



Terra Tasmania Resources

# **2018 ANNUAL REPORT**

**Exploration License EL30/2011**

**Exploration Activity of  
Terra Tasmania Resources Pty Ltd**

**Submitted pursuant to the  
Mineral Resources Development Act 1995**

**12 December 2018**



# Terra Tasmania Resources

## PREFACE

This Report has been prepared in accordance with the conditions outlined in Exploration Licence EL30/2011, subject to the Mineral Resources Development Act 1995 (As amended). To the best of Terra Tasmania Resources Pty Ltd ('TTR') knowledge, the report presented herein represents the intentions and work program undertaken leading up to and including the time of printing of the report.

During preparation of this report TTR has relied upon data, surveys, analysis, designs, plans and other information provided by past reports, third parties, and other individuals and organisations referenced herein. Except as otherwise stated in this report, TTR has not independently verified the accuracy or completeness of all nominated third party data, surveys, analysis, designs, plans and additional supporting information.

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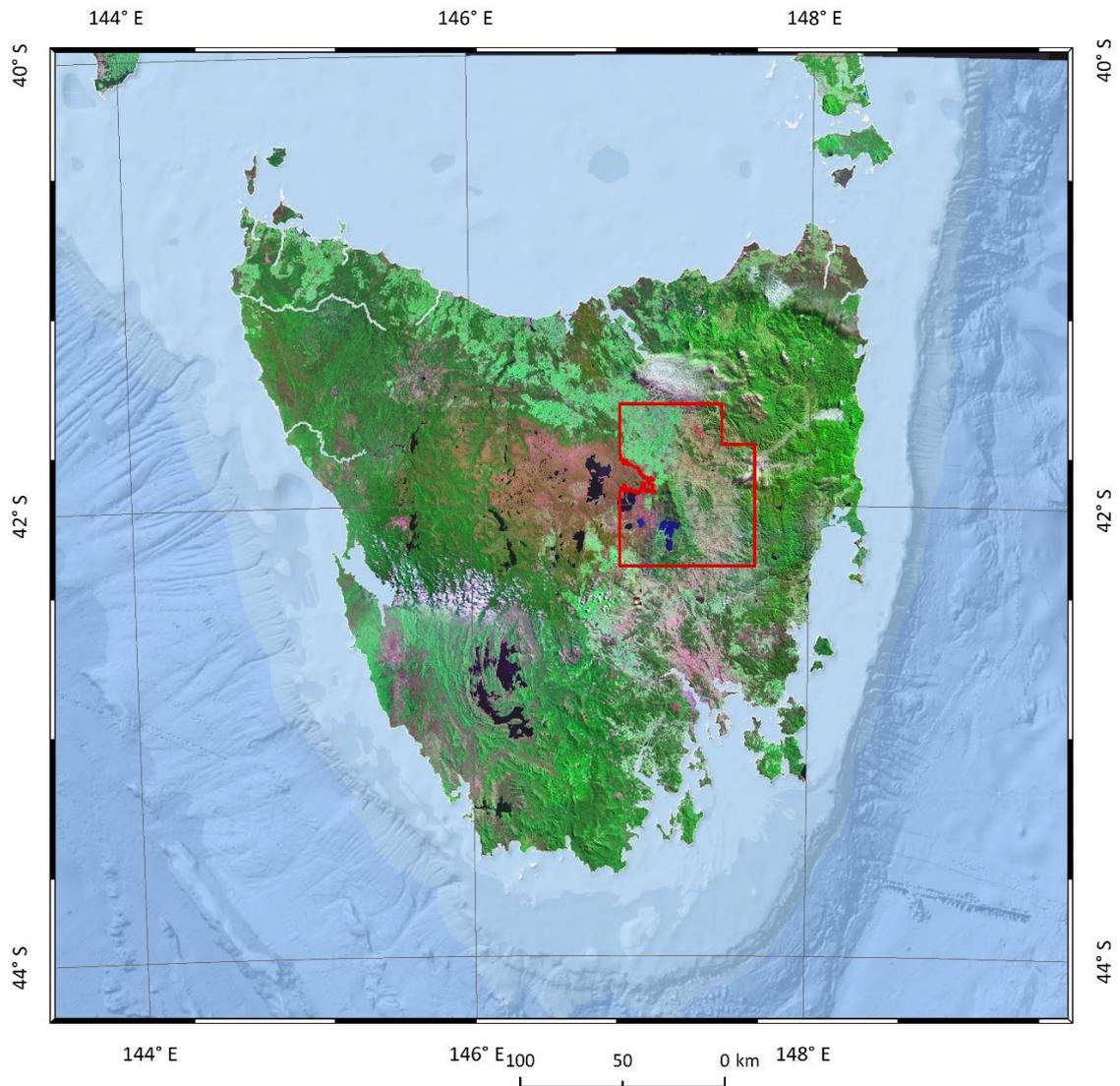
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## Geoscience Report on Category 4 Petroleum Licence EL30/2011



### **TERRA TASMANIA RESOURCES (EL30/2011)**

Date Submitted: 12<sup>th</sup> December 2018



# Terra Tasmania Resources

## 1. EXECUTIVE SUMMARY AND RECOMMENDATIONS

### 1.2 METHODOLOGY USED TO CONTINUE WORK IN 2018

Based on the work carried out in 2016 and its recommendations, work with several STeP® methods was carried further to “zoom” into the leads and prospects identified previously and to obtain additional structural and spectral data on the tenement to move closer to the geophysical field work and exploratory drilling.

Dating back to 2011, the original TTR work program entailed STeP® survey conducted by Terra Insight Services, Inc. ([www.terrainsight.com](http://www.terrainsight.com)) and was accepted by MRT. TTR has reverted to the STeP survey as a part of the play-based approach in order to elevate the value of all of the geological research and use STeP as an additional input and a part of the approach and in order to better high-grade the Area of Interest (AOI or EL30/2011) into zones of prospectivity.

In order to better understand the work carried out in 2017, in furtherance of the work started in 2016 or as from the beginning, the methodologies and action items described below are highlighted **Yellow (to show that the work in 2018 furthered that of 2017 and 2016)** or **Green (to show that the work was started in 2017 only)**. **Purple highlight indicates work under the appropriate heading is complete.**

STeP is a multi-stage approach that consists of the application of the following methodologies:

- **Geodynamic Analysis (GDA); Complete.\***
- **Morphometric Analysis (MMA);**
- **Paleo-reconstruction (PRA); Complete.\***
- **Structuremetric Analysis (SMA); Complete for two targets.\***
- **Spectrometric Analysis (PSP-RSS); Complete.**
- **Conventional Remote sensing; Complete.**
- **Integration of all methods with traditional datasets; Complete for available datasets.\***
- **Other mathematical and geological methods such as artificial neural networks or radar interfometry. Radar Interferometry is Complete.**

\* - updates may be possible

A full STeP description is available to better understand the methods carried out as a part of this play-based approach. The brief description is as follows:

- GDA is based on divisibility of the lithosphere, where most minerogenic systems are confined to specific locations that are calculable and inherited. Thus, GDA uses these principles to located zones of prospectivity;



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- MMA is based on the principle of erosion basis being connected with tectonics, and it quantifies the erosion network in order to located vertical movements or uplifts irrespective of their lithology;
- PRA represents the interior using the model of flows, which examines the Earth from the perspective of dynamics, or movements within the geomedium, and, among other things, locates depocenters, deltaic features, zones of accumulation that are most favorable for accumulation of HCs, as well as interprets such flow patterns in connection with directions of HC migration;
- SMA uses stress patterns in order to identify paleo-stress and zones of unique paleo-stress that are acoustically different in terms of being HC-saturated;
- PSP-RSS uses spectral manifestations of presence of HCs in the subsurface;
- Other methods are conventional and well-understood;
- Integration of STeP results with conventional datasets, including magnetic, gravity and seismic is a part of the STeP analysis.

STeP is typically carried out in two major phases: Phase 1 as a regional survey with exploration leads defined based on the scale ranging from 1:300,000 to 1:100,000, and Phase 2 as a local survey with exploration leads defined based on the scale ranging from 1:50,000 to 1:10,000.

The activities/services and deliverables of the survey are defined as follows:

1. During Phase 1, which shall last for 8 calendar month from the date of execution of this contract, of STeP analysis, Contractor shall perform the following Services:
  - 1.1. Collect from Client and via other available public domain means and sources and analyze the geological, geophysical, geochemical, remote sensing, natural resources exploration records, and such other relevant data in connection with the SERVICE AREA;**
  - 1.2. Conduct assessment of the geological situation of the SERVICE AREA based on the collected data;**
  - 1.3. Acquire and select general and specific, digital satellite data/images, and then prepare and process these satellite data/images;**
  - 1.4. Conduct Geodynamic analysis at the scales ranging between 1:2,500,000 and 1:300,000, as applicable;**
  - 1.5. Conduct Morphometric analysis at the scales ranging between 1:300,000 and 1:100,000, as applicable;**
  - 1.6. Conduct Paleo-reconstruction at scales ranging between 1:2,500,000 and 1:100,000, as applicable;**
  - 1.7. Conduct Proprietary Spectrometric analysis at the scales ranging between 1:300,000 and 1:100,000, as applicable;**
  - 1.8. Conduct Structuremetric analysis at the scale 1:100,000, as applicable;**
  - 1.9. Conduct Photogeological studies; the scale and size of features and tectonic movements described in the study will correspond to their surface expression;
  - 1.10. Conduct traditional remote sensing studies onshore, such as **thermal**, lineament density, and **spectral indexes mapping** (and/or similar); the



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selection of such methods and their working scale are subject to the location and geology of the SERVICE AREA;

- 1.11. Integrate all of the datasets collected via the activities described in items “1.1” through “1.10”, assess HC- prospectivity of the SERVICE AREA, and delineate exploration targets/structures, as applicable;**
- 1.12. Produce a report;**
- 1.13. Produce all cartographic materials.**
- 2.1. Acquire and select additional digital satellite data/images, as needed, prepare and process these satellite data/images;**
- 2.2. Conduct Morphometric analysis at the scales ranging between 1:100,000 and 1:50,000, as applicable;**
- 2.3. Conduct Paleo-reconstruction at the scales ranging between 1:100,000 and 1:50,000, as applicable;**
- 2.4. Conduct Proprietary Spectrometric analysis at the scales ranging between 1:50,000 and 1:10,000, as applicable;**
- 2.5. Conduct Structuremetric analysis at the scale 1:10,000 or better, as applicable;\***
- 2.6. Integrate all of the datasets collected via the activities described in items “3.1” through “3.5”, assess HC- prospectivity of the SERVICE AREA, delineate structures contours and determine potential drilling locations within each structure;
- 2.7. Produce a report;**
- 2.8. Produce all cartographic materials.**
- 3.1. Map(s) showing results of Geodynamic analysis at scale from 1:2,500,000 to 1:300,000, as applicable (from continental/regional scale to local); the results typically consist of a report and maps depicting various geodynamic elements, their analysis, and areas/contours of hydrocarbon prospectivity;
- 3.2. Map(s) showing results of morphometric analysis at the scale ranging between 1:300,000 and 1:100,000, as applicable; the results typically consist of an analytical report and maps containing varying morphometric constructs, base levels, areas of subsurface uplifts, anticlines, and/or closures;
- 3.3. Map(s) depicting results of paleo-reconstruction analysis at the scale ranging between 1:2,500,000 and 1:100,000, as applicable (from continental/regional scale to local); the results typically consist of an analytical report and maps containing paleo-reconstructions of the surface at different scales as well as of the base levels that are relevant to the investigations; paleo-reconstructive features and criteria are superimposed to produce a map of prospectivity for different scales and/or paleo-geographic levels;
- 3.4. Map(s) depicting results of Proprietary Spectrometric analysis at the scales ranging between 1:300,000 and 1:100,000, as applicable; the results typically consist of a short analytical report and map(s) containing spectral anomalies that are indicative of the presence of hydrocarbons;



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- 3.5. Map(s) depicting results of Structuremetric analysis at the scale of 1:100,000 (also other map(s) may be provided at regional scales, as applicable); the results typically consist of an analytical report and maps containing stress fields and contours of targets, but may also include reconstructions of the phases of development of the sedimentary environment and other relevant information and maps as determined applicable in the course of the Services;
- 3.6. Map(s) depicting results of a traditional remote sensing nature, such as thermal maps, lineament density, spectral indexes, and/or similar with scale ranging from approximately 1:300,000 to 1:100,000, as applicable; the results typically consist of appropriate maps such as minerals indexes, thermal gradients, etc.;
- 3.7. Map(s) depicting the results of photogeological analysis at scale equivalent to the size and scale of relevant surface features being analyzed; the results typically consist of an analytical report and appropriate maps of showing tectonic structures, directions of tectonic movements, natural phenomena at the surface indicative of certain subsurface events, etc.;
- 3.8. Map(s) showing the process of superposition and integration of all of the datasets and a resulting map of all exploration leads/structures/anomalies, as applicable, at the scales commensurate with the scale of each type of analysis;
- 3.9. Map(s) of all of the Deliverables described herein in a cartographic format, such as SHP (shape) or MPK, for ease of Client's integration of STeP findings with the Client's internal G&G systems;
- 3.10. The report will be delivered in soft copy and is anticipated to include, to the extent determined to be relevant, recommendations on the Service Area's prospectivity with written justifications and geological conclusions drawn from the STeP® findings:
  - 3.10.1. General assessment of prospectivity for HCs;
  - 3.10.2. Indication (mapping) of the contours of HCs prospectivity with scale 1:300,000 to 1:100,000, as applicable to the various parts of the analysis;
  - 3.10.3. Selection of areas of prospectivity as leads or prospects in cartographic format and recommendations on their further exploration priority;
  - 3.10.4. Interpretation of the analysis results and correlation with existing well control and other G&G data, if available.

In summary: the report will contain a myriad of maps, models, calculations and their interpretations leading to the conclusions and maps of contours of potential HC deposits within the Service Area. Such contours are considered high value exploration targets for further exploration. These anomalies will be high-graded in relation to their exploration priority.

- 4.1. Map(s) showing results of morphometric analysis at the scale ranging between 1:100,000 and 1:50,000, as applicable; the results typically consist



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- of a short report and maps containing varying morphometric constructs, base levels, areas of subsurface uplifts, anticlines, and/or closures;
- 4.2. Map(s) depicting results of paleo-reconstruction analysis at the scale ranging between 1:1,000,000 and 1:50,000, as applicable; the results typically consist of a short report and maps containing paleo-reconstructions that are relevant to the investigation; paleo-reconstructive features and criteria are superimposed to produce a map of prospectivity for different scales and/or paleo-geographic levels;
  - 4.3. Map(s) depicting results of Proprietary Spectrometric analysis at the scales ranging between 1:100,000 and 1:50,000, as applicable; the results typically consist of a short report and map(s) containing spectral anomalies that are indicative of the presence of hydrocarbons;
  - 4.4. Map(s) depicting results of Structuremetric analysis at the scale of 1:10,000 (or better, as applicable); the results typically consist of a short report and maps containing stress fields, structure contours, drilling locations for each analyzed structure, and target depths;
  - 4.5. Map(s) showing the process of superposition and integration of all of the datasets and a resulting map of all exploration leads/structures/anomalies, as applicable, at the scales commensurate with the scale of each type of analysis;
  - 4.6. Map(s) of all of the Deliverables described herein in a cartographic format, such as SHP (shape) or MPK, for ease of Client's integration of STeP findings with the Client's internal G&G systems;
  - 4.7. The report will be delivered in soft copy and is anticipated to include:
    - 4.7.1. Assessment of prospectivity for HCs of the local-scale targets analyzed in Phase 2;
    - 4.7.2. Mapping of structure contours of HCs of the local-scale targets analyzed in Phase 2;
    - 4.7.3. Table listing coordinates of proposed drilling locations and approximate target depths of potential reservoirs.

In summary: the report will contain a myriad of maps, models, calculations and their interpretations leading to the conclusions and maps of contours of potential HC structures at a local scale. Such contours are considered high value exploration targets for further exploration. These structures will be high-graded in relation to their exploration priority. Recommendations of the next steps are expected to be: limited 3D seismic surveys, geochemical surveys, STeP survey at a more detailed scale such as 1:10,000 or better. If 2D or 3D seismic is recommended, such seismic datasets are expected to validate the STeP structures and help solidify the drilling locations.

Each type of the analysis listed above is being carried out independently and in parallel with its other counterparts. Most of the analysis described herein are typically carried out based on several scales – from regional or even continental to local scales. Upon completion of all



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the separate types of processing listed above, they are all integrated in GIS and interpreted in connection with the local geology and geophysical information.

In 2016, the regional phase of STeP was being carried out. A certain trend plus zones of HC prospectivity have been identified.



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The following methodologies have been carried out in 2018 and presented in the following sections of this Report:

1. **Collection of source data. Subject to further work, additional data may be collected.**
2. **Geodynamic Analysis – Work is complete.**
3. **Mineral Indexes – furthered from the work performed in 2017. Work is complete.**
4. **Relief plasticity and Paleo-reconstruction. Work is complete.**
5. **Structuremetric Analysis. Additional work is ongoing. Work is complete.**
6. **Seismic postprocessing. Work is complete.** Please note: only one tranche of the two tranches available were furnished to TTR in the processed format. That data was post-processed. The second tranche of data has not been furnished to TTR by MRT in a processed format (processing of that data will be challenging).



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### 2. STEP ANALYSIS PROGRESS REPORT

#### 2.1 GEODYNAMIC ANALYSIS (GDA)

##### 2.1.1 INTRODUCTION - METHOD OF GDA ASSESSMENT OF SUBSURFACE OIL AND GAS PROSPECTIVITY

**T**he main task of this phase of GDA is allocation of a network of geodynamic fluid-discharging nodes in the Earth's crust, as one of the criteria and indicators for HC prospectivity.

The analysis of the target area was carried out using DEM, satellite images, geophysical maps at the scales of 1:15,000,000, 1:1,000,000, and 1:200,000. Accordingly, the interpretation entailed three stages of work to accommodate for the three scales.

In general, lineaments and zones of arc morphology delineated by GDA are fragments of concentric structures that make up the transregional structural grid/framework of the geomedium's fault system. Such structures indicate that there exist "transport channels" carrying reduced fluids to the upper horizons of the Earth's crust. These channels are "guarantors" of HC-generative processes, if other favorable structure-geodynamic conditions are met. Such conditions are:

- Optimal degree of faulting/displacement for HC's migration and accumulation;
- Intersections of tectonogens of different ranks, their zones of dynamic influence, and concentric structures;
- Existence of HC collectors, seals, and traps.

**Intersections of such major structures invariably cause groups of concentric displacements of varying power and diameter.**

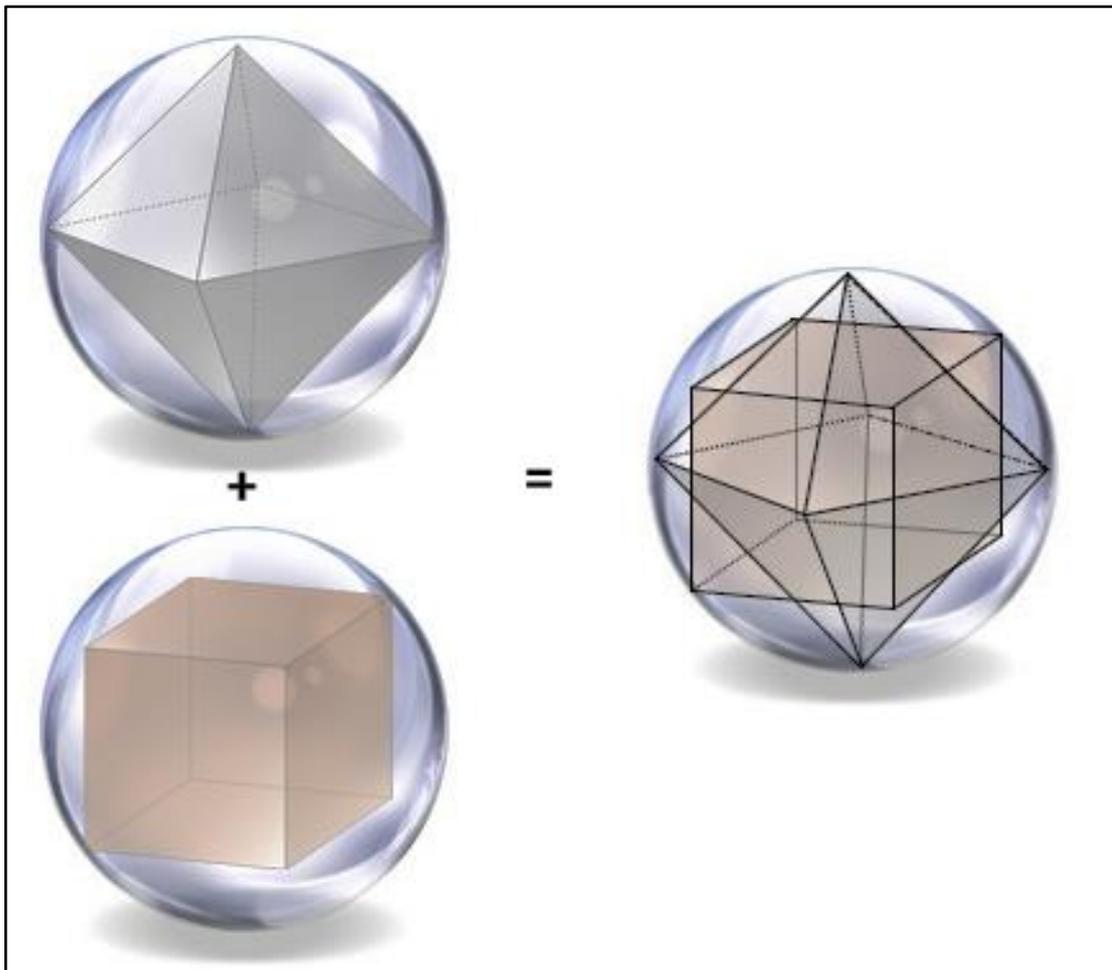
The phenomenon of deep degassing of the Earth's entrails is known. Its major components are H<sub>2</sub>, He, CO, CO<sub>2</sub>, CH<sub>4</sub>, N, F, S, and others. Gases, including hydrocarbons, are carried into the crust from the mantle by flows of "reduced fluids". Their focused introduction into the lithosphere mainly occurs via injection mechanisms similar to plumes. The consequences of such a process are active seismogenesis, intense morphological and lithodynamic movements of the crust, systemic structural organization of the geomedium, as well as an intense and varying mineralization that accompanies these processes.

The products of degassing are directed (along with a variety of commercially valid components) via faults/permeable zones that are called "tectonogens". Their locations correspond to strict systems of locations on the surface that make up the Earth's framework. Such a skeleton of tectonogens can be traced on the entire surface of the globe.

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The organization of the carcass of tectonogens (i.e. their mapped locations on the Earth's surface) follows the symmetry system of regular polyhedrons. Two systems of organization of the geomedium correspond to the history of Earth's development:

1. Cube-octahedral system (**Figure 1**) formed and influenced the geosphere mostly in the Early Precambrian. The regular polyhedrons are cube and an octahedron as illustrated are both inscribed in the sphere, which is the Earth's geoid in this case.



**Figure 1: General model of Cube-octahedral symmetry system of Earth organization.**

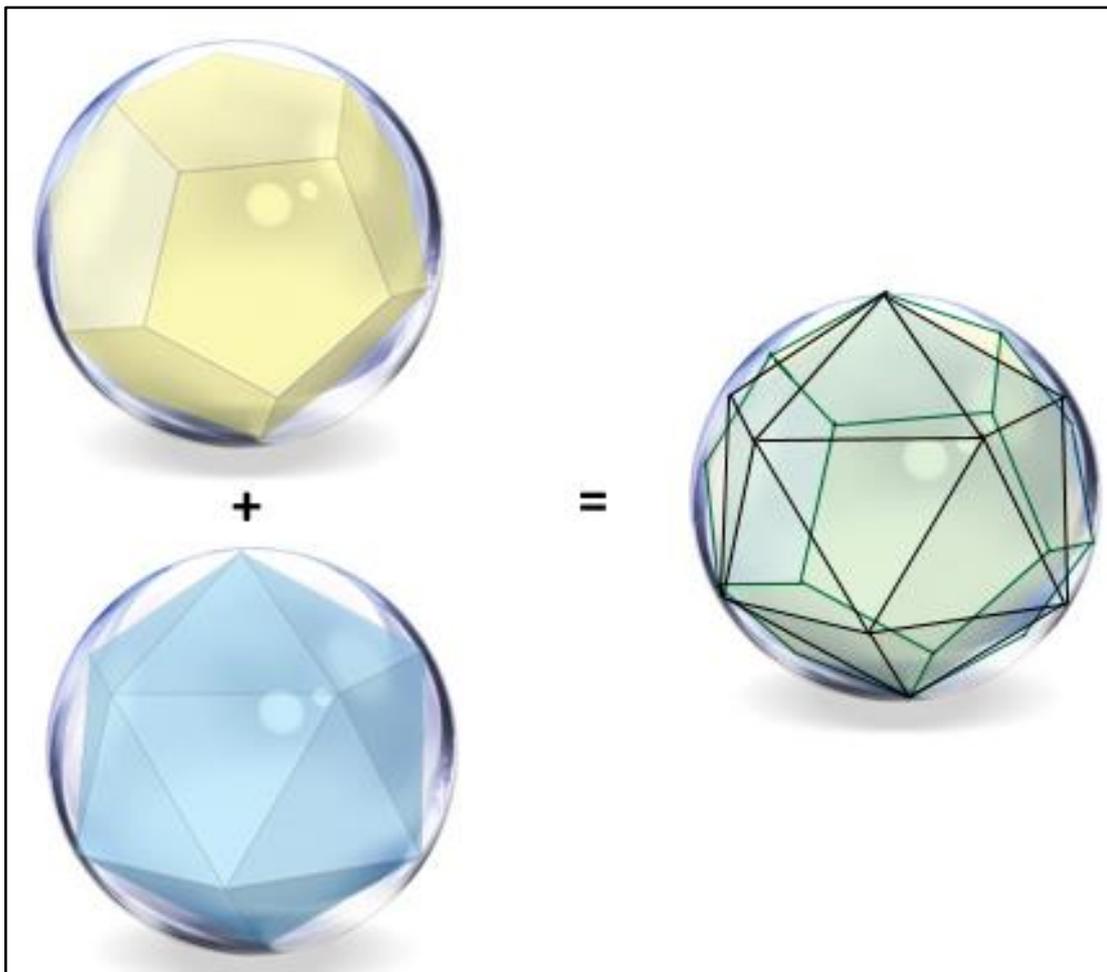
All the edges of these two polyhedrons "project" onto the surface, and their detection is fundamental for the study and analysis of a territory using GDA.

GDA postulates that the cube-octahedral system ended its development in early Proterozoic (about 2.5 billion years ago) in the beginning of a strong tectonic-

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magmatic activation (TMA<sup>1</sup>), which influenced the second system of organization of the geospace.

2. The icosahedron-dodecahedral system (**Figure 2**) began its development with the onset of TMA in the early Proterozoic. The role of regular polyhedrons is played by icosahedron and dodecahedron. Like cube and an octahedron described above they are both inscribed in the sphere of the Earth's geoid as illustrated in **Figure 2**, they provide a different tectonogen framework as compared with the cube-octahedral system.



**Figure 2: General model of icosahedral-dodecahedral symmetry system of Earth organization.**

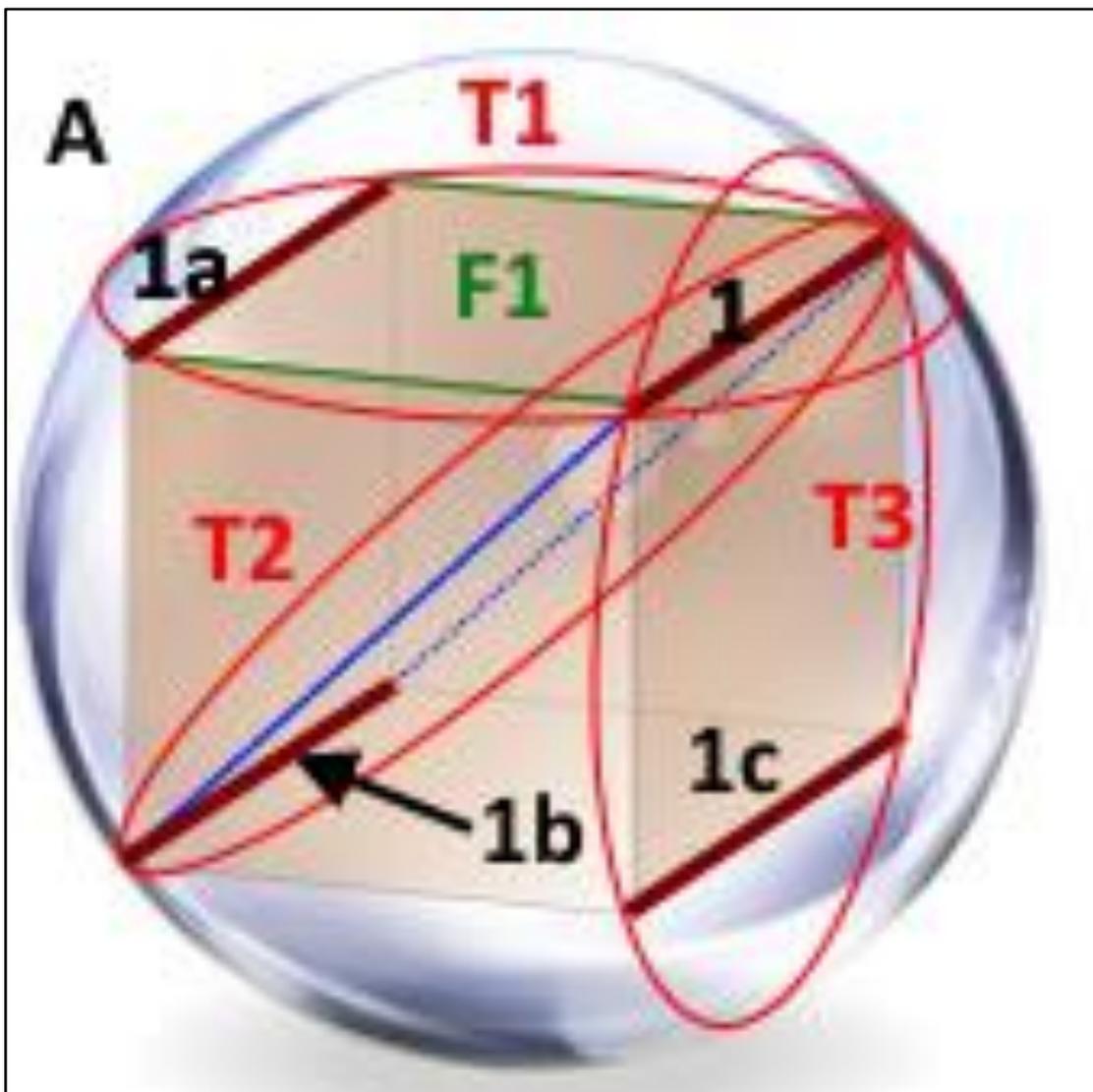
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<sup>1</sup> **Tectonic-magmatic activation (TMA)** - the process of increased intensity of tectonic movements and magmatism that usually manifested after the period of relative tectonic quiescence. It is characterized by varying tectonic deformations and rifting and is associated with either ascent of heated lightweight fluids from the mantle to the base of the crust or collision of continental lithospheric plates and heating of their lower parts. TMA lasted over a considerable period of the Earth's history, at least since the beginning of Proterozoic (2.5 billion years ago) and more clearly and fully in Mesozoic. TMA is associated with the formation of numerous deposits of metal ores, rare elements, precious stones, and other natural resources.

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Tectonogen is a linear structure that can manifest at the surface of the Earth, and its orientation/direction coincides with the orientation/direction of the edge of a regular polyhedron of any of the symmetry systems.

Tectonogen is the line of intersection of an imaginary plane drawn through any two edges of a regular polyhedron with the surface of the Earth. The example in **Figure 3** shows four edges (two green and two burgundy ones numbered 1 through 1a) of the facet F1. Tectonogen T1 can be delineated by extending the plane of facet F1 to the surface of the sphere of the Earth (red ellipse). The edge of this facet 1 is involved in the formation of other tectonogens T2 and T3, which demonstrates that this the facets of both polyhedrons manifest at the surface as multiple tectonogens.

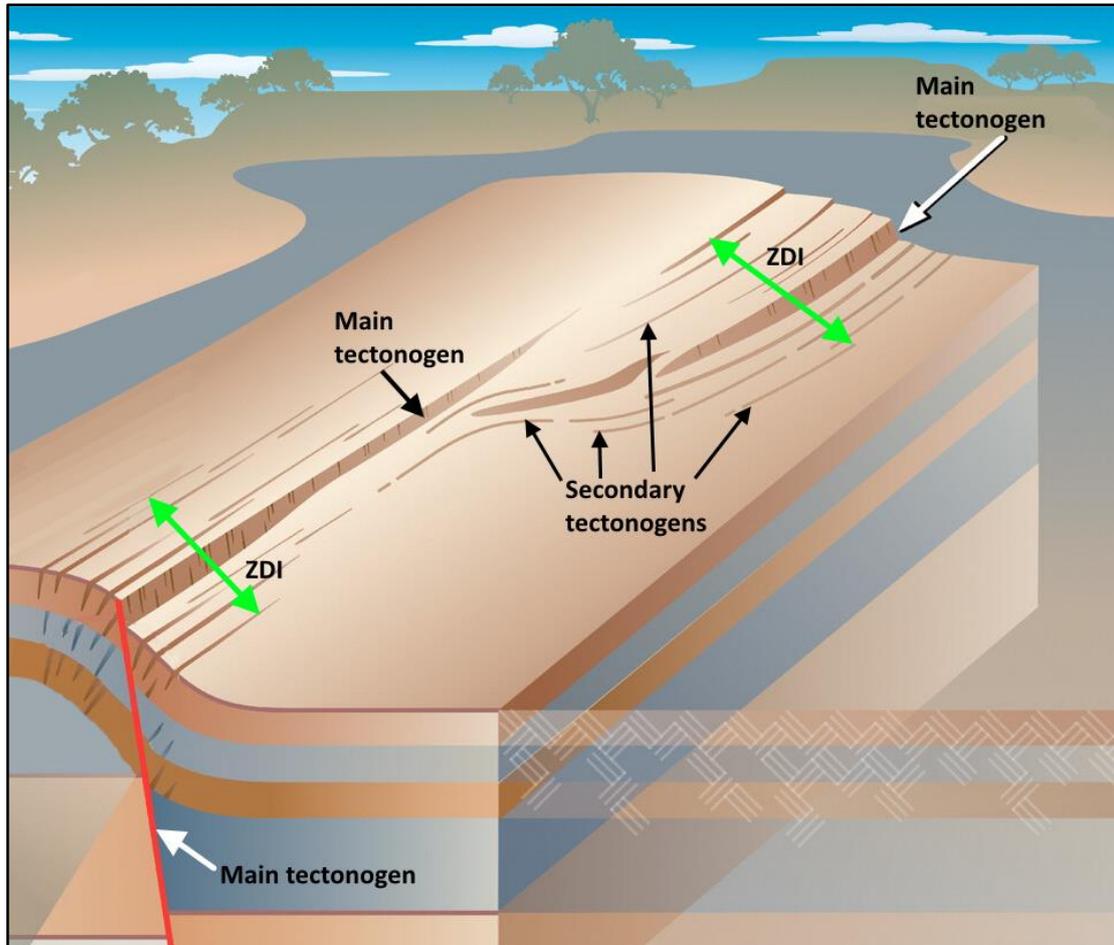


**Figure 3: Principle of formation of tectonogens.**

Because the Earth's interior is heterogeneous, the surface would not reflect a clear and well-defined expression of a tectonogen. The geological life of the planet can change the position of a tectonogen or even fully erase its morphological manifestation. Nevertheless, indirect

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signatures of such tectonogens can be traced using, for instance, secondary tectonogens that extend parallel to the place of the main one. The width of an area where secondary tectonogens can be traced on either side of the main one is the zone of its dynamic effects or the Zone Dynamic Influence, abbreviated as ZDI (**Figure 4**).

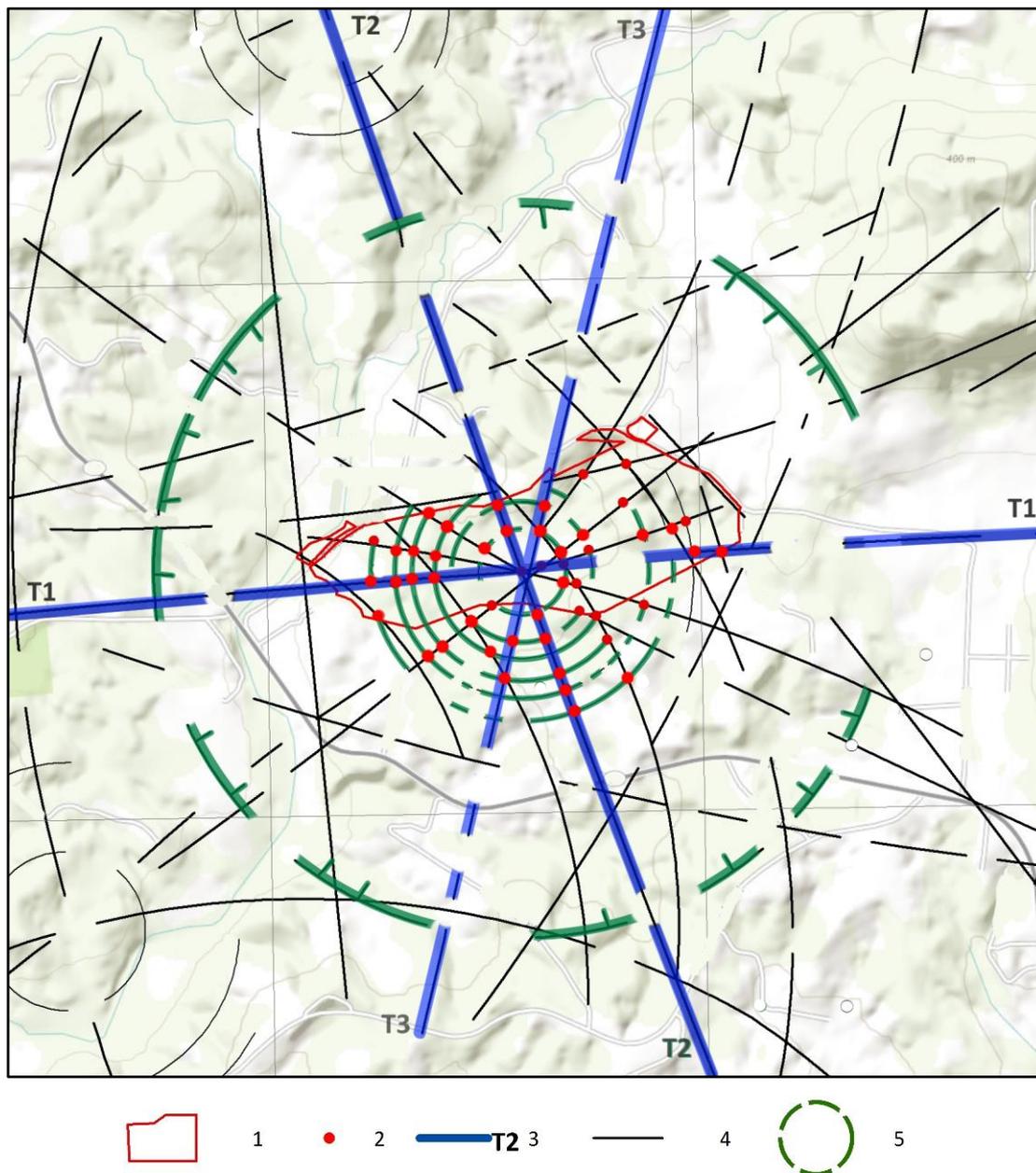


**Figure 4: Schematic image of tectonogen relations.**

Intersecting tectonogens form nodes that are essential elements of GDA. If tectonogens are fractured and permeable zones connecting the interior of the Earth to its surface, an intersection of two or more of tectonogens makes up a stem channel of an enhanced deep fluid discharge. Accordingly, the near-surface region above such a node is the area of high-energy charge of the geomedium, its tectonic stress, and active disintegration of near-surface sediments and rocks. The surface morphology of such areas is often represented by diverse depressions and arched, circular structures.

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**Figure 5** illustrates a schematic example of such a structure, where three tectonogens (T1, T2, and T3) intersect and form a node that serves as an epicenter of multi-ring systems of concentric structures (MSCS), which are marked green in **Figure 5**. The outer contour is a circular depression (downfold).



**Figure 5: Example of a typical MSCS.**

*1 – Third-party area of interest; 2 – Fluid-dynamic nodes; 3 – Tectonogens; 4 – MSCS centers and minor tectonogens; 5 – Depression centers*

The GDA methodology includes the following:

1. Deciphering (manual interpretation) of tectonogens, lineaments, and concentric structures using varying cartographic, satellite, elevation and other materials (geological, geophysical, and tectonic).



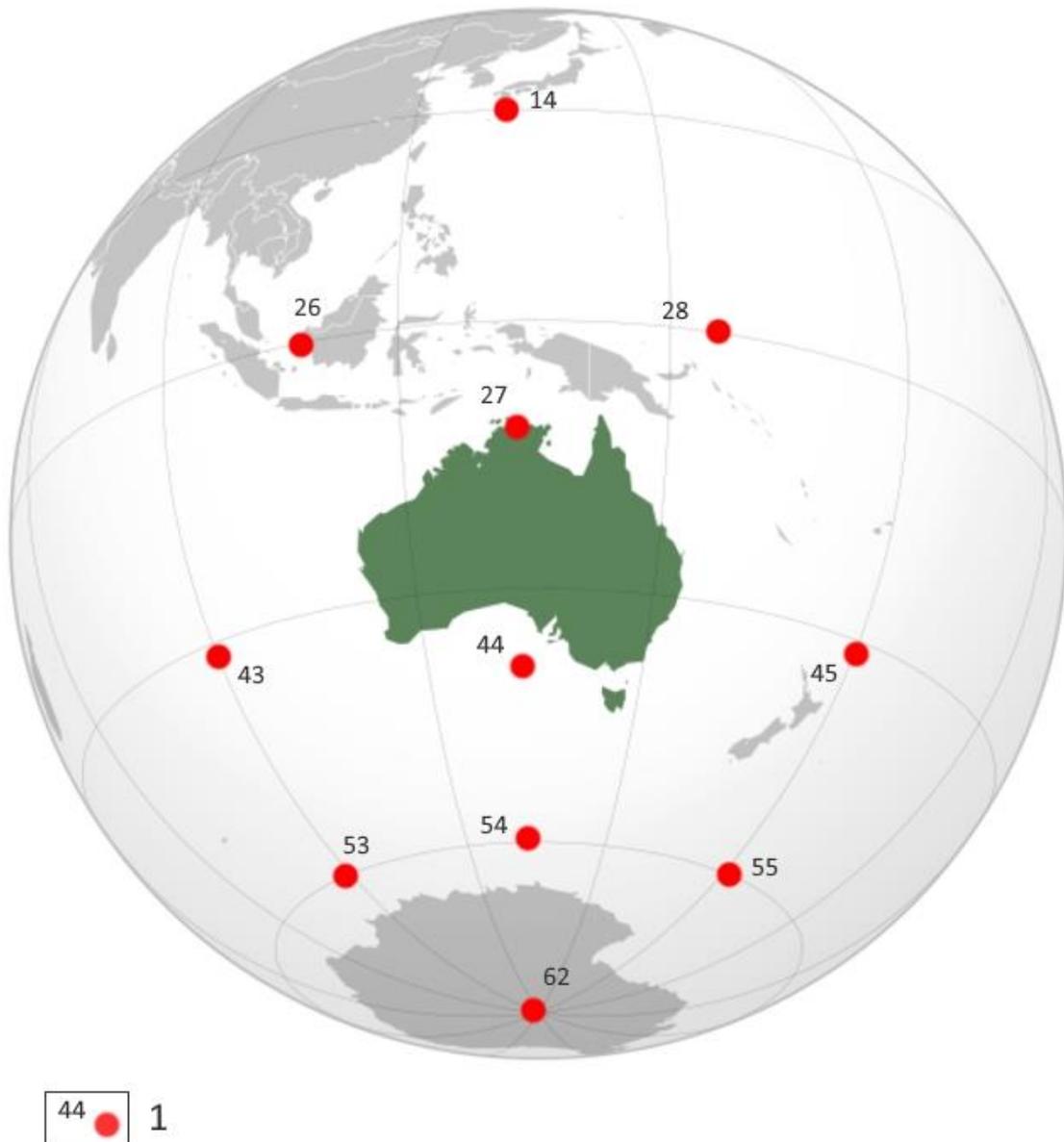
## Terra Tasmania Resources

2. Location of nodes of intersections of tectonic-dynamic zones that serve as fluid discharge zones.
  
3. Delineation of zones of active fluid discharge as contours of zones with high density of said nodes. Such territories are primary objects of prospecting for hydrocarbons.

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### 2.1.2 GEODYNAMIC ASSESSMENT OF SUBSURFACE OIL AND GAS PROSPECTIVITY AT THE PLANETARY SCALE

The general geological development is attributed to the icosahedron-dodecahedron skeletal tectonogen framework of the Earth's interior. This framework consists of nodes and tectonogens of varying rank, which exist inseparably from each other. Initially, GDA distinguishes several major nodes that influence the Australian continent (**Figure 6**) and AOI.

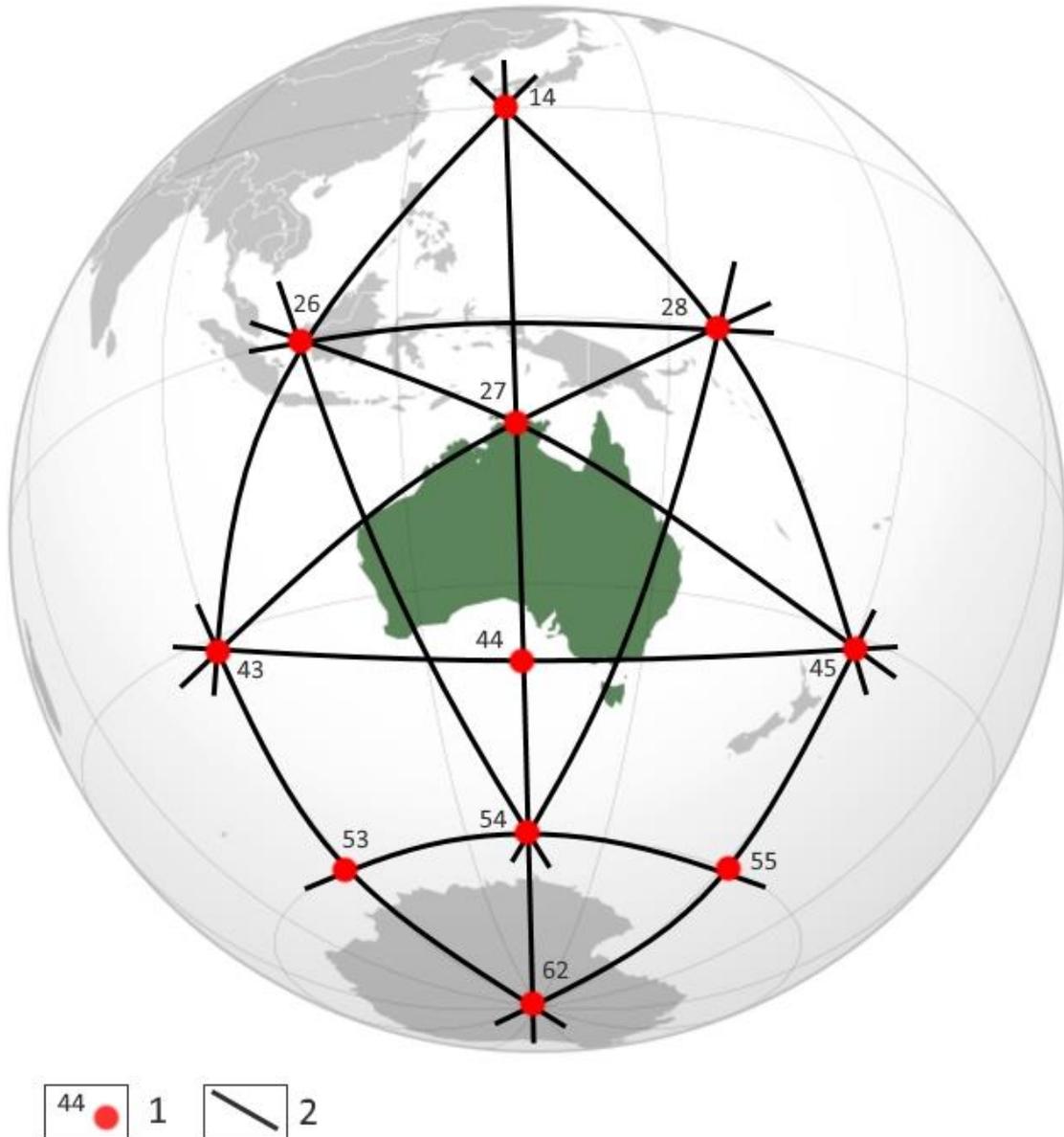


**Figure 6: Fragment of the trans-planetary system of geodynamic control with nodes around the Australian continent.**

*1 – Main planetary node numbered*

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The connection between these nodes comprises the system of planetary tectonogen framework (**Figure 7**).

