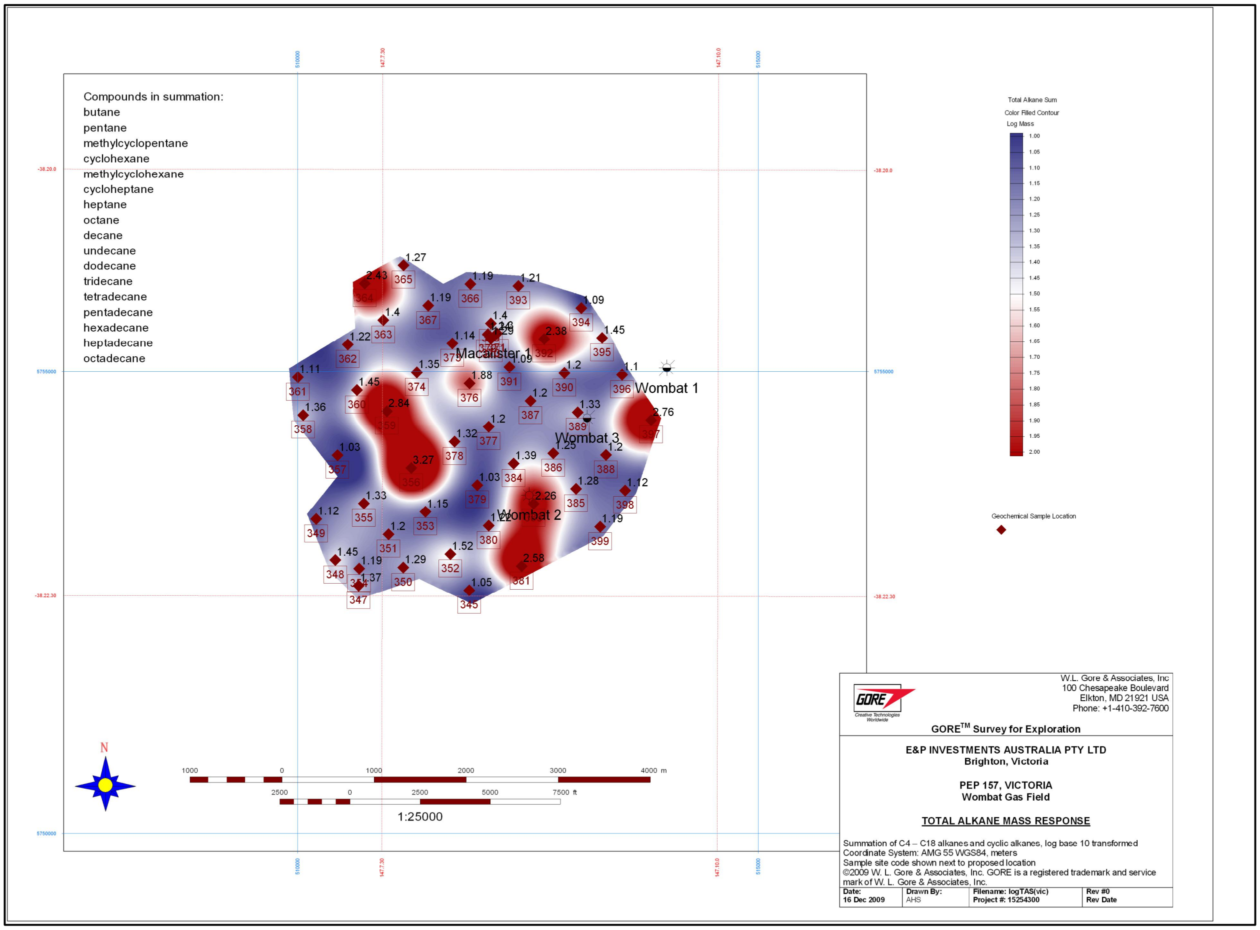

Figure 14. Map of summed hydrocarbon compound response over the Wombat Field.