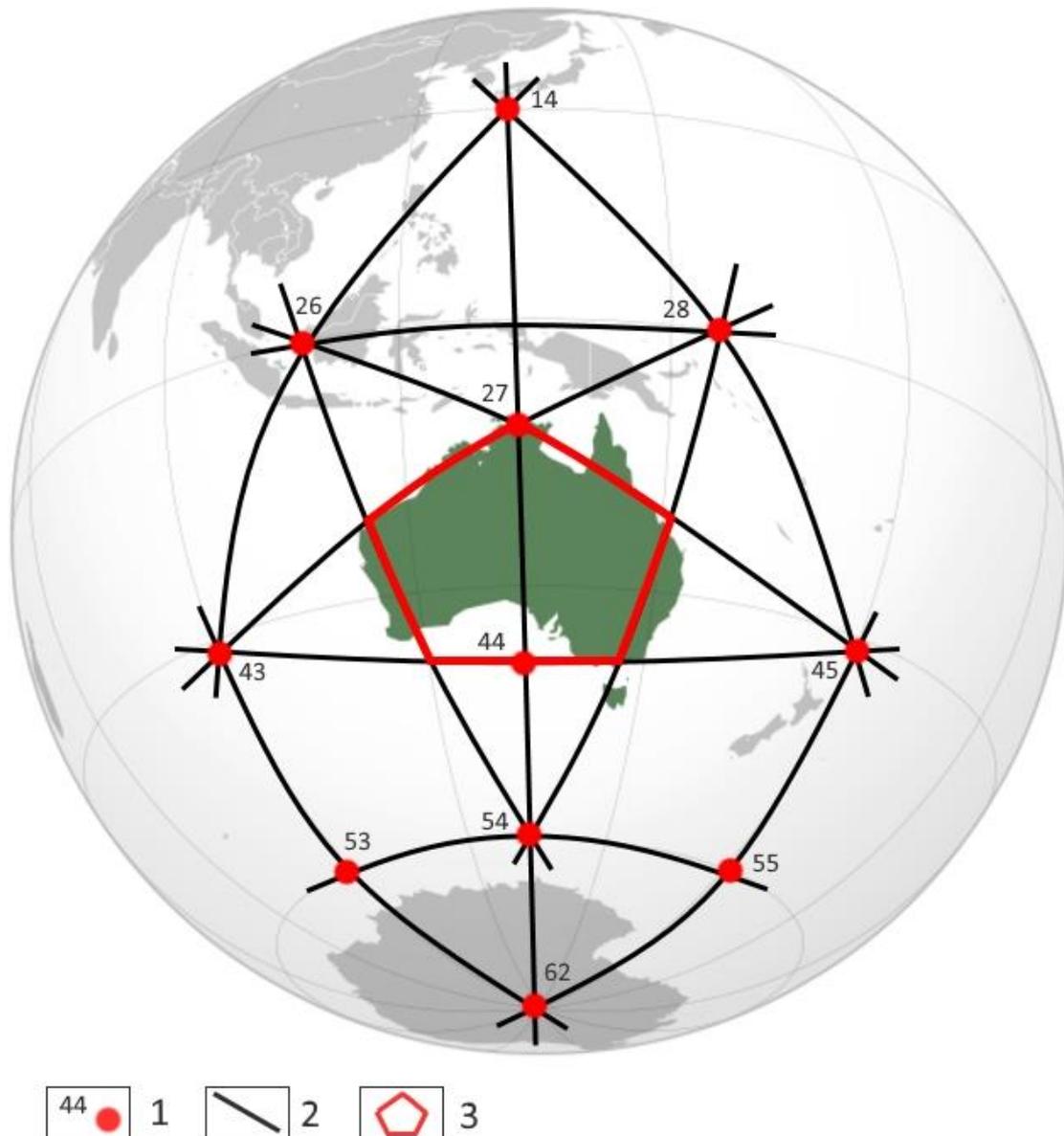


**Figure 7: Scheme of planetary tectonogens and nodes that influence Australian continent.**

*1 – Planetary node with numbers; 2 – Tectonogen*

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This tectonogen framework system distinguishes the pentagon-shaped area attributed to the Australian continent (**Figure 8**), further supporting the GDA model of icosahedral-dodecahedral organization (each side of a dodecahedron is a pentagon).

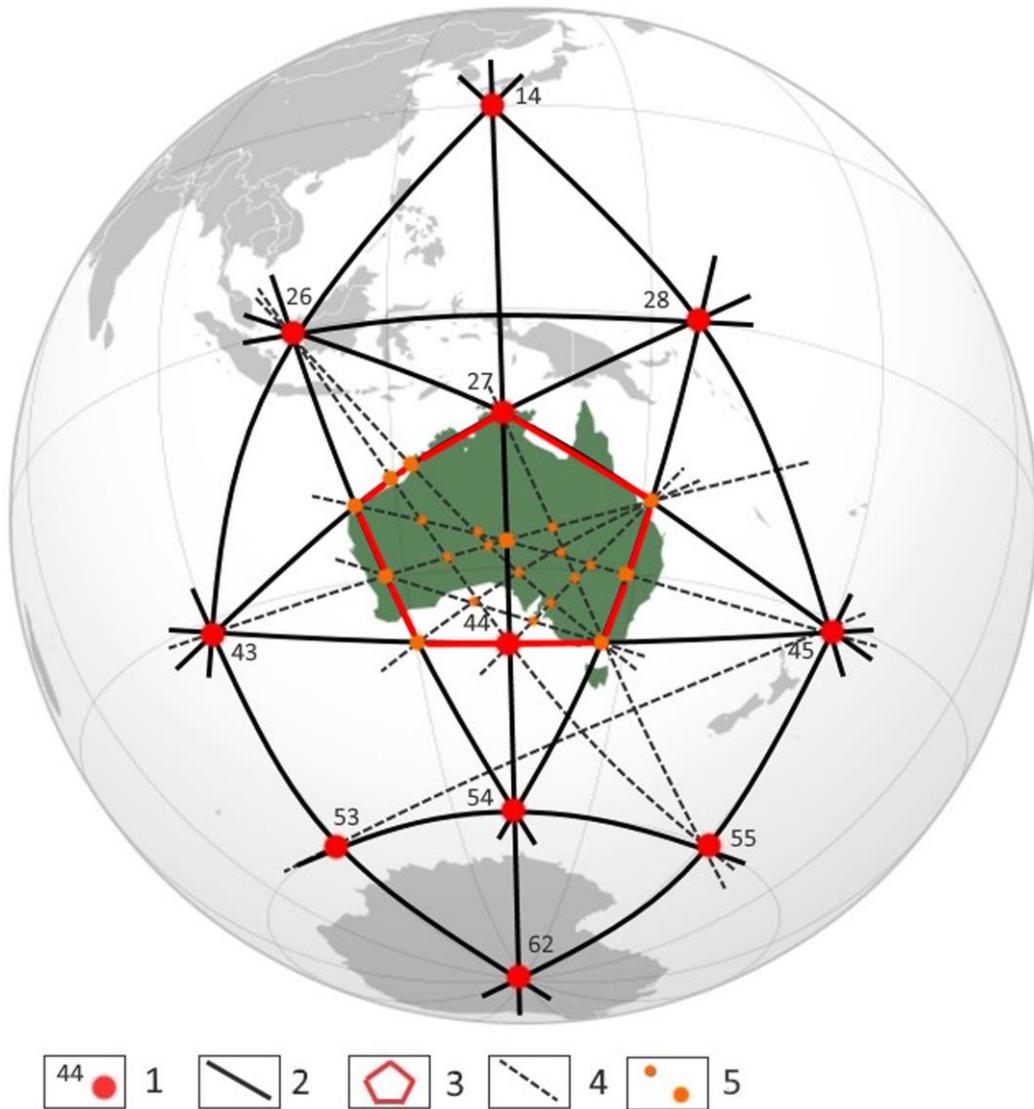


**Figure 8: The Australian pentagon.**

*1 – Planetary node; 2 –Tectonogen; 3 - Pentagon-shaped area*

The cube-octahedral tectonogen system of the continent is weakly expressed in the morpho-dynamic space and can be traced using its limited local manifestations. This is normal, as the cube-octahedral system of symmetry developed much earlier as compared to the icosahedral-dodecahedral one and, at the present time, is almost fully concealed almost everywhere on Earth.

The geodynamic system, however, studies the development of the nodes "connecting" the tectonogens of not only the planetary scale and importance, but also of the tectonogens of lower ranks.

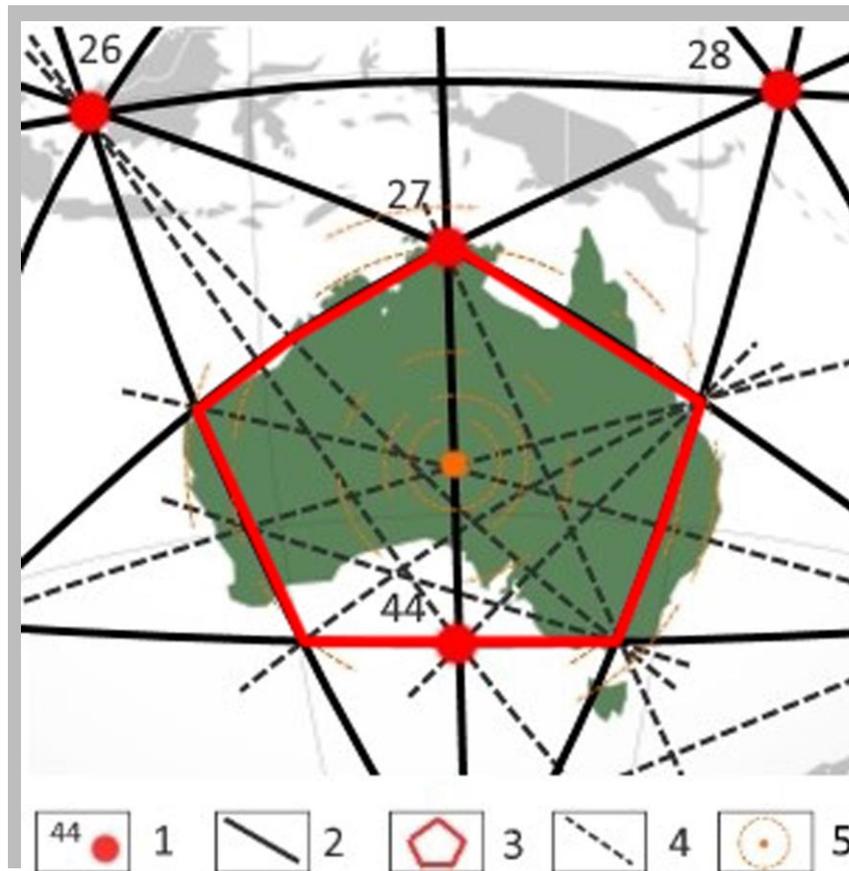


**Figure 9: Scheme of major and minor tectonogens and nodes related to the Australian continent.**  
 1 – Planetary node; 2 – Major tectonogen; 3 - Pentagon-shaped area; 4 – Minor tectonogen; 5 – Minor node

The second and cornerstone GDA phase is the determination of concentric structures. As a general rule, almost every node formed at the intersection of tectonogens is in turn the epicenter of a concentric system that must be identified. Its power and scope correspond to the "parent" node's rank. Powerful, planetary-importance tectonogens generally cause powerful concentric systems with equally powerful nodes at their epicenters.

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A schematic example of a powerful concentric system is shown in **Figure 10**. It is one the most important geodynamic features of the Australian continent, as will be shown in the following chapters.



**Figure 10: Scheme of concentric system genesis.**

*1 – Planetary node; 2 – Major tectonogen; 3 - Pentagon-shaped area; 4 – Minor tectonogen; 5 – Concentric system*

### 2.1.3 GDA AT CONTINENTAL-RANK SCALE OF 1:15,000,000

The geodynamic analysis constructs are best displayed using varying geological and geophysical datasets, including satellite images. As the GDA work progresses, the analysis continues using higher scales of the mapping and data, helping clarify the positions of the previously identified geodynamic constructs.

#### GDA AT CONTINENTAL-RANK SCALE OF 1:15,000,000 - GEODYNAMIC FACTORS OF AUSTRALIA'S STRUCTURAL CONTROL AND INTEGRATION WITH THE GRAVITY AND MAGNETIC SURVEYS

This first phase of GDA was performed at the scale of 1:15M. Satellite, digital-elevation, geological, and geophysical data are typically involved in tying the main tectonogens to the general area with a subsequent evaluation of the main geodynamic criteria of the systemic organization of Tasmania.



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GDA integrated all raster results extracted from varying available maps and data types. For instance, in many cases the confirmation of the existence of lineaments (tectonogens) and concentric structures was based on the integration of the GDA constructs with satellite images showing varying geomorphological features.

GDA also utilized and integrated its constructs with the gravity data, which has many applications in geology. This method depends mainly on the density contrast of the rocks and can image subsurface structures and density distribution using gravity-field interpretation techniques such as horizontal gradient (HG)<sup>2</sup> and tilt derivative (TD)<sup>3</sup>.

GDA also utilized and integrated its constructs with the magnetic data.

The map of seismic activity was also integrated with GDA constructs by analyzing the locations of earthquake epicenters in structures of crust dislocations.

The aim of this integration of the GDA constructs with the multiple available geoscientific datasets was to confirm and enhance the GDA results.

As the GDA work progresses, the analysis continues using higher scales of the mapping and data, helping clarify the positions of the previously identified geodynamic constructs.

The work revealed a number of patterns that make up the structure of the geological environment:

1. A discrete, hierarchical framework of varying-scale-and-rank tectonogens serving as global channels of de-fluidization.
2. Focal discharge in the upper horizons of the geosphere through the multi-rank nodes of tectonogen intersections and their zones of dynamic influence (ZDI).
3. The presence of discrete, concentric systems of tectonic disturbances of varying rank, defining the concentrated nature of “unloading” of the mantle in areas related to energy and fluid discharge.

This regional stage of GDA is best demonstrated if integrated and superimposed with varying geophysical maps such as the Bouguer gravity map of Australia (**Figure 11**).

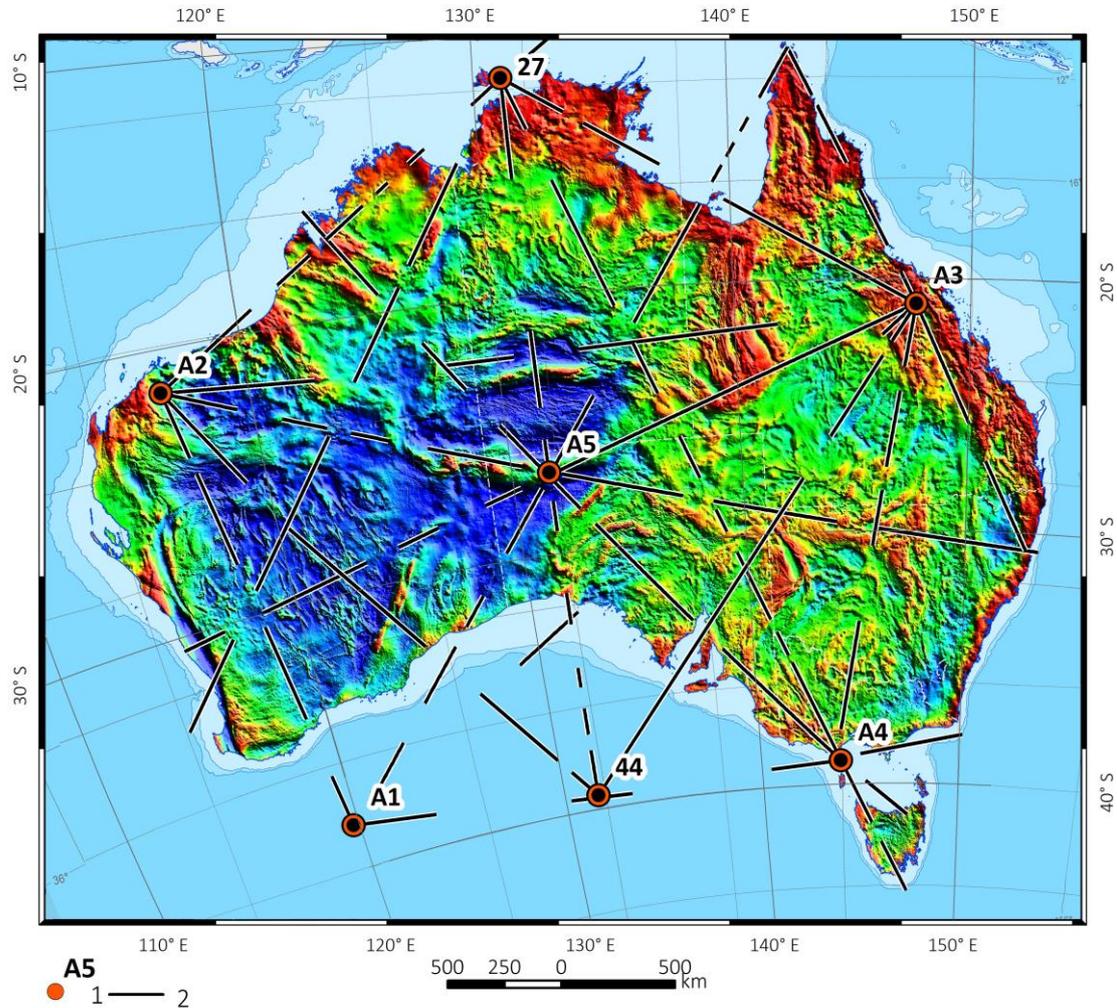
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<sup>2</sup> <https://pangea.stanford.edu/ERE/db/WGC/papers/WGC/2015/13030.pdf>

<sup>3</sup> [https://www.geosoft.com/media/uploads/resources/tilt\\_derivative\\_made\\_easy\\_07-2016.pdf](https://www.geosoft.com/media/uploads/resources/tilt_derivative_made_easy_07-2016.pdf)

## Terra Tasmania Resources

The pentagonal-symmetry tectonogen framework (five vertices of which are the nodes of continental rank shown in **Figure 8** as A1, A2, A3, A4, 27 and 44) can be traced using the gravimetric data as the base map (**Figure 11**).



**Figure 11: Integration of GDA and Bouguer gravity map of Australia. Major tectonogens and nodes.**

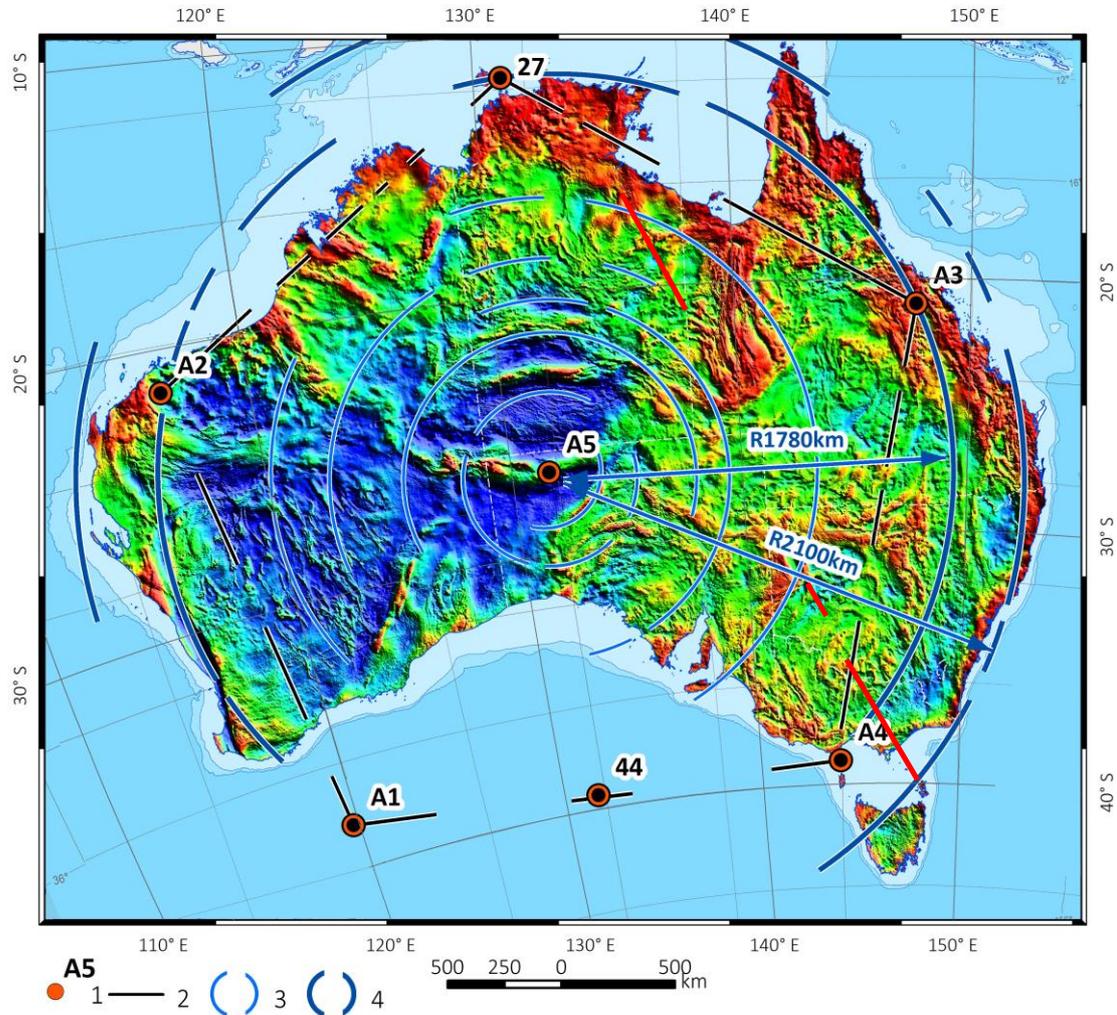
*1 –Node; 2 - Major tectonogen*

The lowest-altitude region, the area of deflection shown with blue color in **Figure 11** of the continent is attributed to the central-eastern part of the pentagonal area. Node A5 of the continental rank is located within this subsidence. The radius connecting all five nodes located at the pentagon's vertices (A1, A2, A3, A4, 27) is equal to 1,780 km. Its outer perimeter is confined to "linear" mountain chains, confidently traced and controlled by the outer edges of the pentagonal system. The exception to this geometric confinement is concealed by the ocean at the southern edge of the polyhedron.

The Australian continent "widens" at the eastern flank of the pentagonal system reaching the radius of 2,100 km at its external concenter (**Figure 12**). The island of Tasmania is located within the zone of dynamic influence of this concenter. At the northern side of Tasmania,

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the external 2,100-km concentric intersects with one of the elements of the pentagonal frame, which is the tectonogen that extends between nodes 27 and A4 (**Figure 11** and **Figure 13**), confidently traced from the northern tip of this pentagon to Tasmania.

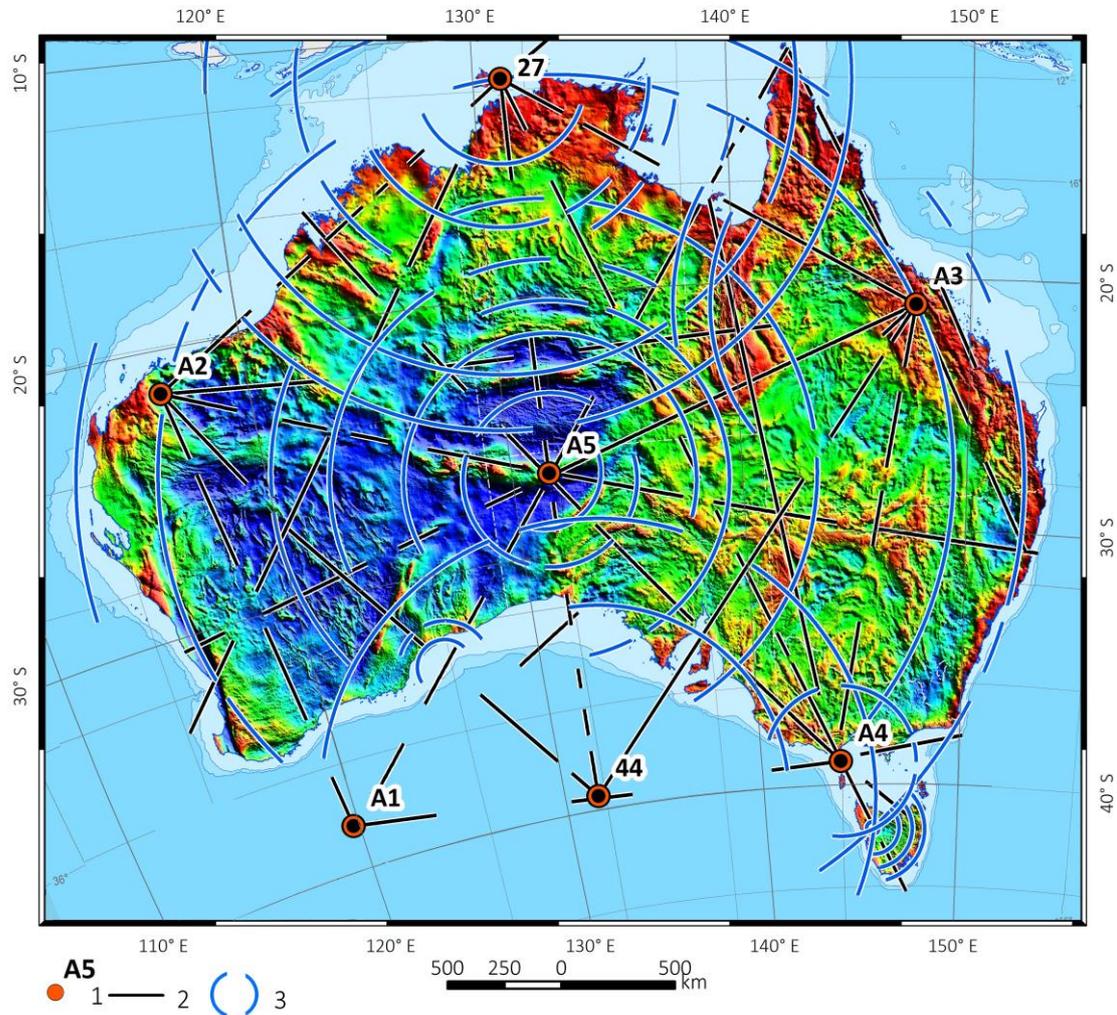


**Figure 12: Integration of GDA and Bouguer gravity data with geodynamic interpretation of this data showing the major tectonogens, nodes, and main concentrers.**

*1 – Node; 2 – Major tectonogen; 3 – Inner concentrer of concentr system of node A5; 4 – Outer concentrer of concentr system of node A5 with radius ranging between 1,780 km and 2,100 km*

## Terra Tasmania Resources

The entire geodynamic model of Australia at the scale of 1:15,000,000 is shown on the Bouguer gravity map in **Figure 13**. This model presents the following geodynamic features of the investigated territory: (i) hierarchical framework tectonogens of a varying rank; (ii) multi-rank nodes of tectonogen intersections; and (iii) the discrete concentric systems of tectonic disturbances of varying scale (**Figure 13**).



**Figure 13: Overlay of the entire set of geodynamic constructs at the scale of 1:15,000,000 and the Bouguer gravity map of Australia.**

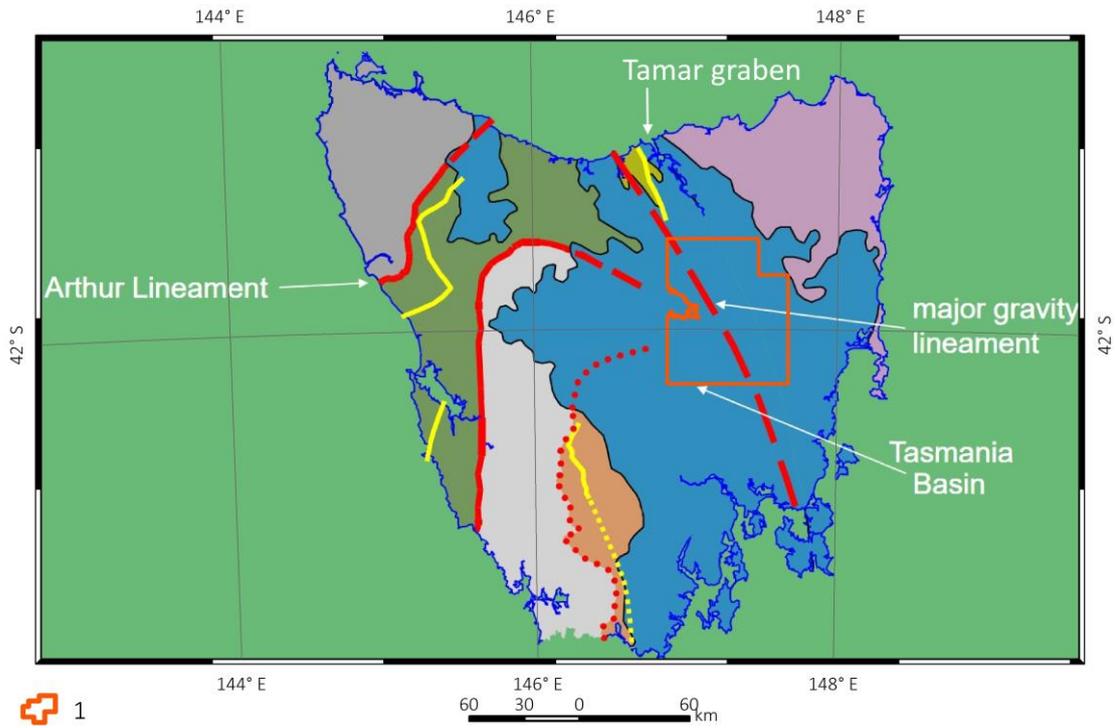
*1 – Node; 2 – Tectonogen; 3 – Concentric system*

Comparing the positions of the known geological structures of Tasmania and of the geodynamic constructs is a worthy exercise.

The generally known Arthur Lineament (**Figure 14**) was formed during the Tyennan Orogeny period. This lineament forms the western limit of allochthonous blocks in Tasmania and appears to mark the maximum extent of the thrust complex. The early part of the thrust indicates thrusting westward.

## Terra Tasmania Resources

The positions of the three powerful, linear (generally) structures are shown using the red lines in **Figure 14**.

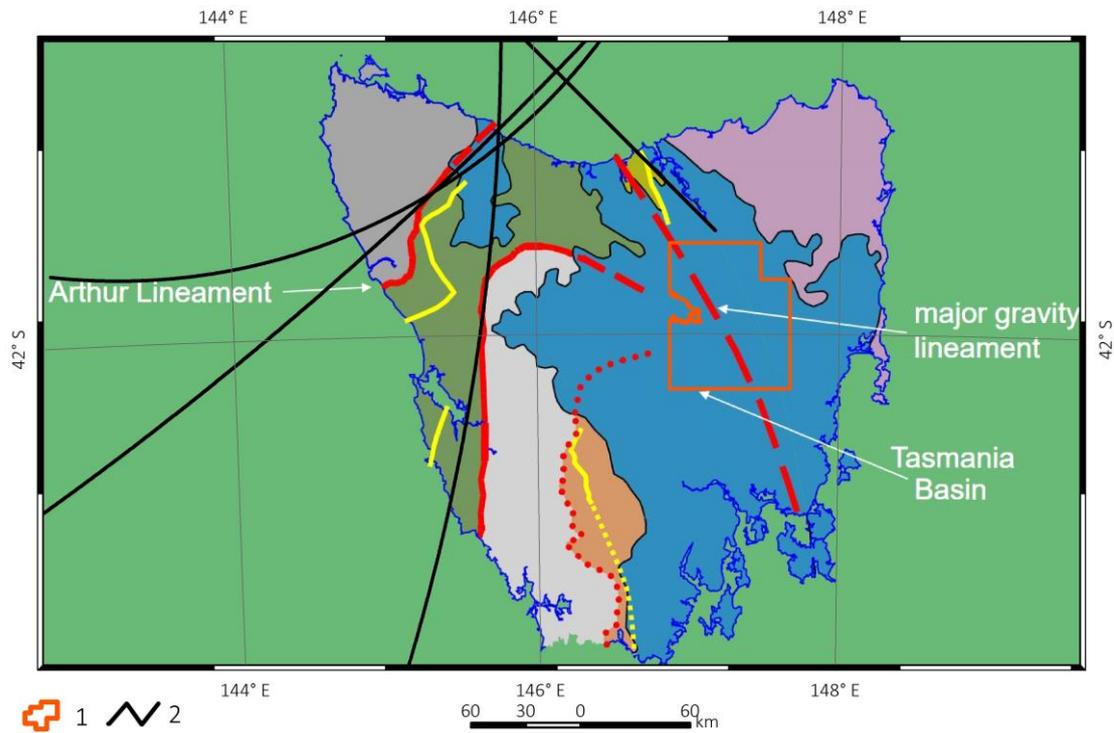


**Figure 14: Location of major tectonic structures of Tasmania - Arthur Lineament, Tamar graben and others.**

1 – EL30

## Terra Tasmania Resources

Comparing the positions of the main GDA tectonogens and concentrers with the locations of the known Tasmanian structures demonstrates that the locations of these structures are controlled by the geodynamic elements (**Figure 15**). For example, the coincidence of the Arthur lineament with the tectonogen and concentrer is of note, while the Tamar graben is partially aligned with a major tectonogen (also a “gravity lineament”) A5-A4 shown previously in **Figure 13**.

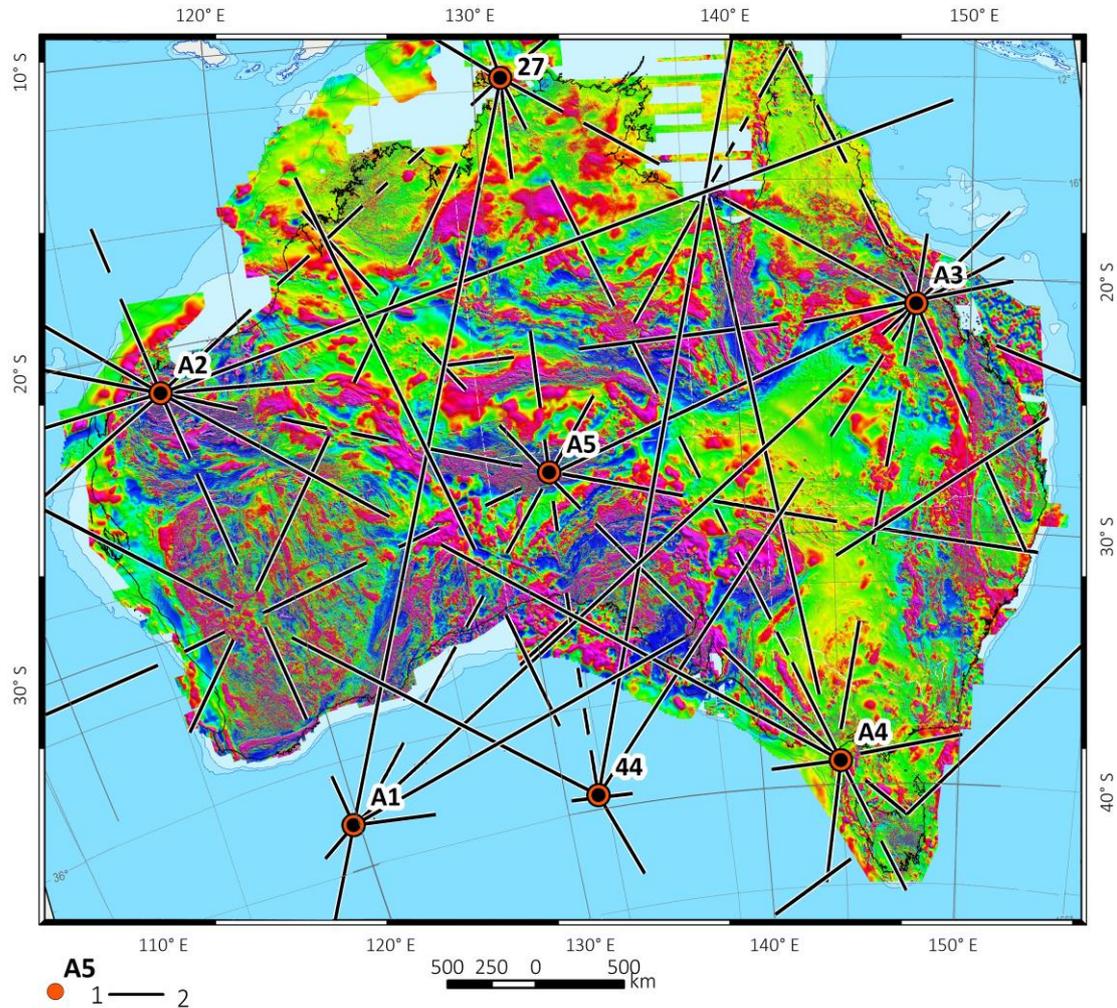


**Figure 15: Comparison the locations of major tectonic structures of Tasmania with the geodynamic elements of this territory.**

*1 – EL30; 2 – geodynamic element (tectonogens and concentrers) overlaid with map of known tectonic structures*

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The pentagonal framework of Australia defined above can also be reliably identified using the magnetometry data using **Figure 16** and **Figure 17**, where both the linear and concentric geodynamic systems can be traced along, proving spatial confinement to the structural elements to them.



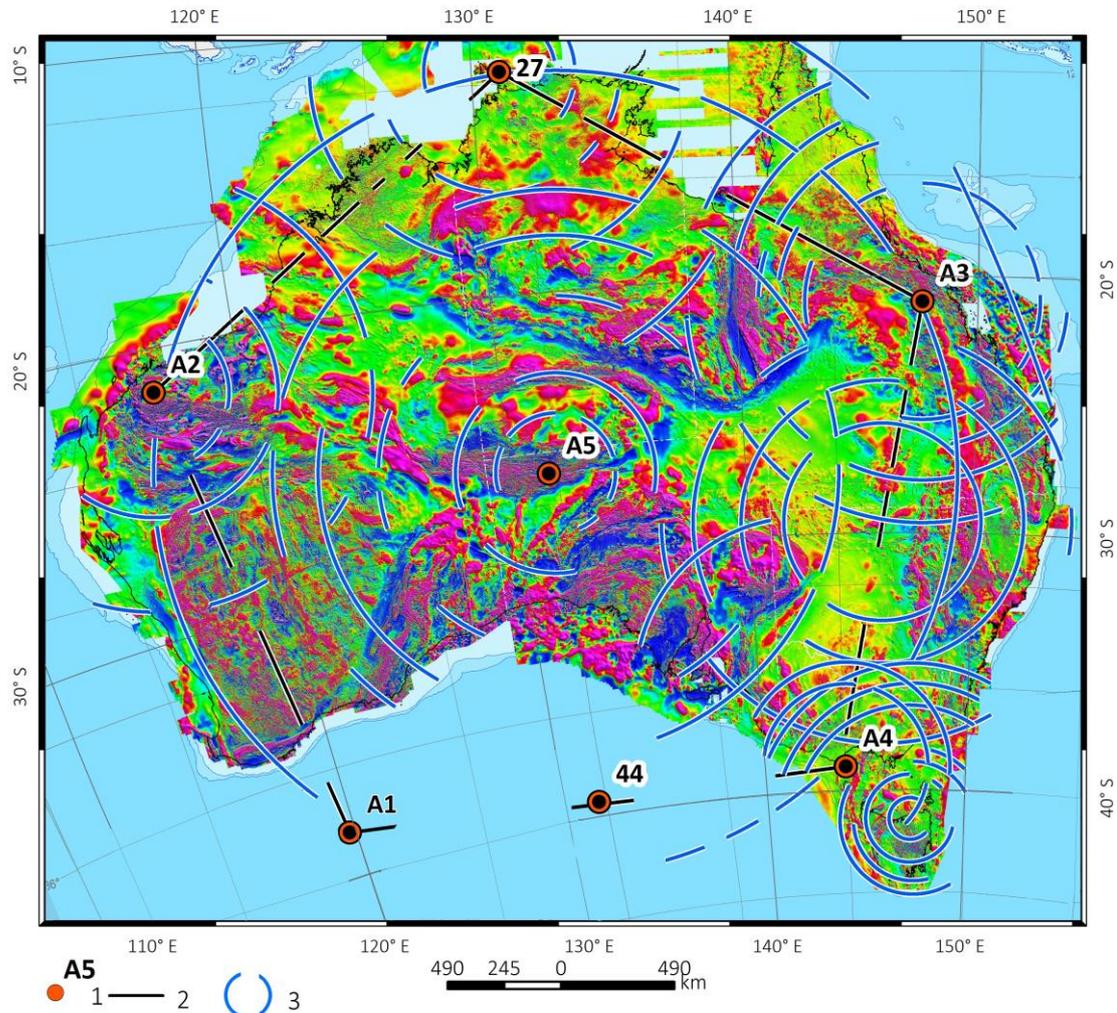
**Figure 16: Overlay of geodynamic constructs and magnetometry data of Australia.**

*1 – Node; 2 – Tectonogen*

The level of the magnetic field of the Australian continent is predominantly high – greater than 15 nanotesla (red-blue color) over most of the territory. Low values (green-yellow) on the magnetic data map characterize the vast northern and eastern flanks of the continent. The latter is apparently defined by the development of a large sedimentary basin within the territory.

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The powerful concentric system of Node A5 (**Figure 12**) can be traced on the magnetometry map (**Figure 17**).



**Figure 17: Overlay of geodynamic concentric systems on magnetic map of Australia.**

*1 – Node; 2 – Tectonogen; 3 - Concentric system*

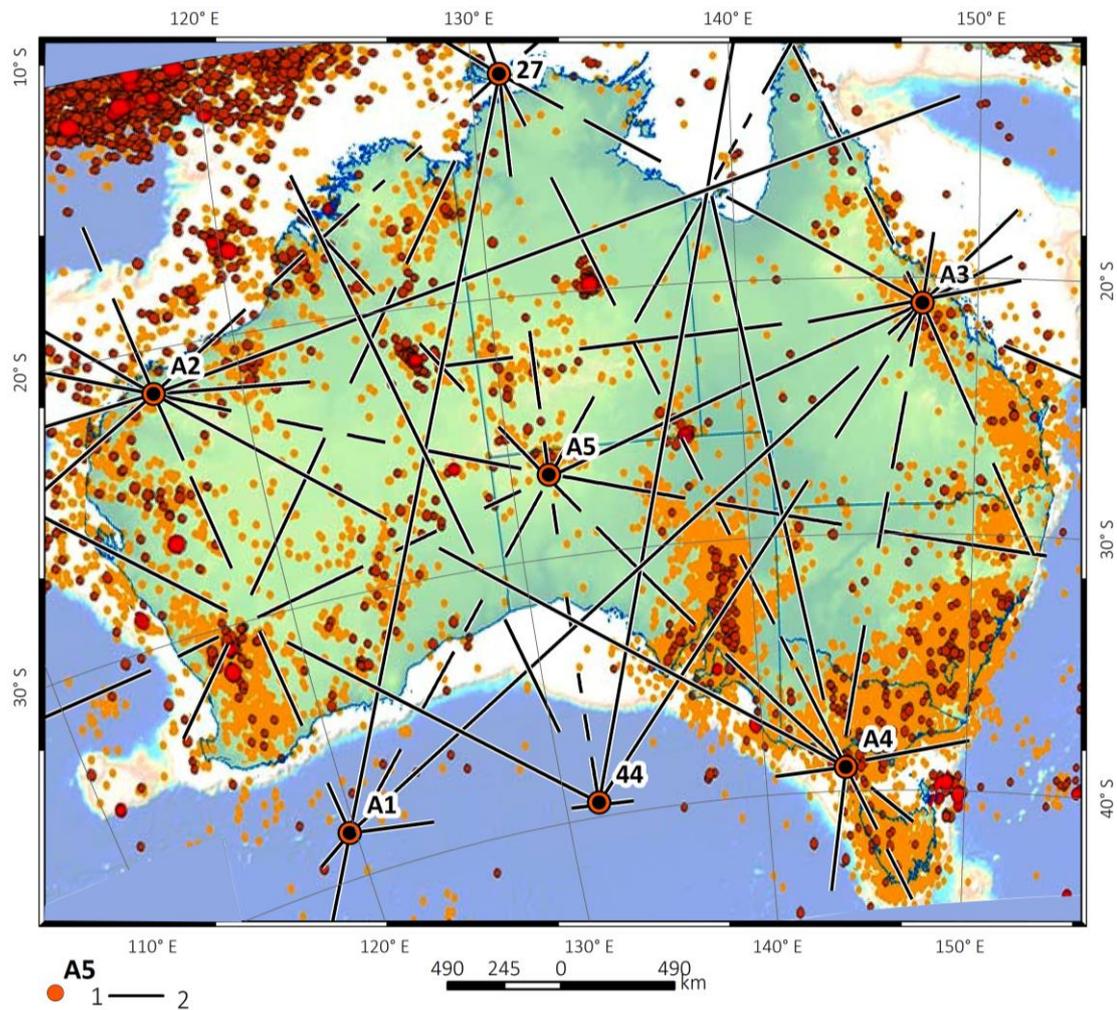
### GDA AT CONTINENTAL-RANK SCALE OF 1:15,000,000 - GEODYNAMIC FACTORS OF AUSTRALIA'S STRUCTURAL CONTROL IN COMPARISON WITH THE SEISMICITY SURVEY AND DISTRIBUTION OF HC-FIELDS

As shown using the gravimetric and magnetic maps (**Figure 11** and **Figure 16**), the systemic structure of the Earth's crust of the Australian continent is a reasonable premise. Seismic activity data recorded on the continent over many years further supports the GDA constructs.

For all three of the aforementioned geophysical indicators (gravity, magnetic, and seismic activity data), the structure of the geological environment at the continental level is confidently controlled by the pentagonal symmetry system of tectonogens, as the linear elements that develop from the geodynamically active nodes.

## Terra Tasmania Resources

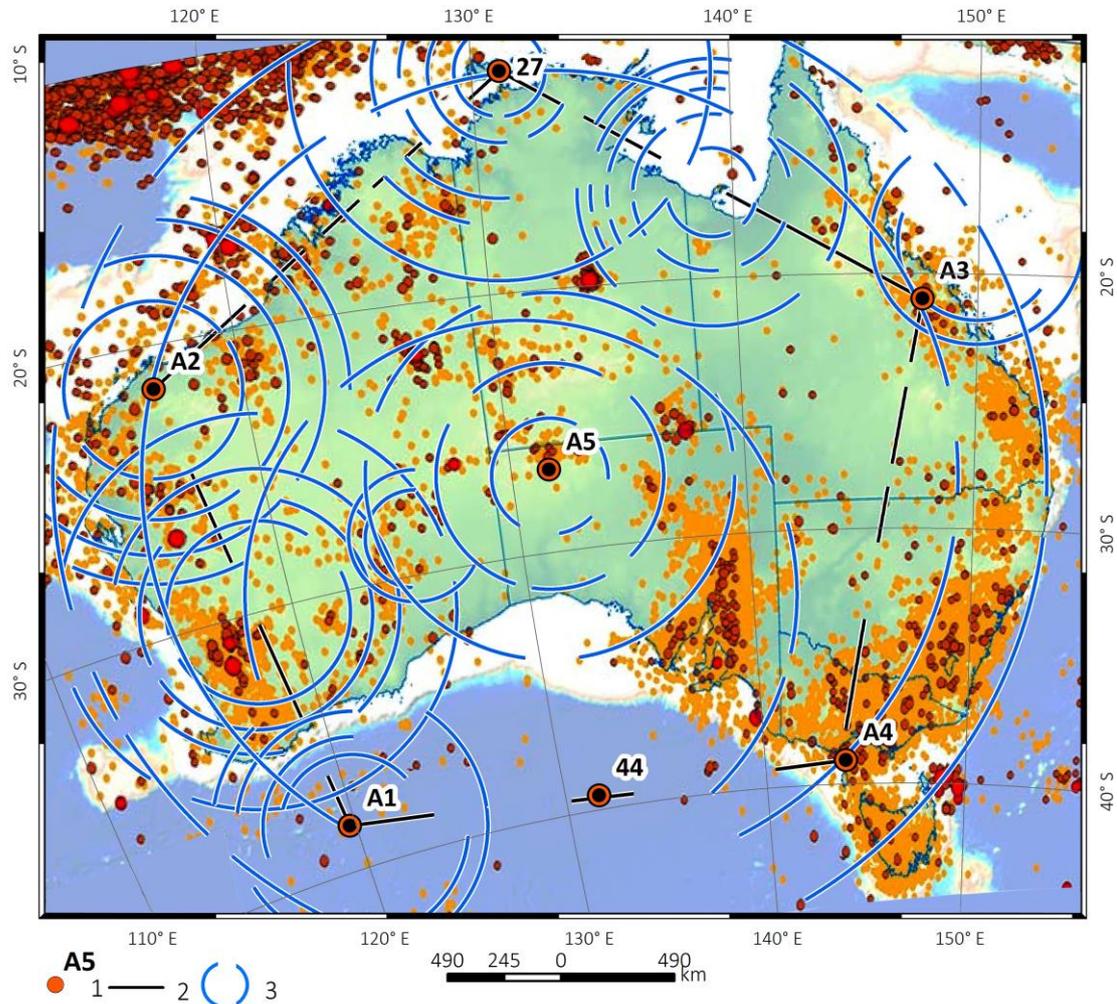
The manifestation of seismic activity is the consequence of tectonic activation processes; the manifestations of mineral deposits are tightly controlled by the geodynamic structural factors based on the pentagonal model of the global structure of the Australian continent, as shown in (Figure 18).



**Figure 18: Overlay of the geodynamic constructs with the seismic activity map of Australia.**  
*1 – Node; 2 – Tectonogen*

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These structural factors consist of the external centers along the edge of the continent with the radii of 1,780 and 2,100 km. Their zones of dynamic influence are anomalously seismically active (**Figure 19**). High seismicity is also characteristic of the tectonogen skeletal framework of the continent as shown in **Figure 11** and **Figure 16** using the system of large structural, circular elements of the pentagonal framework of the continent.



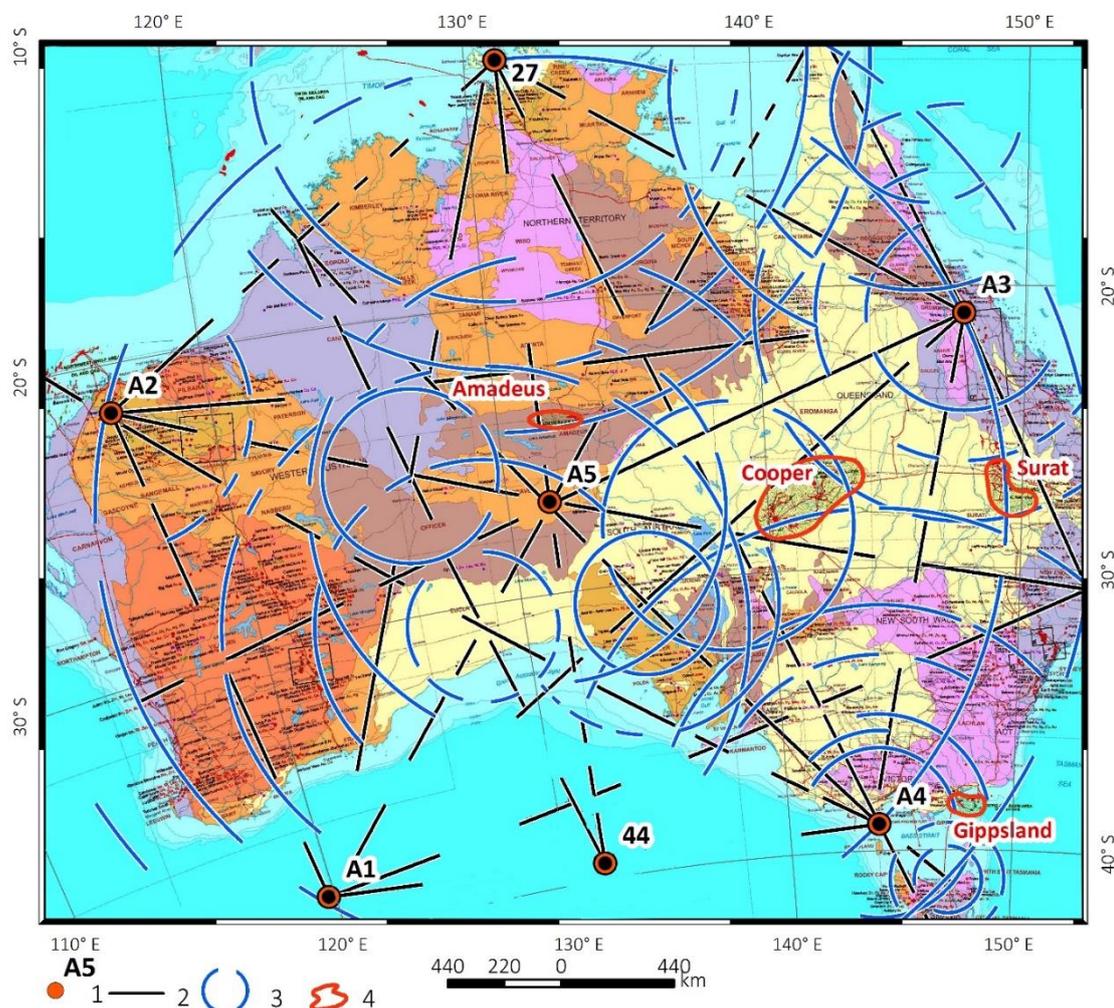
**Figure 19: Geodynamic concentric systems and seismicity map of Australia.**

*1 – Node; 2 – Tectonogen; 3 - Concentric system* Integrating of GDA constructs with the map of natural resources confirms the presence of the pentagonal framework structure of the Australian continent including all of the nodes identified previously. It also shows that the main hydrocarbon basins at South-East of Australia are related to the concentric systems (**Figure 20**).

The above criteria of the structural and geodynamic organization were used herein as a fundamentally new direction of the regional assessment of the hydrocarbon potential on a province level. Analysis of the position of the known sedimentary basins in the structure of the geological environment of the continent indicates for a rigid tectonic-dynamic control of their locations in the geological space.

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As shown in **Figure 20**, they are confined to the large intersections of minor framework elements – concentrers and tectonogens. The presence of any disturbances (concentrers or tectonogens) provides deep outflow of degassing products and, above all, hydrocarbons (methane, ethane, propane, etc.) and other gases accompanying them (H<sub>2</sub>, CO<sub>2</sub>, H<sub>2</sub>S, etc.). The parameter that measures the potential for degassing is density of "deep-draining" nodes, and is significant in connection with the poorly-studied inland part of Tasmania.



**Figure 20: Geodynamic pattern of tectonogens, nodes, and concentric system over the map of natural resources of Australia<sup>4</sup> with HC-basins/production areas (shown with red contours).**

1 – Node; 2 – Tectonogen; 3 – Concentric system; 4 – HC-basin/production area

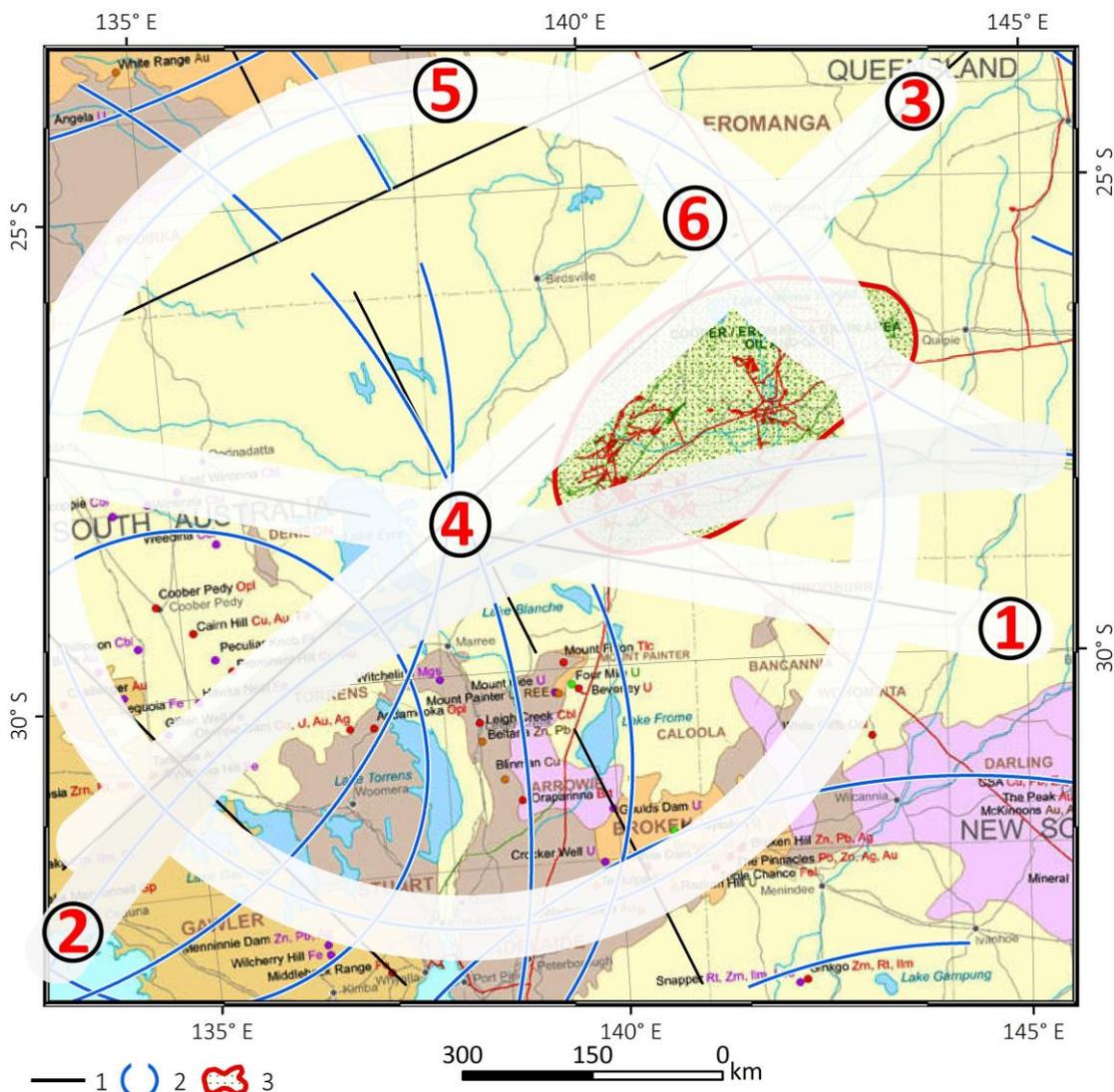
<sup>4</sup> Map of Australian Mines and Mineral Deposits, 1:5 000 000, [www.ga.gov.au](http://www.ga.gov.au)



## Terra Tasmania Resources

At the scale of 1:15,000,000, it is apparent that the Cooper basin is bound by the following numbered features shown in **Figure 22**:

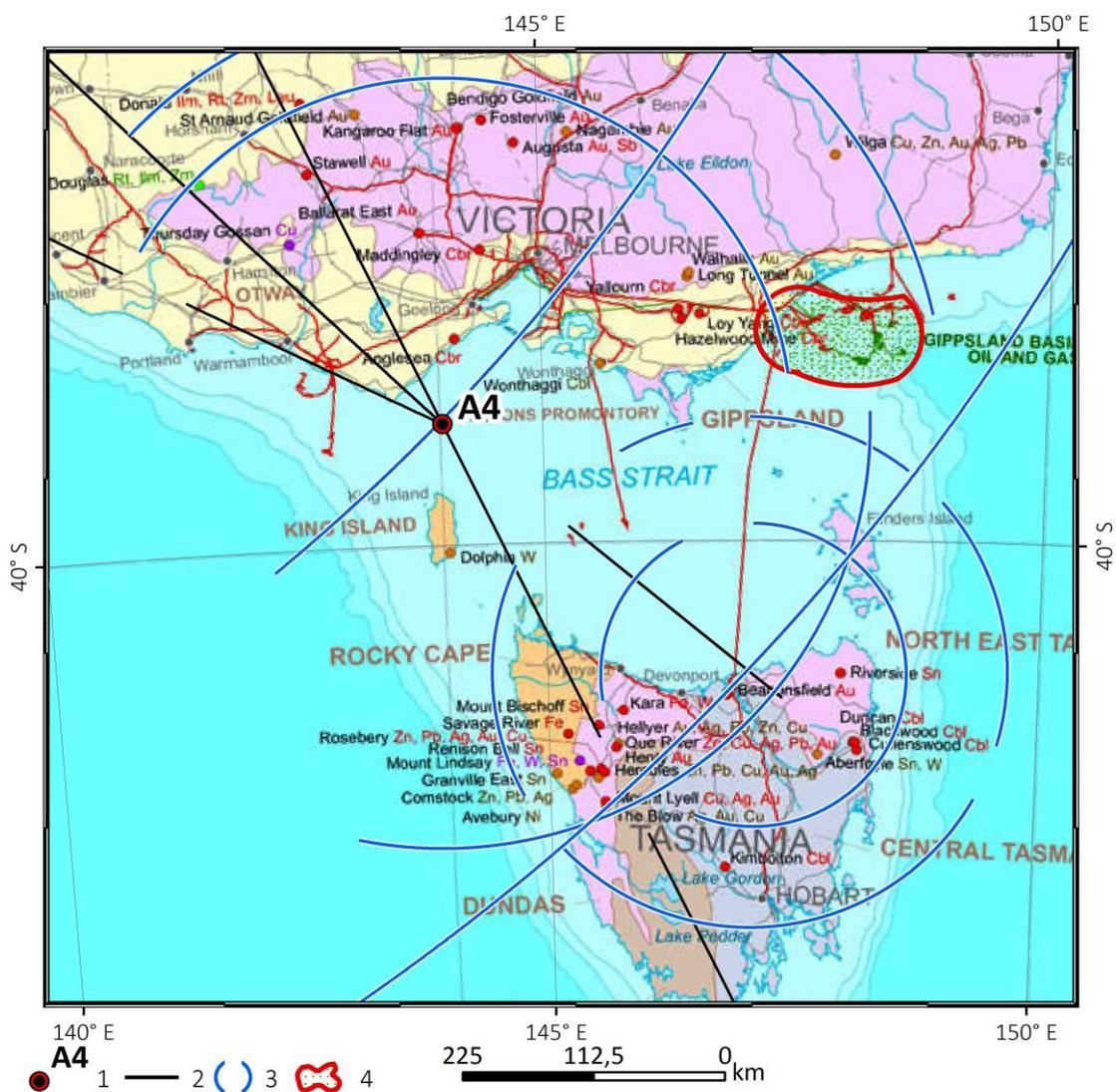
1. In the south - by the powerful tectonogen A2-A5;
2. In the south, by one of the outer concentric nodes of node A4;
3. In the north-west, by the tectonogen passing through nodes A1 and A3;
4. The intersection of features numbered 1, 2 and 3 confirms a powerful geodynamic Node 4;
5. From the northeast – by a concentric structure binding the Cooper basin;
6. From the northeast - by the concentric structure originated from Node A3.



**Figure 22: Visualization of geodynamic elements near the Cooper basin/HC producing area.**  
 1 – Node; 2 – Concentric system; 3 – HC-basin

## Terra Tasmania Resources

The Tasmanian basin, has a similar structural and geodynamic position as compared to the Cooper Basin.



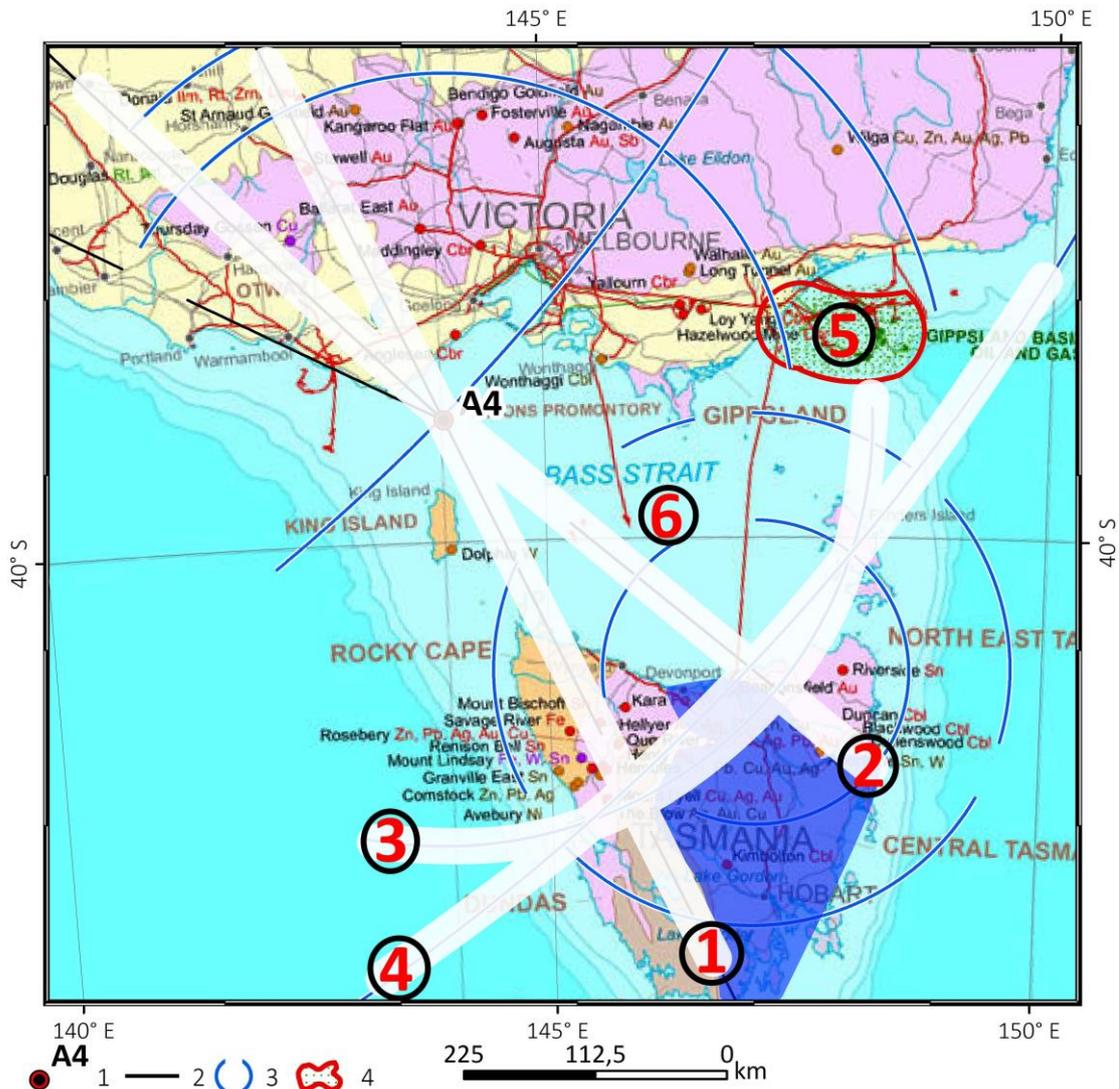
**Figure 23: Geodynamic pattern of tectonogens, nodes, and the concentric system in the Tasmania region.**

*1 – Node; 2 – Tectonogen; 3 – Concentric system; 4 – HC-basin*

## Terra Tasmania Resources

At this scale and stage of GDA, the HC potential of Tasmania is promising due to the following favorable factors and numbered features as shown in **Figure 24**:

1. To the southwest, the onshore basin is bound by tectonogen 27-A4;
2. To the northeast, the onshore basin is bound by tectonogen A5-A4;



**Figure 24: Visualization of geodynamic elements in the Tasmania area.**

*1 – Node; 2 – Tectonogen; 3 – Concentric system; 4 – HC-basin*

To the northwest, the flank the onshore basin is bound by two concentric structures:

3. A notable concenter from the concentric system that originated at Node A4;
4. The outer concenter of node A5 (with radius of 2,100 km).

The presence of the Gippsland and Bass hydrocarbon basins within the concentric system of node A4:

5. Gippsland hydrocarbon basin;
6. Bass hydrocarbon basin.

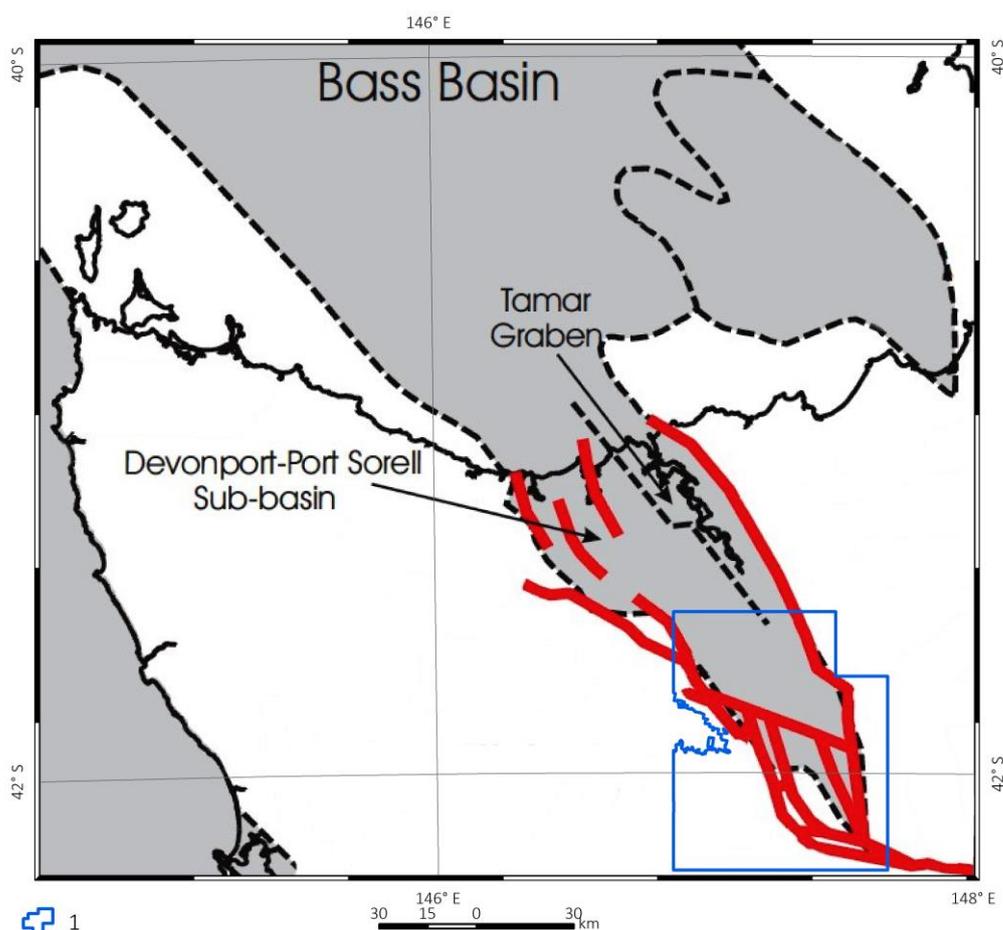
## Terra Tasmania Resources

### 2.1.4 GDA AT THE REGIONAL SCALE OF 1:1,000,000. PRIORITY DIRECTIONS OF LOCALIZATION OF HC-PROSPECTIVE AREAS IN TASMANIA

The 1:1,000,000-scale GDA was performed in conjunction with the varying geological, geophysical, geomorphological, and cartographic materials. The objective was to test a number of tectono-dynamic criteria in connection with HC potential within the boundaries of the Tasmanian sedimentary basin (blue area in [Figure 14](#)).

The basin is located in the eastern part of the island and includes the rift Tamar Graben as a satellite/extension of the Bass basin.

The factor of confinement of the Bass basin ([Figure 25](#)) to the NE sector of Tasmania is of note.



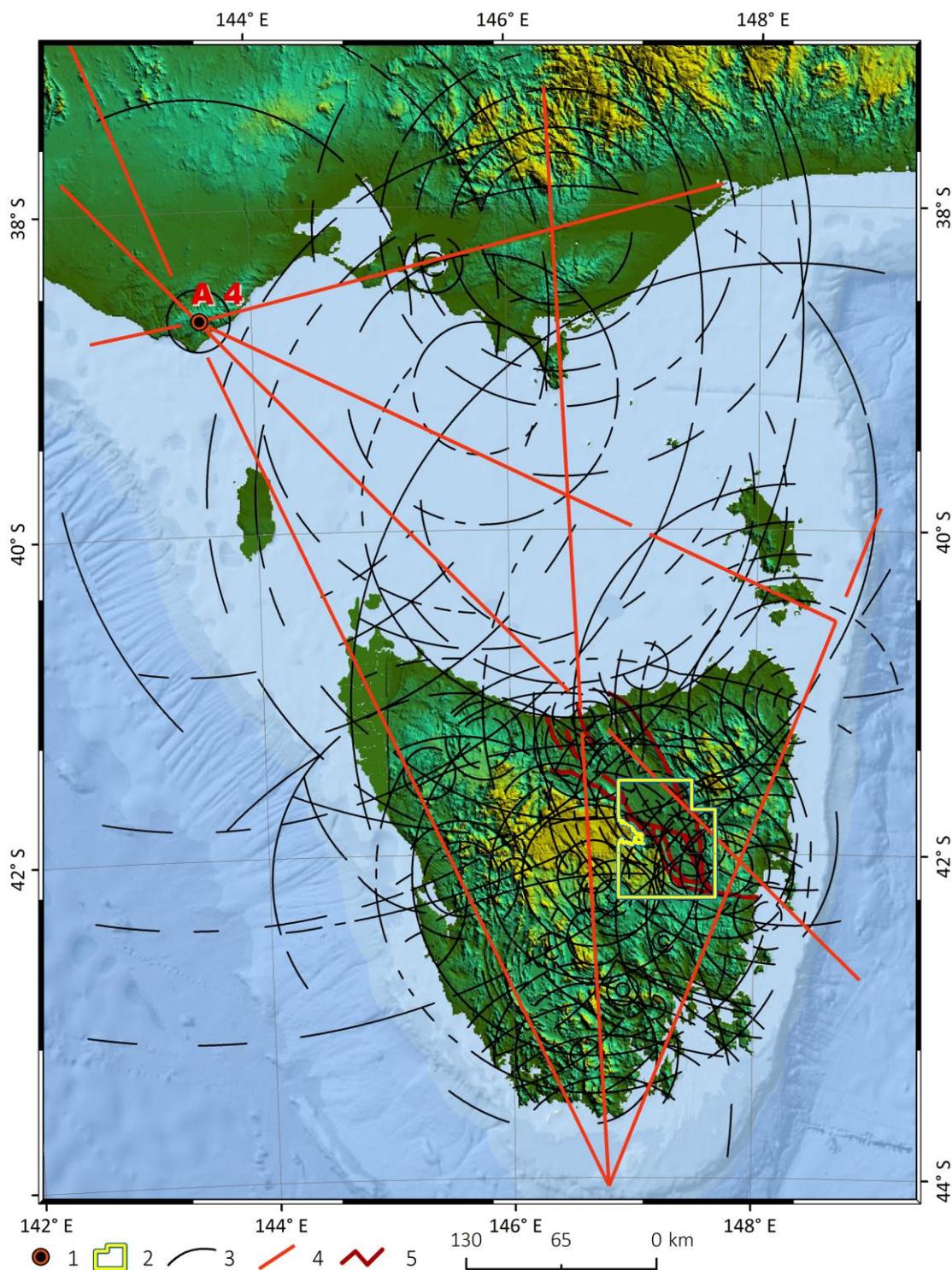
**Figure 25: Location of the Tamar Graben.**

1 – AOI EL30

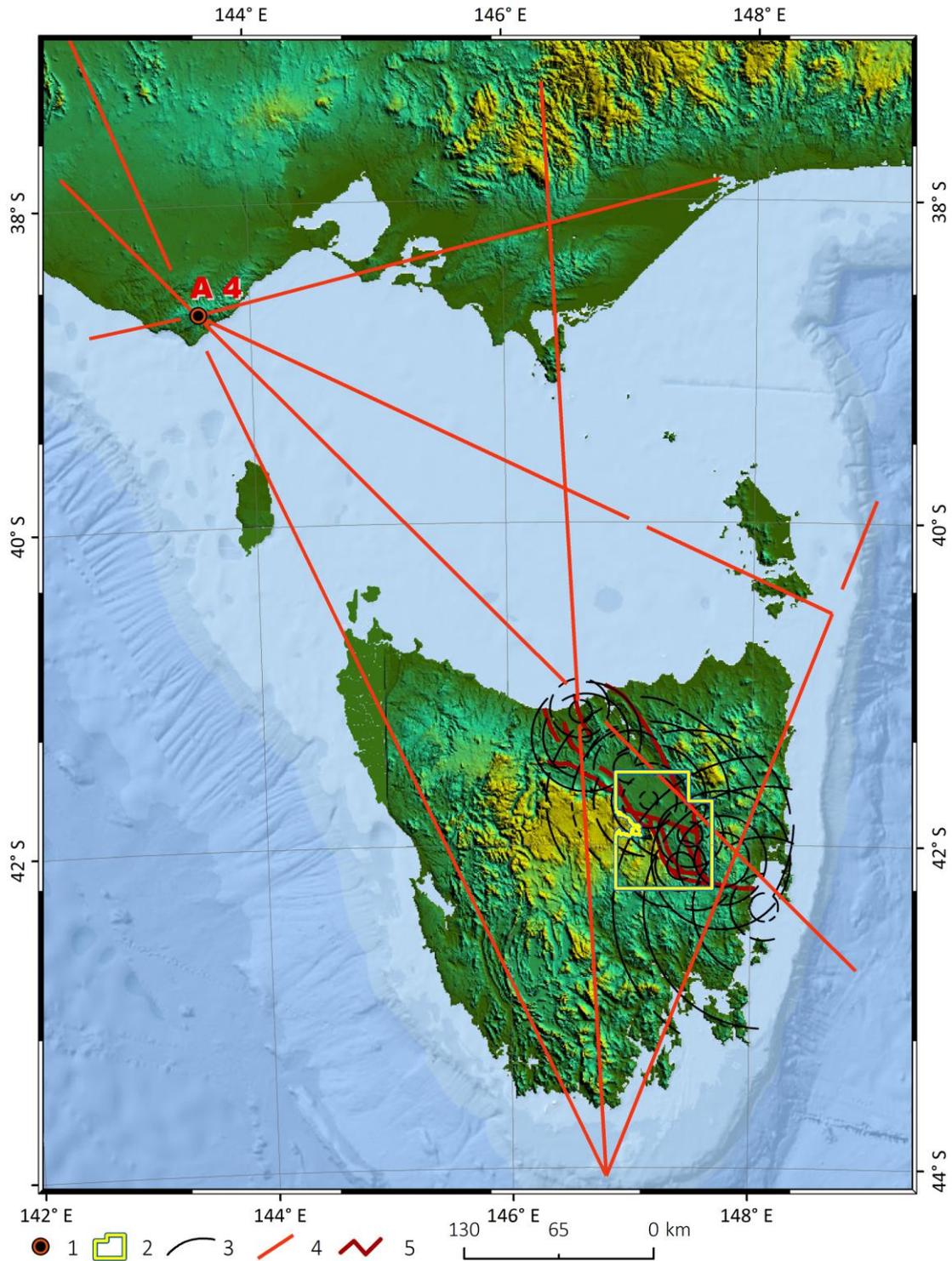
Tamar rift zone (red on [Figure 25](#)) stretches in the southeastern direction, consistent with the orientation of the tectonogen of the pentagonal framework of the Australian continent ([Figure 18](#)).

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This tectonogen continues in the SE direction from node A5 to node A4 and further through the territory of Tasmania. In modern relief this transcontinental morpho-structure is identified by a long, wide valley of the Tamar river (**Figure 26** and **Figure 27**).



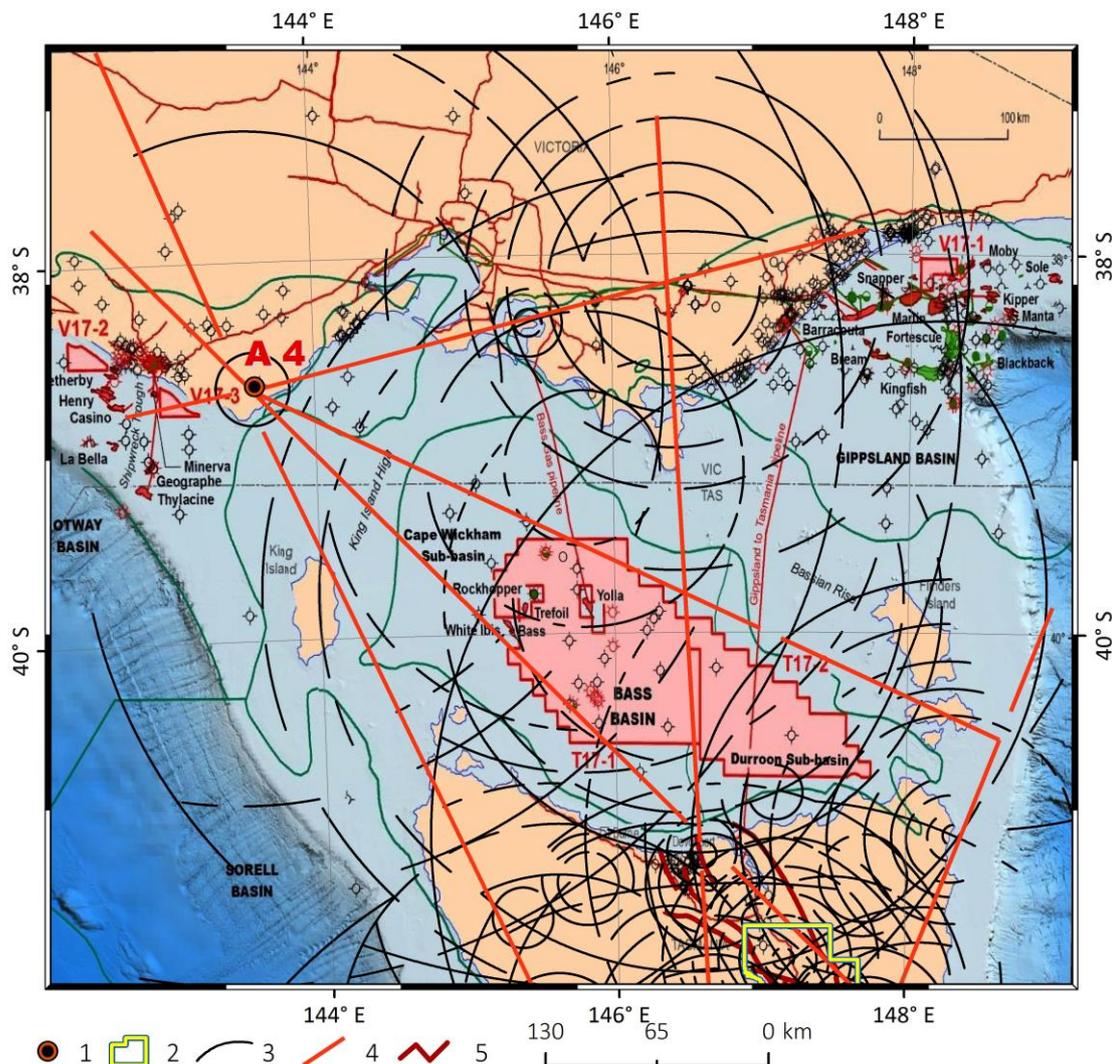
**Figure 26: Geodynamic structural elements of Tasmania and adjacent areas.**  
 1 – Node; 2 – EL30; 3 – Concentric system; 4 – Tectonogen; 5 – Tamar graben



**Figure 27: Geodynamic structures related to the Tamar graben.**  
 1 – Node; 2 – EL30; 3 – Concentric system; 4 – Tectonogen; 5 – Tamar graben

## Terra Tasmania Resources

The Bass basin is situated between two major, continental-rank tectonogens (Figure 28).

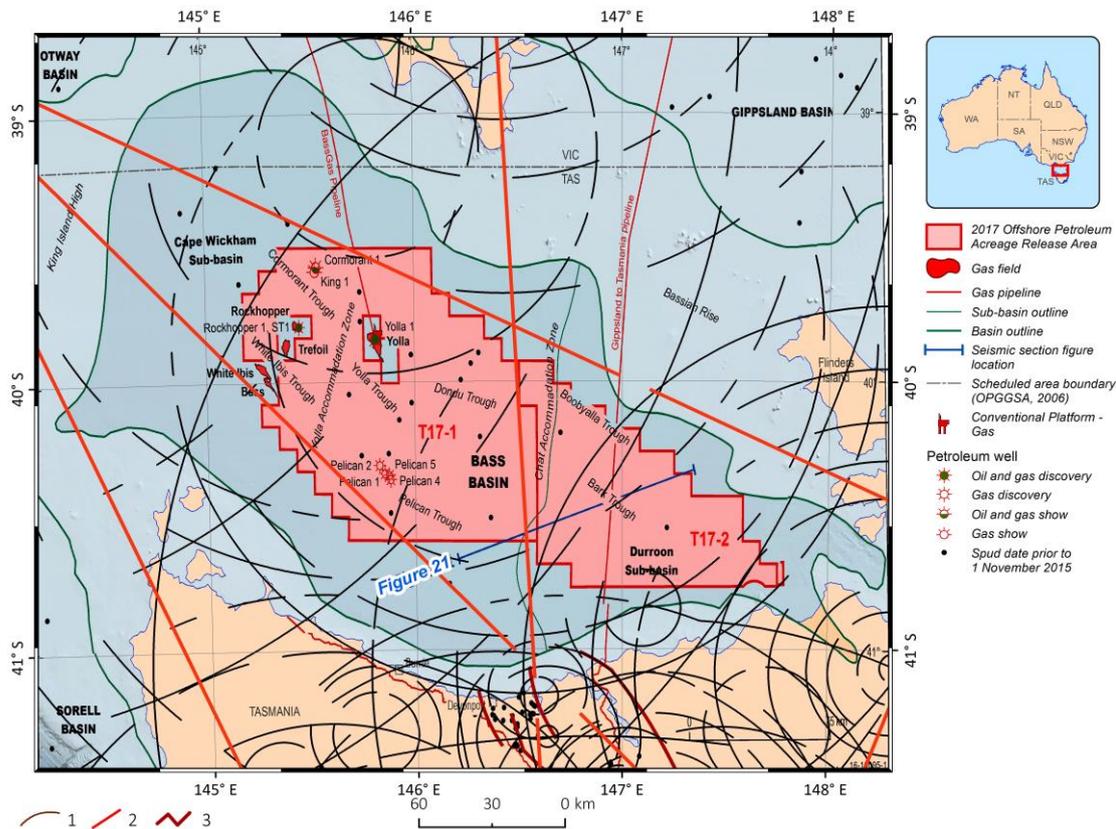


**Figure 28: Location of the Bass basin and its sub-basins Cape Wickham and Durroon in relation to geodynamic elements.**

1 – Node; 2 – EL30; 3 – Concentric system; 4 – Tectonogen; 5 – Tamar graben

## Terra Tasmania Resources

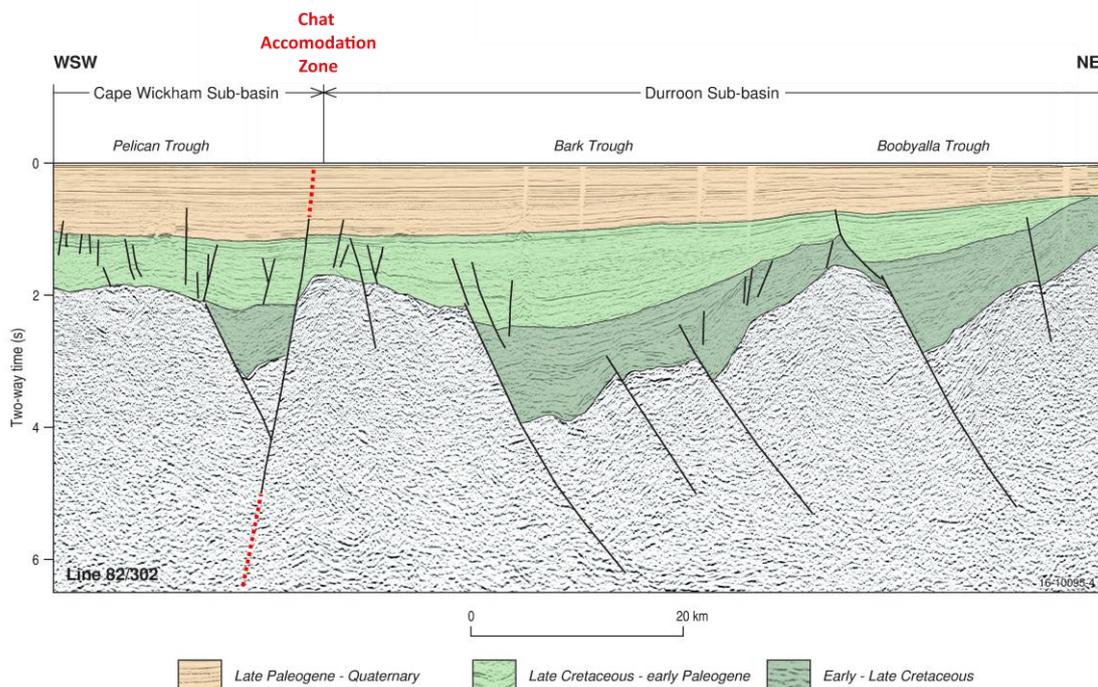
The Early Cretaceous to Neogene Durroon Sub-basin is the eastern depocenter of the Bass Basin, and it is separated from the Cape Wickham Sub-basin (western part of Bass Basin) by the north-to-south trending, basement-controlled Chat Accommodation Zone, identified by GDA as a powerful tectonogen of N-S orientation (**Figure 29**).



**Figure 29: Location of Chat Accommodation Zone.**  
 1 – Concentric system; 2 – Tectonogen; 3 – Tamar graben

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The Durroon Sub-basin is a largely terrestrial, intracratonic rift basin that extends over the area covering approximately 9,800 sq. km. The basin underlies Bass Strait in water depths of less than 100 m. The Durroon Sub-basin consists of a series of northwest-trending half grabens that formed during two phases of upper crustal extension during the Early Cretaceous (Southern Margin rifting) and early Late Cretaceous (Tasman Basin rifting). While subsequent extension continued to affect structures in the Cape Wickham Sub-basin, sediments from the Late Cretaceous onwards in the Durroon Sub-basin were deposited under sag (subsidence) conditions. The Durroon Sub-basin is characterized by narrow, fault bounded Palaeozoic basement blocks. It contains approximately 3,000 to 5,000 m of Cretaceous syn-rift fluvial and lacustrine deposits, overlain by up to 2,000 m of Cainozoic post-rift fluvio-deltaic sandstones, marine mudstones and marl. The Chat Accommodation Zone (also a Geodynamic tectonogen) divides Durroon tectonic structures – Bark Trough from Cape Wickham Dondu and Pelican Troughs (**Figure 30**).



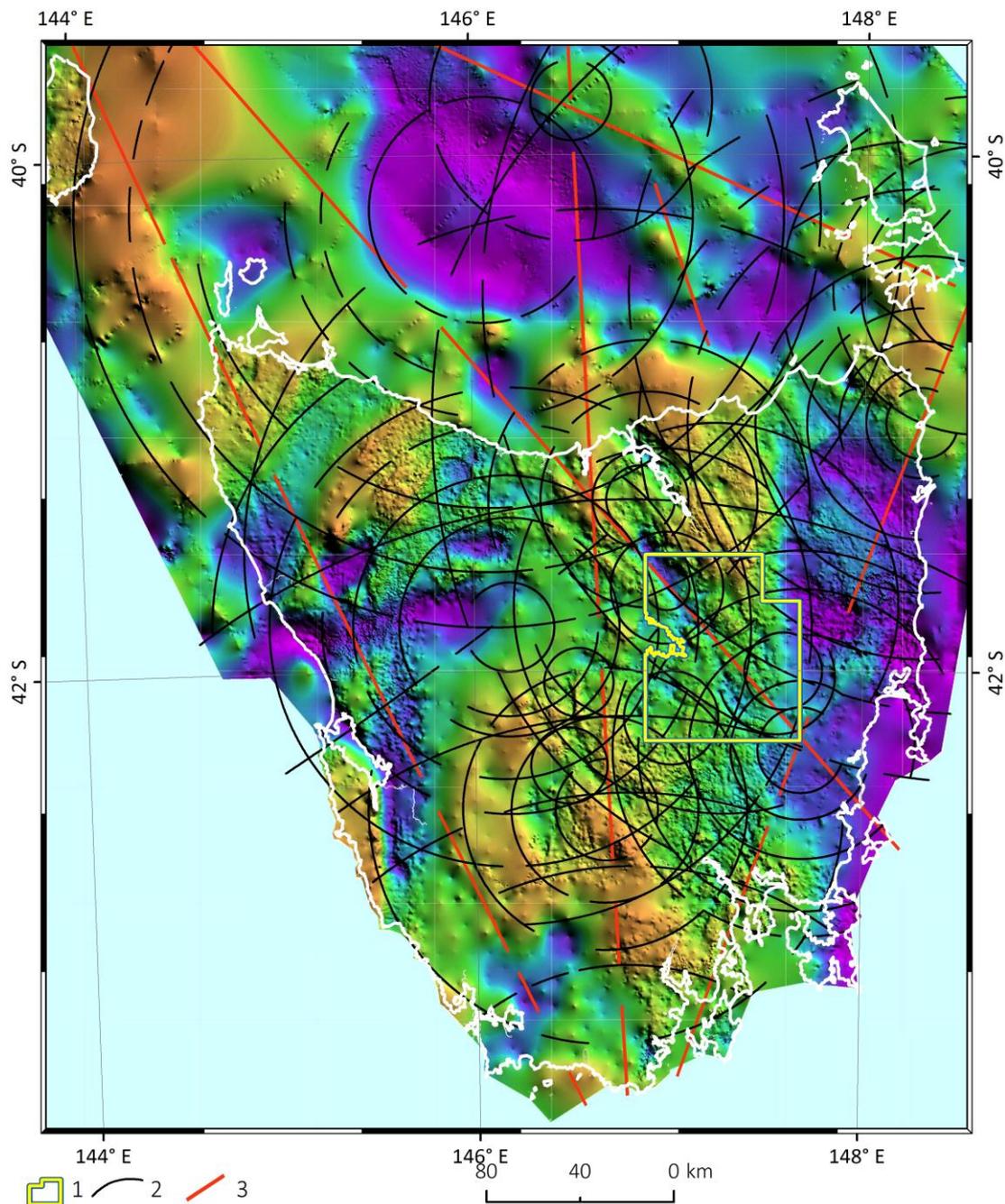
**Figure 30: Cross-section through Durroon Sub-basin and Chat Accommodation Zone. Red-dotted line shows possible location of geodynamic tectonogen.**

A series of several local isometric "subsidence troughs" of the Earth's surface with a radius of 30-50 km is confined to the Tamar rift zone (**Figure 32** and **Figure 34**). They are clearly visible as "concentric morphostructures" with a slightly differentiated surface relief.

Based on the analysis of the superposition of GDA constructs with small-scale gravimagnetic (**Figure 31**, **Figure 32**, **Figure 33**, and **Figure 34**) and seismo-tectonic data (**Figure 35** and **Figure 36**) at the scale of 1:1,000,000, the confinement of the areas of subsidence/troughs to the major nodes of intersection between tectonogens extending across the island and concentric structures can be identified. This indicates for the active process of de-

## Terra Tasmania Resources

fluidization from the Earth's interior within the boundaries of these subsidence areas, causing the sedimentary strata within the areas of sagging to saturate with HC-gases, leading to the development and spreading of bitumen cover in the sedimentary rocks.

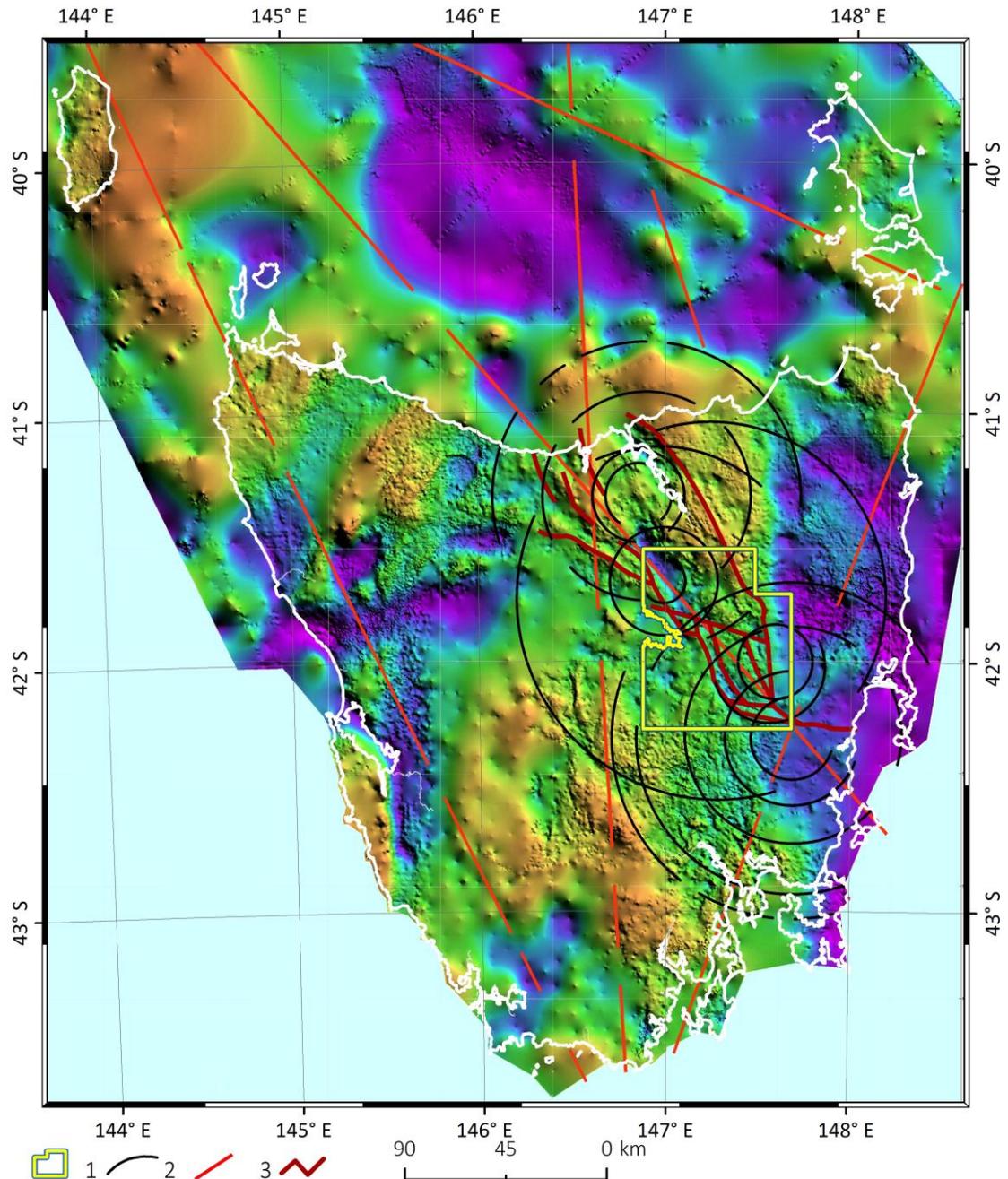


**Figure 31: Integration of the geodynamic elements and gravity data over Tasmania.**

*1 – EL30; 2 – Concentric system; 3 – Tectonogen*

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The Tamar-graben example demonstrates that the blue-green areas on this gravity map correspond to the lower-density (thus, most likely sedimentary) rocks within the area of this structure. These areas are located near the epicentral parts of the geodynamic concentric systems, which suggests that these areas were submerged, and, accordingly, sediments accumulated within the limits of these areas (**Figure 32**).