Another feature of the above results, particularly summed hydrocarbon mass, is to demonstrate the potential effect of reservoir depletion. As reservoir pressure drops through production, microseepage is negatively affected to the point that surface hydrocarbon signatures approximate background. The reservoir may still be in production with surface geochemical signatures lacking strong hydrocarbon expression.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The objectives of this survey are to detect hydrocarbon signatures related to oil or gas accumulations in the survey area, and to identify regions of petroleum prospectivity within the survey area. Hydrocarbon compounds were detected by the samples of the survey, at levels significantly above system baseline. Cluster analysis of survey samples identified an enhanced hydrocarbon signature, which was applied in geochemical model form to the survey data. The result of the cluster modeling exercise is a map of petroleum influence probability throughout the survey. This model result defines a series of geochemical features in specific locations in the survey area. These features are confirmed by mapping hydrocarbon response levels over the survey.

Three geochemical features are identified for further consideration: southern coastal, northern coastal, and northern inland. These features are comprised of at least several anomalous sample locations, both against geochemical model and hydrocarbon summation maps. The northern geochemical features are not particularly well defined, as sample resolution in these regions was at least 1,000 meters. Just as a second phase of infill sampling has been able to provide better resolution for the southern coastal feature, additional geochemical sampling should be considered for the northern features.

Thee findings provide reasonable evidence for an active petroleum system in the survey area. Hydrocarbon signatures in the region resemble in basic composition surface signatures measured in an active oil seepage area of the Tasman Shale (Lonnavale Quarry). Regional signatures do not show strong similarity to Wombat Field surface data.

This recommendation is based solely on the evaluation of geochemical results; no geological or geophysical data are available to GORE. The geochemical results of this report should be integrated fully with other geological and geophysical information, if available. E&P INVESTMENT is in the best position to complete this integration effort. GORE is able and available to assist with the interpretation and evaluation of these geochemical results.

APPENDIX A

GORE® Survey for Exploration Decription of Service

GORE
Creative Technologies Worldwide

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GORE® Survey
for Petroleum Exploration
“Amplified Geochemical Imaging^{SM} Services”

DESCRIPTION OF SERVICE

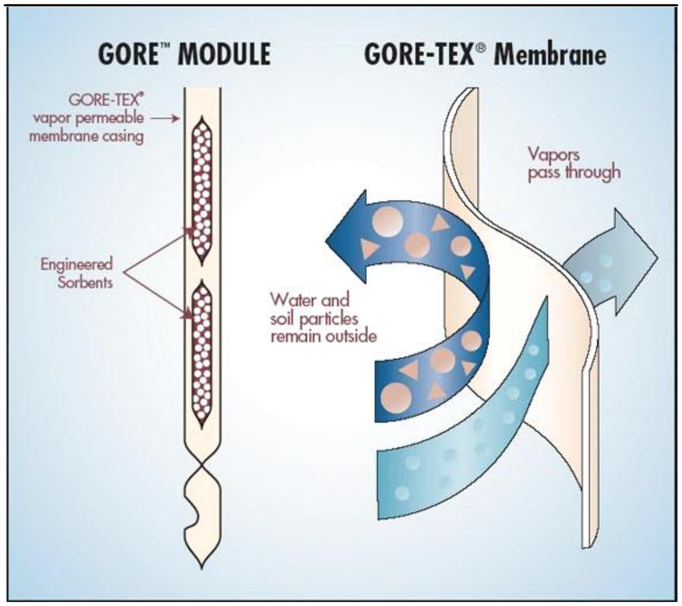
Exploration Survey Applications

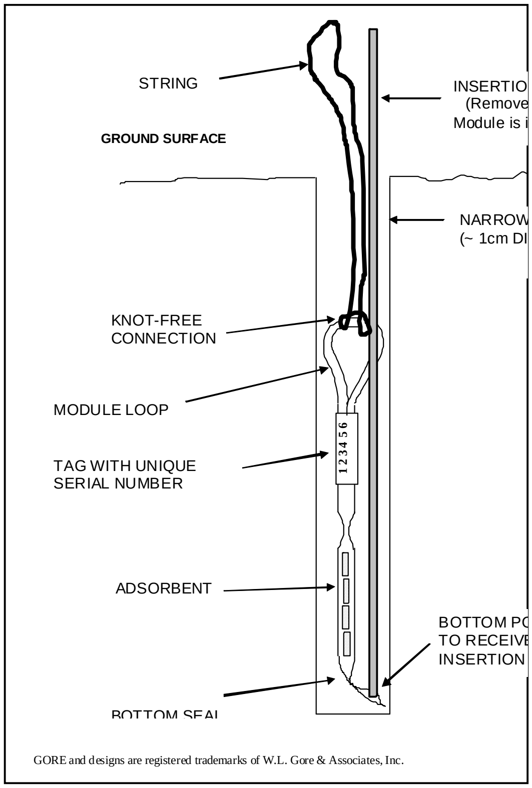
The GORE® Survey ”Amplified Geochemical Imaging^{SM} method is an advanced surface geochemical prospecting tool capable of detecting and quantifying many organic compounds up through phytane. This geochemical sampling system employs the GORE® Module (patented passive soil vapor sampling device), state-of-the-art chemical analysis and sophisticated statistical geochemical pattern recognition and has evolved from over twenty years of experience in soil gas geochemical exploration and analytical chemistry. It is capable of differentiating accumulated reservoir hydrocarbons from “background” hydrocarbons such as those emanating from source rock or residual migrated oil