**Figure 32: Integration of the geodynamic elements and gravity data over Tasmania. Concentric geodynamic structures (subsidence areas/troughs) related to the Tamar graben and tectonogen A5-A4.**

*1 – EL30; 2 – Concentric system; 3 – Tectonogen; 4 – Tamar graben*

The method of magnetometry is based on the study of the magnetic field associated with varying magnetic properties of rocks. Changes in the magnetic properties and various forms



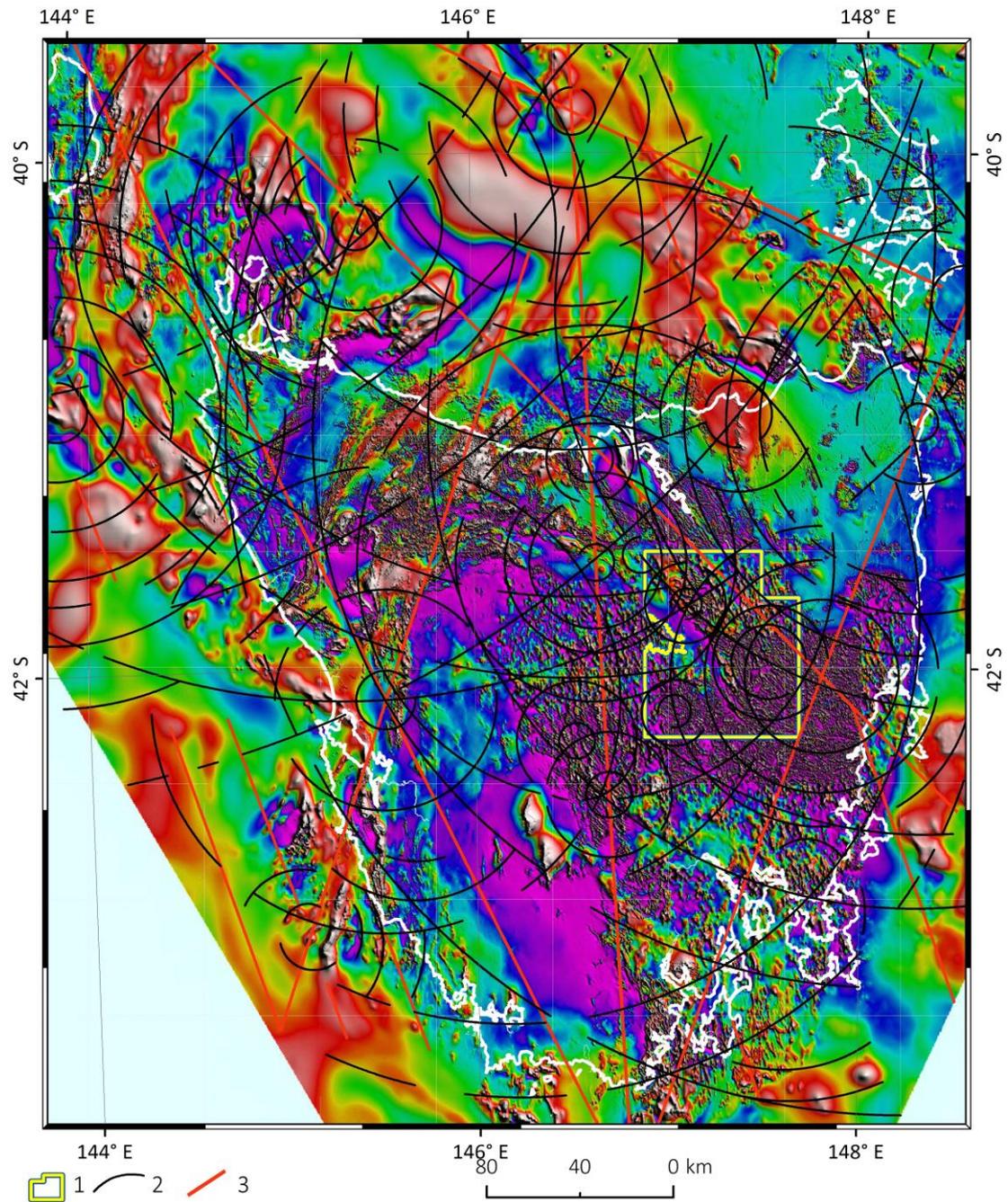
## Terra Tasmania Resources

of rocks and the varying forms of their occurrence and deposition create magnetic anomalies, i.e. deviations in the intensity of the geomagnetic field in a given region.

Magnetic data analysis in oil and gas exploration is generally limited to studies of a regional character of the geological structure of areas of interest. The result of interpreting of magnetic survey data can include the depth and other characteristics of deposition in the Earth's crust of the magnetized bodies serving as the sources of anomalous magnetic field. The magnetic survey, alone or in combination with other geophysical and geological methods, is used to study the regional deep-seated structures of the Earth's crust.

## Terra Tasmania Resources

In the context of GDA, its constructs were superimposed with the map of magnetic anomalies of the Tasmanian region (**Figure 33**).

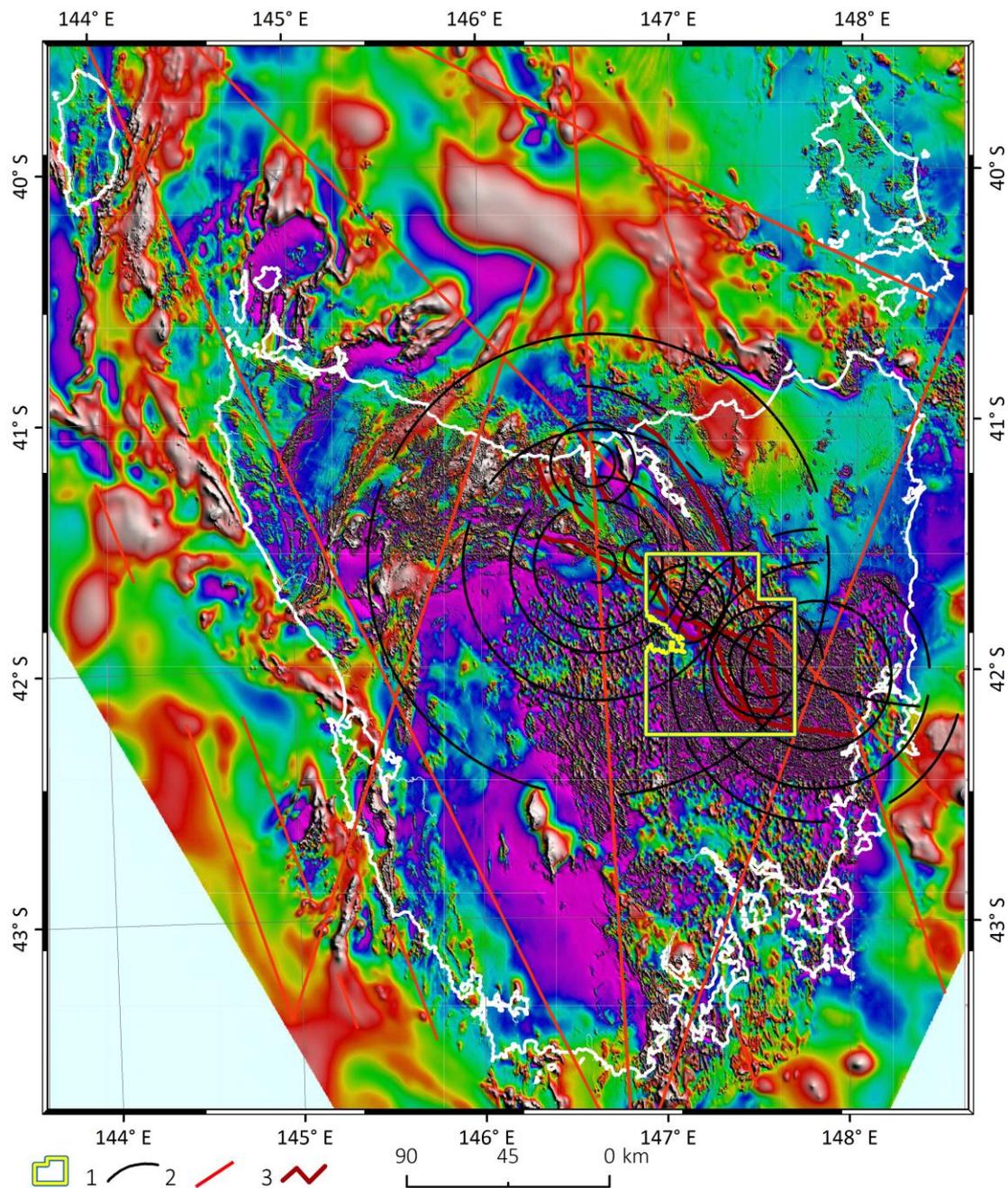


**Figure 33: GDA elements overlay with the magnetic map of Tasmania.**

*1 – EL30; 2 – Concentric system; 3 – Tectonogen*

## Terra Tasmania Resources

GDA identifies the structural control of the HC-potential within the range of concentric structures, which, in this case, are located along the axis of Tamar Graben and are related to its tectonogen (**Figure 34**).

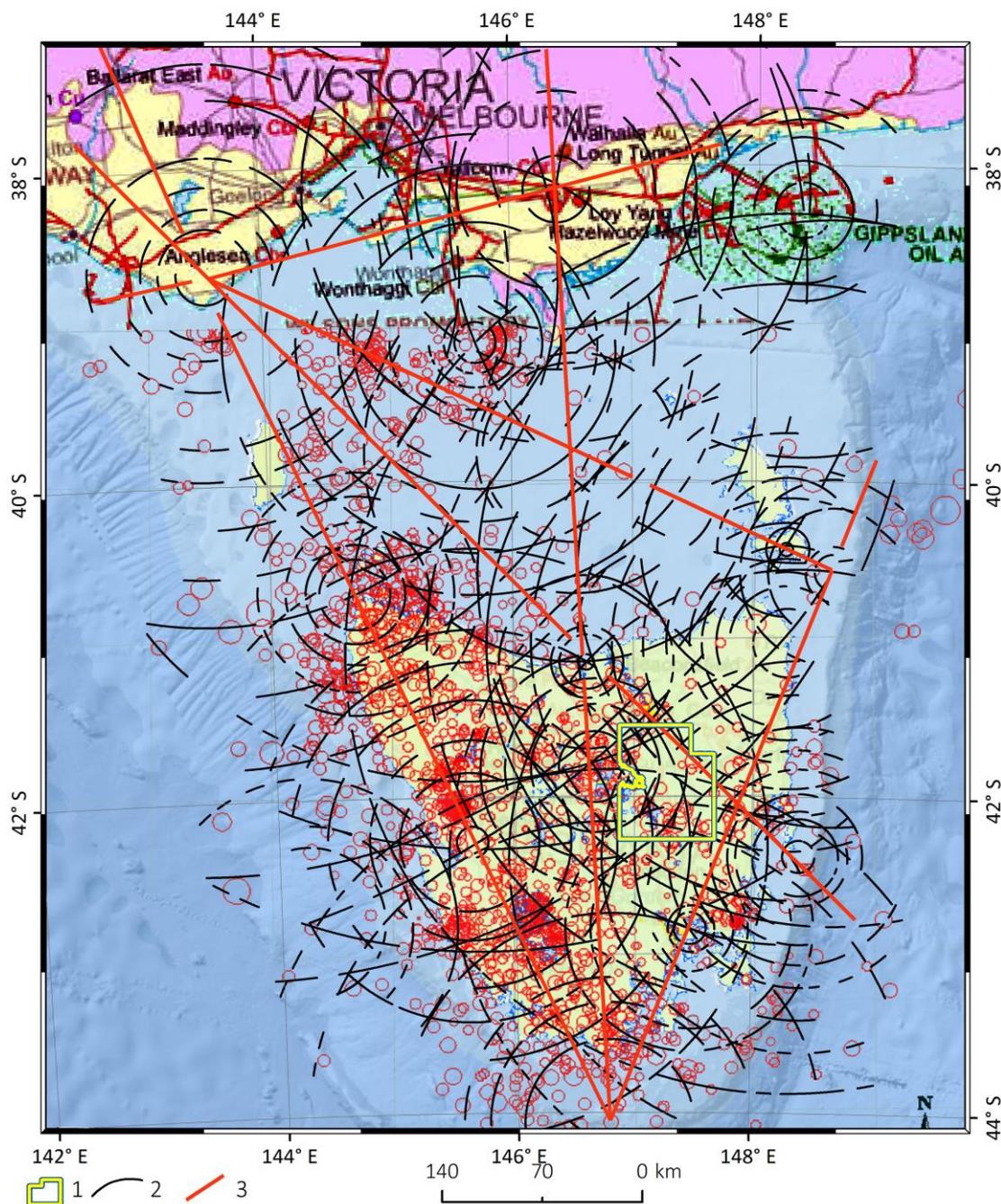


**Figure 34: GDA elements overlay with the magnetic map of Tasmania. Geodynamic structures related to the Tamar graben and tectonogen A5-A4.**

*1 – EL30; 2 – Concentric system; 3 – Tectonogen; 4 – Tamar graben*

## Terra Tasmania Resources

The additional encouraging factor speaking for the HC potential of the area that the ranges of the aforementioned concentric systems are devoid of seismic activity (**Figure 35**). This indicator holds true for all HC-producing areas in Australia, including the Bass Basin.

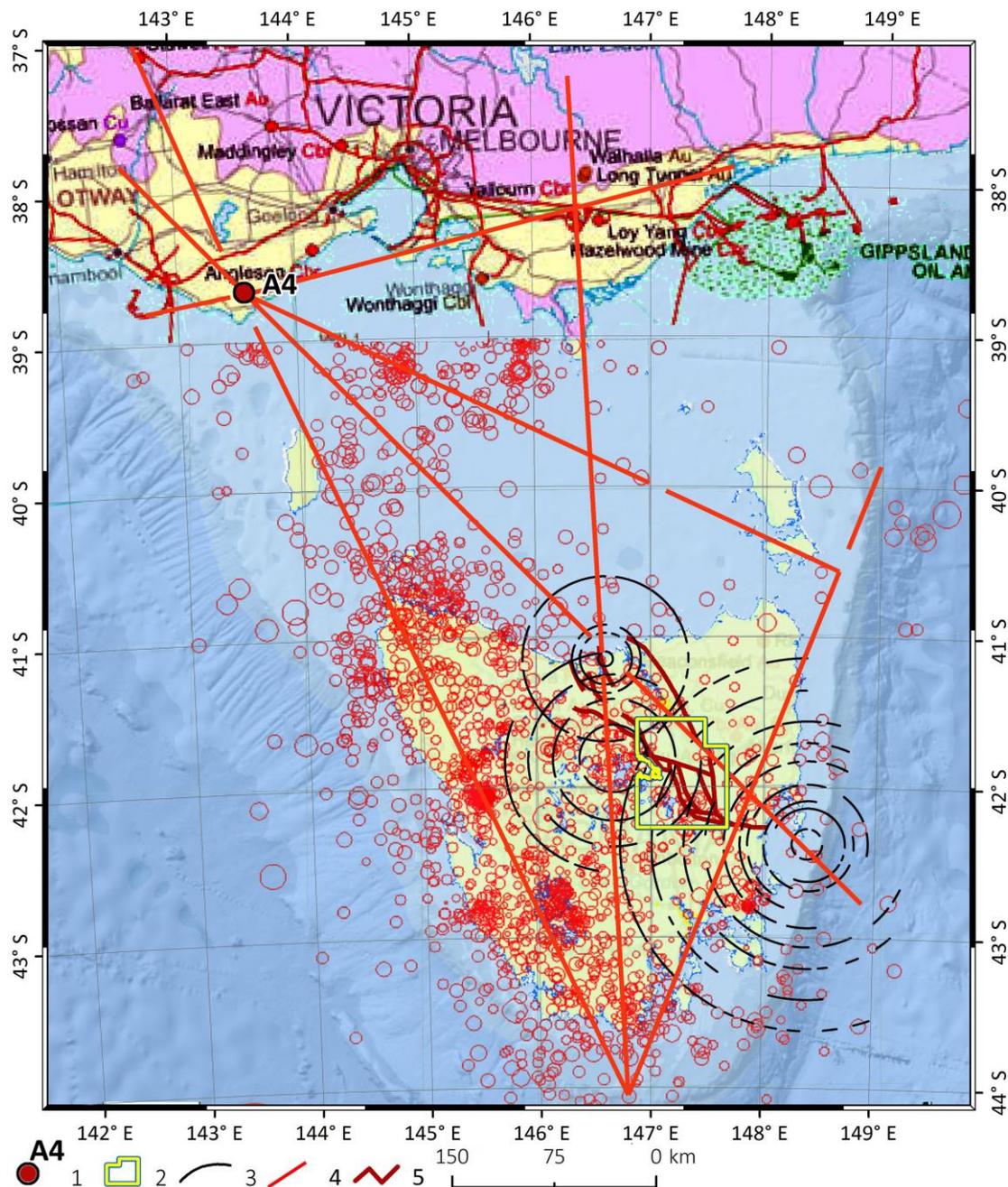


**Figure 35: GDA elements overlay with the seismicity map of the Tasmania region.**

*1 – EL30; 2 – Concentric system; 3 – Tectonogen*

## Terra Tasmania Resources

Only very few earthquakes manifest at EL30, as is the productive areas of Bass Strait - **Figure 36**, which confirms the area's strata was not significantly disturbed (favorable for the accumulation of HC's), significantly reducing the containment risk.



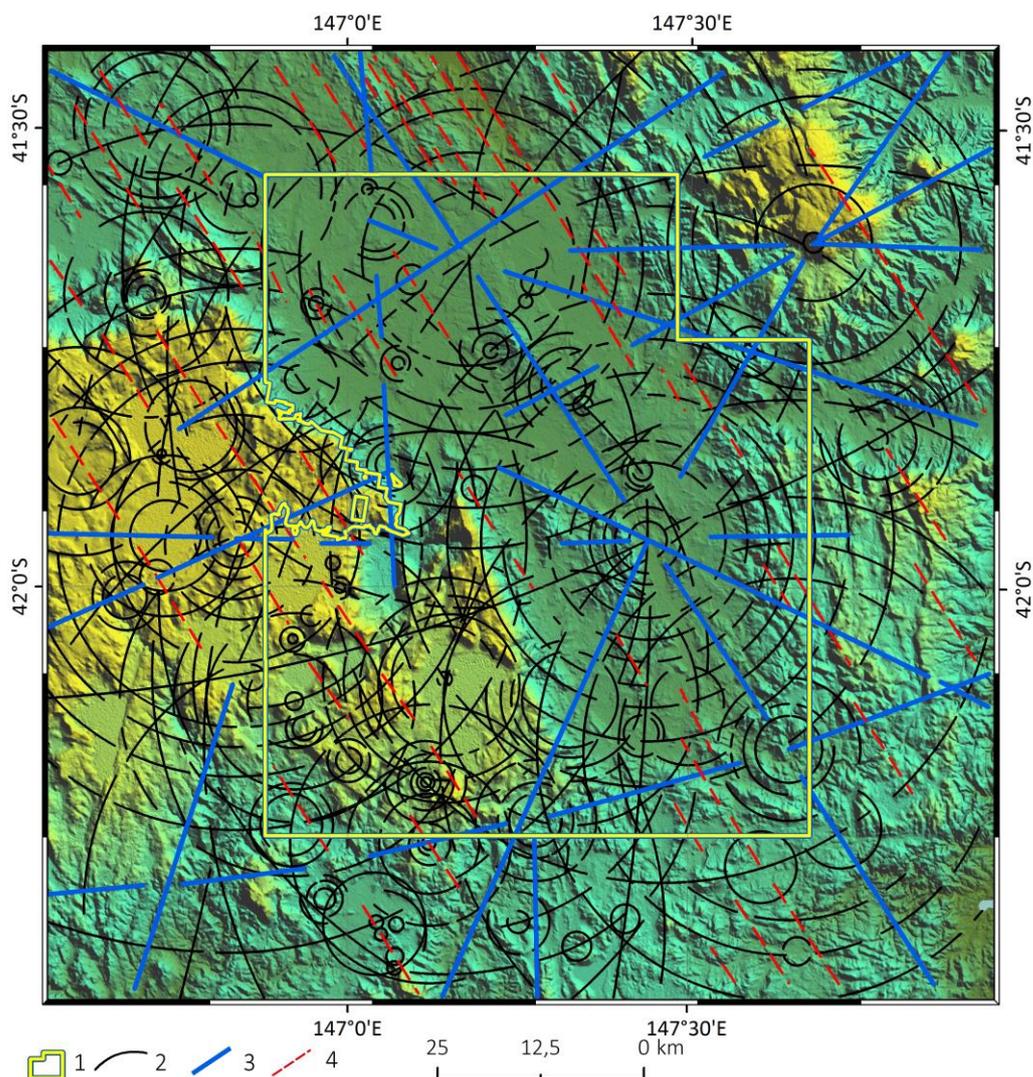
**Figure 36: Geodynamic analysis and Seismicity map of Tasmania region.**

1 – Major GDA node; 2 – EL30; 3 – Concentric system; 4 – Tectonogen; 5 – Tamar graben

EL30 owes its HC potential to the geodynamic activity the concentric systems ("subsidence troughs").

## 2.1.5 GDA OF EL30-2011 AT SCALE 1:200,000

GDA constructs at the scale of 1:200,000 were integrated and superimposed with the elevation map as shown in **Figure 37**. A considerably high tectonic disruption of the near-surface geological environment within the region is of note. GDA took into account the locations of varying geodynamic nodes at this scale and their manifestation as disjunctive dislocations of the Earth's crust.



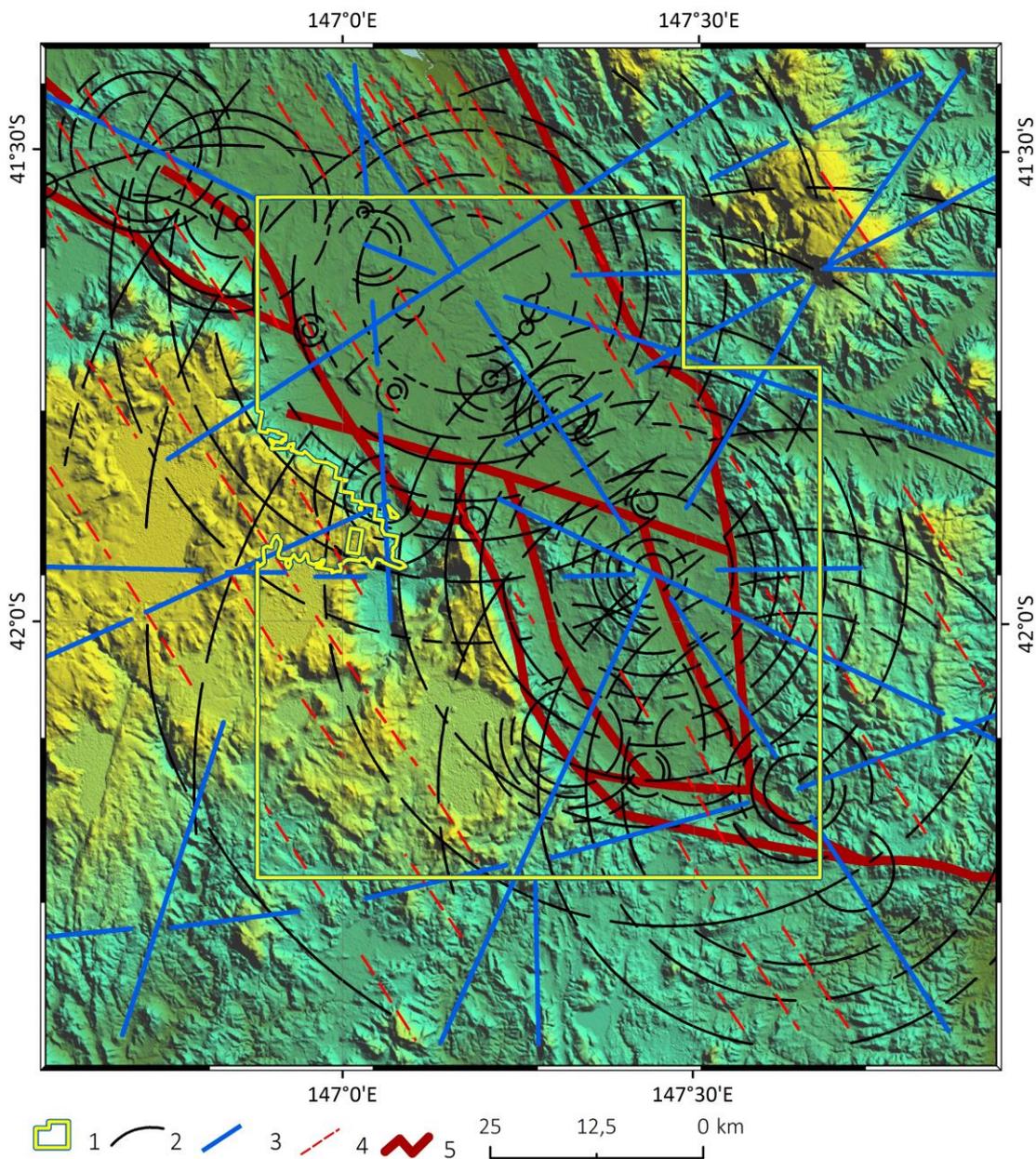
**Figure 37: GDA analysis overlay with DEM map of EL30 at 1:200,000 scale.**

1 – EL30; 2 – Concentric system; 3 – Major tectonogen; 4 – Minor tectonogen within Zone of Dynamic Influence or ZDI (see Figure 4) of major tectonogen

The linear and circular dislocations indicate for the presence of high-density disjunctive nodes within the area (regionally and locally) that are responsible for the focal degassing of the subsurface and the concentrated discharge from the zones of deep stress. Thus, the high density of structural disjunctive nodes of varying genesis is a reliable indicator for the presence of favorable conditions of a compartmentalized accumulation of HC's.

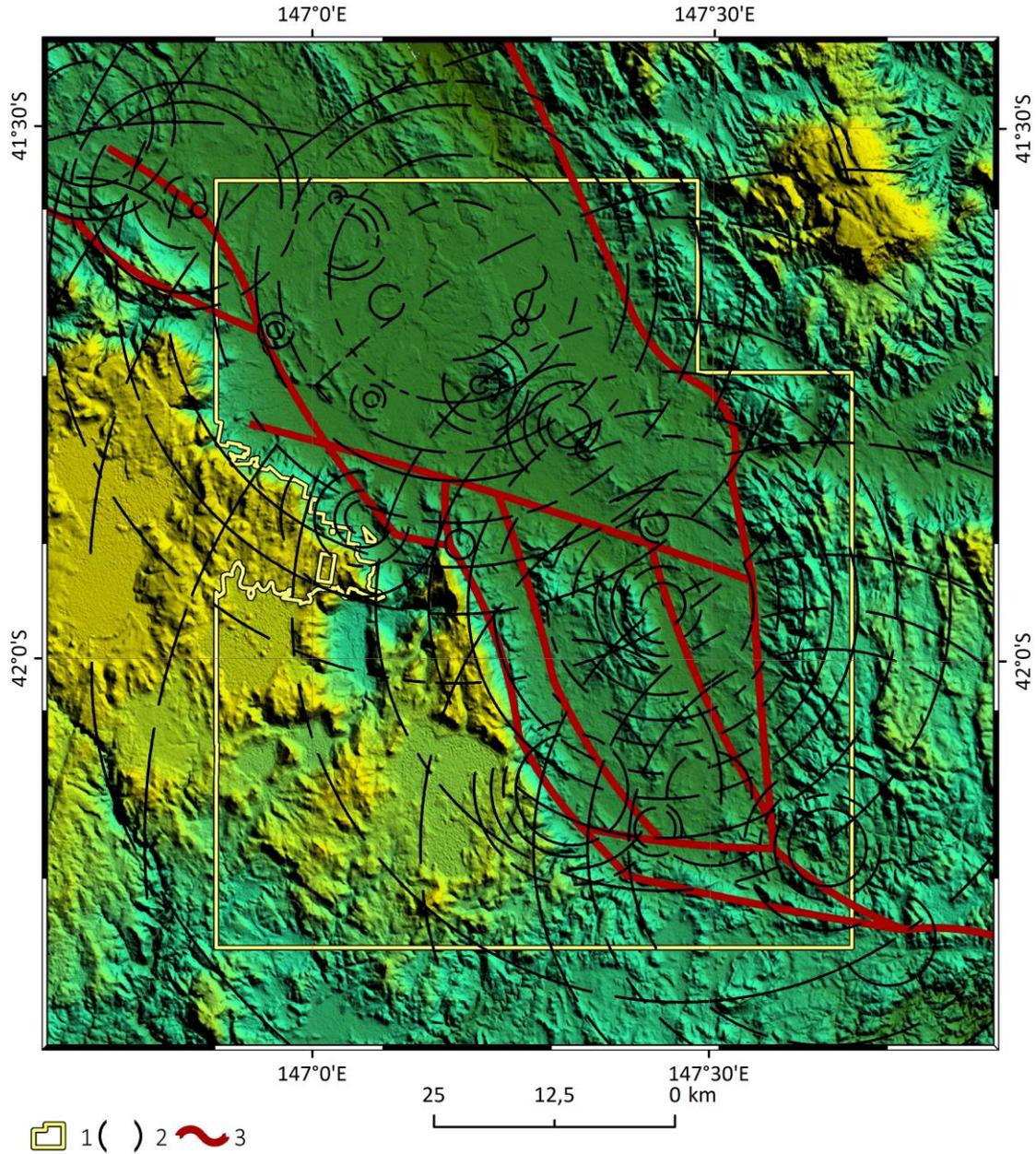
## Terra Tasmania Resources

The tectonogens bounding the Tamar graben at its flanks (marked with a red dotted line - **Figure 38**) can be traced using the elevation map, and the concentric systems developed within its borders are marked as shown in **Figure 39**.



**Figure 38: Geodynamic structures pattern along the Tamar graben.**

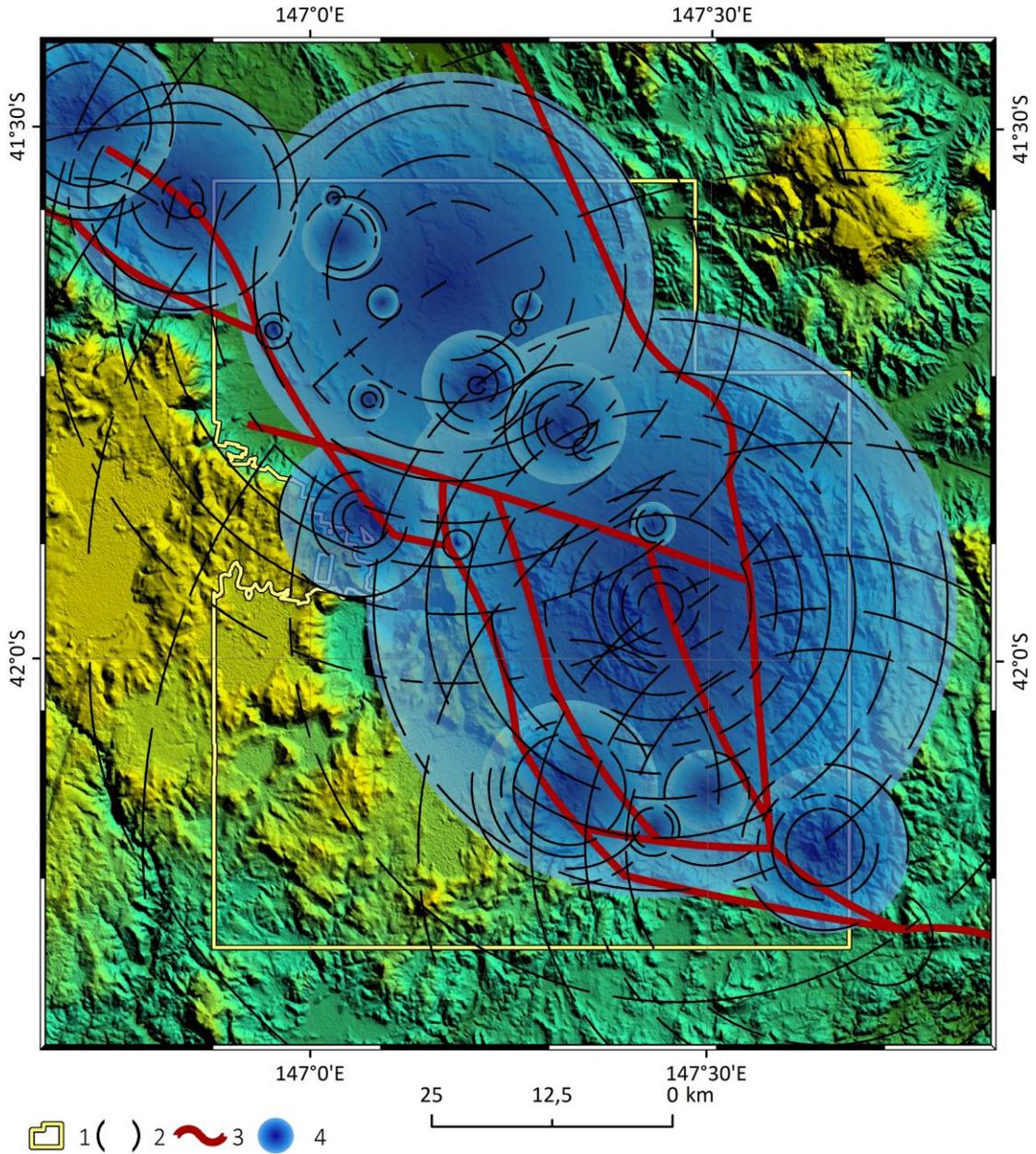
1 – EL30; 2 – Concentric system; 3 – Major tectonogen; 4 – Minor tectonogen within Zone of Dynamic Influence or ZDI (see Figure 4) of major tectonogen; 5 – Tamar graben



**Figure 39: Geodynamic concentric systems along the Tamar graben.**  
1 – EL30; 2 – Concentric system; 3 – Tamar graben

## Terra Tasmania Resources

As mentioned above, these concentric structures are the depressions of varying rank. The assumption is that the deeper parts of sagging/deflection are located at or near their epicenters (**Figure 40**).



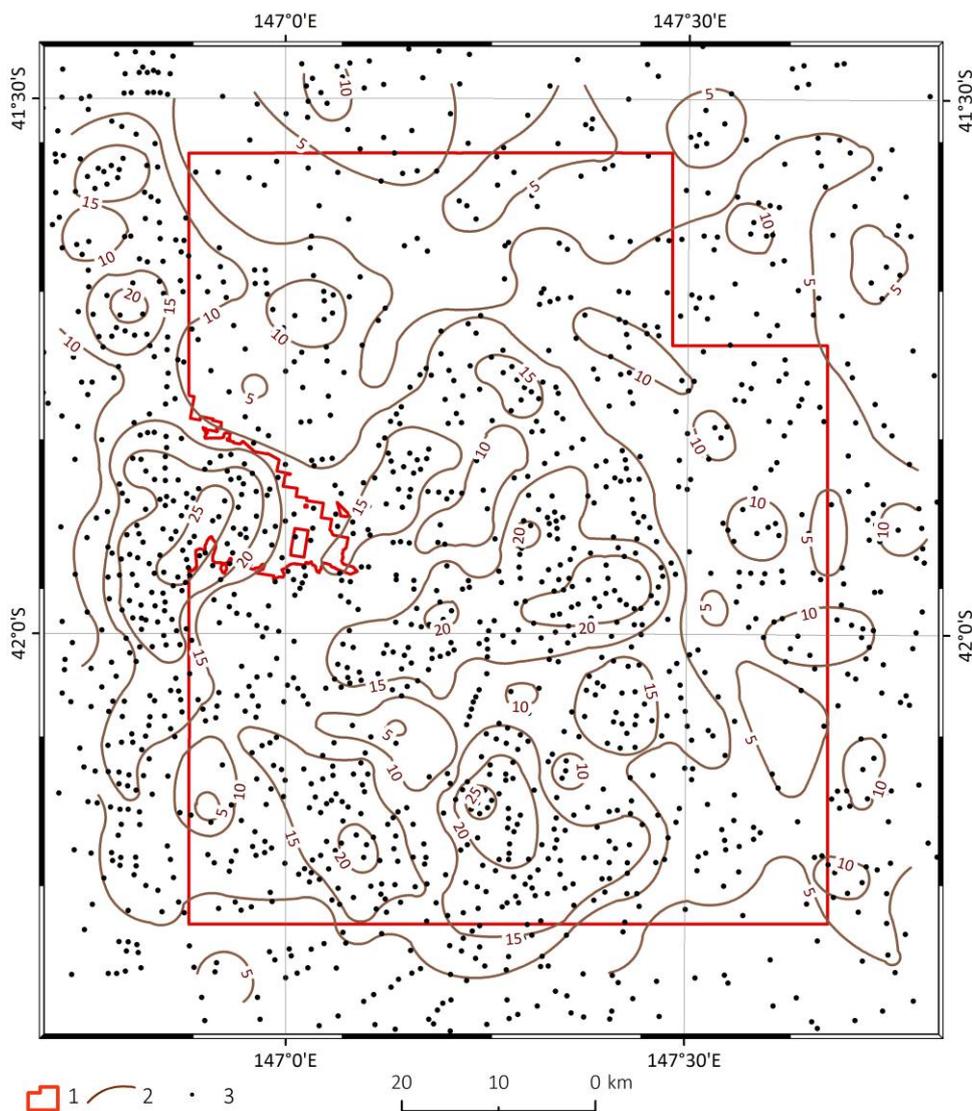
**Figure 40: Visualization of geodynamic concentric structures pattern within Tamar graben.**  
 1 – EL30; 2 – Concentric system; 3 – Tamar graben; 4 – Visualization of depression

## Terra Tasmania Resources

The last GDA stage entails the identification of locations of nodes of intersections of geodynamic structures (Figure 41) that serve as energy-and-fluid discharge zones, followed by the delineation of these zones of active fluid discharge using the contours of the zones with high density of the said nodes (Figure 42). Such territories are the primary leads of prospecting for hydrocarbons.

The differentiation of the density field of disjunctive nodes appears to be quite high. Figure 41 shows the high-node-density (greater than 15) in EL30's central zone, which are clusters of nodes with their density of 15 to 20 units and higher.

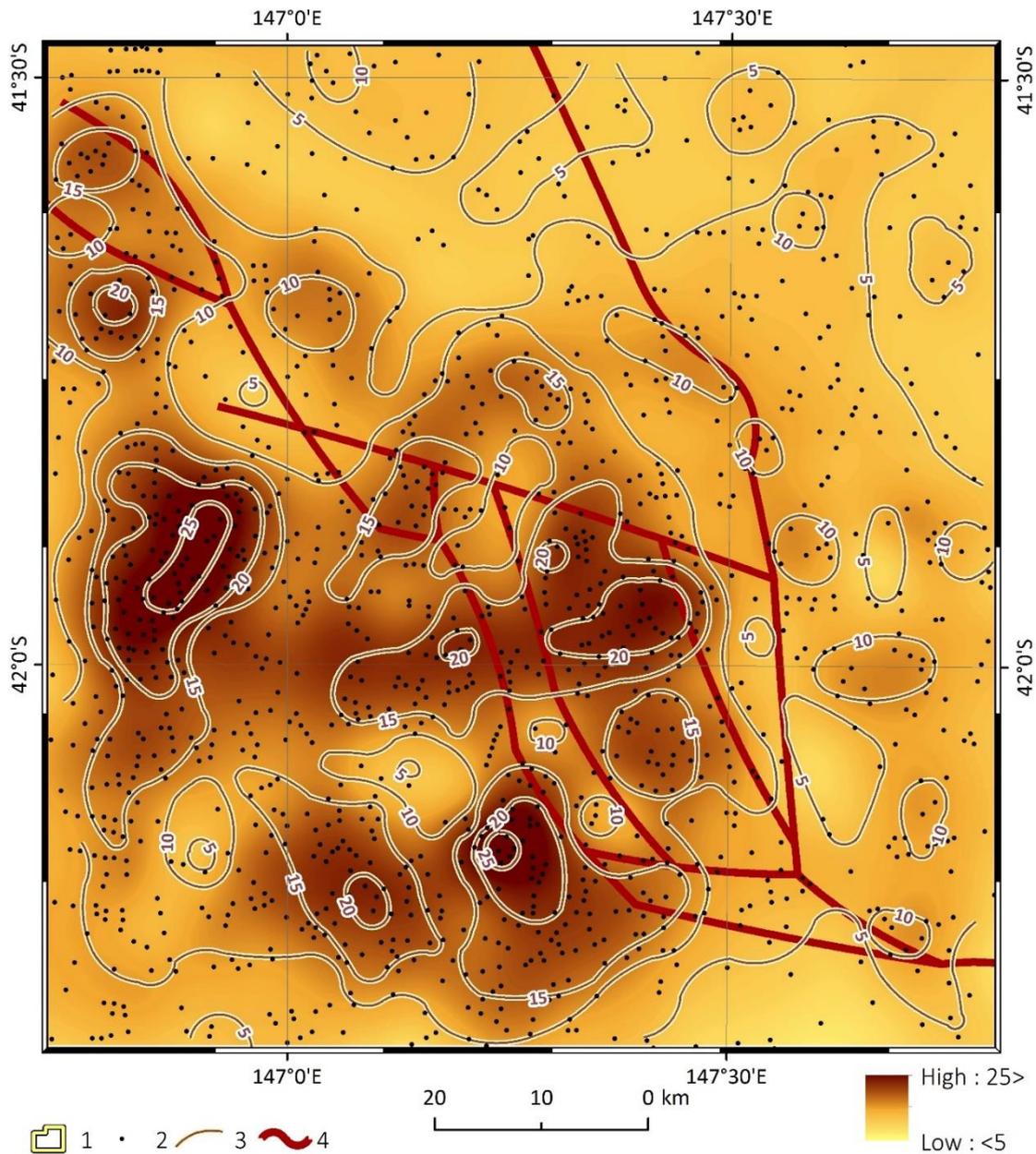
The high node density (up to 25) was identified at the southern flank of EL30 (two anomalies 2 to 3 km across).



**Figure 41: GDA result – locations of nodes of intersections of geodynamic structures with isolines/contours of node density.**

*1 – EL30; 2 – Isoline of node density; 3 – Nodes of intersections of geodynamic structures*

# Terra Tasmania Resources

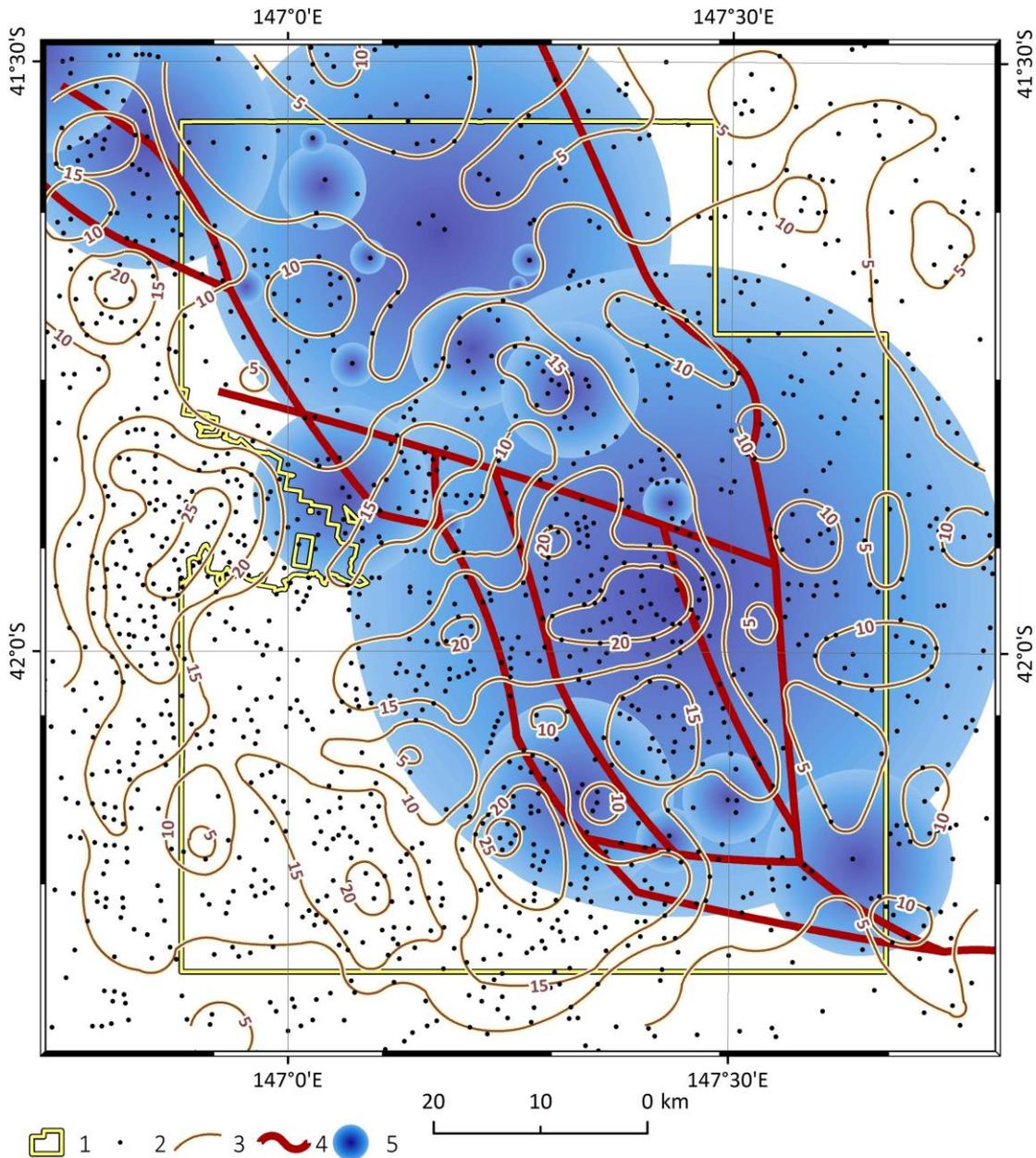


**Figure 42: GDA result – locations of nodes of intersections of geodynamic structures with isolines/contours and color shading of node density.**

*1 – EL30; 2 – Isoline of node density; 3 – Nodes of intersections of geodynamic structures*

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The next step was to superimpose the GDA-depressions (Figure 40) with the pattern of density of nodes (Figure 41), which rendered Figure 43.

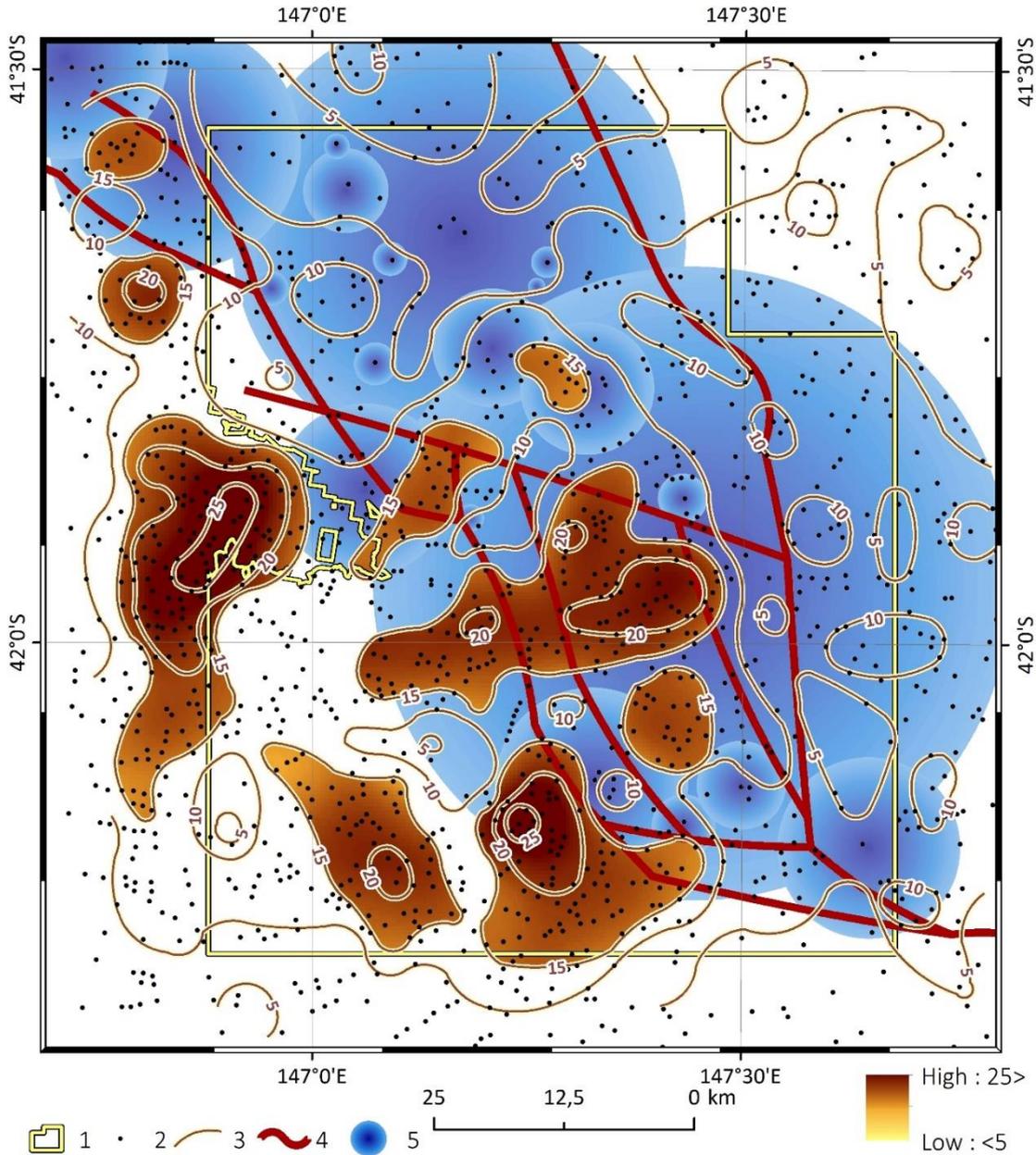


**Figure 43: Final GDA result of HC potential of EL30.**

1 – EL30; 2 – Node of intersections of geodynamic structures; 3 – Isoline of node density; 4 – Tamar graben; 5 – GDA-depression

## Terra Tasmania Resources

Superimposing the zones of high node density and depressions, with their deep parts, renders **Figure 44** and **Figure 45**.

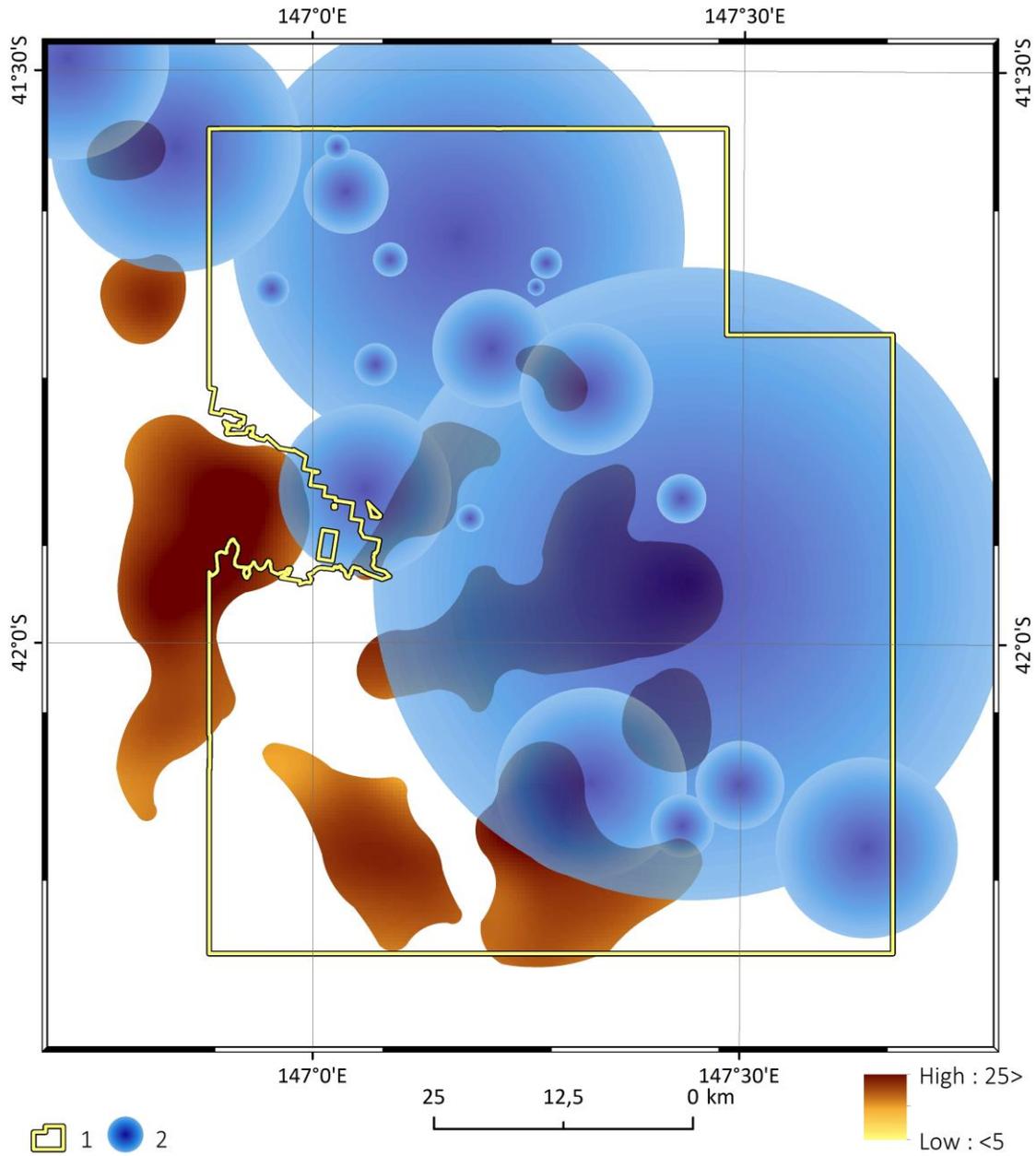


**Figure 44:** Superposition of the geodynamic depressions with the distribution of geodynamic nodes.

1 – EL30; 2 – Node of intersections of geodynamic structures; 3 – Isoline of node density; 4 – Tamar graben; 5 – GDA-depression



# Terra Tasmania Resources



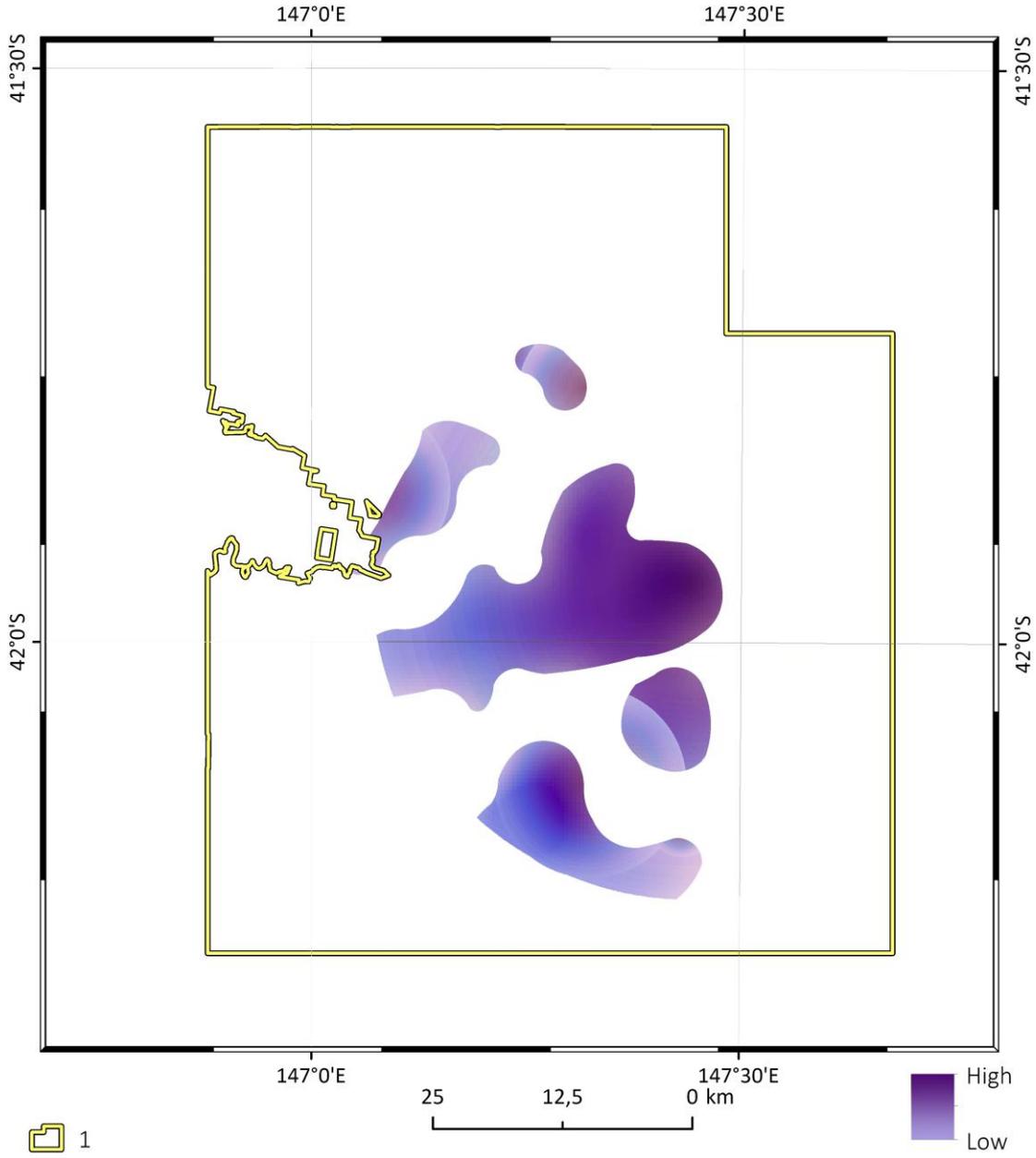
**Figure 45: Superposition of the geodynamic depressions with areas of anomalous geodynamic node density.**

*1 – EL30; 2 – GDA-depressions*



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Thus, the areas with Priority 1 HC potential are shown in **Figure 46** with darker color.



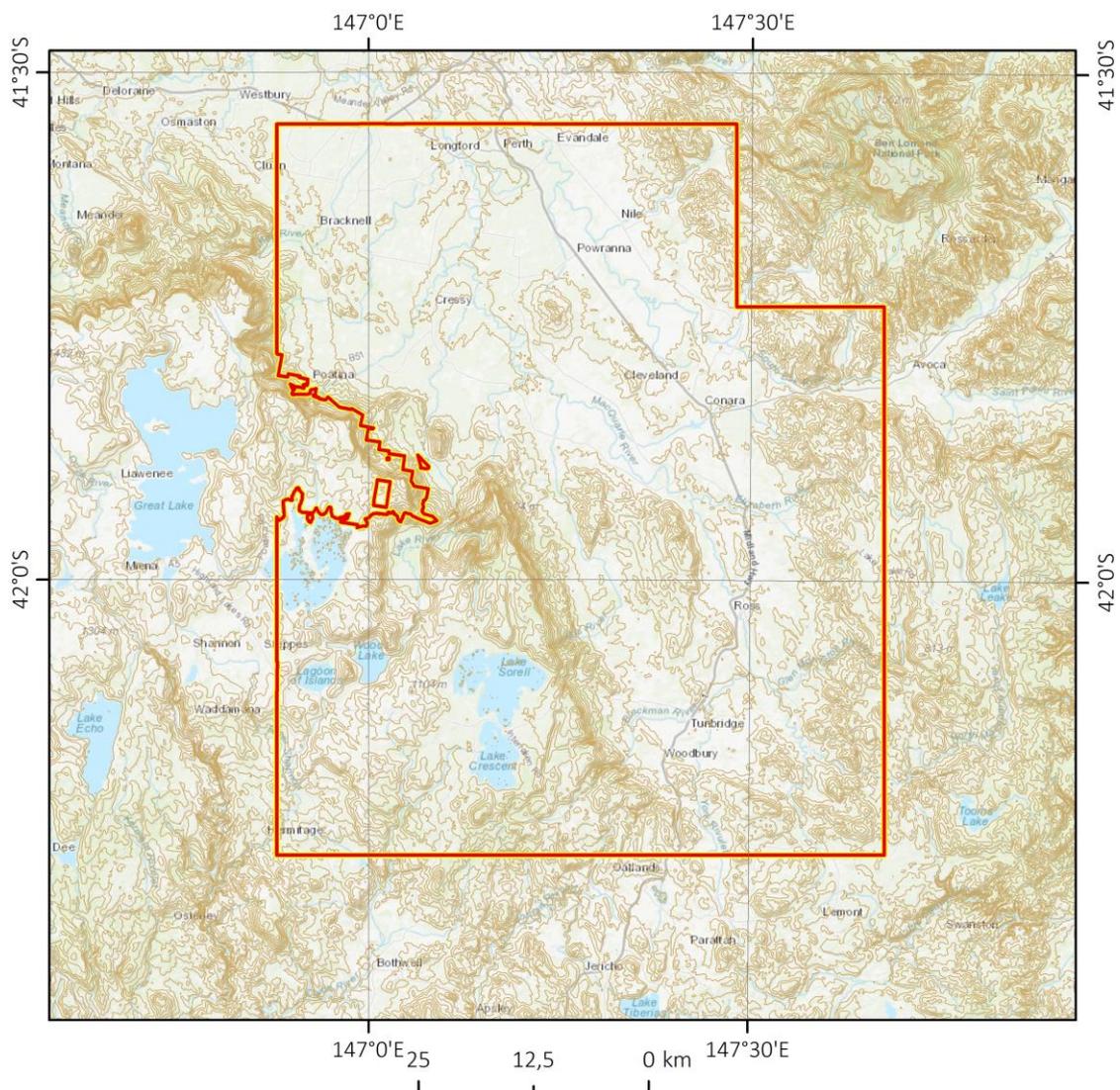
**Figure 46: Priority 1 areas for HC potential – GDA result.**

*1 – EL30*

## 2.2 PALEO-RECONSTRUCTION ANALYSIS (PRA)

### 2.2.1 DETECTION AND ANALYSIS OF FLOW STRUCTURES OF EL30/2011 AT THE SCALE OF 1:100,000

To better understand the lithodynamic situation of EL30/2011 (or Area of Interest or “AOI”), paleo-reconstruction (“PRA”) at the scale of 1:100,000 of AOI and the adjoining territory was performed. It was necessary to analyze a significantly larger area, as certain features and structures located outside AOI may directly or indirectly influence HC prospectivity of the EL30/2011. PRA allows seeing patterns in the tectonic development of the region and understanding the reasons for oil and gas prospectivity.



 1

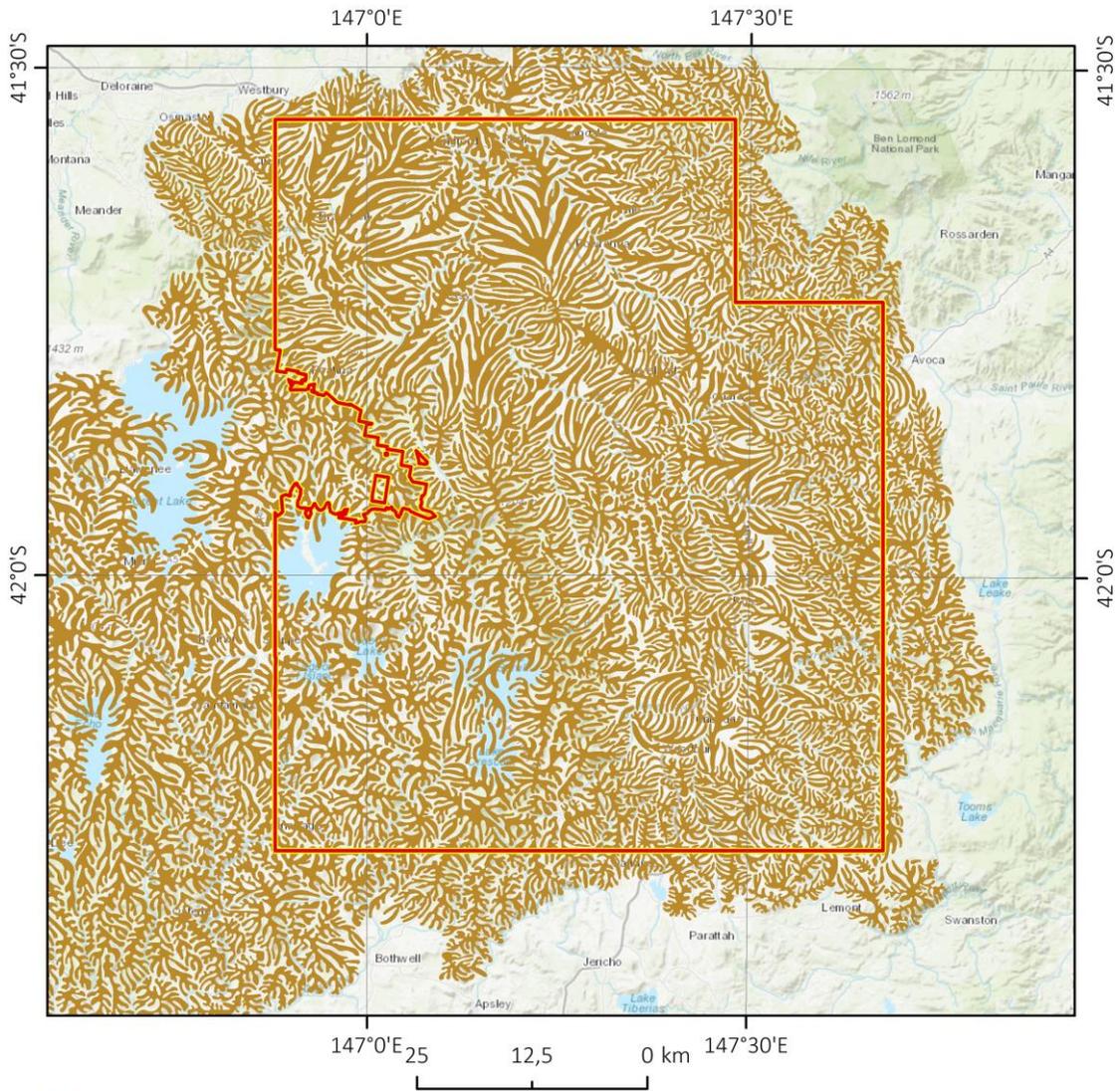
**Figure 47: Topographic map of AOI EL30/2011. Scale 1:100,000.**

1 – EL30/2011

## PALEO FLOWS

The objective was to differentiate the surface of AOI EL30/2011 into positive (convexities) and negative (concavities) lithodynamic flows.

The "Relief Plasticity" technology, often used interchangeably with PRA, differentiated the AOI's surface into the lithodynamic flows, flow structures and their subsystems of convexities and concavities - **Figure 48**.



1 2

**Figure 48: Relieve plasticity map of EL30/2011. Scale 1:100,000.**

1 – EL30/2011;

2 – litho-dynamic flow



## Terra Tasmania Resources

### DETECTION OF LITHODYNAMIC FLOW STRUCTURES, THEIR SUBSYSTEMS AND ZONES OF THEIR CONTACT

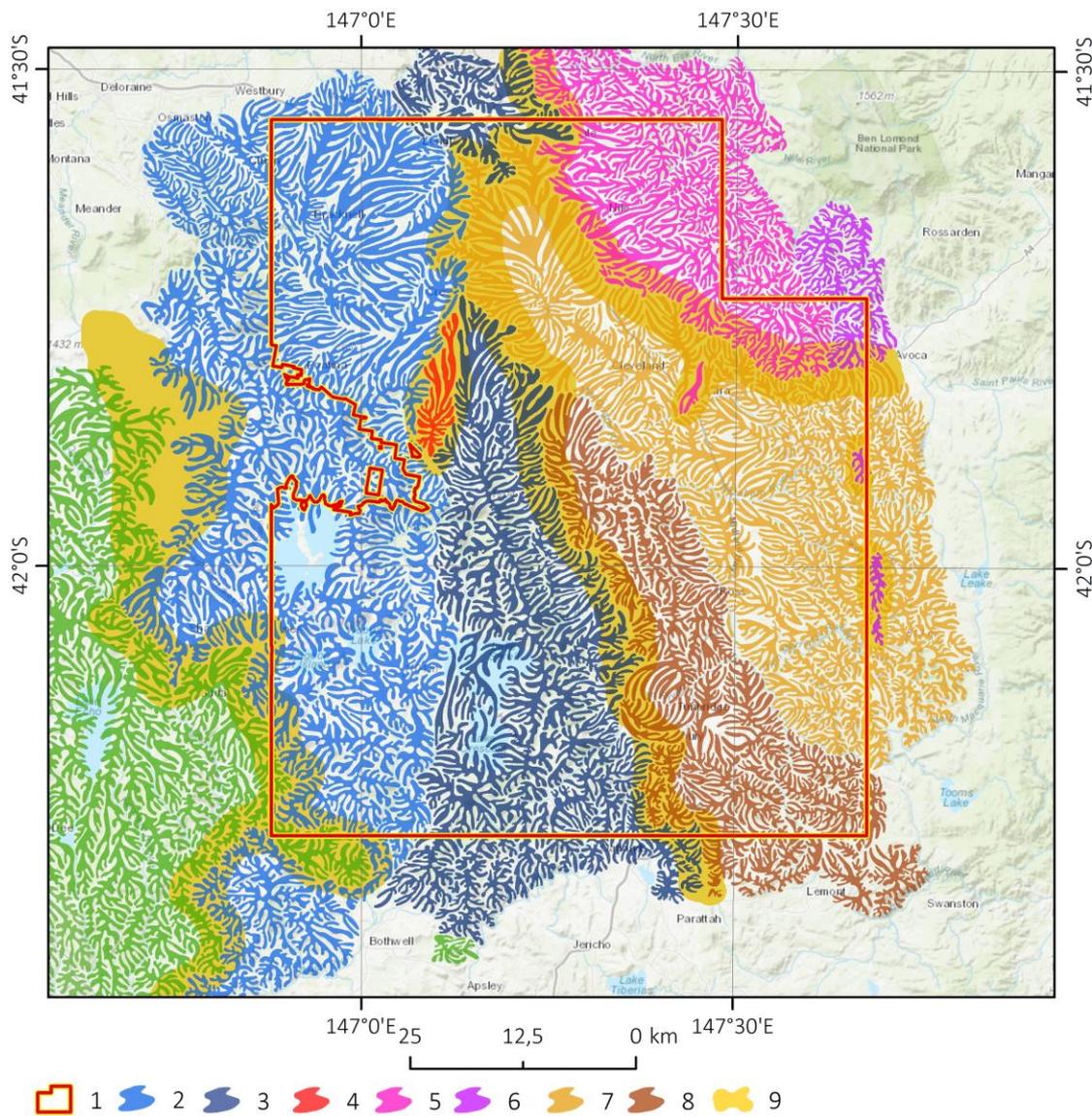
*The objective was to distinguish (by color shading) of flow subsystems, define the lithodynamic framework of AOI, and locate the zones of contact between separate flow systems.*

A group of several flows emanating from a single center (an elevated point) is a complex body with its own boundaries. Such a geological entity is called "lithodynamic structure." A set of compact structures with similar dimensions (in hundreds or even thousands of kilometers) and a relatively consistent, common direction is called a flow system. Within a complex, branched flow system, separate sub-groups of flow structures, or subsystems, can be identified.

**Figure 49** shows the main flows of AOI that belong to the Eastern subsystem. The structures of the Eastern subsystem are homogeneous in their orientation. All structures of EL30/2011 have a common NW-SSE orientation. The difference (in color) between the individual groups of structures is due to the presence of large tectonic faults, dividing the entire subsystem into three main groups (thus the difference in color for each group of flows within the subsystem). Red color, however, shows the anomalous lithodynamic flow structures in terms of their general orientation. This structure is likely a remnant of an older system, the orientation of which differed from the younger rocks of the territory. These subsystems are clearly visible at the scale of 1:500,000. These sub-systems branch out at the southern tip of Australia (being integral parts of the East Australian lithodynamic system), "flowing" around the Bass Strait basin and "meeting" again on the island of Tasmania (in the southwestern part of AOI).

Contact zones of the three groups of structures are of interest from the oil and gas prospectivity perspective, as potential geochemical and mechanical barriers favorable for the formation of trapped hydrocarbon reservoirs. The flows of the Eastern subsystem come in contact with the flows of the Western subsystem, forming large areas of potential HC accumulation in the region.

# Terra Tasmania Resources



**Figure 49: Lithodynamic flow structures within EL30/2011. Scale 1: 100,000.**

1 - EL30/2011; 2 and 3 - group of flow structures of the Eastern lithodynamic subsystem present on the western part of AOI; 4 - residual flow structure; 5-8 - group of flow structures of the Eastern lithodynamic subsystem located on the eastern part of AOI; 9 - zones of contact of groups of flow structures of the Western and Eastern lithodynamic subsystems within the Eastern lithodynamic subsystem



## Terra Tasmania Resources

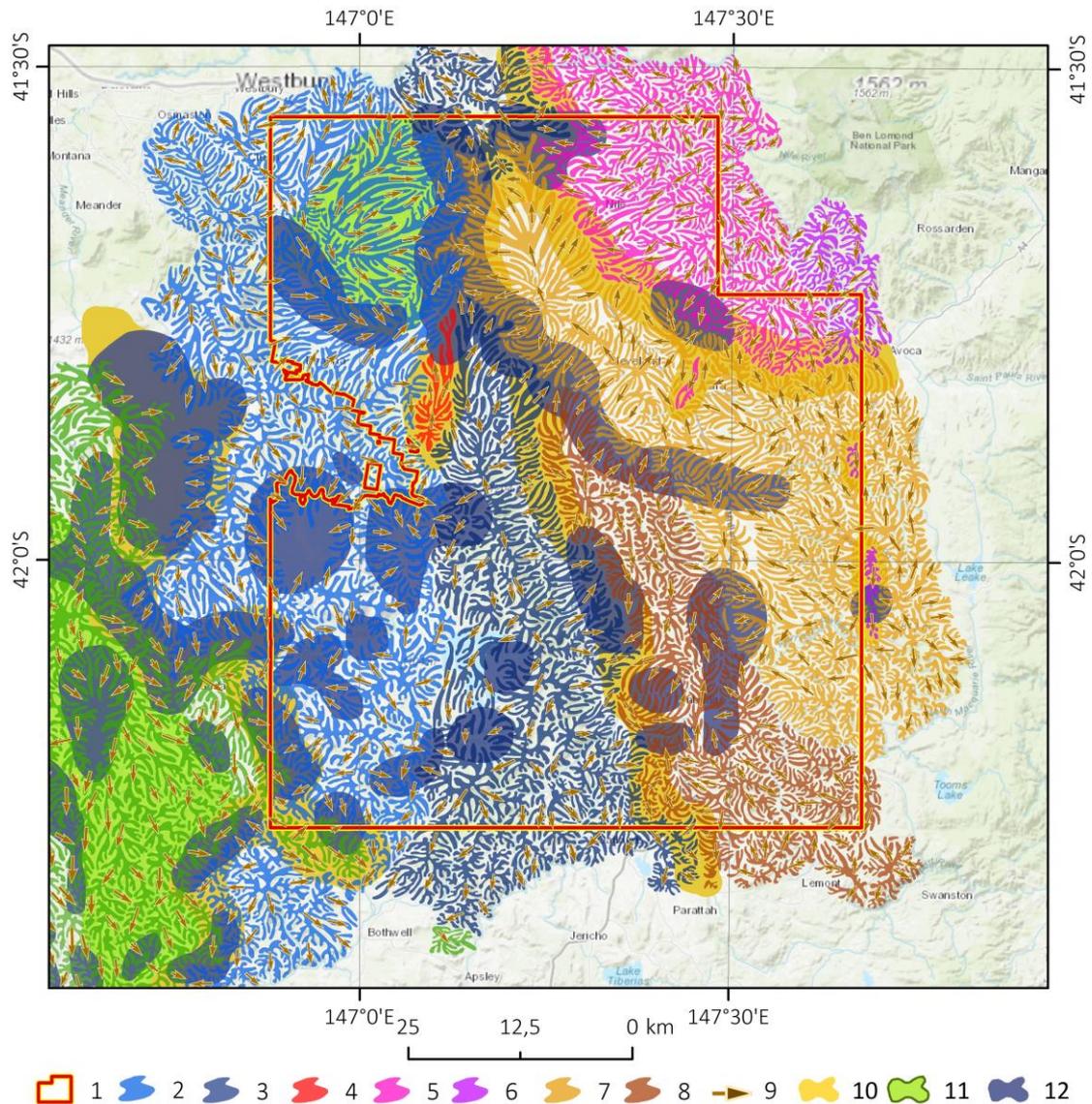
### VISUALIZATION OF PALEO-DELTAIC STRUCTURES AND LARGE CLOSED DEPRESSIONS

*The objective was to identify paleo-river deltaic features, which are areas with favorable reservoir properties.*

Modern surface features mask the paleo-flow structures and the supposed vast network of paleo-rivers within the area. However, PRA helped reveal and identify the elements of this paleo-river network. **Figure 50**, therefore, shows the only, fan-shaped paleo-deltaic features in the north of EL30/2011. Flows-convexities of the paleo-delta structure and other flow structures rush toward troughs as areas with active sedimentation. Some such depressions are circular, indicating for relatively long, stagnant periods of sedimentation; others are elongated and stretch along the contact zones of flow structures, indicating for their tectonic nature. Discrete locations of the depressions on a relatively small area suggests larger depressions could have been there, accumulating organic material and potentially leading to the generation of HC's. Their HC potential increased in case these processes were stable and lengthy. However, the subsequent tectonic activity may have subjected these deposits to breach. If the rate of oceanic regression was greater than that of the accumulation of the organic matter, while the flows "found" the next favorable depression along the gravity/attraction vector in the southeastern and southern directions, the deposits would be low thickness.

Using these criteria, PRA attributes the HC potential of AOI as moderate: (i) the paleo-delta is relatively small; (ii) the areas of extensive depressions in the west, north, and in the center of AOI are more prospective; (iii) the trough extended in the north-southeastern direction is of note - it is located at the junction of two groups of flow structures of the Eastern lithodynamic subsystem with the only paleo-delta "flowing into it" (**Figure 50**).

# Terra Tasmania Resources



**Figure 50: Paleo-delta structures within AOI EL30/2011. Scale 1: 100,000.**  
 1 - EL30/2011; 2 and 3 - group of flow structures of the Eastern lithodynamic subsystem present on the western part of EL30/2011; 4 - residual flow structure; 5-8 - group of flow structures of the Eastern lithodynamic subsystem located on the eastern part of EL30/2011; 9 - vector of migration of geological material via lithodynamic flows; 10 - contact zone of groups of flow structures of the Western and Eastern lithodynamic subsystems, inside the Eastern lithodynamic subsystem; 11 - paleo-delta; 12 - depression (areas of accumulation of lithological and organic material)



## Terra Tasmania Resources

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### DETECTION OF CIRCULAR LITHODYNAMIC STRUCTURES AND LINEAR STRESS ZONES

*The objective was to identify the circular and linear structures as areas of tectonic stress and strain (and potentially anomalous fracturing).*

PRA identifies and interprets circular and linear stress zones as one of important criteria of the method. It allows to establish the locations of circular and linear structures based on the form of lithodynamic flows. All these formations are a consequence of the tectonic activity in the given territory at different times. While currently it is a relatively stable region, traces of the former volcanic (circular-shaped structures) and tectonic (linear structures) activity are preserved and reflected in lithodynamic shapes. These anomalies contribute to the creation of favorable conditions for the formation of hydrocarbon deposits.

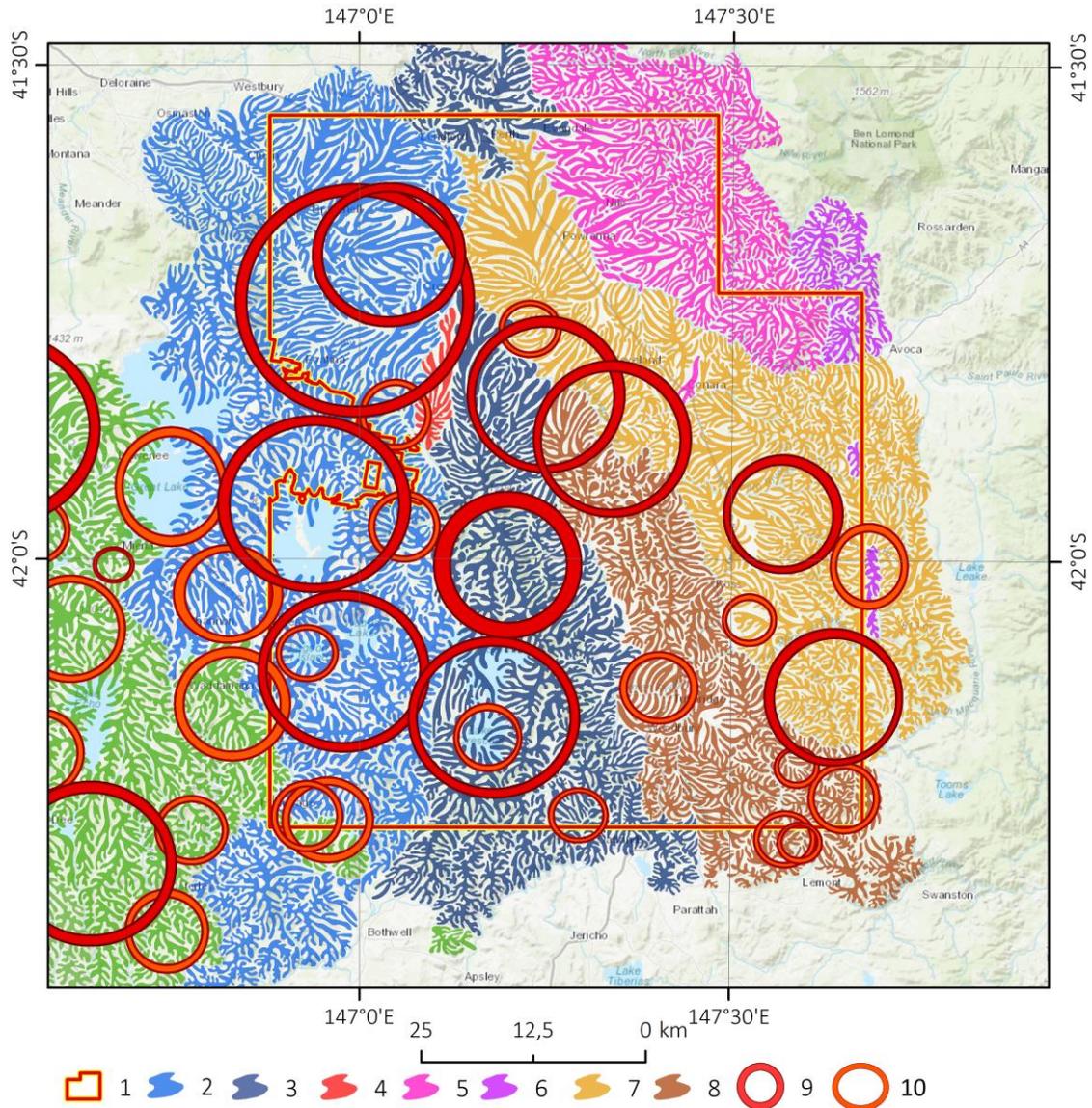
Two groups of circular structures are identified within AOI as presented in [Figure 51](#). They differ in size as follows:

- The first group contains the large-diameter structures (first-order structures);
- The second group includes the small-diameter structures (second-order structures).

Structures belonging to the same group, as a rule, do not intersect with each other, except for when one structure is inscribed in the other. Contact zones of neighboring structures are a more frequent occurrence.

Intersections between circular structures, as areas of elevated stress, are of interest. Such areas are characterized by high fracturing of rocks, which may be a beneficial factor. In addition, vertical zones of migration of hydrocarbons from the lower horizons to the upper horizons will occur within stress zones (faults).

# Terra Tasmania Resources



**Figure 51: Map of circular anomalies at EL30/2011. Scale 1:100,000.**

1 - EL30/2011; 2 and 3 - group of flow structures of the Eastern lithodynamic subsystem present on the western part of AOI EL30 / 2011; 4- residual flow structure; 5-8 - group of flow structures of the Eastern lithodynamic subsystem located on the eastern part of EL30/2011; 9 - circular structure of the first order; 10 - circular structure of the second order

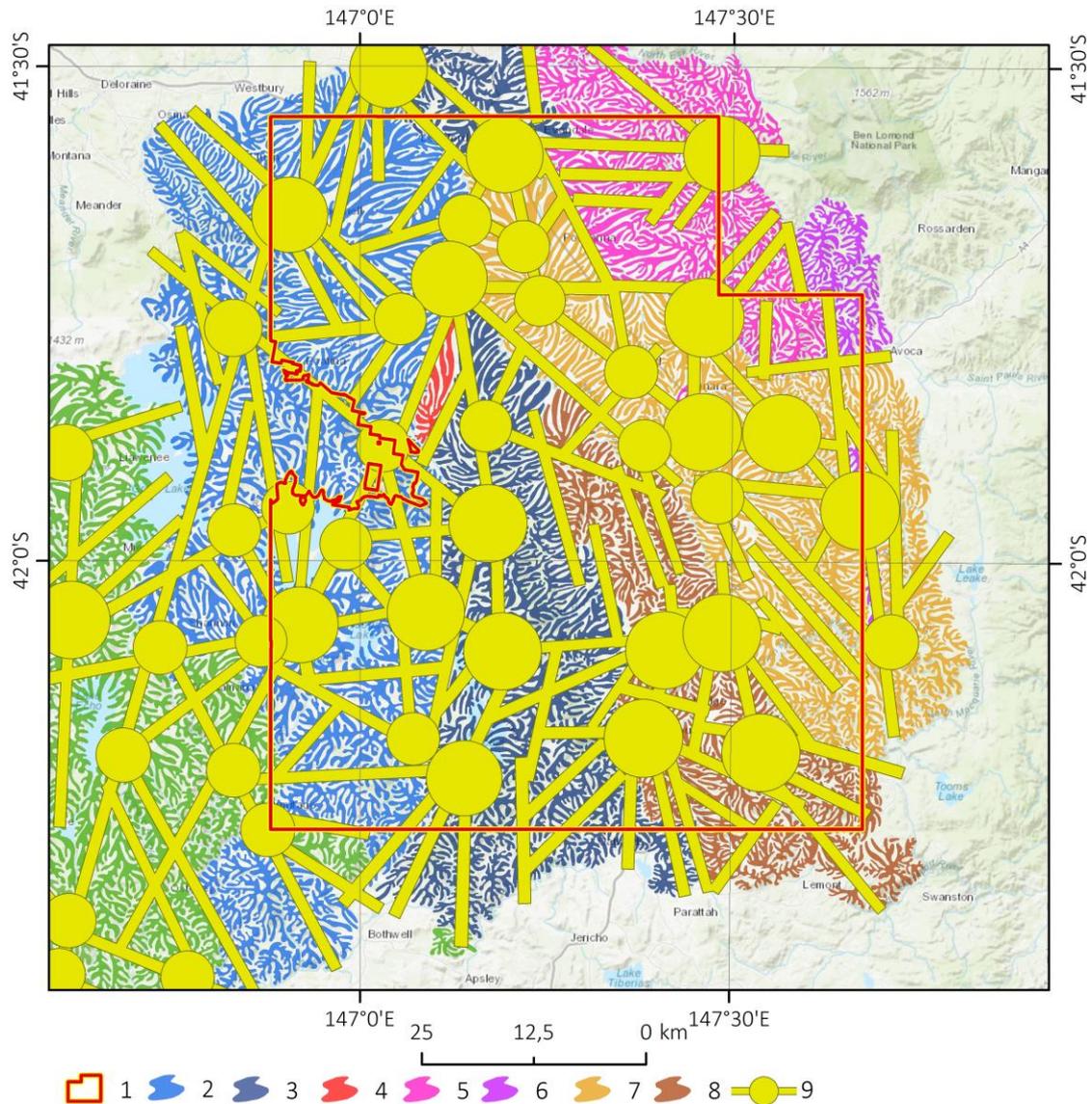
The linear areas of stress are shown in **Figure 53**.

PRA distinguished the most prospective areas as intersections of three or more linear structures (“nodes”) and the areas of intersection of linear and circular structures, especially at contact zones of several circular structures.

The lithodynamic analysis of flow structures shown in **Figure 49** revealed a fairly high number of linear structures - **Figure 52** and **Figure 53**.

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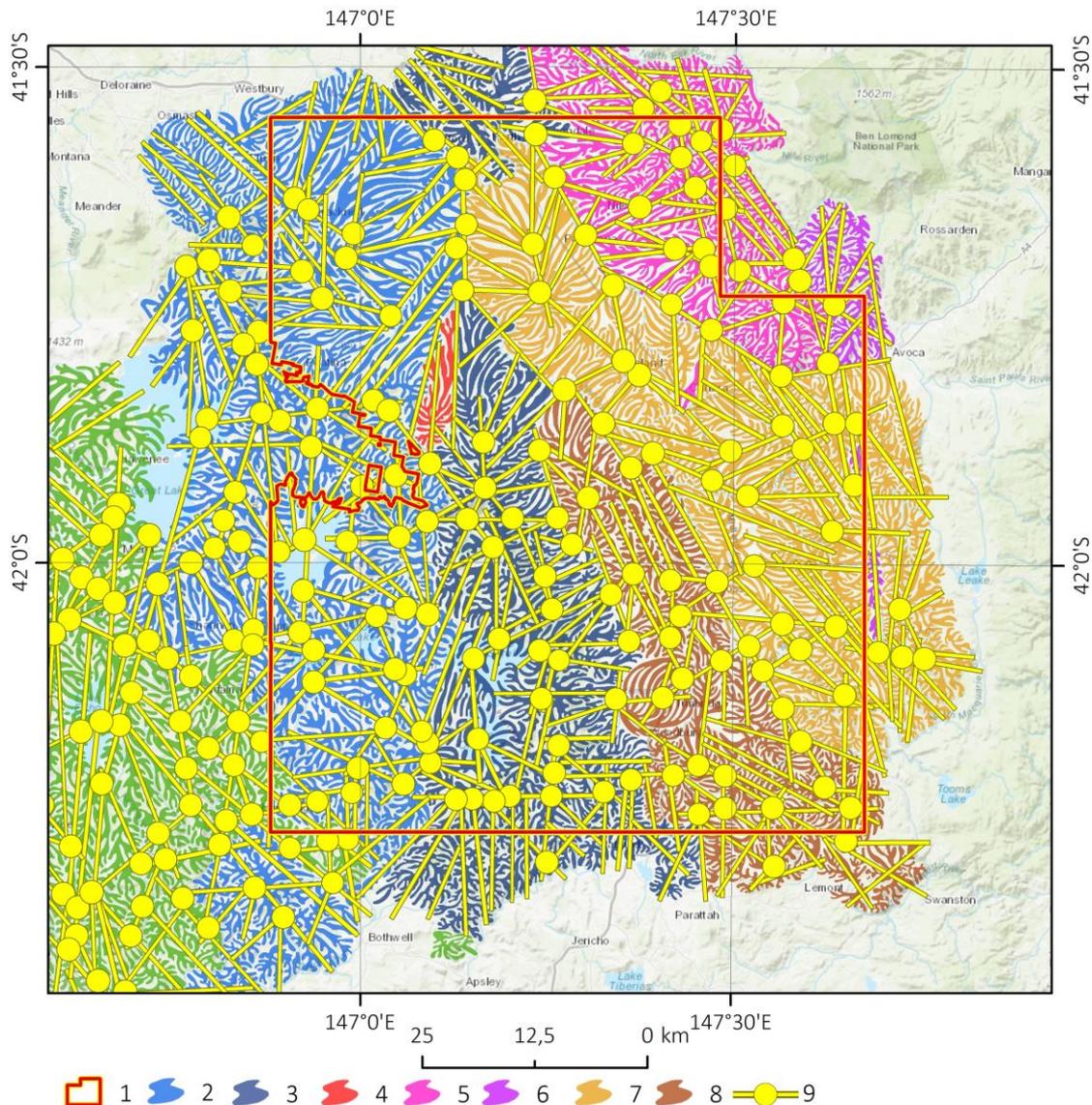
These structures are not coeval. In order to identify the older and more stable formations, we used the scaling method (utilizing PRA at several scales). Scale variation of the lithodynamic flow structure map in [Figure 49](#) allowed identification of two groups of linear structures: 1) first order structures of regional scale ([Figure 52](#)) and 2) second order structures - local scale ([Figure 53](#)).



**Figure 52: Map of linear anomalies of the first order within EL30/2011. Scale 1:100,000.**

*1 - EL30/2011; 2 and 3 - group of flow structures of the Eastern lithodynamic subsystem present on the western part of EL30/2011; 4- residual flow structure; 5-8 - group of flow structures of the Eastern lithodynamic subsystem located on the eastern part of EL30/2011; 9 - linear zone of the first order and node of intersection*

# Terra Tasmania Resources



**Figure 53: Map of linear anomalies of the second order within EL30/2011. Scale 1: 100,000.**

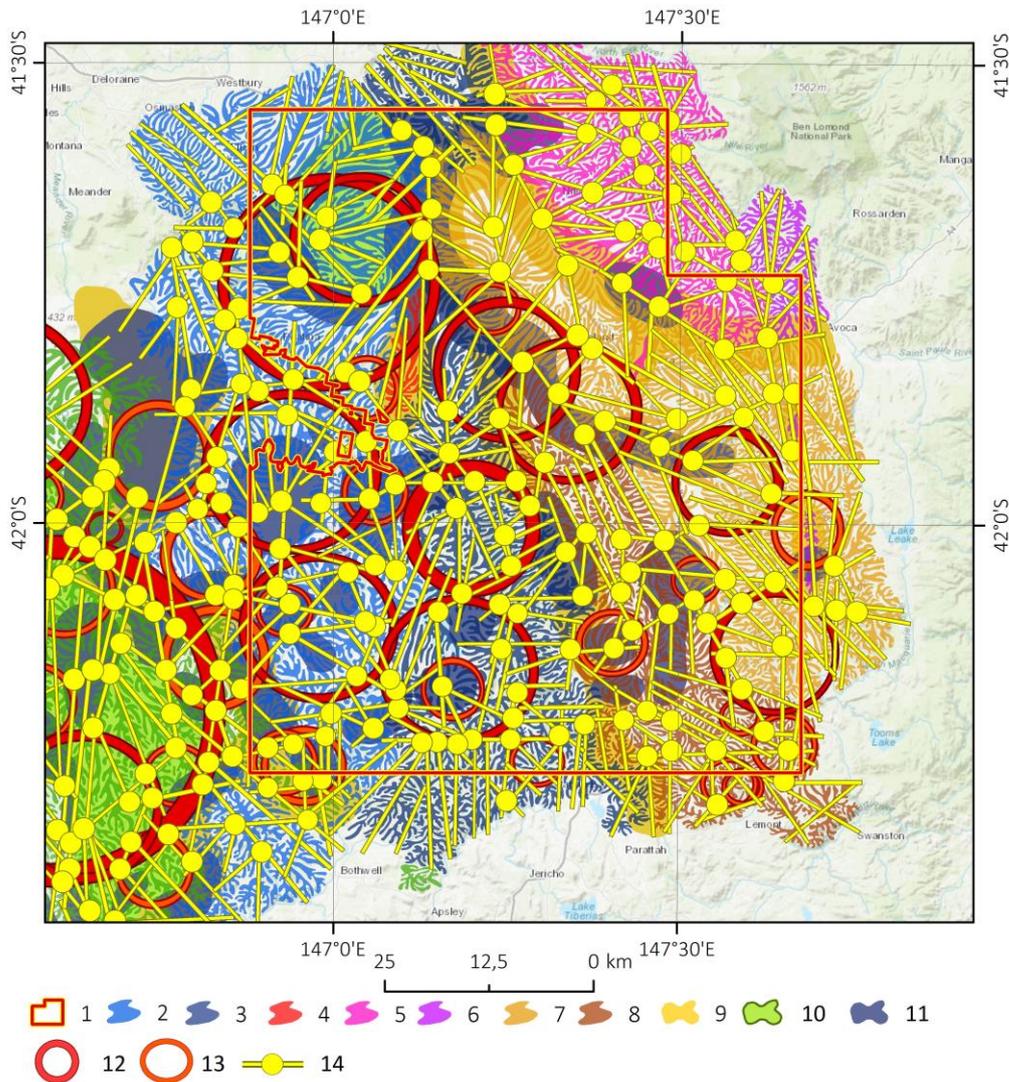
1 - EL30/2011; 2 and 3 - group of flow structures of the Eastern lithodynamic subsystem present on the western part of EL30/2011; 4- residual flow structure; 5-8 - group of flow structures of the Eastern lithodynamic subsystem located on the eastern part of EL30/2011; 9 - linear zone of the second order and node of intersection

## IDENTIFICATION OF THE MOST PROSPECTIVE ZONES

*The objective was to integrate the previously identified prospectivity criteria to determine areas of greatest hydrocarbon prospectivity.*

## Terra Tasmania Resources

Based on the data of all of the identified HC prospectivity criteria (maps of paleo-deltas, contact zones, circular, and linear structures) were combined into one map for further interpretation. The integration was carried out in two stages. Stage 1: with local-level structures - circular (first and second order) and linear (second order) structures - **Figure 54**.



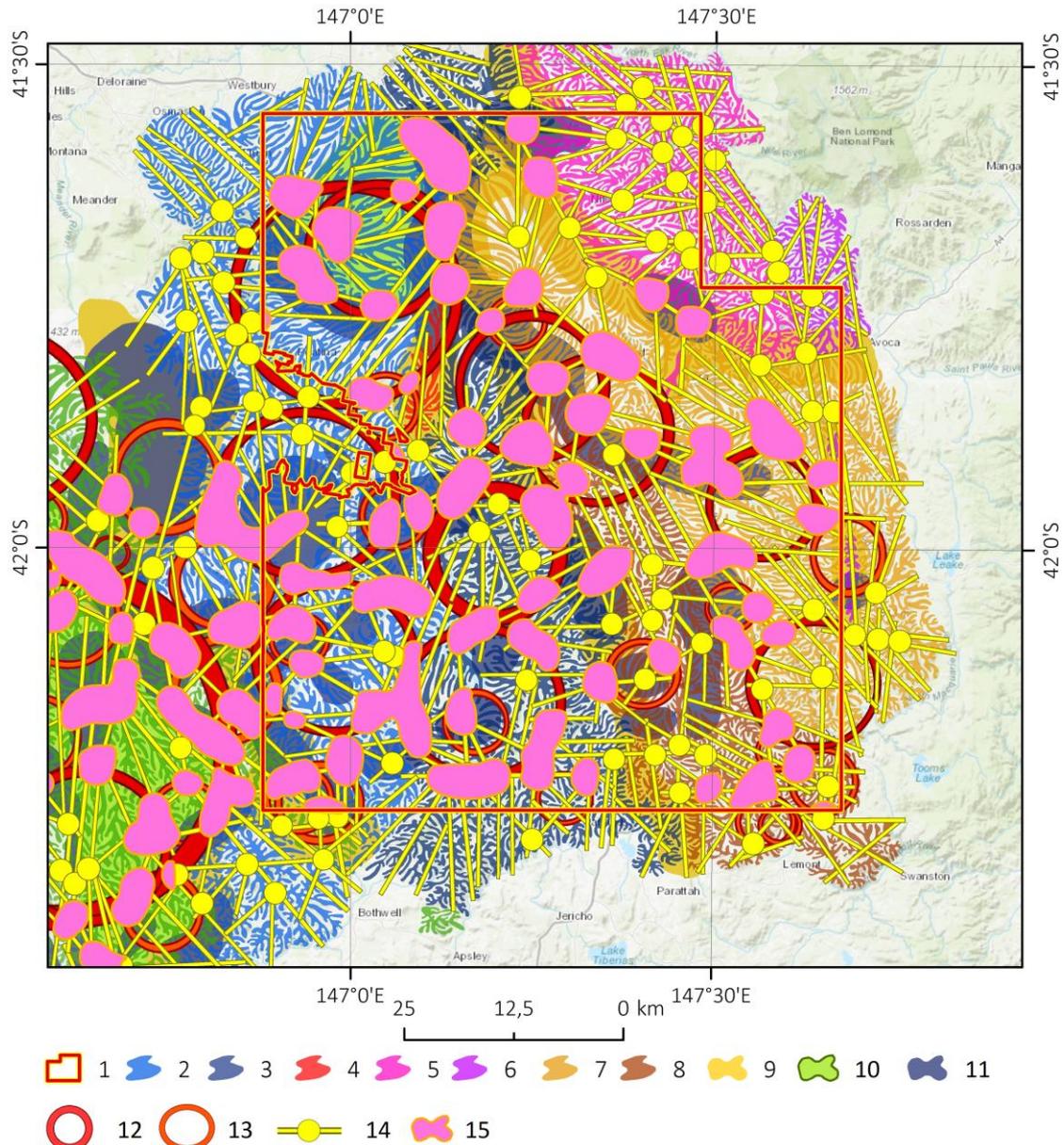
**Figure 54: Map of the prospective HC prospectivity criteria integration on a local level within EL30/2011. Scale 1: 100, 000.**

1 - EL30/2011; 2 and 3 - group of flow structures of the Eastern lithodynamic subsystem present on the western part of EL30/2011; 4 - residual flow structure; 5-8 - group of flow structures of the Eastern lithodynamic subsystem on the eastern part AOI EL30 / 2011; 9 - contact zone of groups of flow structures of the Western and Eastern lithodynamic subsystems inside the Eastern lithodynamic subsystem; 10 - paleo-delta; 11 - depression (areas of accumulation of lithological and organic material); 12 - circular structure of the first order; 13 - circular structure of the second order; 14 - linear zone of intensity of the second order and places of intersection (node)

**Figure 54** shows a high concentration of nodes along the margins of circular structures. These areas may be prospective for the formation of deposits.