Typical applications of this technique include: 1) Frontier - to determine hydrocarbon potential over large previously unexplored areas; 2) Exploration - focus geophysical efforts, prioritize leads or investigate stratigraphic traps; 3) Development - define the areal extent of producing fields and locate potential areas for secondary recovery. Prudent use and integration of the geochemical results can have significant benefits to the success of an exploration program, resulting in fewer dry holes.

Description of GORE Module Sampling Device

Each GORE Module contains a minimum of two (duplicate) samples and consists of several separate passive sorbent collection units called sorbers. Each sorber contains an equal amount of engineered sorbent materials, specifically selected for their affinity to a broad range of volatile organic compounds and semi-volatile organic compounds (VOCs and SVOCs), while minimizing uptake of water vapor (the principal soil gas constituent in most areas). The sorbers are sheathed in the bottom of a vapor-permeable retrieval cord looped at the top. The loop is used as a means of tying the module to a string for installation and retrieval. The figure below shows a typical GORE Module. The retrieval cord and the sorbent containers (sorbers) are constructed of an inert, hydrophobic, microporous expanded polytetrafluoroethene (ePTFE) membrane. The microporous structure of the membrane allows vapors to move freely across the membrane and onto the sorbent material. The microporous structure also protects the granular adsorbents from physical contact with soil particulates and water ensuring a consistent mechanism for collection of organic compounds (vapor-phase transfer only). The GORE Module is installed to a depth of one to two feet (30 to 60 centimeters) by creating a small pilot hole using a narrow steel rod or similar tool (a long screwdriver works well) and inserting the sampler manually using a narrow insertion tool provided by GORE. The sampler is retrieved by hand and returned to GORE for analysis and data processing.





GORE® Module & Installation Schematic

GORE

The unique ability to protect the sorbent media from contact with ground and soil pore water without retarding soil vapor diffusion facilitates the application of GORE's Amplified Geochemical Imaging method in very low permeability and poorly drained soils and swamp areas. Indeed, the GORE Module can even be deployed *in-situ* in shallow marine sediments using divers. Deeper marine applications involve acquisition of seabed cores which are then subcropped and placed in an airtight contained with the GORE Module sampling device.

Quality Assurance (QA) Measures

As standard practice, all modules are individually numbered and tracked throughout the entire manufacturing, field deployment, and analytical process. Completed modules are sealed into clean glass vials, and stored under zero grade air until shipment to the customer. Cleanliness is verified by testing a select number of modules from each manufacturing lot. Prior to shipment, a minimum of ten inventory blanks are randomly selected and set aside as controls to be analyzed along with returned modules. All modules are transported to and from the customer's site in sealed glass vials and boxes supplied by GORE. Additional trip blanks (a minimum of ten, or one per box, whichever is greater) are provided to accompany the modules to and from the site for QA/QC purposes. Upon receipt, returned modules along with associated inventory blanks and trip blanks are randomized to minimize analytical bias.

Geochemical Survey Design

Prior to initiating a survey, specific survey objectives are established with the client and an appropriate sampling scheme and modeling strategy are identified. Information relating to target size, trap type, reservoir orientation and geometry, structural fabric, and details of analogous production and background wells, are important factors in developing an appropriate survey design. Of paramount importance is the objective of the survey and an understanding of the decisions expected to be made based on the geochemical results. The survey design must therefore be consistent with the agreed programme objectives

Sampling plans typically follow a grid pattern with regular or variable spacing of samplers, sampling traverses, or a combination of both. Sample spacing generally ranges from 300 meters to one kilometer. Appropriate wells are selected for the purpose of modeling surface geochemical character over analogous production and dry/background areas.