## Terra Tasmania Resources

The areas with positive superposition of two, three or more criteria were delineated and shown in **Figure 55**.

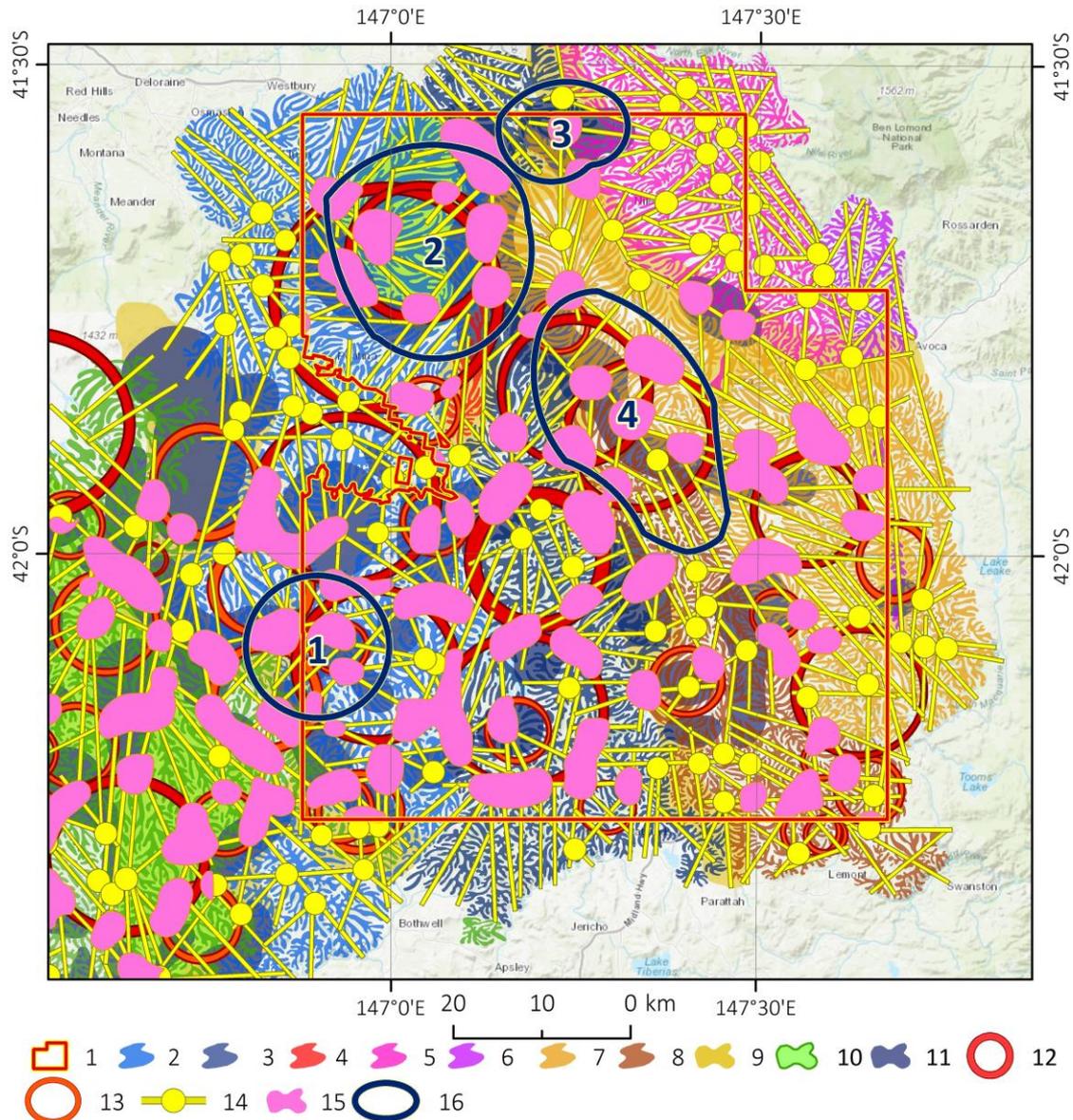


**Figure 55: HC potential of EL30/2011 using the circular and linear anomalies at a local level. Scale 1: 100,000.**

1 - EL30/2011; 2 and 3 - group of flow structures of the Eastern lithodynamic subsystem present on the western part of AOI EL30 / 2011; 4 - residual flow structure; 5-8 - group of flow structures of the Eastern lithodynamic subsystem on the eastern part AOI EL30 / 2011; 9 - contact zone of groups of flow structures of the Western and Eastern lithodynamic subsystems inside the Eastern lithodynamic subsystem; 10 - paleo-delta; 11 - depression (area of accumulation of lithological and organic material); 12 - circular structures of the first order; 13 - circular structure of the second order; 14 - linear zone of stress of the second order and intersection (nodes); 15 – prospective area of two, three or more factors' agreement

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**Figure 56** visualizes the following priority areas: the western part of AOI located in the immediate vicinity of the contact zone of the eastern and western subsystems (1); northwestern part - the paleo-delta region within which two circular-shaped structures come into contact and the intersection of several linear structures occurs (2); northern part - the contact zone of four groups of flow structures (3); central part - zone of extended faults and depressions (4).

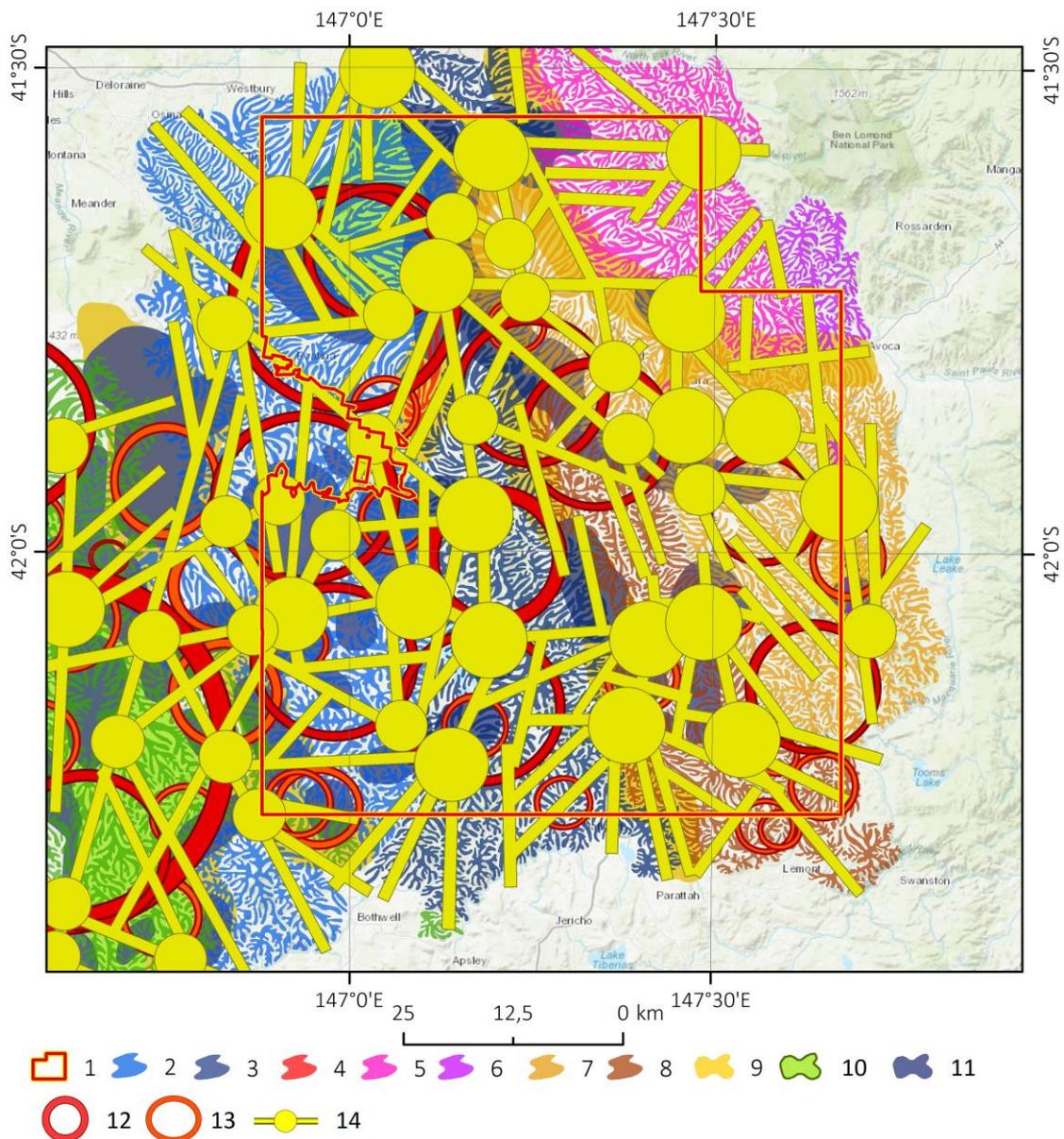


**Figure 56: Visualization of priority areas. Scale 1: 100,000.**

1 - EL30/2011; 2 and 3 - group of flow structures of the Eastern lithodynamic subsystem present on the western part of AOI EL30 / 2011; 4 - residual flow structure; 5-8 - group of flow structures of the Eastern lithodynamic subsystem on the eastern part AOI EL30 / 2011; 9 - contact zone of groups of flow structures of the Western and Eastern lithodynamic subsystems inside the Eastern lithodynamic subsystem; 10 - paleo-delta; 11 - depression (area of accumulation of lithological and organic material); 12 - circular structures of the first order; 13 - circular structure of the second order; 14 - linear zone of stress of the second order and intersection (nodes); 15 - prospective area of two, three or more factors' agreement; 16 - priority areas

## Terra Tasmania Resources

Figure 57 shows a similar integration of PRA criteria using the regional level map and features.



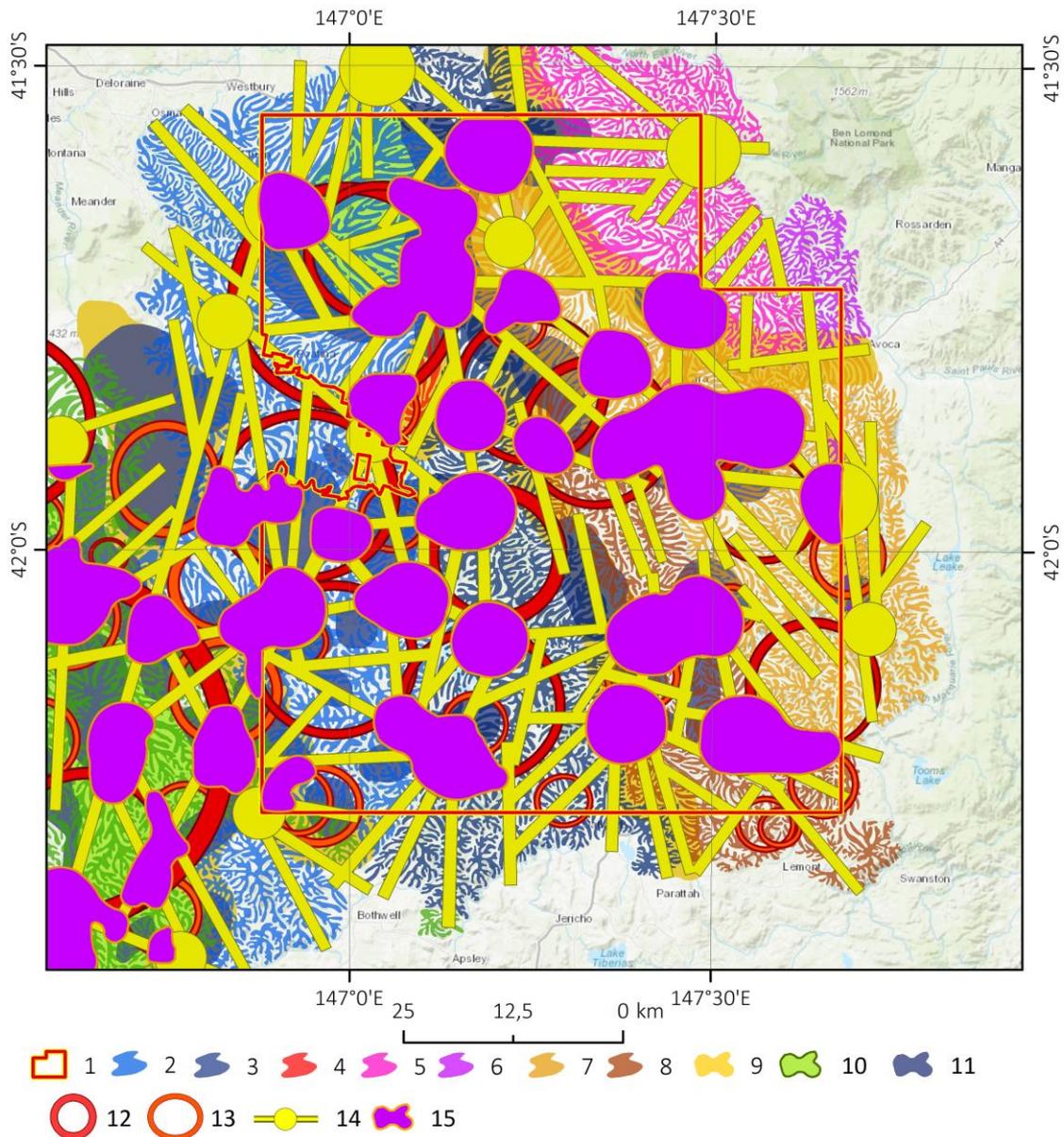
**Figure 57: Superposition of PRA prospectivity criteria within EL30/2011 at the regional level.**

**Scale 1: 100,000.**

1 - EL30/2011; 2 and 3 - group of flow structures of the Eastern lithodynamic subsystem present on the western part of EL30/2011; 4- residual flow structure; 5-8 - group of flow structures of the Eastern lithodynamic subsystem on the eastern part AOI EL30 / 2011; 9-contact zones of groups of flow structures of the Western and Eastern lithodynamic subsystems inside the Eastern lithodynamic subsystem; 10 – paleo-delta; 11 - depression (areas of accumulation of lithological and organic material); 12 - circular structure of the first order; 13 - circular structure of the second order; 14 - linear zones of stress of the first order and intersection (node)

## Terra Tasmania Resources

The areas with positive superposition of two, three or more criteria were delineated and shown in **Figure 58**.



**Figure 58: HC potential of EL30/2011 using the circular and linear anomalies at a regional level.**

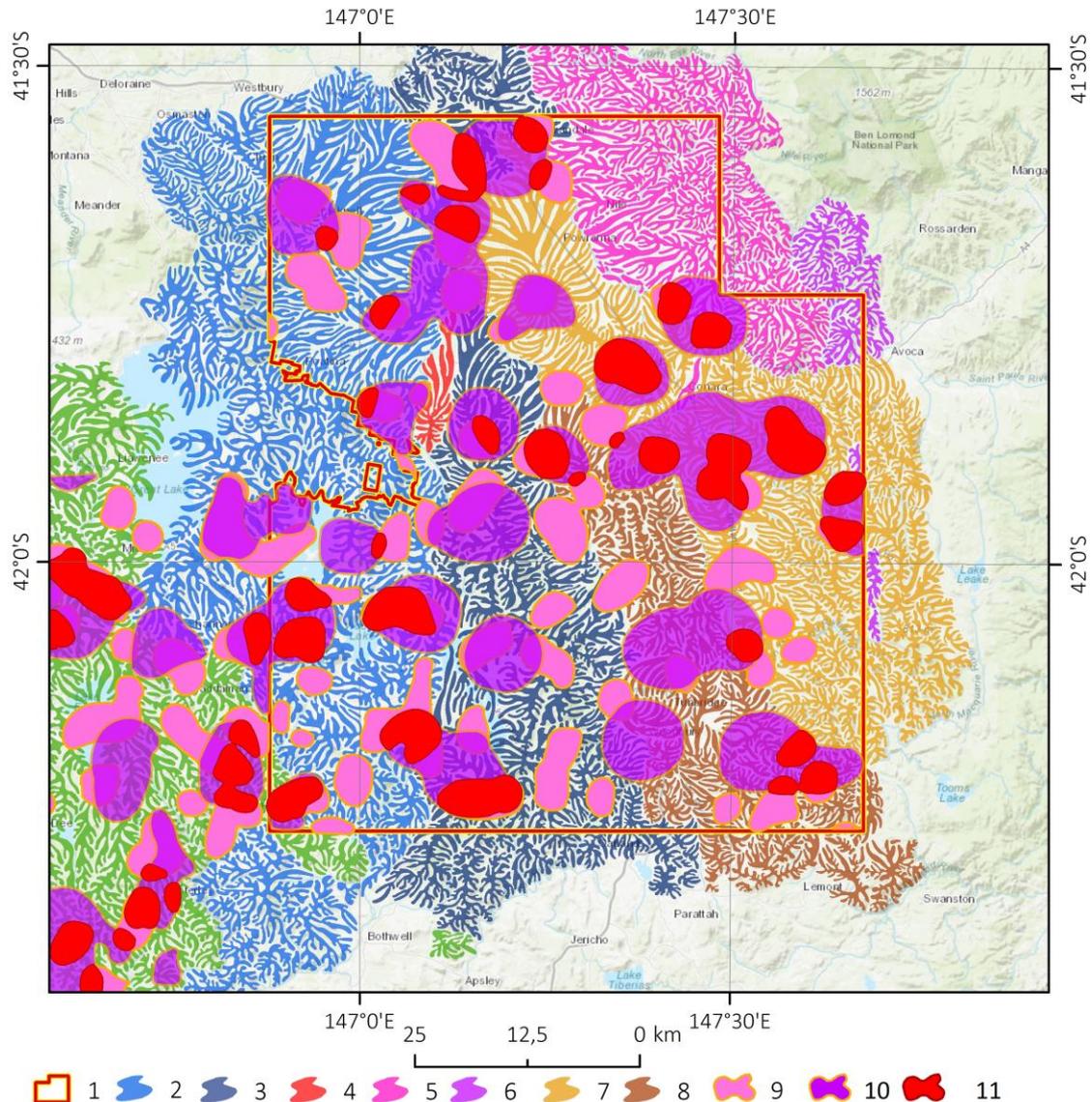
**Scale 1: 100,000.**

1 - EL30/2011; 2 and 3 - group of flow structures of the Eastern lithodynamic subsystem present on the western part of EL30/2011; 4 - residual flow structure; 5-8 - group of flow structures of the Eastern lithodynamic subsystem on the eastern part AOI EL30 / 2011; 9 - contact zones of groups of flow structures of the Western and Eastern lithodynamic subsystems inside the Eastern lithodynamic subsystem; 10 - paleo-delta; 11 - depression (areas of accumulation of lithological and organic material); 12 - circular structure of the first order; 13 - circular structure of the second order; 14 - linear zones of stress of the first order and intersection (node); 15 - area of prospectivity based on combining two, three or more factors

# Terra Tasmania Resources

## COMBINING THE POSITIONS OF PROSPECTIVE ZONES

The resulting prospective zones were delineated based on the results in **Figure 55** and **Figure 58**, as shown **Figure 59**.

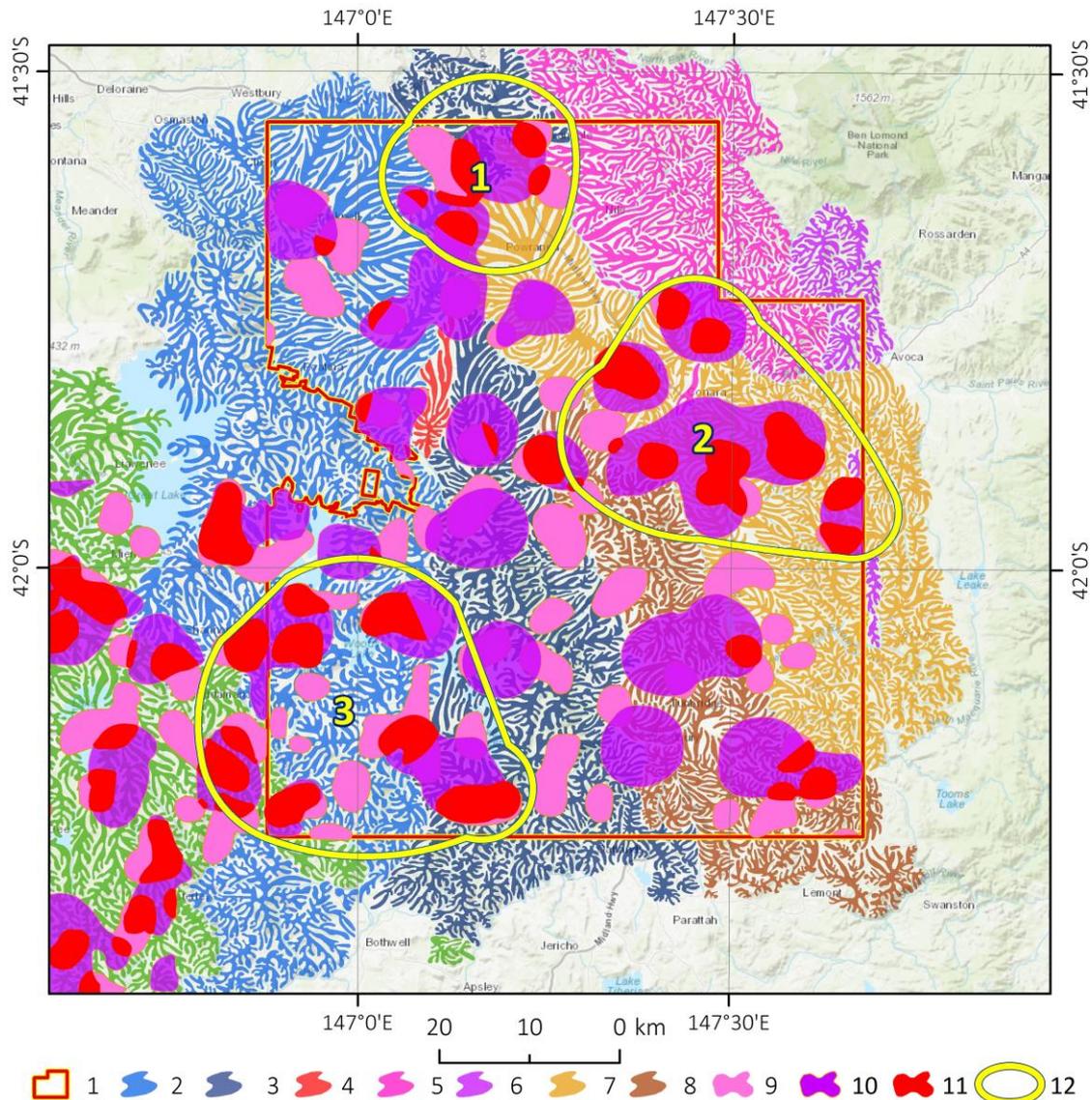


**Figure 59: Combined result of HC prospectivity zones in EL30/2011. Scale 1: 100,000.**

1 - AOI; 2 and 3 - groups of flow structures of the Eastern lithodynamic subsystem present on the western part of EL30/2011; 4 - residual flow structure; 5-8 - group of flow structures of the Eastern lithodynamic subsystem on the eastern part of EL30/2011; 9 - area of overlap of two, three or more PRA factors based on circular and linear anomalies on local level; 10 - areas of overlap of two, three or more factors based on circular and linear anomalies of the regional level; 11 – final resulting prospectivity areas

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Figure 60 shown that the greatest correlation between the prospective areas is observed in the north (1), east (2), and south-west (3) of AOI. This correlation is poor in the center and in the southeast, which may be due to the lack or unstable conditions for the formation of hydrocarbon deposits.

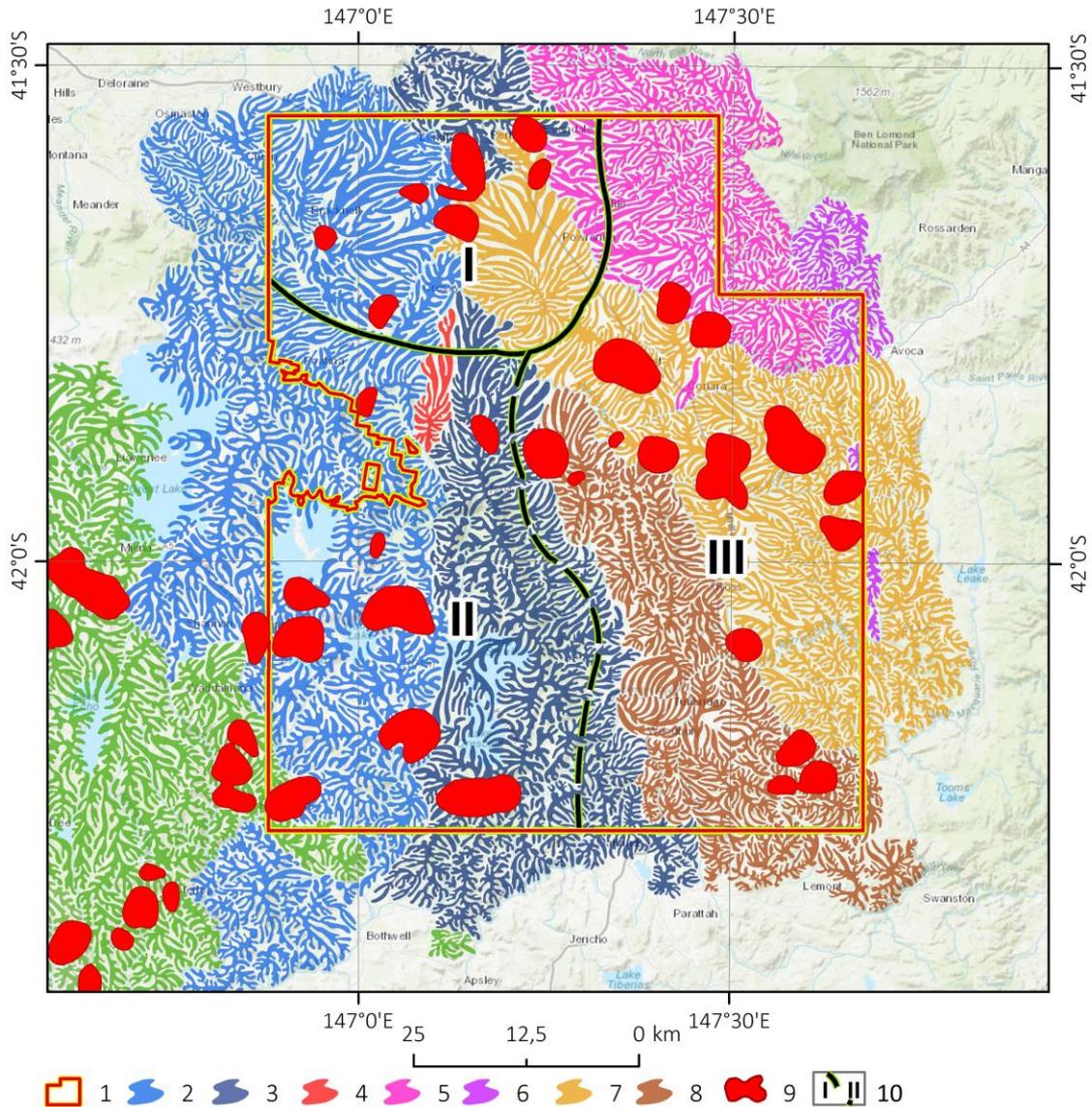


**Figure 60: Visualization of result of HC prospectivity zones in EL30/2011. Scale 1: 100,000.**

1 - AOI; 2 and 3 - groups of flow structures of the Eastern lithodynamic subsystem present on the western part of EL30/2011; 4 - residual flow structure; 5-8 - group of flow structures of the Eastern lithodynamic subsystem on the eastern part of EL30/2011; 9 - area of overlap of two, three or more PRA factors based on circular and linear anomalies on local level; 10 - areas of overlap of two, three or more factors based on circular and linear anomalies of the regional level; 11 – final resulting prospectivity areas; 12 – areas of best correlation between prospective areas

All the HC-prospective areas areas can be divided into three larger zones as shown in Figure 61.

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**Figure 61: Final map of HC prospectivity areas within EL30/2011. Scale 1: 100,000.**

1 - EL30/2011; 2 and 3 - group of flow structures of the Eastern lithodynamic subsystem present on the western part of EL30/2011; 4 - residual flow structure; 5-8 - group of flow structures of the Eastern lithodynamic subsystem on the eastern part of EL30/2011; 9 - final resulting PRA prospectivity areas; 10 – prospective zones' identification

**Prospectivity Zone I** is characterized by a large circular structure, a paleo-delta, and a contact area of five groups of flow structures. This zone is priority one from PRA standpoint.

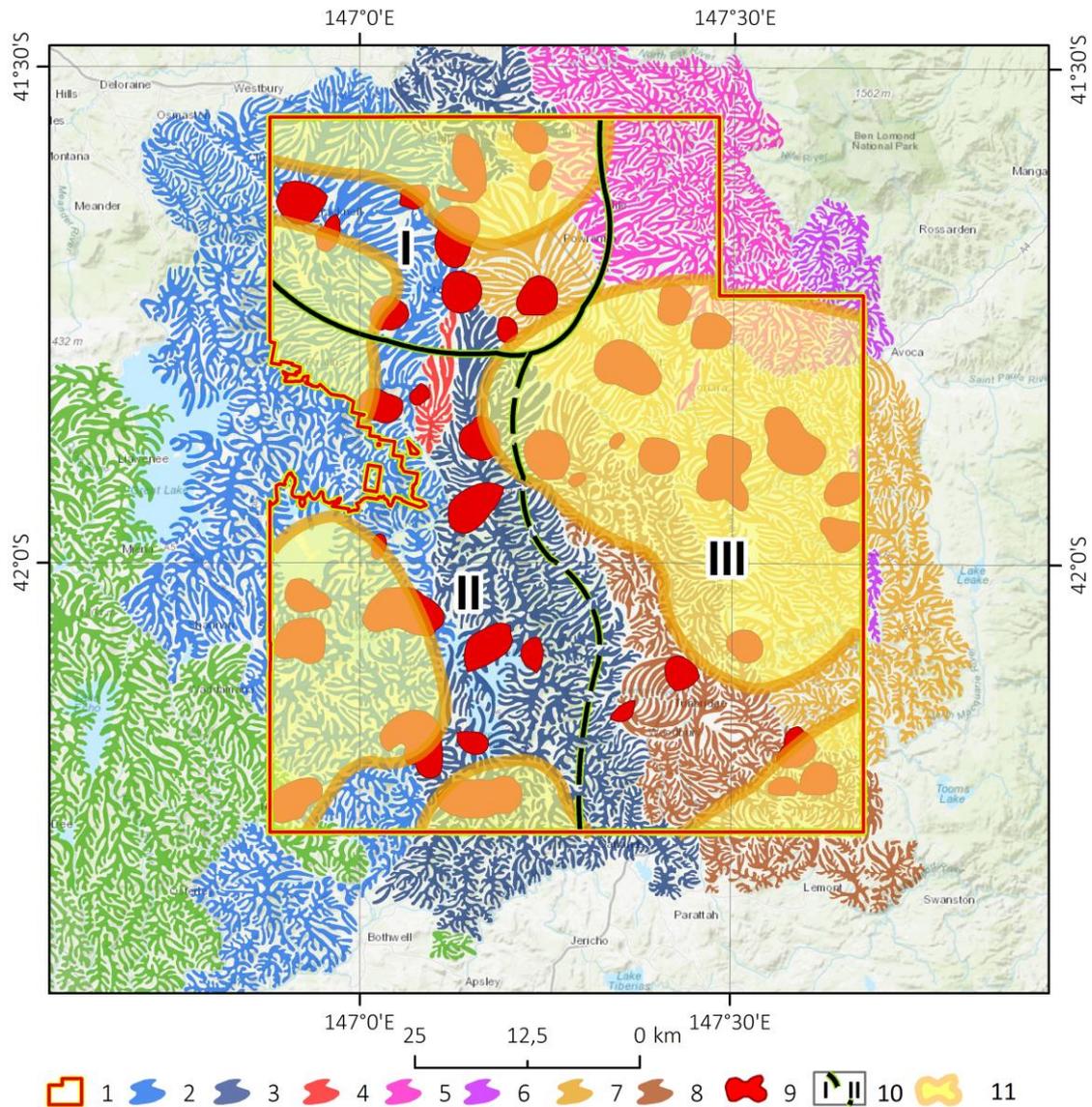
**Prospectivity Zone II** is characterized by high-density of circular structures; close proximity to the contact zone with the Western lithodynamic subsystem is of note. This zone is priority 2 from the PRA perspective.

**Prospectivity Zone III** is located at a distance from the contact zone with the Western lithodynamic subsystem. It does not have any paleo-deltaic structures. This is a priority III zone.

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### INTEGRATION OF PROSPECTIVITY ZONES DERIVED AT THE SCALES OF 1:100,000 AND 1:500,000

The positions of the prospective zones derived at two scales (1: 100,000 and 500,000) have been superimposed in order to achieve a higher result reliability/stability as shown in **Figure 62**.



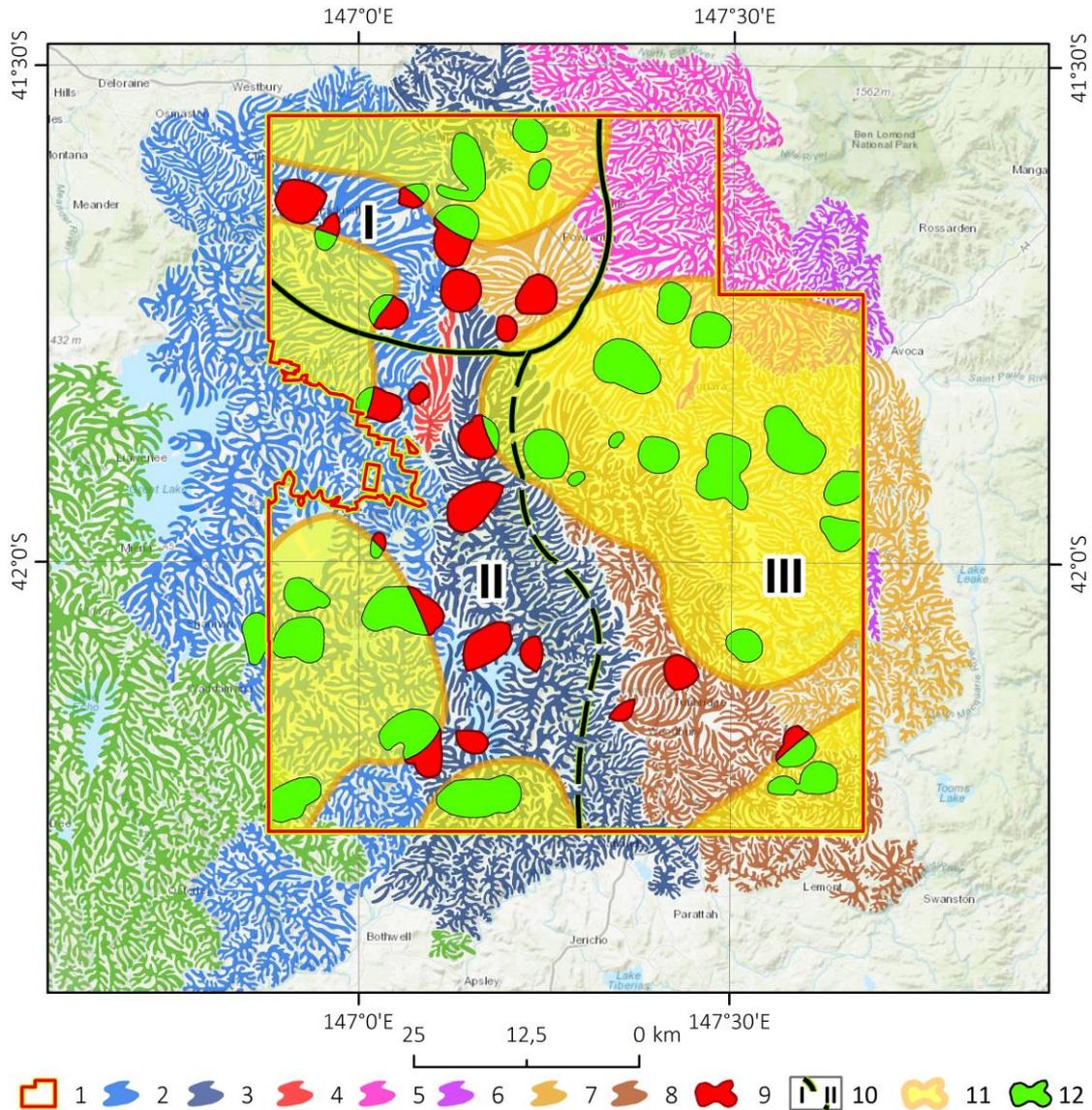
**Figure 62: Combining PRA perspective areas derived at the scales of 1: 100,000 and 1:500,000 over EL30/2011.**

1 - EL30/2011; 2 and 3 - group of flow structures of the Eastern lithodynamic subsystem present on the western part of EL30/2011; 4 - residual flow structure; 5-8 - group of flow structures of the Eastern lithodynamic subsystem on the eastern part of EL30/2011; 9 - prospective area (M 1:100,000); 10 – selected prospective zone; 11 - prospective area (M 1:500,000)

The combination of prospective areas delineated using two scales (**Figure 62**) showed the coincidence of approximately 50-60%.

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At the same time, HC-prospective areas produced at different scales across AOI have the following aspects in common: high concentration of such areas in the north of EL30/2011; separate islets of prospects in the south-west and southeast. The areas of overlap of the two PRA analyses are shown in green in **Figure 63**.

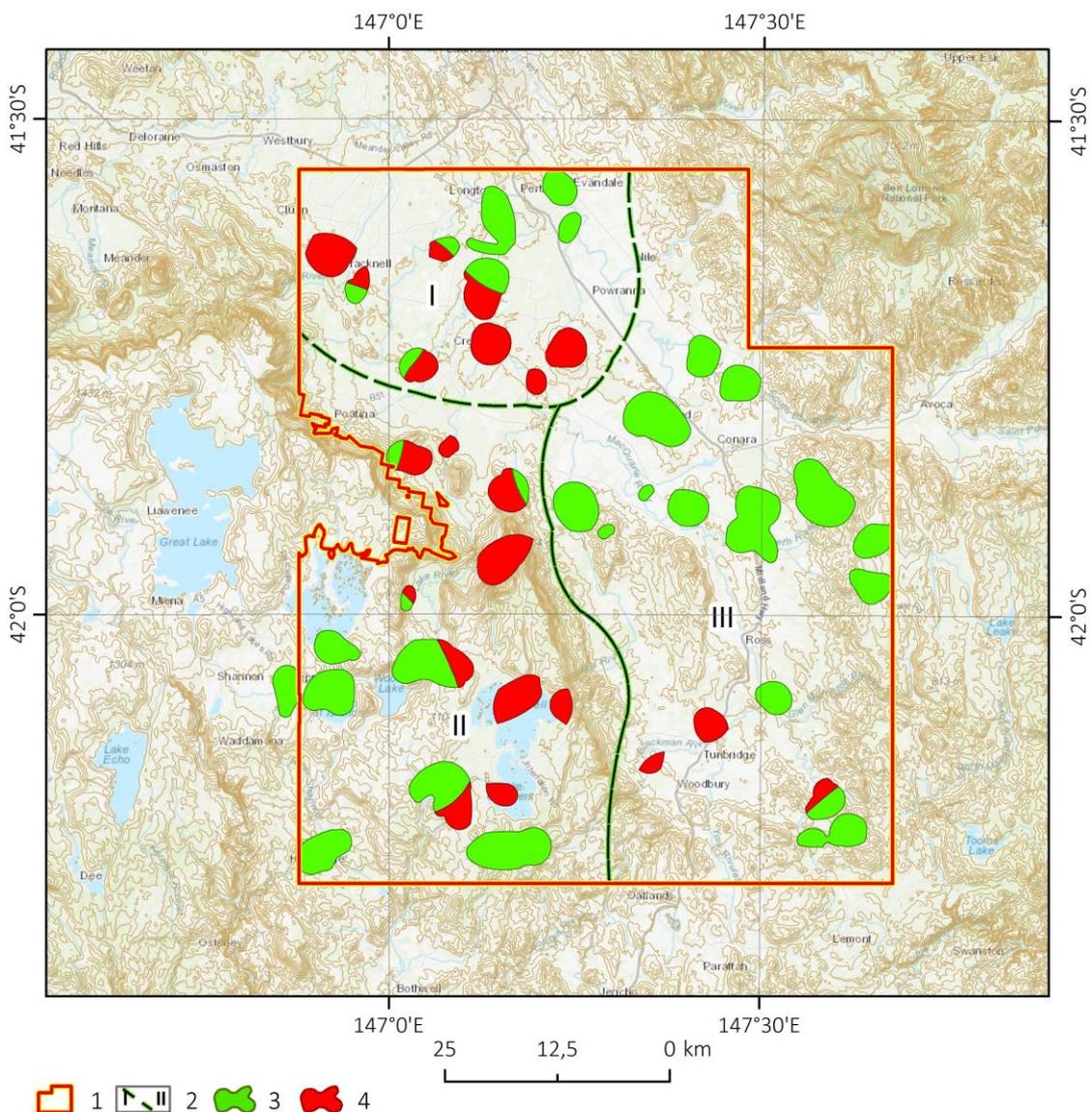


**Figure 63: Resulting prognosis as the combination of prospective areas produced at scales 1: 100,000 and 1:500,000 for EL30/2011.**

1 - EL30/2011; 2 and 3 - groups of flow structures of the Eastern lithodynamic subsystem present on the western part of EL30/2011; 4 - residual flow structure; 5-8 - group of flow structures of the Eastern lithodynamic subsystem on the eastern part of EL30/2011; 9 - prospective area (Scale 1:100,000); 10 - target zones; 11 - prospective area (Scale 1:500,000); 12 - area of overlapping of prospective sites at scales 1: 100,000 and 1:500,000

## CONCLUSIONS

1. The AOI is HC-prospective as per the PRA criteria.
2. The most HC-prospective part of EL30/2011 (Zone I) is located in the northwest of AOI - **Figure 61**, and its prospectivity is derived from the coincidence of several PRA criteria identified within its contour, including a paleo-deltaic structure.
3. Zones II and III are less prospective.
4. PRA results obtained at two scales 1: 100,000 and 1:500,000 were superimposed and revealed a reasonable stability of result, which is presented in **Figure 63**, although PRA gives preference to the result obtained at 1:100,000. These areas achieved via the said superposition shown in **Figure 64**. The second priority areas should be considered as those obtained using the scale of 1: 100,000.



**Figure 64: Prospective areas of the first and second priority. Scale 1:100,000.**

1 - EL30/2011; 2 - prospective zone; 3 - priority 1 area; 4 - priority 2 area.

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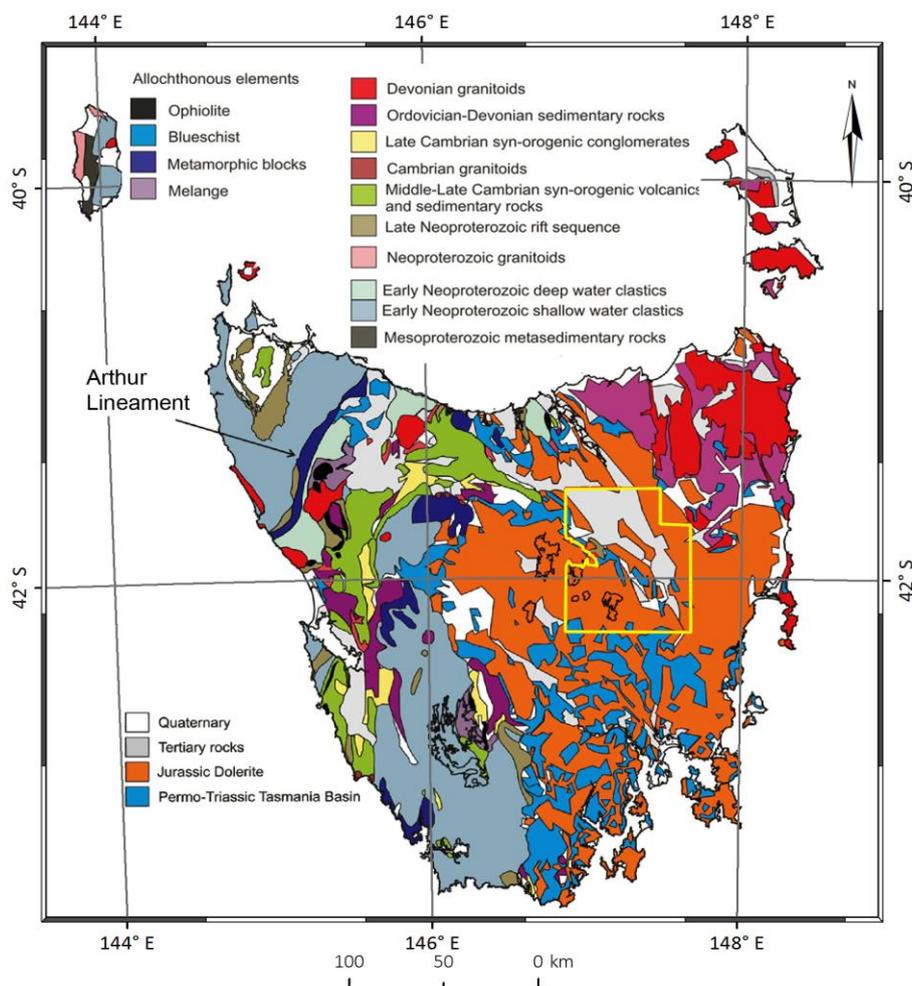
### 2.3 STRUCTURE-METRIC ANALYSIS (SMA)

#### 2.3.1 BRIEF GEOLOGICAL ESSAY<sup>5</sup>.

This essay was published in 2004. SMA used this and other geological reports and evaluated them using its criteria and understanding. The purpose of its inclusion in this SMA section is not only to present the geological setting, but also, where appropriate, to make comments from the structuremetric perspective.

##### 2.3.1.1 EARLY NEOPROTEROZOIC STAGE

The early Neoproterozoic stratigraphy of northwest Tasmania (**Figure 65**) is dominated by shallow water siliciclastics (Rocky Cape Group in the north west, Clark Group in the south) and turbidites (Burnie and Oonah Formations, Badger Head Block in the north). The age of these units of the uncomfortably overlying succession is 750 Ma. The Burnie Formation contains dolerite sills (Cooee Dolerite) that have a  $725 \pm 35$  Ma minimum age.

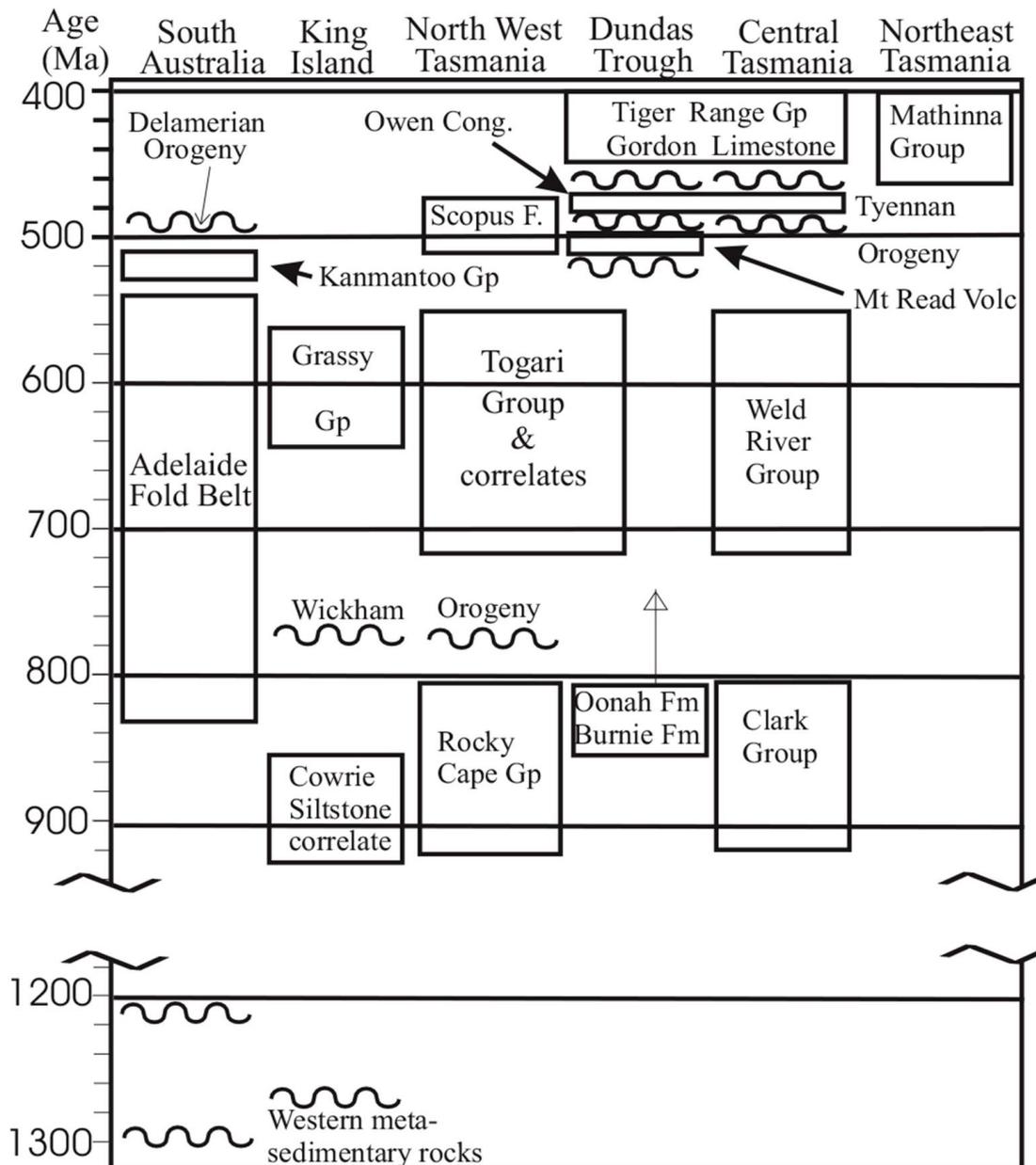


**Figure 65: Geologic map of Tasmania.**

<sup>5</sup> A.R. Stacey and R.F. Berry – “The structural history of Tasmania: a review for petroleum explorers”, 2004

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This sequence is probably older than the Wickham Orogeny ([Figure 66](#)).



**Figure 66: Space-time diagram for the Western Tasmanian Terrane up to the Middle Devonian.**

The internal stratigraphy of the early Neoproterozoic siliciclastic sequences varies dramatically. In the NW there are three basic facies varying from deep shelf though storm dominated shelf to massive quartzites deposited above fair weather wave base. The Clark Group includes similar shallow marine orthoquartzite units but has more carbonate units. The deep-water facies (Burnie and Oonah Formation) shallow up from classical turbidites to storm-affected siliciclastics and carbonates.

The stratigraphic relationship between these units remains contentious. A possible scenario is when the deep-water facies stand out in the northeast, which coincides with the SMA



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data. Very little work has been done on the petroleum potential of these sequences. The shallow-water units are low in carbon. Mudstones in the turbidite units are more graphitic. All the sections have low porosity. The rocks are generally referred to as low greenschist facies. No evidence of petroleum migration has been reported. Crystalline basement is proposed to be of Middle-Proterozoic age or older (1,600 Ma).

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### 2.3.1.2 SECOND FOLDING PHASE IN LATE NEOPROTEROZOIC

The second folding phase followed in late Neoproterozoic, starting as early as 740 Ma. The most intense phase of folding (Wickham Orogeny) happened on King Island with the polyphase deformation and extensive granitoid intrusion at about 760 Ma. According to the common view, the King Island granitoids are related to rifting and the breakup of Rodinia, although the SMA does not share this viewpoint Rodinia existed as a single super-continent.

The Wickham Orogeny may correlate with the low angle unconformity observed on mainland Tasmania. The late Neoproterozoic rift sequence (e.g. Togari Group) has an initial siliciclastic shallow water section, followed by a lower dolomite and diamictite. Subsequent widespread intrusion of tholeiitic dolerite dykes (Rocky Cape dyke swarm), extrusion of tholeiitic basalts and associated volcanogenic sediments were followed by a second dolomite section and finally marine siliciclastics. The most complete example of this section is in NW Tasmania and elsewhere only parts of the section are known. The Neoproterozoic sequence in Tasmania has largely been considered as “unmetamorphosed”. These units are best regarded as very low-grade metamorphic rocks. The age of this metamorphism is problematic. No structural model developed so far explains the inferred depth of burial (approximately 10 km) of these rocks during either the Cambrian or the Devonian orogeny. Reported that the Neoproterozoic mudstones have very low organic C contents. No evidence of petroleum migration has been reported.

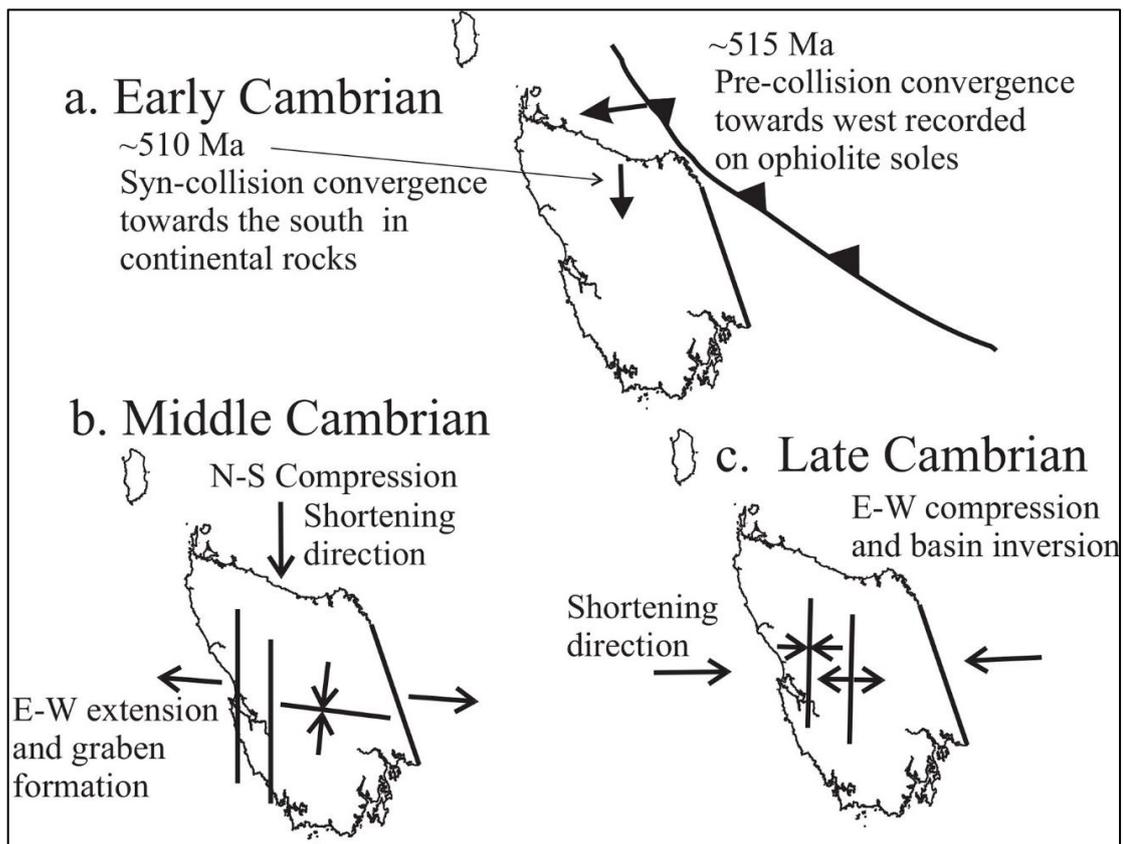
The Early Paleozoic, Cambrian-Devonian orogenic structural-formational complex Tyennan, which lies directly on the Neoproterozoic base, is the basement for the Carbon-Jurassic sedimentation stage of the Tasmanian basin. The Tyennan Orogeny in Tasmania was a complex event. At 520 Ma, Tasmania collided with an oceanic arc, and major slices of fore-arc lithologies were thrust over the Proterozoic sedimentary rocks. The only allochthonous element was the mafic/ultramafic complexes Forth, Badger Head, Port Davey, Franklin, Mersey River and the Arthur Metamorphic Complexes and the Wings Sandstone. These blocks are scattered across Tasmania lying structurally above the late Neoproterozoic rift facies and are unconformably overlain by late Middle Cambrian and younger sedimentary rocks. The Arthur Lineament ([Figure 65](#)) was formed during the Tyennan Orogeny, but its tectonic significance remains in doubt. This lineament forms the western limit to allochthonous blocks in Tasmania and appears to mark the maximum extent of the thrust complex. A major phase of thrusting to the south, recorded in the amphibolite facies metamorphic rocks and widespread cataclasites in western Tasmania is interpreted as the second stage of the obduction process.

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### 2.3.1.3 THE SECOND STAGE OF THE TYENNAN OROGENY

The second stage of the Tyennan Orogeny was the Middle Cambrian extensional event that produced rapid subsidence, active syn-orogenic deposition and major post-collisional felsic-dominated volcanism (Mt Read Volcanics, **Figure 66**). East–West extension is recorded in the hydrothermal vein geometry and the Henty dyke swarm. The extensional phase was closely followed, or may be coincident with, a N–S compressional event that produced E–W trending folds to the east of the Mt Read Volcanics (**Figure 67**).

In the Late Cambrian, earlier extensional phases inverted for compression, which led to the formation of meridional stretch zones in the central part of the basin and to the closure of the peripheral western fault system (**Figure 67**) with the formation of folds of the meridional strike.



**Figure 67: Pattern of Cambrian deformation, Tyennan Orogeny.**

This phase also caused uplift of the Tyennan block with syn-orogenic sediments (Owen Conglomerate) accumulating in synclinal cores and other structural depressions. Most of the folding in the Neoproterozoic stratigraphy in Tasmania is correlated with the Tyennan Orogeny. Two generations of early recumbent folding are recognized in allochthonous blocks and high strain underlying elements. These are overprinted by upright NS (e.g. NW Tasmania) or EW (e.g. Tyennan block) folding and related high angle reverse faults. The structure across northern Tasmania formed at the end of the Cambrian.

West of the Arthur Lineament upright folding and thrusting dominated the Proterozoic. The allochthonous units are scattered across the rest of Tasmanian and overly a variably thrust-



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influenced Neoproterozoic section. Two middle Cambrian grabens are visible on this section. They are strongly influenced by volcanism and intruded by high level Cambrian granitoids. The basins were inverted in the Late Cambrian and syn-orogenic conglomerates accumulated in structural depressions.

Following the Late Cambrian basin inversion western Tasmania was peneplained, and a new cycle of deposition began in the Middle Ordovician. This cycle has a thin basal sheet sand followed by widespread intertidal to shallow marine tropical carbonate (Gordon Group) that is overlain by a Silurian to Early Devonian shallow marine siliciclastic sequence (Tiger Range Group). At the same time, the Mathinna Group was deposited in NE Tasmania. The earliest unit, Stoney Head Sandstone, is a proximal turbidite and is overlain by Middle Ordovician deep-water mudstone unit.

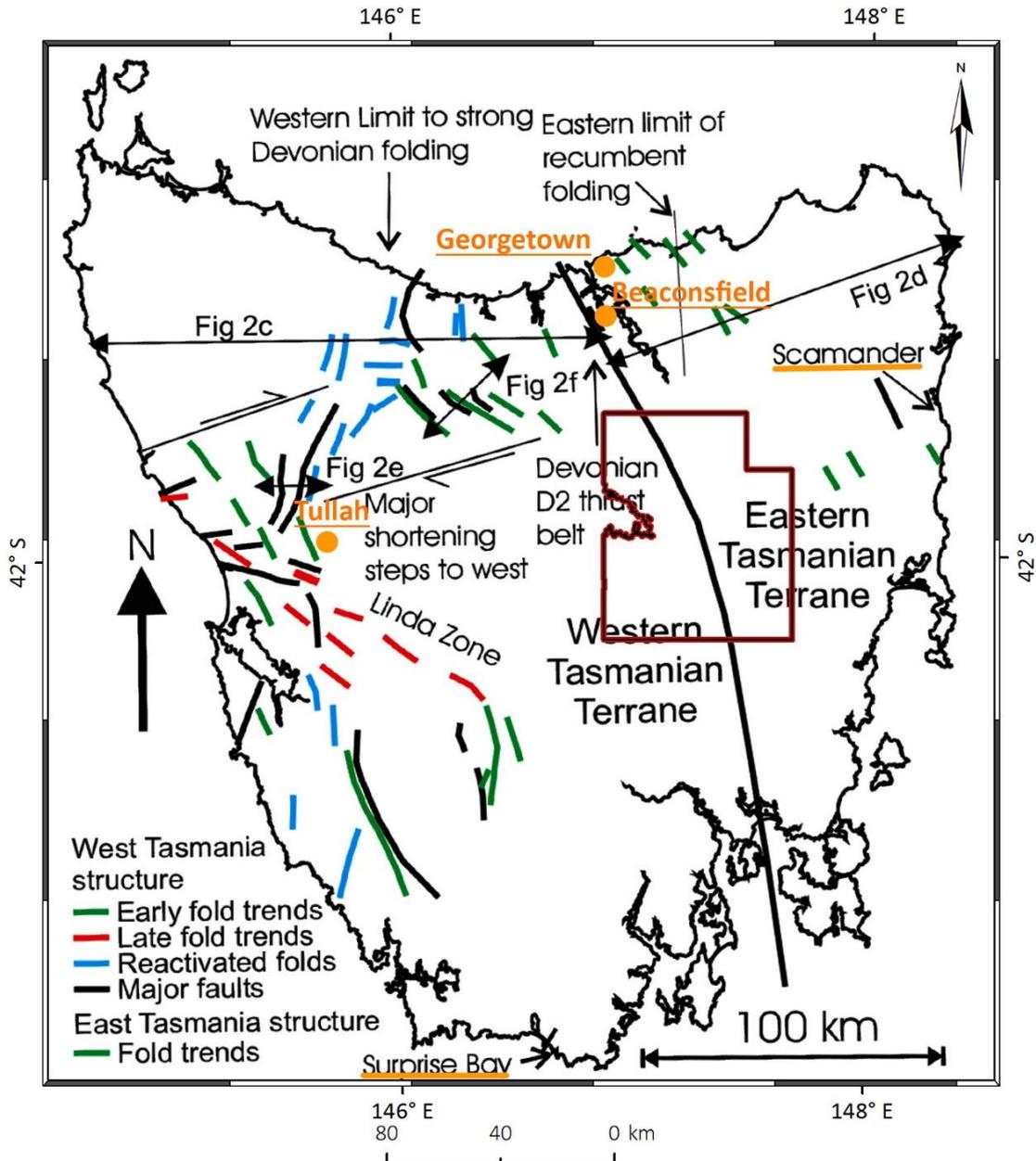
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### 2.3.1.4 THE SILURIAN AND EARLY DEVONIAN STAGE

The deposits of Silurian and Early Devonian are represented by strongly modified polyfacial turbidite rocks with volcanic layers. Middle Devonian deformation (390 Ma) occurred throughout Tasmania and characterized by the complexity of fold orientations, explained, in large part, by reactivation of older structures. In many areas, the fold geometry is controlled by the Cambrian fold trends, which were tightened during the Devonian. This led to Devonian cleavage orientations that are not parallel to the axial plane of the folds with which they are associated. In the west, N-trending Cambrian folds are tightened with an associated NNW-striking Devonian cleavage (**Figure 68**). NNE-trending folds, north of Tullah, are controlled by the reactivation of the Henty Fault. NNE fold trend is probably a rotated N trending Cambrian trend cross-section of the Dundas Trough shows the strong fault control on deformation and the influence of granitoids. The subsequent N- to NNE-trending compression produced WNW-trending folds and thrusts in the south, and NW-striking thrusts and associated folds in the north. In NE Tasmania, the early phase of deformation thrust the passive margin east across the deep-water section with recumbent folds in the Georgetown area, and this was followed by back thrusting, especially strong in the Beaconsfield zone. Late stage of N trending compression produced strike slip movement on some faults. The regional metamorphic grade associated with the Devonian orogeny is prehnite-pumpellyite with local zones of greenschist facies in the vicinity of late syn-to post-orogenic granites.

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Areas of low-grade metamorphism occur in the Western Terrane at Surprise Bay (Figure 68) and in the Mathinna Group on the far east coast at Scamander.



**Figure 68: Devonian structural trends in Tasmania.**

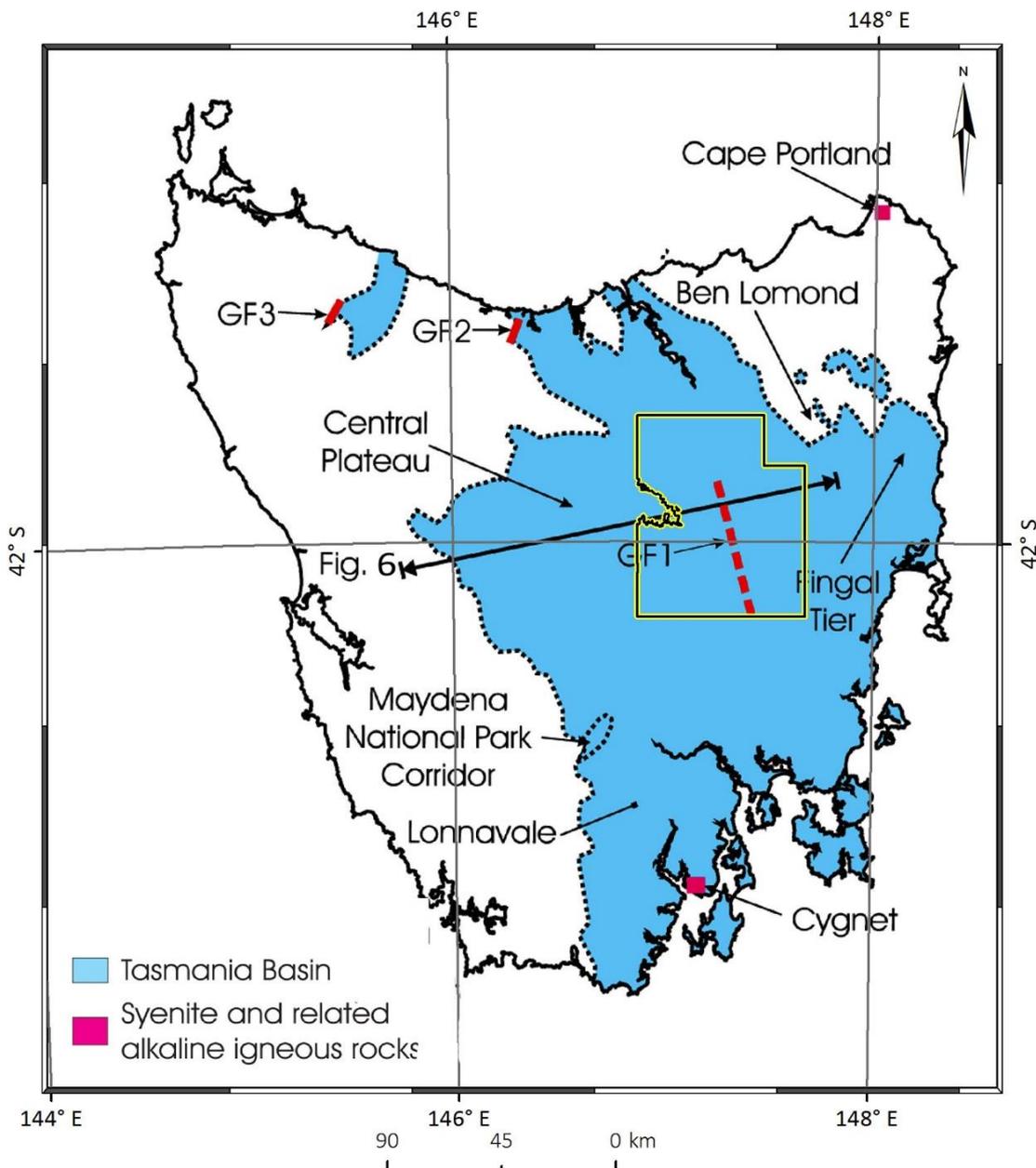
Large-scale granitoid intrusion in NE Tasmania started before the Devonian deformation and continued after (400–380 Ma). The more restricted granite intrusions scattered throughout western Tasmania and King Island, post-date peak deformation (375–350Ma).

### 2.3.1.5 CARBON-JURASSIC STAGE OF DEVELOPMENT OF THE TASMANIAN BASIN

Following the Devonian deformation there was large-scale erosion. Deposition restarted in the late Carboniferous with 1.5 km of generally flat lying sedimentary rocks of Late Carboniferous to Late Triassic age deposited in the Tasmania Basin. The basin is unconformable on Late Devonian Granites and older folded rocks, and is subdivided into two

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broad lithological and environmental associations, the Lower and Upper Parmeener Supergroups. The Lower Parmeener Supergroup consists of glacial and glaciomarine sedimentary rocks, while the Upper Parmeener Supergroup comprises non-marine sedimentary rocks. Both units contain subordinate coal measures. The basin, covering an area greater than 30,000 km<sup>2</sup> (**Figure 69**), is best preserved in northern and southeastern Tasmania.

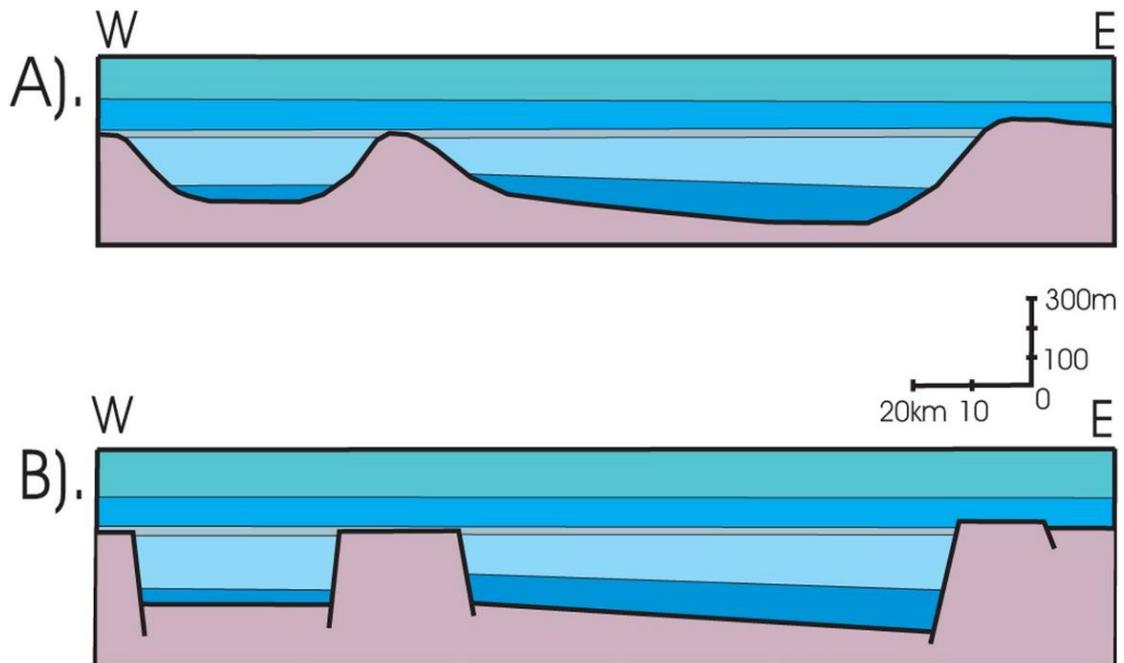


**Figure 69: Current extent of the Tasmania Basin, locations of alkaline igneous intrusions and growth faults associated with early basin structure.**

However, the present basin limits are erosional, rather than depositional, and the basin was once considerably larger. The accumulation of 1.5 km of sediment in 100 million years is an order of magnitude slower than classic foreland basins. While a Mesozoic foreland basin developed to the east, the effect of continental margin loading was not significant this far inboard. There is evidence for minor normal faulting early in the basin history, but the

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limited nature of such faulting and the relatively slow sedimentary accumulation rate is not typical of rift basins. The early development of a marine basin and its subsequent infilling may relate to a eustatic sea-level rise rather than any tectonic events. The history of sedimentary accumulation is more typical of a continental margin ("pericratonic") basin. The variable development of lower glaciogene beds, especially evident in the lowermost units (Wynyard Tillite and the Woody Island Siltstone), has generally been interpreted as the infilling of glacial valleys (Figure 70a).



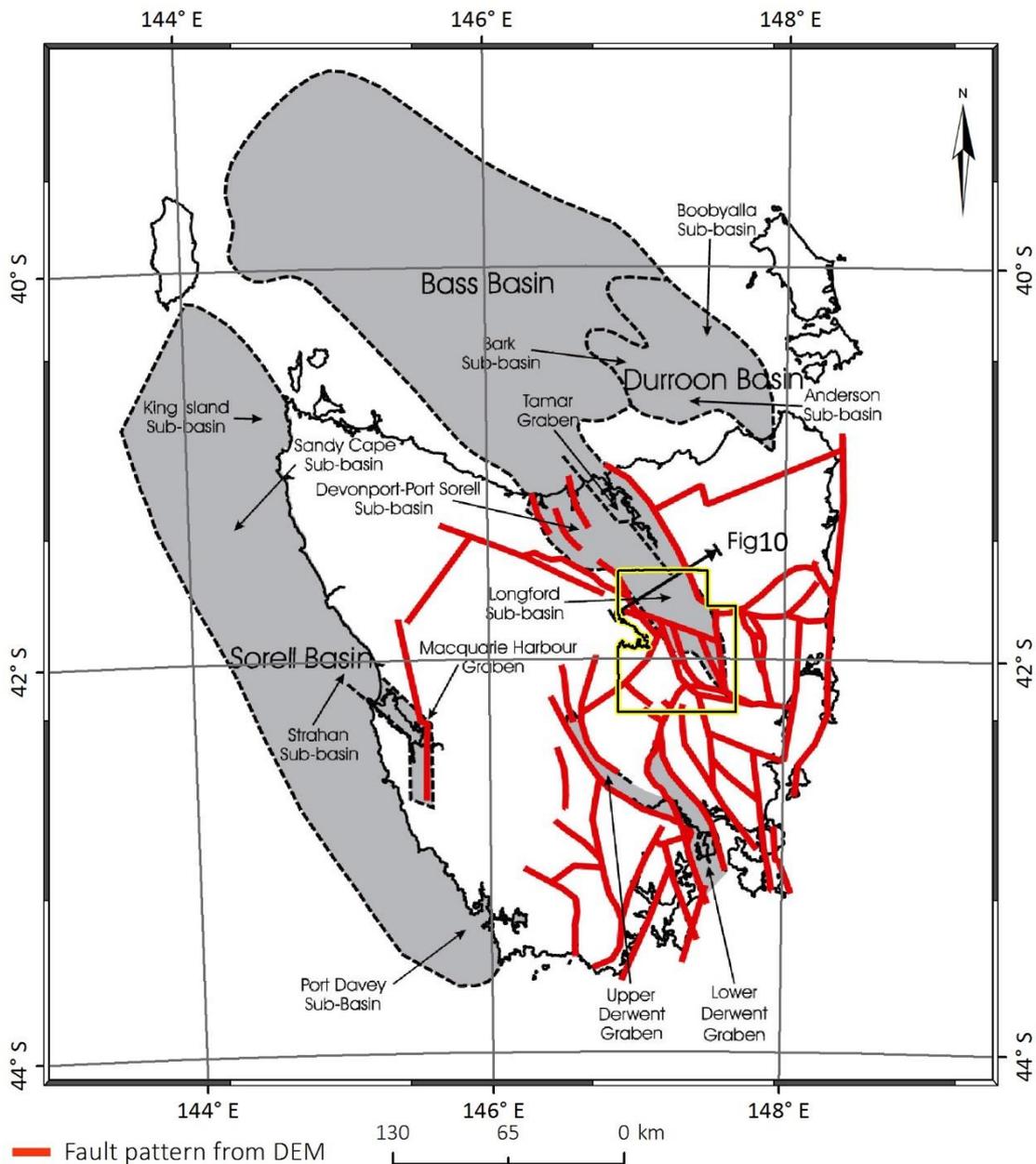
**Figure 70: Two models for the initial development of the Tasmania Basin: A). Infilling of glacial valleys, B). Growth on a west-dipping fault (location of section shown on Figure 69).**

The Wynyard Tillite and Woody Island Siltstone occupy an elongate depocenter through central and southern Tasmania, which rapidly thins to the east (Figure 69, GF1).

Figure 70 (A, B) shows a variant of the interpretation of the available data. Further evidence for structural control on the basin's evolution can be seen in north and northwestern Tasmania.

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The Devonport sub-basin ([Figure 71](#)) is now bounded in the east by an east-dipping normal fault ([Figure 69](#), GF2), although this fault could be younger than the basin.



**Figure 71: Late Jurassic to Middle Tertiary basins and fault patterns interpreted from the high-resolution DEM**

In northwestern Tasmania approximately 300 m of growth in the Wynyard Tillite can be seen on an east-dipping fault adjacent to the Arthur Lineament ([Figure 65](#), [Figure 69](#) GF3), suggesting reactivation of the Arthur Lineament during the Late Carboniferous to Early Permian. No other growth faults have been observed in the Tasmania Basin across the Central Plateau and the Longford Sub-basin ([Figure 69](#), [Figure 71](#)). Faulting was minor during the deposition of the Tasmania Basin and limited to the earliest stages of basin development.



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Jurassic faults. There is evidence of faults in Tasmanian Basin rocks that were active before the mid-Jurassic intrusion of dolerite. By far the best example is the strong transgressional zone along the Maydena-National Park corridor (**Figure 69**). This zone has the appearance of a dextral positive flower structure and is truncated at the eastern end by a major dolerite dyke.

While there is evidence of rifting during the Jurassic phase in the Hobart area, it is not strong, and no evidence of mid-Jurassic rifting was found in other areas with a lower amount geological work. The nature of late Triassic to mid-Jurassic deformation remains contentious, thus this important matter remains open.

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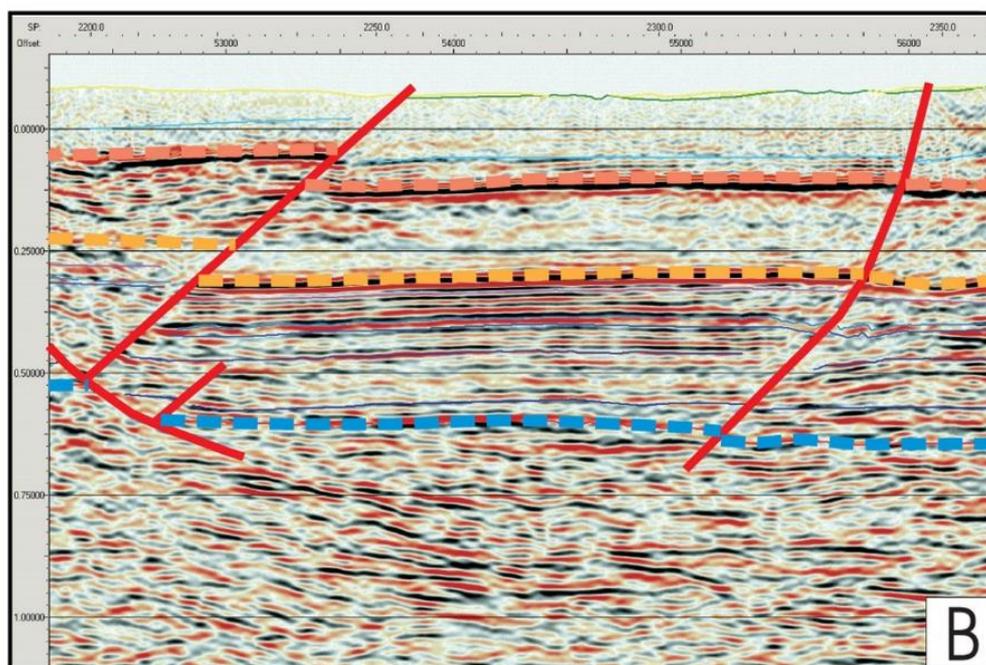
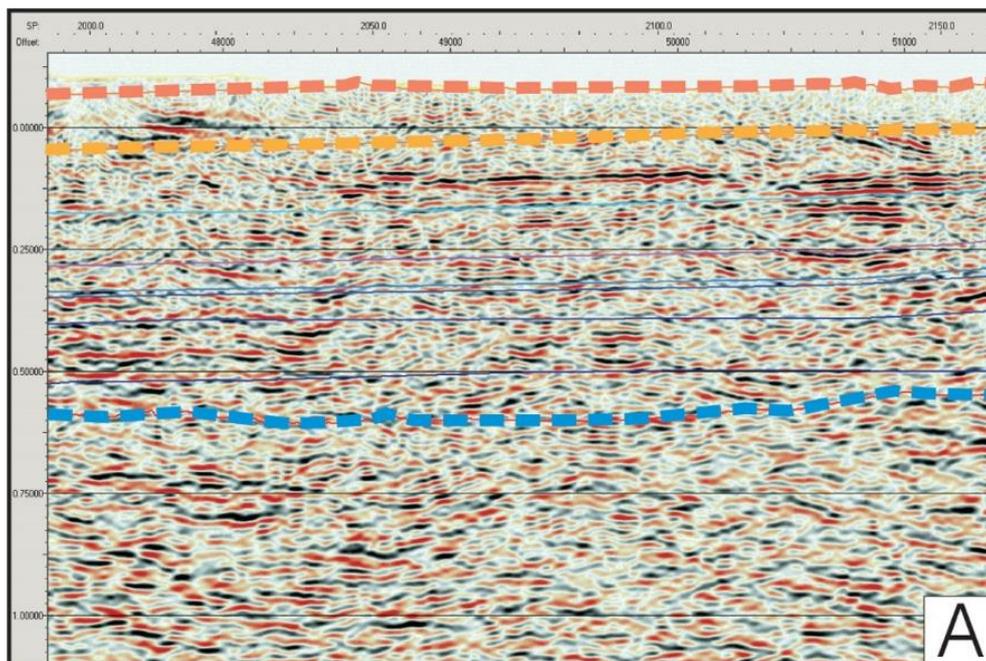
### 2.3.1.6 JURASSIC DOLERITE

By the early Jurassic the Parmeener Supergroup formed a shallow syncline, plunging towards the SSE, with possibly some gentle folding in an otherwise sub-horizontal succession. Large volumes of tholeiitic dolerite intruded into the Tasmanian crust during the Middle Jurassic are probably related to a major thermal anomaly occurring along the eastern margin of Gondwana. The dolerite formed mainly as sills in the Tasmania Basin. The dolerite is exposed over an area of 30,000 km<sup>2</sup> and has an estimated volume of 15,000 km<sup>3</sup>.

The dolerite has been a major deterrent to petroleum exploration in Tasmania, with nearly every part of the basin being intruded by at least one dolerite sill. Recently acquired seismic data across the Central Plateau and the Longford Sub-basin, demonstrates the variations in data quality associated with acquiring seismic through the dolerite.

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When at, or near, the surface, dolerite is generally highly diffusive resulting in poor resolution of underlying events (**Figure 72a**). Seismic events beneath the dolerite at depth are in general, better resolved (**Figure 72b**).



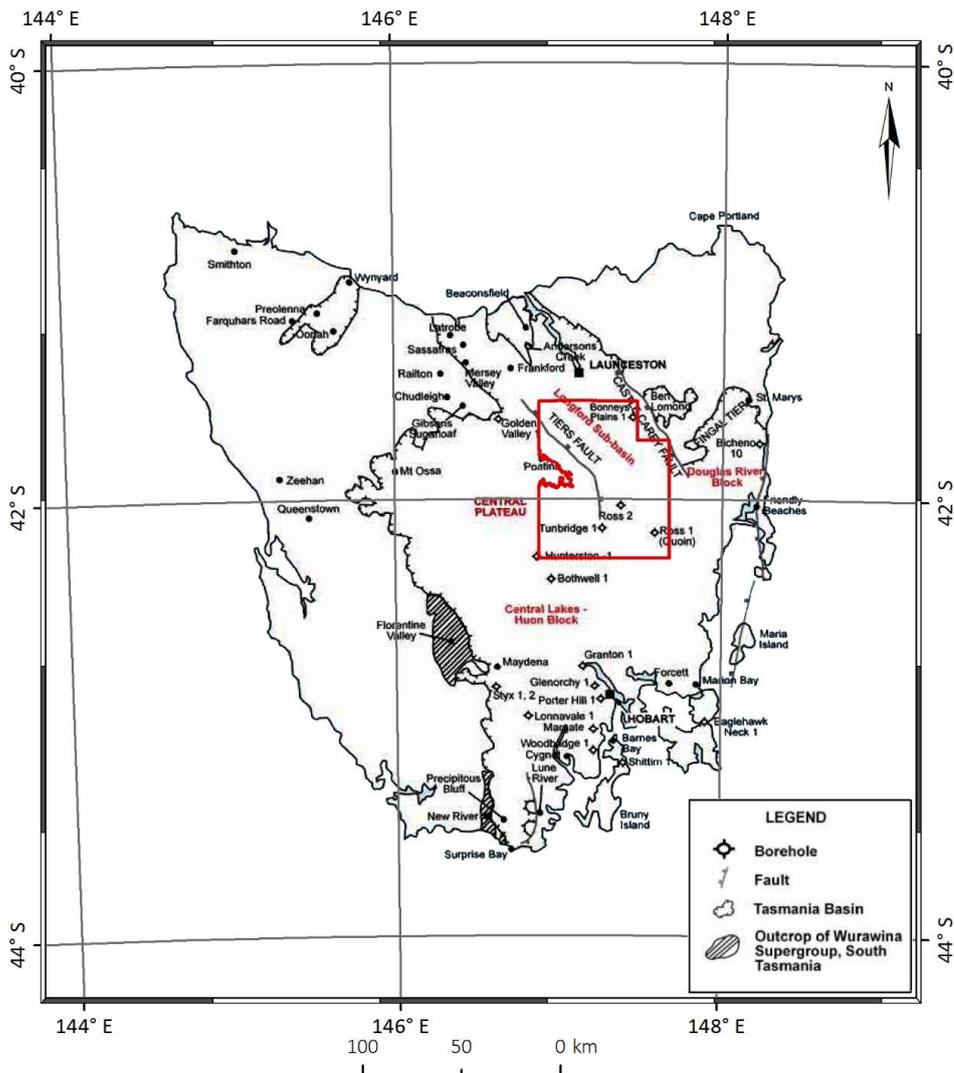
- — — — Top Dolerite
- — — — Base Dolerite
- — — — Base Parmeener Unconformity

**Figure 72: The effect of Jurassic Dolerite on seismic resolution: A) at/near surface (SP 2,000–2,150) and, B) at depth (SP 2,200–2,350).**

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Most dolerite intrusions have the form of a flattened cone connected to a source or sources at the deepest point, the limbs are concordant (sills) or approximately concordant with abrupt transgressions when rising to higher levels. The metamorphic effects resulting from dolerite intrusion are usually confined to within a few meters of the intrusion margin, the effect being more severe at the top of the intrusions. In the Hobart area, two or three sills are commonly present. The sills are usually either less than 1 m, or 300 m to 400 m thick. The thick sills in middle or lower Permian rocks are typically 30 km<sup>2</sup> in area, while sills in Triassic rocks are more extensive. In contrast, only a single sill, intruding the Upper Parmeener Supergroup, has been recognized in the northern part of the basin (Central Plateau, Ben Lomond and the Fingal Tier, [Figure 69](#)).

A single, 650 m thick, sill was intersected near the Upper–Lower Parmeener Supergroup boundary in the Hunterston-1 DDH ([Figure 73](#)).



**Figure 73: Tasmanian basin major structural elements<sup>6</sup>.**

<sup>6</sup> RPS ENERGY - Competent Persons Report Assets of Great South Land Minerals Limited, Tasmania, 2008



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From the interpreted seismic this sill appears to cover many hundreds of square kilometers.

Late Jurassic to Cretaceous events. Extension related to the rifting between Australia and Antarctica initiated the Bass, Durroon and Sorell Basins in the latest Jurassic to Early Cretaceous (**Figure 74**). The direction of extension in Bass Strait is contentious, with seismic data acquired north of Tasmania revealing extensional features with NW–SE, NE–SW and N–S orientations. The exploration results from these basins have been disappointing when compared to the neighboring Gippsland and Otway Basins. Only two wells (Yolla-1 and Pelican-5) have flowed hydrocarbons in the Bass Basin. While in the Sorell Basin four exploration wells have been drilled, with only Cape Sorell-1, in the Strahan Sub-basin, recording minor hydrocarbon shows. Extension in the Bass Basin resulted in the development of a series of NW–SE trending half-grabens with faults dipping to the SW, these faults are generally planar though listric and ramped faults have been found. The Durroon Basin comprises three sub-basins, the Bark, Anderson and Boobyalla sub-basins (**Figure 71**). The basin adjoins the southeast Bass Basin and its earliest development is related to the same extensional forces, but has a different structural history. Deposition of Otway Group correlates probably began in the Early Cretaceous in a broad linear depression with fault bounded margins. Sediments of the Sorell Basin cover the western continental margin of Tasmania. The basin contains four depocentres, from north to south the King Island, Sandy Cape, Strahan and Port Davey Sub-basins (**Figure 71**), each with over 4 km sediment thickness. These sub-basins were probably developed in the latest Jurassic to earliest Cretaceous. The sub-basins are bounded along their eastern edges by strike-slip faults, except for the King Island sub-basin that lies inboard of the major fault. They are separated by basement highs. Both the King Island and Sandy Cape Sub-basins were initiated in or before the Early Cretaceous, and contain Early Cretaceous Otway Group correlates. The King Island Sub-basin is a perched half-graben, apparently formed by extension, that deepens eastward to a high angle NW dipping normal fault. The Strahan Sub-basin is a NNW–SSE trending slot comprising two EW trending half-graben. There is little evidence to suggest that the Tasmania Basin or any onshore Tasmanian rocks have been affected by a Late Jurassic-Early Cretaceous rift phase.

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### 2.3.1.7 MIDDLE TO LATE CRETACEOUS EVENTS

By the mid-Cretaceous, rifting along the southern margin of Australia had given way to spreading. In the Bass Basin, the event is recorded as an angular unconformity at the top of the Otway Group, extension continued during this period with reduced movement on normal faults. While in the Sorell Basin (at least in the King Island and Sandy Cape Sub-basins) rifting was followed by low-energy sag fill or late rift deposition.

Extension coupled with lithospheric cooling in the Durroon Basin split the basin into northwest trending graben and half-graben separated by major listric faults. Graben development in the basin is asymmetrical with fault blocks tilted southwest. The Durroon Basin experienced increased geothermal gradients (up to 55°C/km) from 100 Ma to 90 Ma, followed by Cenomanian uplift and erosion. A 110 Ma to 90 Ma cooling event is recorded



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throughout eastern Tasmania. Onshore, intrusions of alkaline igneous rocks occur in the southeast (Cygnet-Oyster Cove area) and in the far northeast (Cape Portland) (Figure 69).

The Cygnet Syenites occur as a series of sheetlike bodies and sills a few tens of metres thick, and as numerous widely dispersed smaller sills, dykes and pipes. They mainly intrude the lowermost units of the Lower Parmeener Supergroup. At Cygnet, the Lower Parmeener Supergroup is domed above a 750 m thick laccolith lying close to the surface. The alkaline rocks near Cape Portland occur in a series of small flows, dykes and irregular plug-like intrusions. Tasmania experienced an elevated geothermal gradient in the Middle to Late Cretaceous. K-Ar ages indicate the age of emplacement of the Cygnet intrusion is  $100.5 \pm 3$  Ma, and the rocks at Cape Portland are dated at  $101.3\text{--}102.3 \pm 2.6$  Ma.

Organic matter taken from the Parmeener Supergroup in the Cygnet area has been totally carbonized by regional heating associated with the intrusions while the Gordon Group at Ida Bay has been remagnetised by a Late Cretaceous heating event that persisted for about 10 million years. This Cretaceous thermal event is widely recognized across the adjacent parts of Antarctica and New Zealand. By the Late Cretaceous active spreading in the Tasman Sea had begun. In the Bass Basin, relatively high rates of subsidence associated with extension continued. In the Durroon Basin there was significant growth on NE trending extensional faults in the early Late Cretaceous, resulting in thick (up to 2.5 km) wedges of Durroon Formation, unconformably overlain by a Campanian to Maastrichtian sag sequence.

In the latest Cretaceous, a series of extensional structures began to develop across NE Tasmania (Figure 74). The onshore extension of the Bass Basin, the Tamar Graben was the first of these structures, beginning to develop in the Late Cretaceous (Figure 74). The Tamar Graben is a NW striking structure, defined by a series of graben and half-graben dipping to the west, which contain several hundred metres of latest Cretaceous to Tertiary non-marine sediments. A phase of strike slip faulting is prominent in western and southern Tasmania. These faults are widespread but largely minor in nature. No major faults of this age have been recognized on the Tasmanian mainland. The faults affect rocks as young as 100 Ma and these fault movements predate the normal faulting in the Derwent Graben. The faults increase in intensity towards the SW and no faults or fractures of this style are known in NE Tasmania.

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### 2.3.1.8 EARLY TERTIARY

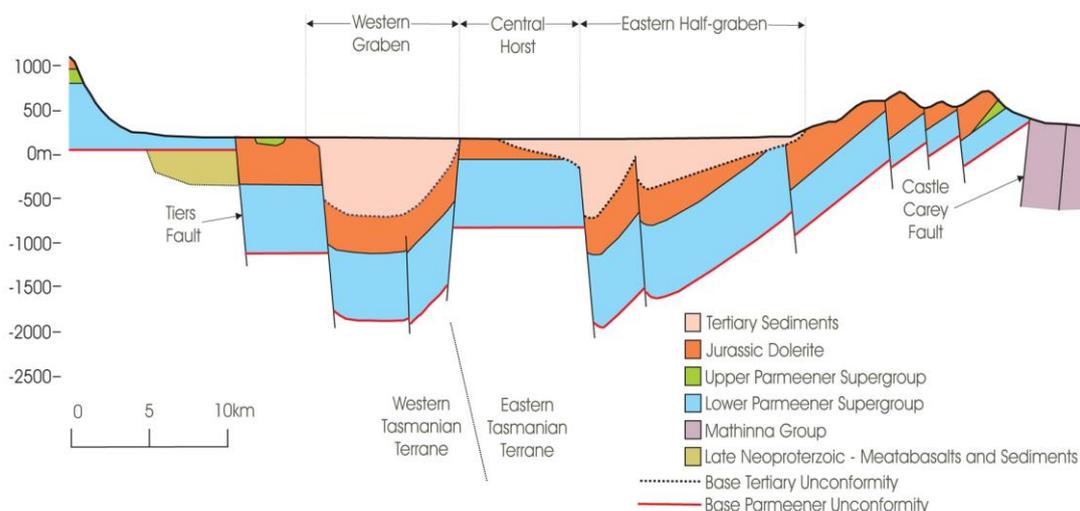
The Devonport-Port Sorell Sub-basin contains interbedded Paleocene to Late Oligocene non-marine sediments and basalt flows. The sub-basin is structurally related to the Bass Basin. The dominant structures are NNW–SSE trending, sub-vertical, en echelon normal faults. Gravity data suggest that the basin was land-locked, until at least the end of the Eocene. Analysis of the DEM shows three NNW striking faults including the east and west boundary of the basin. In the south, the basin is bounded by the uplifted Central Plateau (Figure 71).

The Longford Sub-basin has received considerable attention, its structure being variously described as a graben with a central horst comprising Mt Arnon and Hummocky Hills, and as

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a south-westerly dipping surface fractured by normal faulting down throwing to the east. Direen and Leaman considered the basin to be an asymmetrical depression developed on multiple, fluviially incised blocks, most of which exhibit half-graben rotation. Interpretation of recent regional seismic data acquired across the basin found the basin to consist of a NW trending western graben and eastern half-graben separated by a central horst (**Figure 74**). These structures developed sub-parallel to the basin bounding Tiers and Castle Carey Faults. It was interpreted the western graben to have formed at the onset of rifting, with a series of NE trending transfer faults active during the initial extension.

Reactivation of the transfer structures initiating the development of the eastern half-graben. Many of these faults were continuously active during deposition. Basin fill was deposited under lacustrine/fluviatile conditions and was largely derived from the erosion of basement rocks. The sediments in the basin are largely Eocene in age, but extend back to the Paleocene in the deepest part of the basin near Hagley. The large-scale topographic depressions produced by the Tamar Graben, the Devonport-Port Sorell and the Longford sub-basins, are easily observed on the DEM, as are the main boundary faults of these structures (**Figure 74**).



**Figure 74: Cross-section across the Longford Sub-basin showing architecture and Tertiary growth faults (modified from Lane 2002) (location of section shown on Figure 71).**

The most obvious is the Tiers Fault, a major structure with several hundreds of metres of normal movement in the Early Tertiary. Erosion was greatest in the NE with only remnants of Permian strata remaining on dolerite-capped hills, indicating that uplift and subsequent erosion was probably at its greatest in this area. In the Strahan Sub-basin, Paleocene to mid-Oligocene strike-slip-related structures have been interpreted. An en echelon, onshore extension of the Strahan Sub-basin, the Macquarie Harbour Graben (**Figure 71**) contains about 500 m of Eocene marginal marine sediments. The Derwent Graben consists of two linked structures, the lower-and upper-Derwent Graben.

The Lower Derwent Graben is a narrow NW trending structure, bounded on the west by the Cascades Fault system and by the Meehan Ranges in the east. The structure contains only a few hundred metres of sediment, the oldest being of Paleocene age, indicating faulting



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initiated in the early Tertiary. The Upper Derwent Graben is bounded on its southwestern side by a shallowly concave normal fault, down to the NE that approaches the Cascades Fault near Hobart. These faults as identified here are indicative of a regime of low extension. A complex transfer zone dominated by north-and east-striking faults links the Longford and Derwent Grabens (**Figure 71**).

According to the Proterozoic history of geological development, Tasmania is a microcontinent, an independent island system with continental crust, whose age in the western part according to separate data is 1,600 million years.