In most cases, available mapping and satellite imagery are used to pre-plot the planned sample locations and extract target sample location coordinates for use by the field teams. Location coordinates are usually extracted in geodetic degrees or UTM relative to the WGS84 datum, or some other standard coordinate system appropriate to the survey location.

Accurate topographical surveys using geodetic receivers, ground- and satellite-based augmentation systems, long-period data acquisition and a whole host of sophisticated post processing, are beyond the scope of our services, and are not a necessary component to our work.

Exploration Survey Installation and Retrieval Procedures

GPS Positioning

The field team navigates to the pre-planned sample location using consumer grade GPS receivers in stand-alone mode. Due to the relatively wide sample spacing of several hundred to perhaps one or two thousand metres, horizontal positional accuracies of +/- 10 metres are acceptable. In most cases, accuracies of <5m are achievable, depending on terrain and vegetation cover. Because GORE Survey data require no correction for altitude or variations in ground elevation, vertical positioning accuracy is not required. In general, consumer-grade hand-held GPS receivers can consistently achieve horizontal accuracies of 6 metres or better since Selective Availability was switched off by the US government in 2000, however, vertical errors of 10-20 metres are not uncommon.

Installation of the modules is performed either by experienced subcontract field personnel or by the customer. The GORE Module is installed to an average depth of one to two feet (30 to 60 cm) below grade by driving a narrow (1cm diameter) pilot hole with a narrow steel tool (such as a long screwdriver) and a mallet, if necessary.

After the pilot hole is completed, modules are tied to a section of cord and inserted into the completed boreholes, using the stainless steel insertion rod supplied by GORE. The cord is secured at the ground surface by collapsing the hole. The location of the sample is marked on a map and location coordinates are secured where possible with a global positioning system (GPS) receiver, preferably equipped with a buffer for data storage and subsequent download to a personal computer. Additional modules that are designated as trip blanks should be noted on the installation/retrieval log and left (unopened) in the shipping box for the duration of the field exposure.

Module retrieval requires that field personnel locate the retrieval cord and manually pull the module from each location. The cord is separated from the module and discarded properly. The exposed modules are resealed in their respective designated shipping vials and placed in the supplied shipping box. Boxes with field-exposed modules and trip blanks are returned along with the Chain-of-Custody (COC) form to GORE's laboratory in Elkton, Maryland in the United States, usually via overnight courier. Detailed instructions are provided in our *Module Storage, Installation & Retrieval Guidance* documents.

During field work, field personnel make every effort to protect the security of every sample, from intentional and unintensional human inteference. Steps may include:

- Informing local government or security officials and landowners of field activities
- Ensuring that local populations do not actively observe field activity at close proximity
- Using unobtrusive means to mark sample locations so they can be readily identified only by the installation team
- Placement of samples along field borders in areas of active farming,

Despite the best efforts of the field team, some loss may occur. Losses may result from human or animal interference, or from other natural causes such as landslide or flood. In general, loss rates may range from 0% to 3%. Such data loss rates if reasonably distributed do not generally impact the integrity of the survey and will not be cause to ship additional samples for redeployment. Should module loss rates exceed 5% and have a spatial distribution that does in GORE's judgment affect data integrity, GORE and Client will work together to decide on an appropriate solution. Fieldwork conditions or project timing may not allow for redeployment and thus an adjustment to module number and cost may be appropriate. As a normal practice, GORE provides additional samples (at no charge) for use as needed; opportunistic sampling of an unexpected field condition, to replace a sample with a broken container, or to replace a sample that is found, during the course of the installation phase, to have been destroyed (by ploughing, for example).

Module Exposure Time

GORE's suggested target time for module exposure in the ground is 17 to 20 days. This time period has been evaluated over the course of thousands of surveys and has been found to be optimal for most regions and climatic conditions. However, this period is at times modified to accommodate special site conditions such as excessive rainfall, extreme cold, etc.

Analytical Procedures

All GORE Survey samplers are inspected upon receipt at the GORE laboratory. Among the conditions checked are sampler container seal integrity, condition of the samplers, and proper sequence of sampler numbers. All samples, including project trip blanks and inventory blanks are then randomised, resequenced, and transferred to a temporary storage location until analysis.

Each GORE Module contains a minimum of two duplicate samples, which are available for analysis. One sample is extracted from the GORE Module prior to analysis by cutting the bottom of the retrieval cord. The duplicate samples remain in sample storage until discarded. All soil gas samples are analyzed by thermal desorption followed by gas chromatographic separation and mass selective detection (TD/GC/MS). The laboratory analytical method has been developed by GORE specifically for application with petroleum geochemical exploration and yields chemical data for a wide variety of organic (including thermogenic) compounds up through C_{20} (phytane).

Before each analytical run sequence, a system flush (an empty thermal desorption tube), a sampler exposed to BFB (bromofluorobenzene), a method blank, calibration standards, and an instrument blank are analyzed. Method blanks, calibration standards, and instrument blanks are analyzed at the beginning, middle, and end of the run sequence. QC samples are evaluated according to set criteria to ensure proper system performance. If after review the system is found out of control, appropriate actions are taken, and the replicate samples are analyzed. Compound identification is based on the presence of appropriate target compound mass fragments within a specific retention-time window, as determined through use of reference standards.

Prior to data processing, trip blank, method blank, inventory blanks and instrument blank data are reviewed to identify potential ambient exposures, or laboratory conditions, which may affect data quality.

GORE's laboratory operates under the guidelines of its "Quality Assurance Manual, Operating Procedures and Methods".

Data Processing and Modeling

GORE's Amplified Geochemical Imaging technique incorporates sophisticated statistical processing and modeling of the complex geochemical signatures (up through phytane) obtained for each sample. Some of the processes used include hierarchical cluster analysis and discriminant analysis.

Hierarchical Cluster Analysis

Hierarchical cluster analysis (HCA) is often called an "unsupervised" multivariate technique, since no additional information other than the data itself is required to perform the operation.

That is, it is not necessary to identify “end-members” of the data or qualify the data in any manner in order to perform subsequent comparison or evaluation of the data, as is the case with multivariate classification techniques. HCA proceeds by grouping samples of like composition according to the values of all input variables. The result is a list of subsets of samples of the data, which are alike (forming “clusters” of similar samples). Since the input variables of the data are in the form of hydrocarbon compound intensities, the clusters are subsets of chemically similar samples. The HCA method is used to determine the structure of a set of data when no other geological or geophysical information for the prospect is available. The results of HCA may be used to further classify the samples of the data (i.e.; whether particular samples show petroleum hydrocarbon influence).

Principal Components Analysis

Principal components analysis (PCA) is a data reduction/simplification technique which is used to transform a set of data from measured variable space into components space. The measured variables are for target organic compound response values, and it is understood that many of the various compound recordings for this geochemical method are correlated: as the amount of one compound varies, so will vary one or more other measured compounds. The components derived through PCA are by definition not correlated so that, viewing the components as coordinate axes in a data space, the components are orthogonal. With ***n*** measured variables as input to PCA, ***n*** components are calculated. By definition, the orientation of the components is determined by the primary variance orientation in n-space. Hence component “1” is oriented along the prime variance of the data, component “2” is constrained to be orthogonal to component “1” and oriented along the next most variant direction, and so forth for the entire ***n*** component set. There are significant advantages offered by PCA, particularly for this form of data (surface geochemical measurements of volatile organic compounds). One has subsequently fewer data variables to process, without loss of information (recalling that many of the original measurement variables are correlated). Also, the components are linear combinations of the original measurement variables and are more akin to geochemical influences, being mixtures of numerous compounds. One further advantage to components is that they facilitate plotting the data, and hence allow easier evaluation of data trends and outlier identification.

Canonical Variates Analysis

Canonical variates analysis (CVA) is a data processing technique that is used determine data “fitness for use” by investigating the relationship between subsets of samples, as represented by the centroids of the sample subsets. The technique determines the orientation of the data space, such that the defined sample subsets are viewed as most separate. The separation between sample subsets is then expressed as a linear combination of measurement variables, and the relationships between subsets can be evaluated more efficiently. Given a data matrix of ***n*** variables, and ***m*** subsets of samples, this technique will derive minimum of (***m***-1, ***n***) canonical variates. In practice, we use CVA to evaluate whether there is reasonable separation between subsets of samples in the chemical measurement space. Typically, the input sample subsets comprise various blank sample classes and the samples deployed across a survey area. If distinct separation is noted between field samples as a class, and the various control blank samples, then one can be reasonably assured that the field sample data is meaningful (in the sense that it is not “manufactured” signal).

Discriminant Analysis

Discriminant analysis (DA) is a multivariate data classification technique. At least two subsets of input samples must be identified as belonging to separate groups (with any such "group" of samples presumably representative of a particular physical influence in the sampled environment). The DA technique will then find the best separation of the groups in a minimum residual sense, in terms of the input variables for the samples. Since the input variables are of a chemical nature, the separation of the sample groups is expressed as a chemical difference between the groups. The classification of samples of unknown influence is then performed; each unknown sample is compared to the identified groups of samples and a probability of match to each sample group is calculated. Therefore, if a group of samples is identified as petroleum-influenced, and another group of samples is identified as being like geochemical background, DA will statistically describe the difference between these two groups. The comparison of unknown samples to these two groups will yield for each unknown sample a probability of being like the petroleum influence, as well as a probability of being like the geochemical background influence.

Contour Maps of Geochemical Probabilities

The results of a GORE Survey for Petroleum Exploration are expressed in terms of probability that a given grid sample exhibits the surface geochemical character associated with known reservoir hydrocarbon accumulations, as defined by model set samples placed around analogous production wells and dry or background wells. Derived model probability values are contoured and may include other geological structural information provided by the customer. Either minimum surface curvature or kriging models are employed. Maps are plotted at a scale appropriate to the size of the survey and spatial distribution of the samples, typically at 1:50,000 or 1:100,000. Where possible, geographical information system (GIS) layer files containing relevant geological and geophysical (G&G) information (seismic line locations, structural interpretation contours, mapped fault polygons, etc) should be provided by the client for appropriate integration into the geochemical result. All electronic GIS layer files (shape files, Ascii XYZ etc) provided by the customer must be projected in real-world coordinates (UTM, State plane, etc). Map projection and coordinate system details information must be clearly indicated.

Reporting of Results

The results of the GORE Survey for Petroleum Explroation are summarized in a report deliverable, which includes a review of survey objectives, design, modeling information and results. Field summary documentation, grid sample model probability summary table, and color contour maps of petroleum-like probability distribution (compared to the model) are also included. Report deliverables will be in slide show, montage/poster or narrative format. Electronic deliverables are provided on CD-ROM or via e-mail/ftp transfer, and contain links to supporting electronic information

Interpretation and Integration of Petroleum Exploration Survey Results

Survey results should always be integrated with other geological or geophysical information to prioritize areas for further exploration.

In reviewing the results of a specific survey the following factors should be considered:

Fault Zones: Greater emanation of hydrocarbons is generally associated with fault zones. Additionally the geochemical signature of emanations along a fault zone will differ from that of the geochemical model developed over a reservoir. Thus, near surface free petroleum associated with fault zone seepage would not be expected to correlate to or appear anomalous with respect to a model developed over a reservoir accumulation.

Correlation with Structures: A geochemical anomaly map is a surface plan view of the distribution of all contributing analogous petroliferous geochemical influences throughout the stratigraphic column. The detected anomalies may correlate with structural traps on one or more horizons, or with stratigraphic traps that have not been resolved with geophysical methods; similarly a potential target may be shown to be geochemically unprospective.

Contour Plots: The geochemical contour maps provided by GORE represent an objective computer-derived probability value surface interpolated from sample values. In general, no effects or influences from the underlying geology (such as fault boundaries or other structures) are specifically accounted for in the contour interpolation. However, such boundary conditions or other geological features *should* impact the configuration of a geochemical anomaly. The exploration geoscientist is encouraged to independently hand contour the probability surface using his or her expert geological and geophysical knowledge of the prospect or region (integration of information). When provided by the client, GORE can incorporate appropriate fault lines and polygons or structural trend bias information into the data contouring process.

Contour Uncertainty: Probability values are most accurate at the sampled locations. The contour surface developed between the data points is an estimate of the probability and is subject to uncertainty, which increases with distance from each sample location. Further resolution of the contoured surface may be appropriate through additional soil gas sampling depending on the end-use of the data.

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APPENDIX B

Information Received from E&P INVESTMENT

APPENDIX C

Information Sent to E&P INVESTMENT

APPENDIX D

Signature of Potential Outlier Samples