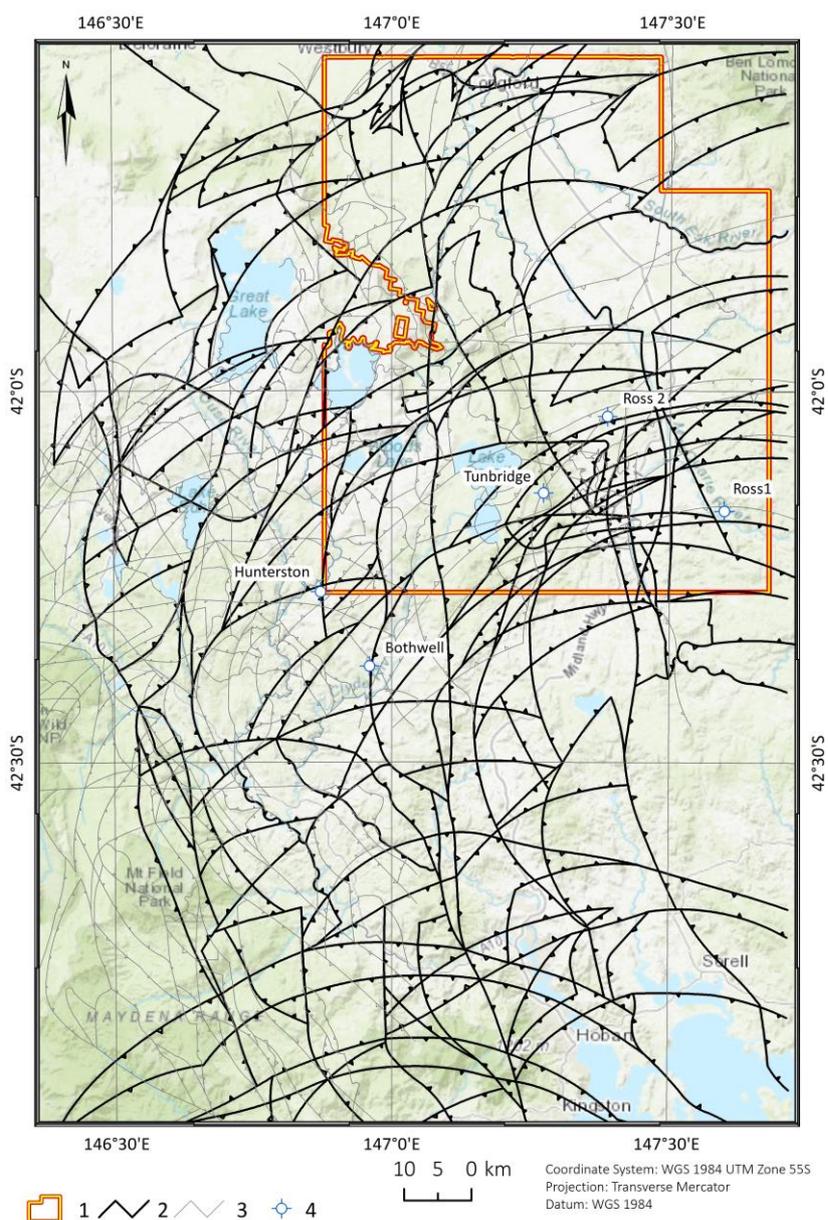
## Terra Tasmania Resources

### 2.3.1.9 MIOCENE TO PLEISTOCENE COMPRESSIONAL TECTONICS

Mio-Pliocene compressional tectonics measurements of the modern stress fields indicate that Tasmania is also affected by a NNW compressional stress. However, there is very little evidence for neotectonic structures in Tasmania. The only active fault scarp is the Lake Edgar Fault. Tasmania is actively rising at present, but this appears to be a regional response to high heat flow rather than a structural response to regional stress.

### 2.3.2 SMA VIEW ON PHASES OF DEVELOPMENT OF THE GENERAL AREA

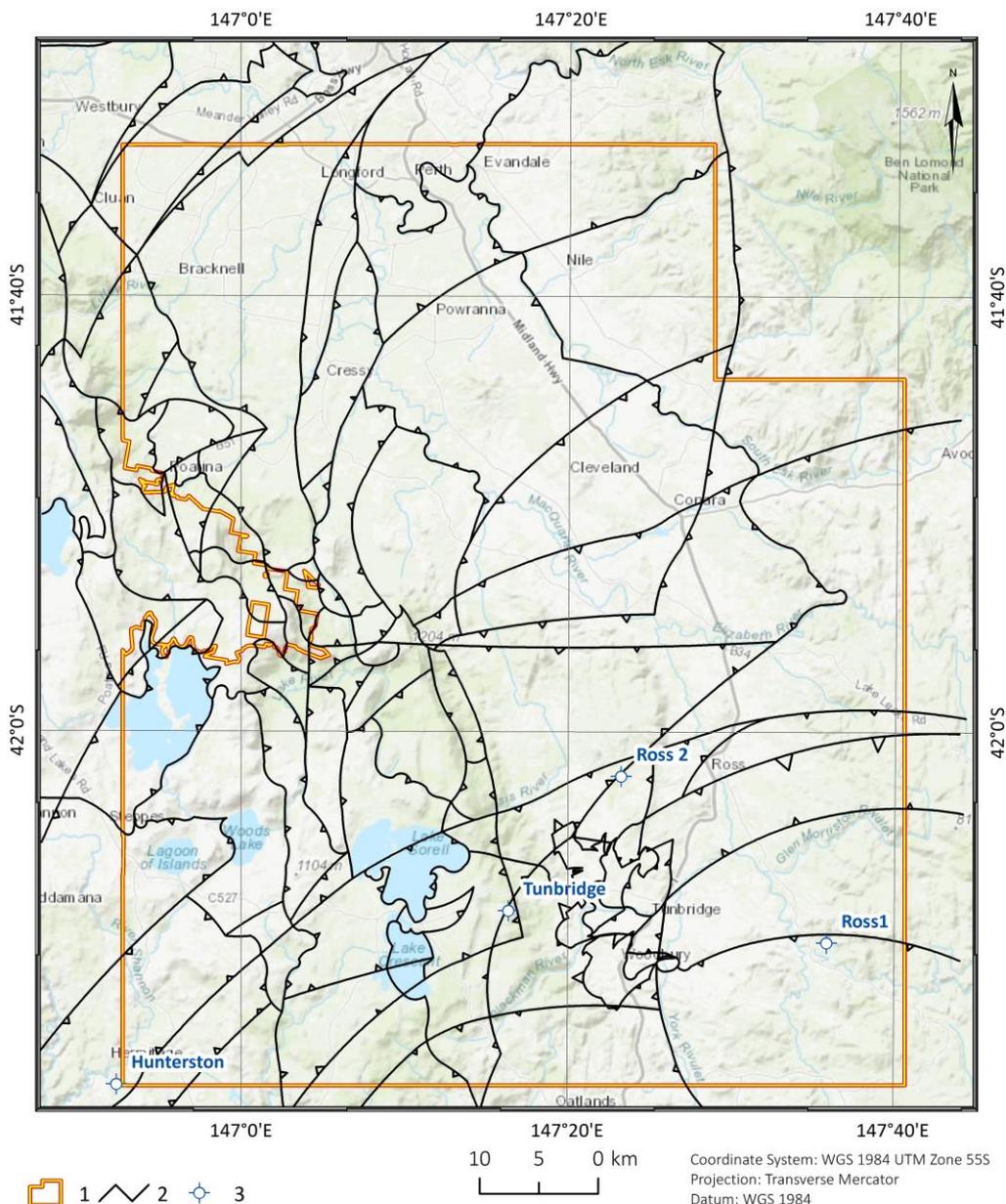
SMA of the oil and gas prospectivity of EL30 is based on the analysis of stress fields (the stress field schemes are shown in [Figure 75](#) and [Figure 76](#)).



**Figure 75: Regional structuremetric scheme at the scale of 1:25,000.**

*1 - EL30; 2 – first-order stress fields; 3 – second/third-order stress fields; 4– area prospective for HC accumulation; 5 - stratigraphic wells*

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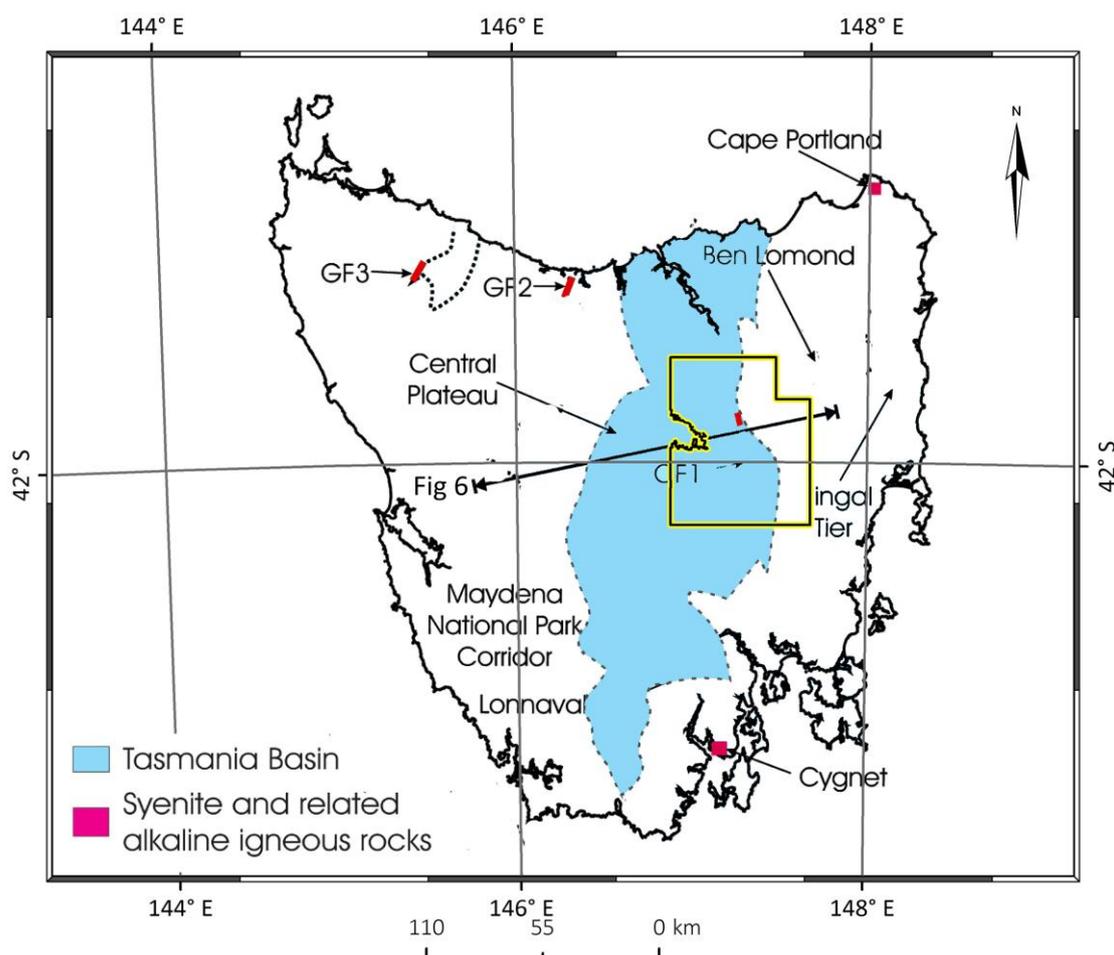
**Figure 76: Predictive structuremetric diagram of EL30/2011 tenement compiled based on the scale of 1: 5,000.**  
 1. - EL30; 2 – first-order stress fields; 3 – Areas prospective for HC accumulation; 4 - stratigraphic wells

Stress fields characterize the intensity of structural changes in a geosystem over a certain period of geological time. They can be expressed in a vector-like form and interpreted to be presented in a structure-material form (for example, paleo-structural reconstructions). Layer-by-layer structuremetric scanning allows to distinguish the areas of sagging of the basement, increase in the thickness of the sedimentary cover, as well as distinguish paleo-uplifts and deflections. The accumulation and distribution of hydrocarbons are related to the conditions of development of sedimentation in the basin, the lithological composition of the strata, and the thickness of sediments, facial and structure-formational features of the study area. SMA interpretation uses the direct and indirect manifestations of HC presence and identifies the locations of area for the further, greater-detail/high-scale

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structuremetric mapping. The SMA criteria include: zones of decompactification in the sedimentary cover, anomalously-high thickness of the sedimentary cover, cycles of tectonic inversion movement in the basin, the presence of anticlinal/domal and other types of oil-bearing traps, abrupt changes in the structural and material conditions. According to the existing regionalization adopted in Tasmania, the license area is located in the Longford sub-basin, which is part of the Tasmanian basin (**Figure 71**). From the SMA viewpoint, the Tasmanian basin is characterized by the greatest maturity of the Paleozoic and Mesozoic sediments.

According to SMA's regional paleo-reconstructions, the boundaries of the Tasmanian basin are as shown in **Figure 77**.



**Figure 77: Present boundaries of the Tasmanian basin according to the SMA.**

The central structure of the Longford sub-basin is the Tamar Graben. According to the geological information, the structure of the Tamar Graben is defined as a system of grabens and semi-grabens, filled with Late Cretaceous and Early Tertiary sediments. It includes interbedded Paleocene and Late Oligocene sediments with basalt interbeds. The Longford sub-basin is structurally connected in the north with the Bass Basin and Devonport-Sorell Basin. The trend directions are represented by sub-vertical, “en echelon” faults.



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According to the obtained structuremetric data, the Devonport-Sorell and Longford basins are combined into a single system of the Meso-Cenozoic troughs (grabens), which also include the Bass Basin in the north, the Lower Derwent and the Upper Derwent grabens in the south, separating the Tasmanian Mezo-Cenozoic basin into the West and East Terrane (Figure 68).

The areas of prospective HC accumulation identified via SMA fall into the central part of the Longford sub-basin. The trend of the proposed zone of hydrocarbon accumulation coincides with the general direction of the NNW-trending system of deflections. According to SMA, the formation of hydrocarbons in the Tasmanian basin started with the formation of Carbon-Jurassic lithology: the lower and upper super groups of the Lower Parmeener Supergroup, which developed only within the Tasmanian basin. The Lower Parmeener supergroup consists of glacial and glacial-marine sedimentary rocks, and the Upper Parmeener supergroup includes continental sedimentary rocks. Both blocks contain subordinate coal interlayers. Structural studies show that the Tasmanian basin is a mature structure in terms of the formation of oil and gas deposits. The maturation and initial migration of hydrocarbons were probably associated with an increased geothermal gradient in the middle and late Cretaceous, and the subsequent restructuring of the basin led to the final formation of traps for hydrocarbon accumulation.

SMA entails two phases of analysis. The first phase identifies the areas of hydrocarbon accumulation and their localization (varying resolutions/scales help with the identification and precision of SMA mapping). The second phase involves assessing of the HC potential of the identified areas based on the correlation of SMA data with the existing geological and geophysical information. Within the framework of SMA Phase 1, regional SMA of EL30 was carried out at the scale ranging from 1:100,000 to 1:25,000 (Figure 75). The SMA paleo-structural maps were created in order to establish the main stages of development of EL30 and to high-grade areas of the most likely hydrocarbons accumulations. Within the license area, the structuremetric analysis was carried out (work in ongoing for some parts of EL30) at several scales ranging from 1:100,000 and 1:5,000. The purpose of a multi-scale approach is to correlate the SMA results obtained at varying scales (resolutions of satellite data) in order to isolate high-probability areas and “zoom-in” to those areas at a higher level of precision/scale/detail, and .

SMA is being conducted at 1:2,000 to delineate HC-bearing contours within the areas of prospectivity obtained using the lower scales. SMA is also expected to render the depth of HC-bearing horizons, as well as the priority areas for exploratory drilling.

SMA conducted at the scale of 1:100,000 (Figure 75) helped map a series of paleo-structural maps in order to better understand the stages of development of the Tasmanian basin within the area of EL30.



## Terra Tasmania Resources

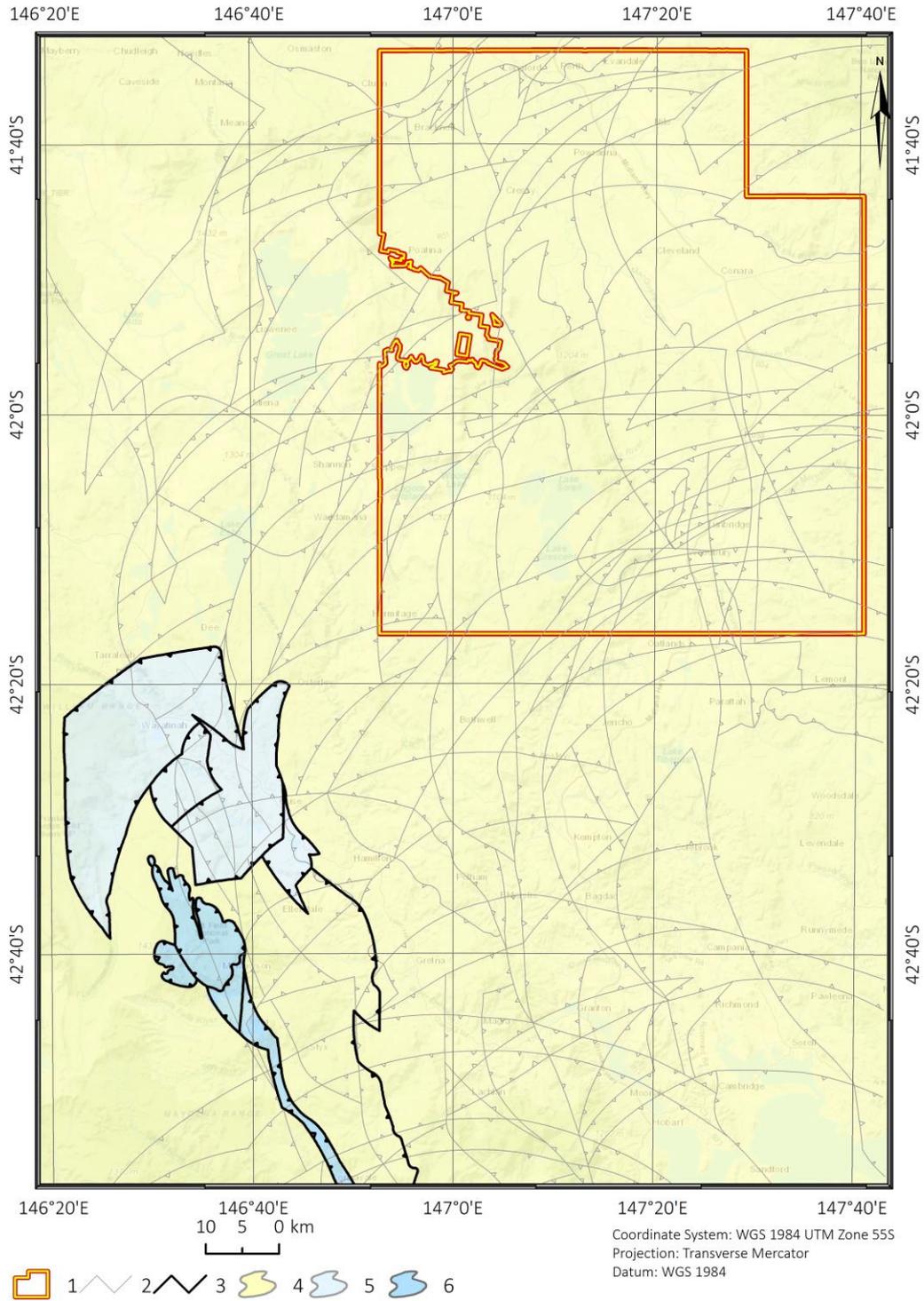
### LOWER PALEOZOIC, CAMBRIAN - DEVONIAN STAGE

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SMA associates this stage with the beginning of the formation of Tasmanian basin. The first structural element that initiated the formation of the basin is the area in the territory of the Maydena National Park (**Figure 69** and **Figure 77**) or the extreme south-western part of the Tasmanian basin. Depressions began forming between the Cambrian and the Devonian associated with the onset of the Tyennan orogenic cycle that extended in a wave-like manner across the Tasmanian basin from the southwest to northeast. **Figure 78**, **Figure 79**, and **Figure 80** shows the sequence of formation of deflections due to the oscillatory movements of the earth's crust (with the general trend of tectonic activity shifting eastward).

In the first phase of tectonic activation (**Figure 78**), a narrow zone of the trough/depo-center was formed (shown by hatching), where later, in the mid-to-late Cretaceous, the hydrocarbon deposits were formed. As previously noted, the process of activation was wave-like, cyclical. Each phase of activation ended with the inversion of movements with the subsequent, almost complete, leveling of the territory.

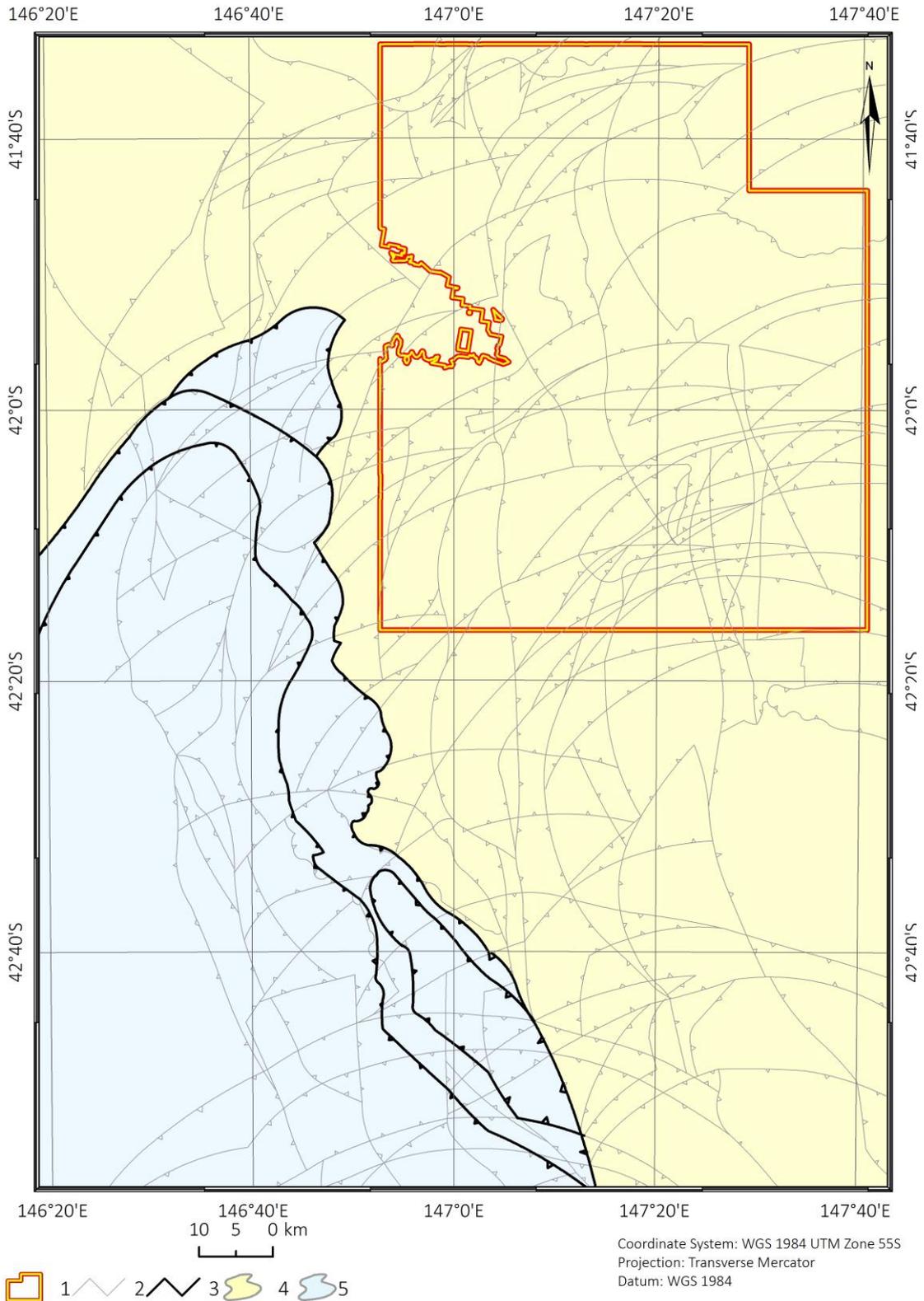
# Terra Tasmania Resources



**Figure 78: Paleo-structural reconstruction of the development of the area attributed to Early Paleozoic (Cambrian – Devonian). First activation phase.**  
*1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 – area of denudation-accumulation levelling; 5 – shallow tectonic depression; 6 – maximum subsidence (tectonic depocenter)*



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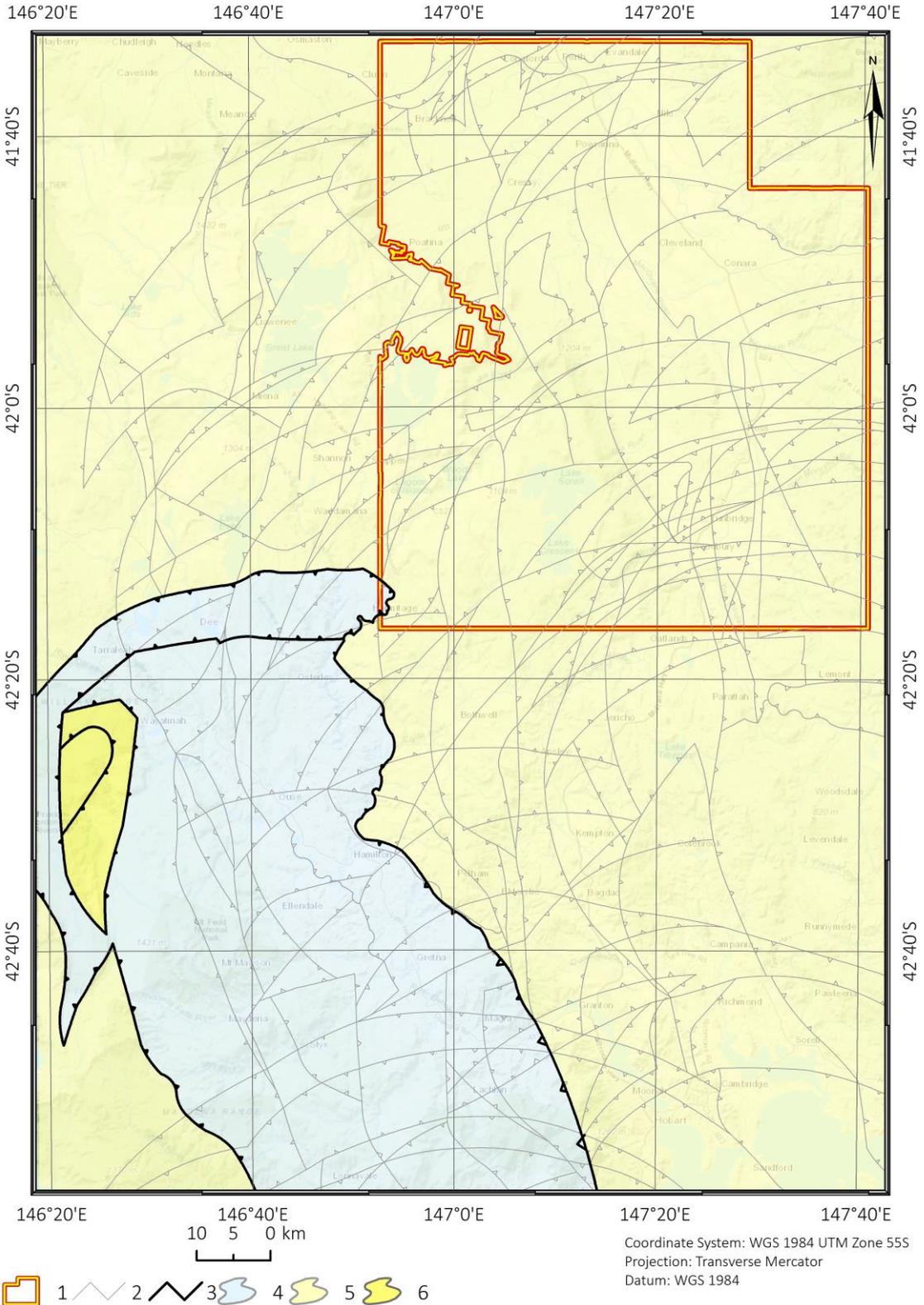


**Figure 79: Paleo-structural reconstruction of the development of the area attributed to Early Paleozoic (Cambrian – Devonian). Second activation phase**

*1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 – area of denudation-accumulation levelling; 5 – depression*



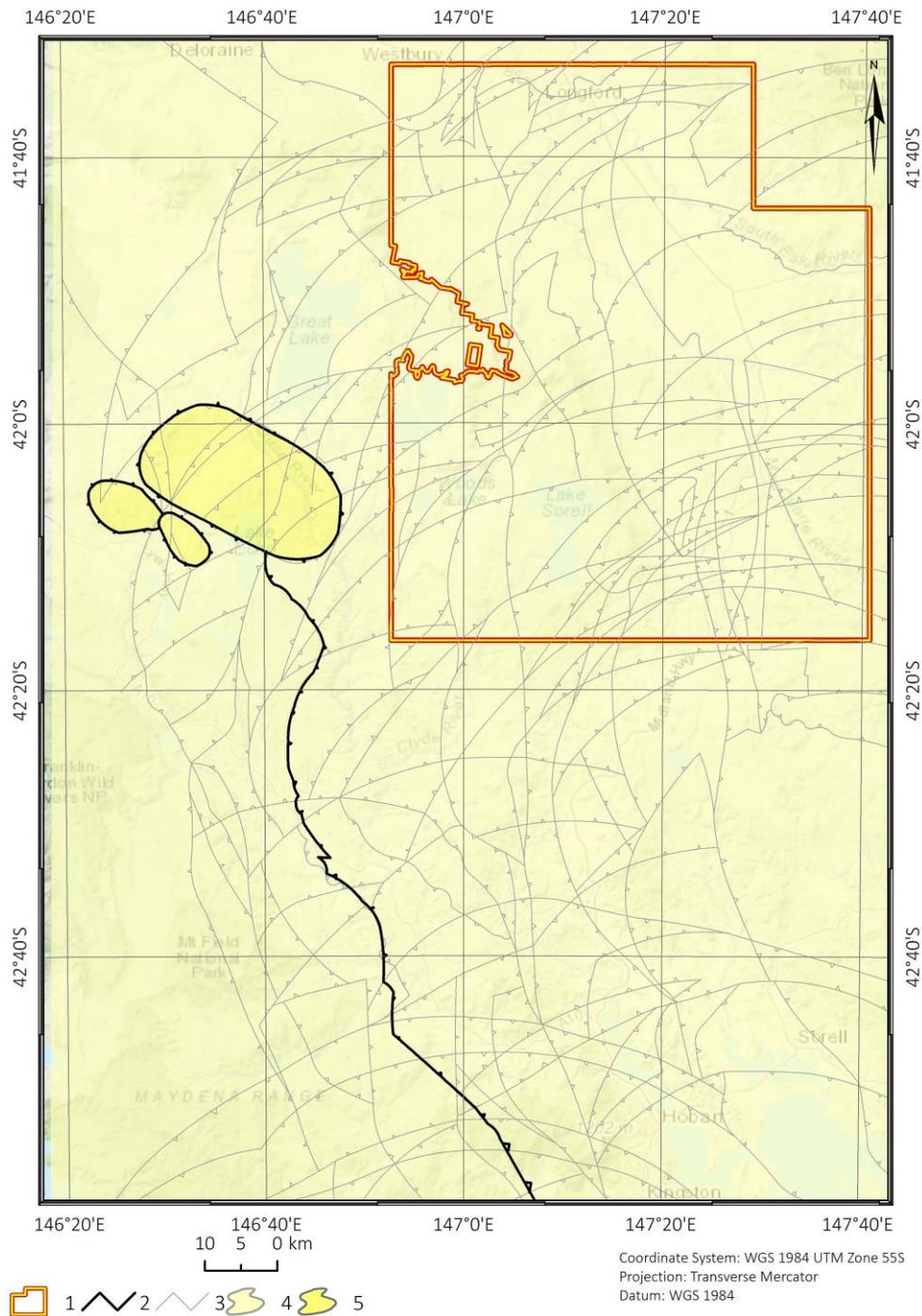
# Terra Tasmania Resources



**Figure 80: Paleo-structural reconstruction of the development of the area attributed to Early Paleozoic (Cambrian – Devonian). Third activation phase.**  
 1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 – subsidence; 5 - area of denudation-accumulation levelling; 6 – uplift

## SILURIAN-EARLY DEVONIAN STAGE

Opens a new page in the development of the Tasmanian basin. After a rather long stage of leveling the territory in the region of the western border of the license area, separate uplifts appear as a result of the new activation phase (**Figure 81**), apparently laid on a Cambrian-Devonian basement.

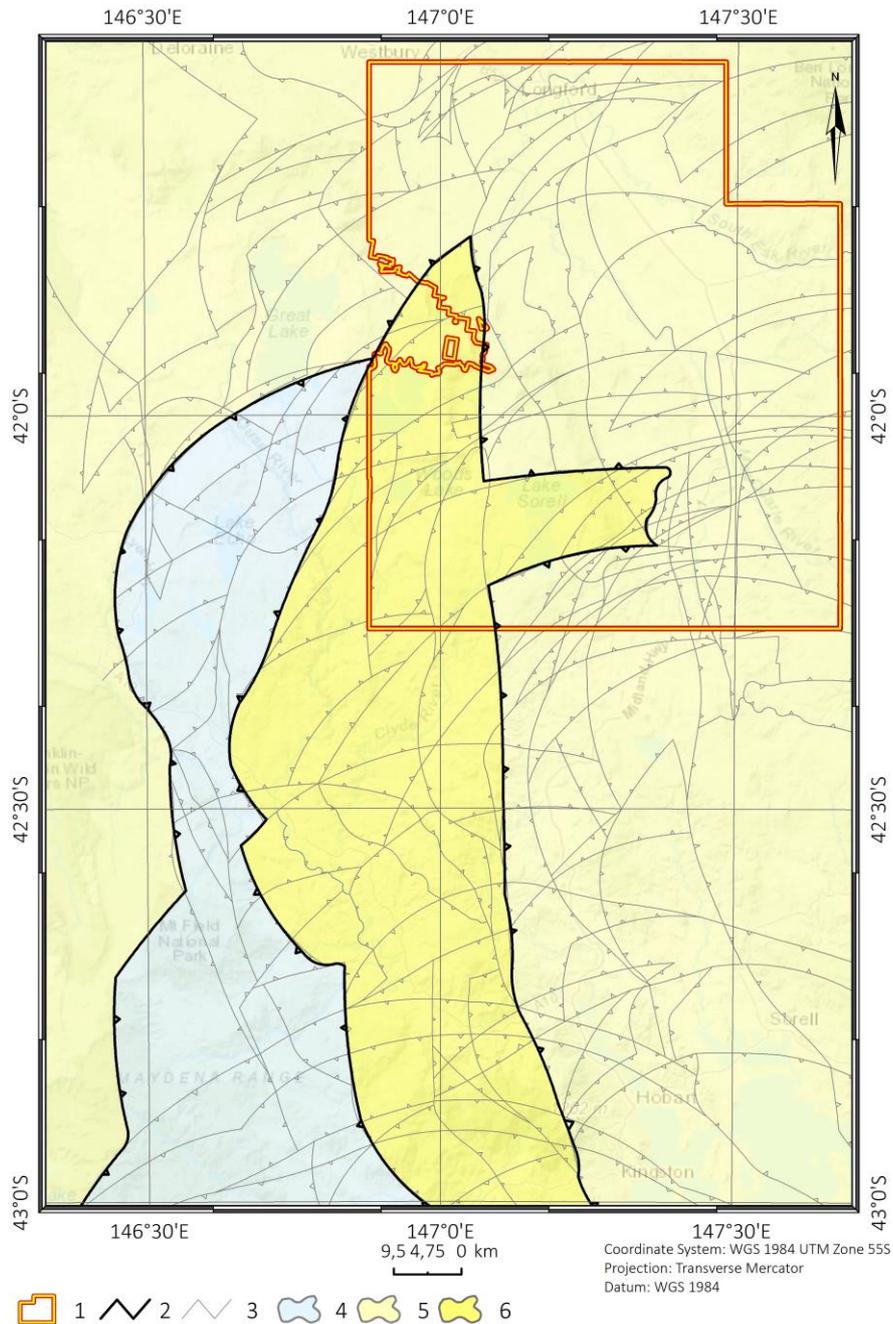


**Figure 81: Paleo-structural reconstruction of the development of the area attributed to Silurian – Early Devonian. First activation phase**  
 1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 - area of denudation-accumulation levelling; 5 - uplift

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Some of these structures were identified using the seismic exploration in the past; SMA confirms them. However, the complex of SMA indicators does not project HC's in in all of them, mainly due to the relatively small sediments thickness.

In the final activation phase (Figure 82), a meridionally oriented uplift formed along the western border of the license area, which uplift is associated with a relatively elevated basement block, apparently covered by the orogenic Tyennan structure-formational complex.

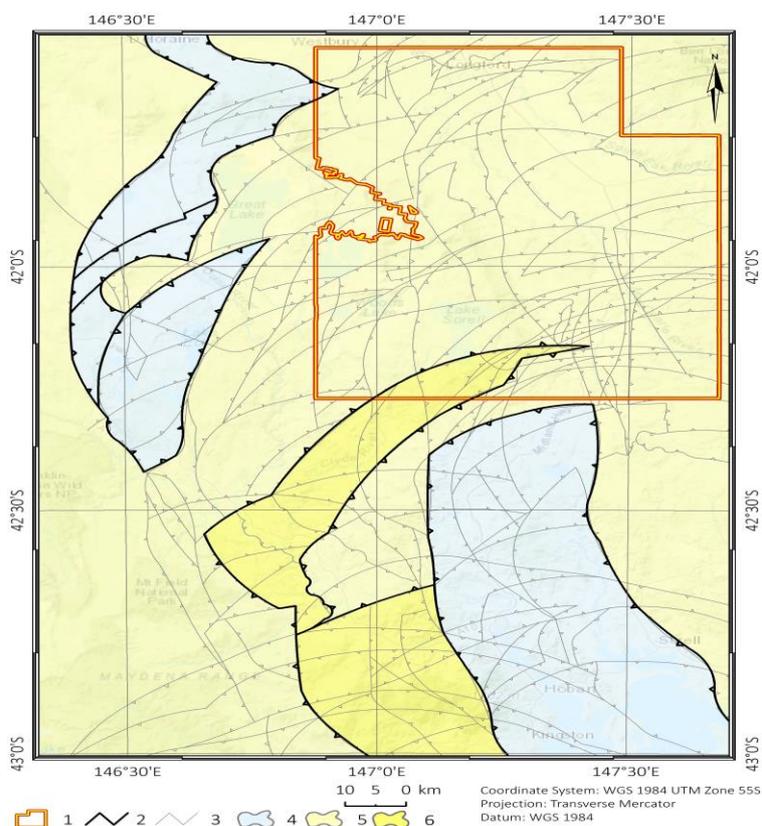


**Figure 82: Paleo-structural reconstruction of the development of the area attributed to Silurian – Early Devonian. Second activation phase**  
 1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 – subsidence; 5 - area of denudation-accumulation levelling; 6 - uplift

## Terra Tasmania Resources

A trough can be seen developing to the western and parallel to the uplift. This trough filled with synchronous sediments, and its southern part is a potential depocenter covered by overlying deposits **Figure 78**, which, SMA projects, industrial-size hydrocarbon accumulations. The Tyennan complex is characterized by the rapid, active sedimentation, powerful acid volcanism, as well as the presence of hydrothermal veins in the Henty dykes group. In the late Cambrian, the expansion stage was replaced by compression, which led to the formation of meridional zones of deflections and horsts. This phase of orogenesis led to the rise of the Tyennan block. **Much of the folding in the Neoproterozoic section of Tasmania coincides with the Tyennan orogenesis. All these features of the geological structure indicate for a high probability of HC formation on the territory of the Maydena National Park.** Structural deformations in the Mid-Devonian occurred throughout Tasmania and were characterized by a complex orientation of the folds, largely due to the activation of older structures. In many areas, the geometry of the folds is controlled by the trends of the Cambrian folding, which were reinforced in the Devonian. This led to the formation in the Devonian folds of secant to the axial plane of the Cambrian structural directions with which they are associated.

The paleo-structural scheme, which characterizes the second stage, the Silurian-Early Devonian development of the Tasmanian basin, was reconstructed via SMA and is shown on **Figure 83**.



**Figure 83: Paleo-structural reconstruction of the development of the area attributed to Silurian – Early Devonian. Third activation phase.**

*1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 – subsidence; 5 - area of denudation-accumulation levelling; 6 – uplift*



## Terra Tasmania Resources

The change in the compression vector from latitudinal in the first stage to the NNW is of note. The compression phase led to the rise of the Tyennan block with the formation of syn-orogenic sediments (Owen conglomerate), accumulating in the centers of synclines and other structural depressions. An uplift is shown in the center of the area in [Figure 83](#) with its axis oriented in the northeastern direction. The elevated block appears to be composed of the Late Hercynian rocks of the second Tyennan orogenic complex. The deflections delineated in the northwest and southeast appear to be filled with synchronous sediments of Silurian-Early Devonian age and are the depocenters (for this phase) with maximum sediment thickness. The remaining area by this period is covered with a relatively small thickness of synchronous sediments.

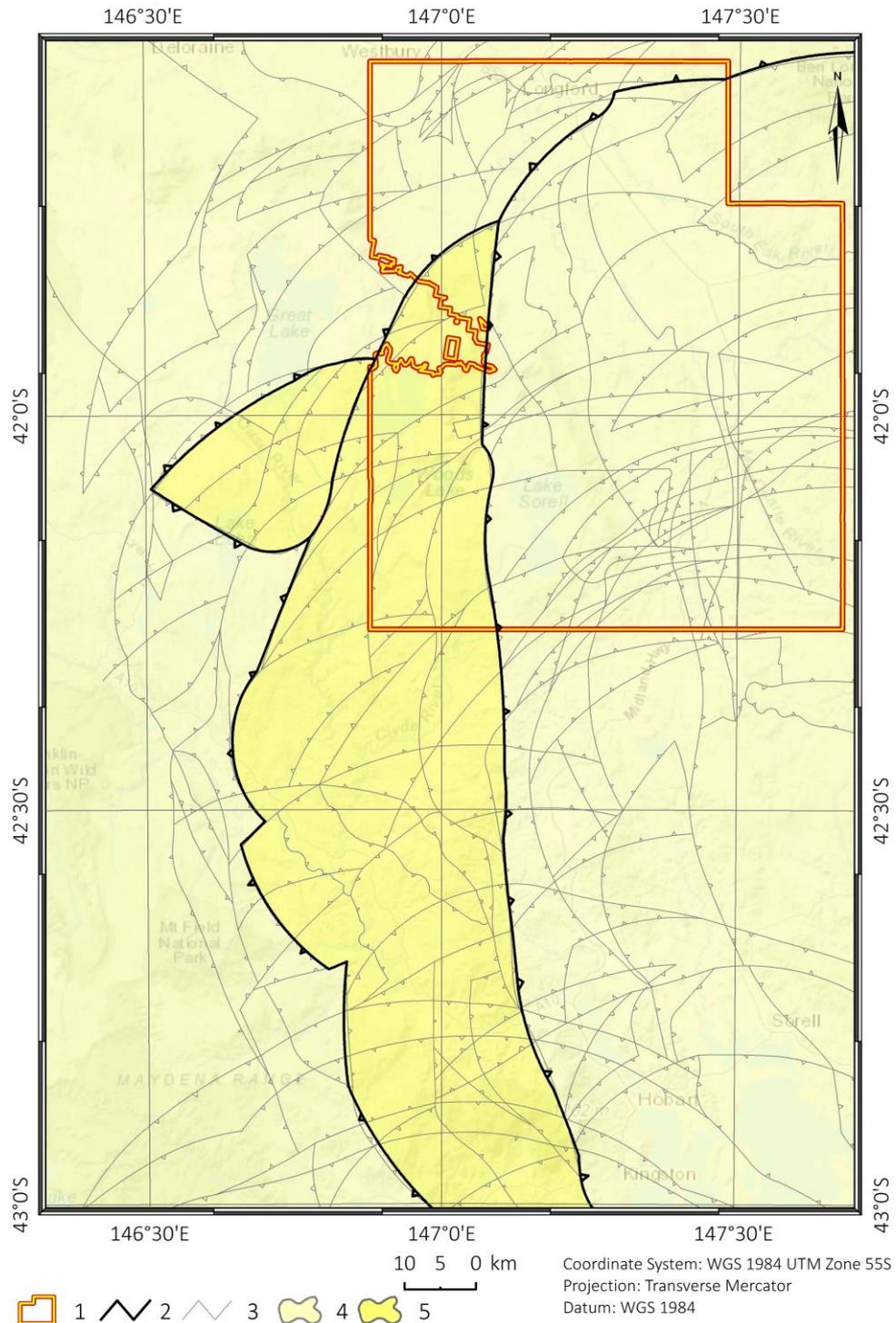
### CARBON-JURASSIC STAGE

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A large-scale leveling of the territory occurred after the Devonian folding. According to geological data, sedimentation has resumed in the Late Carboniferous with the formation of the gently inclined sedimentary rocks from the Late Carboniferous to the Late Triassic with the thickness of 1.5 km. The sediments are laid unconformably over the Late Devonian granites and folded basement rocks and are subdivided into two lithological source-rock associations: the lower and upper supergroups of the Parmeener rocks. The accumulation of 1.5 km of sediments of this group of sediments in the Tasmanian basin over the span of 100 million years is significantly slower than that of the classical basins with marginal deflection, which strongly indicates for an independent, with its own sedimentation regime, and unrelated to the Australian continent platform type of development of the Tasmanian microcontinent. SMA of the Cooper Basin in Australia revealed dramatic differences in structure as compared to the Tasmanian basin. Similarly, the accumulation of continental rocks in eastern Tasmania was also insignificant, which is a negative factor in relation to the formation of hydrocarbon deposits.

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Structural reconstruction of this stage (Figure 84) coincidentally shows that the selected zone of uplifting corresponds to the elevated basement block of the Silurian-Devonian phase (Figure 82).



**Figure 84: Paleo-structural reconstruction of the development of the area attributed to Carboniferous – Jurassic.**

1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 - area of denudation-accumulation levelling; 5 - uplift



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This means that the tectonic activity of the Tasmanian basin is more consistent with the stationary models of the development of the continental crust, as is also indicated by other features of the structure of this basin. The eastern wing of the uplift has a flat bed and is covered apparently by synchronous, relatively low-thickness sediments. SMA concluded that the formation of the Sorrell basin is associated with this phase; the beginning of its formation is middle-to-late Cretaceous, which is coeval to the Bass and Durroon basins.

### LATE-JURASSIC, CRETACEOUS STAGE

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The development of the Tasmanian basin is associated with tectonic processes that determine the further consolidation of the Neoproterozoic basement. One of these processes is the intrusion of large volumes of dolerites during the Middle Jurassic. This factor seems to have played an important role in the formation of the Tasmanian basin. According to SMA, the Tasmanian tectonic regime is autonomous and proceeded against the backdrop of slow, oscillatory, platform-type movements with low sediment accumulation rates. In the beginning of this phase, the territory of Tasmania almost completely leveled, and dome-type structures formed in the western and north-western parts of the area, as shown in [Figure 85](#). Some of these structures can also be seen using the seismic data. At this scale of SMA, these structures did not indicate for the presence of (or conditions for accumulation of) hydrocarbons, with the main reason for the lack of accumulation likely being low sediment thickness. Since both activation phases manifested themselves in a relatively short period, the geological time for accumulation and formation of hydrocarbon deposits was likely insufficient.

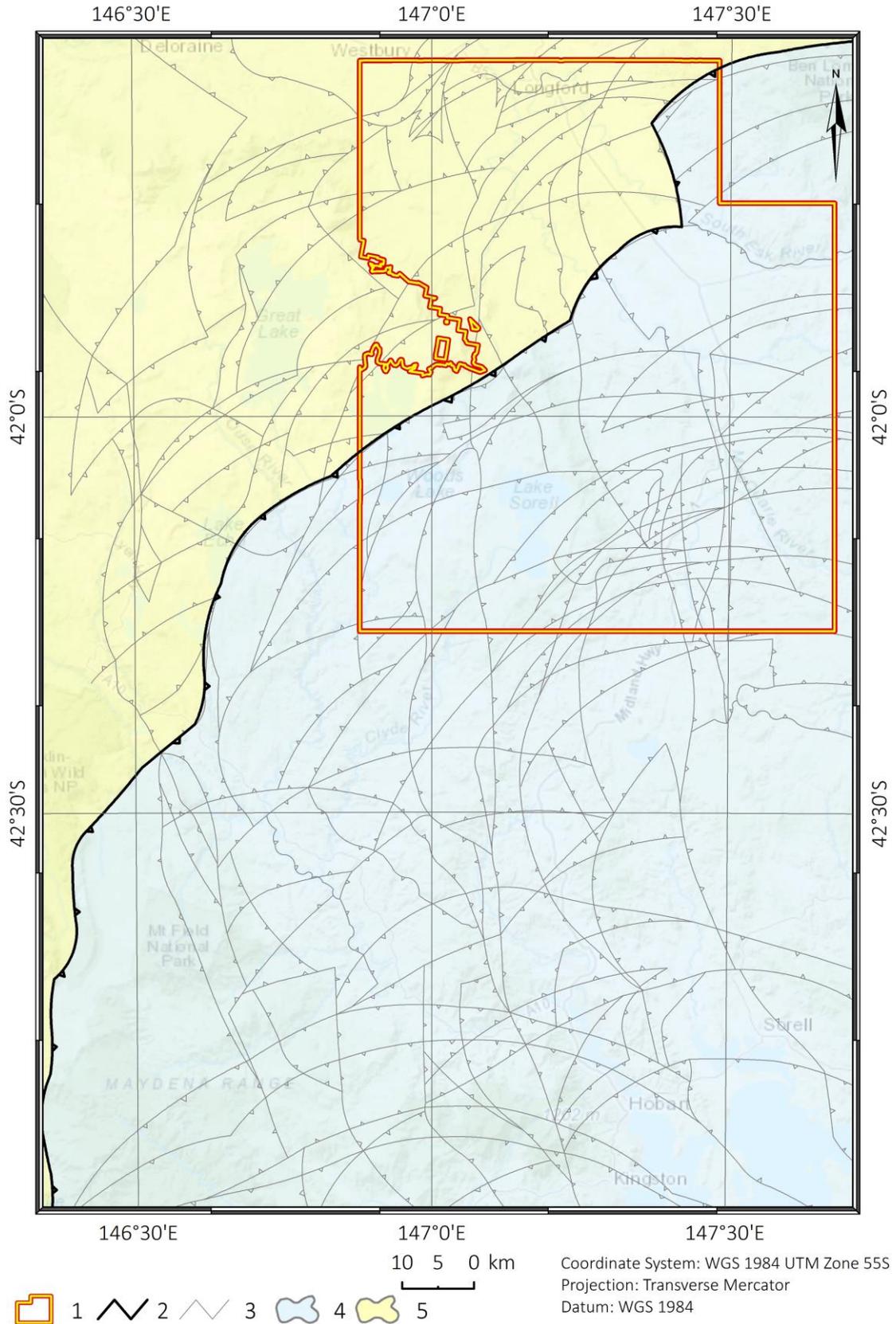
# Terra Tasmania Resources

In the final stage of this phase, SMA projects a regional, likely short-term, subsidence of the southeastern part of the area (**Figure 86**).



**Figure 85: Paleo-structural reconstruction of the development of the area attributed to Late Jurassic – Cretaceous. First activation phase.**  
 1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 - area of denudation-accumulation levelling; 5 - uplift

# Terra Tasmania Resources

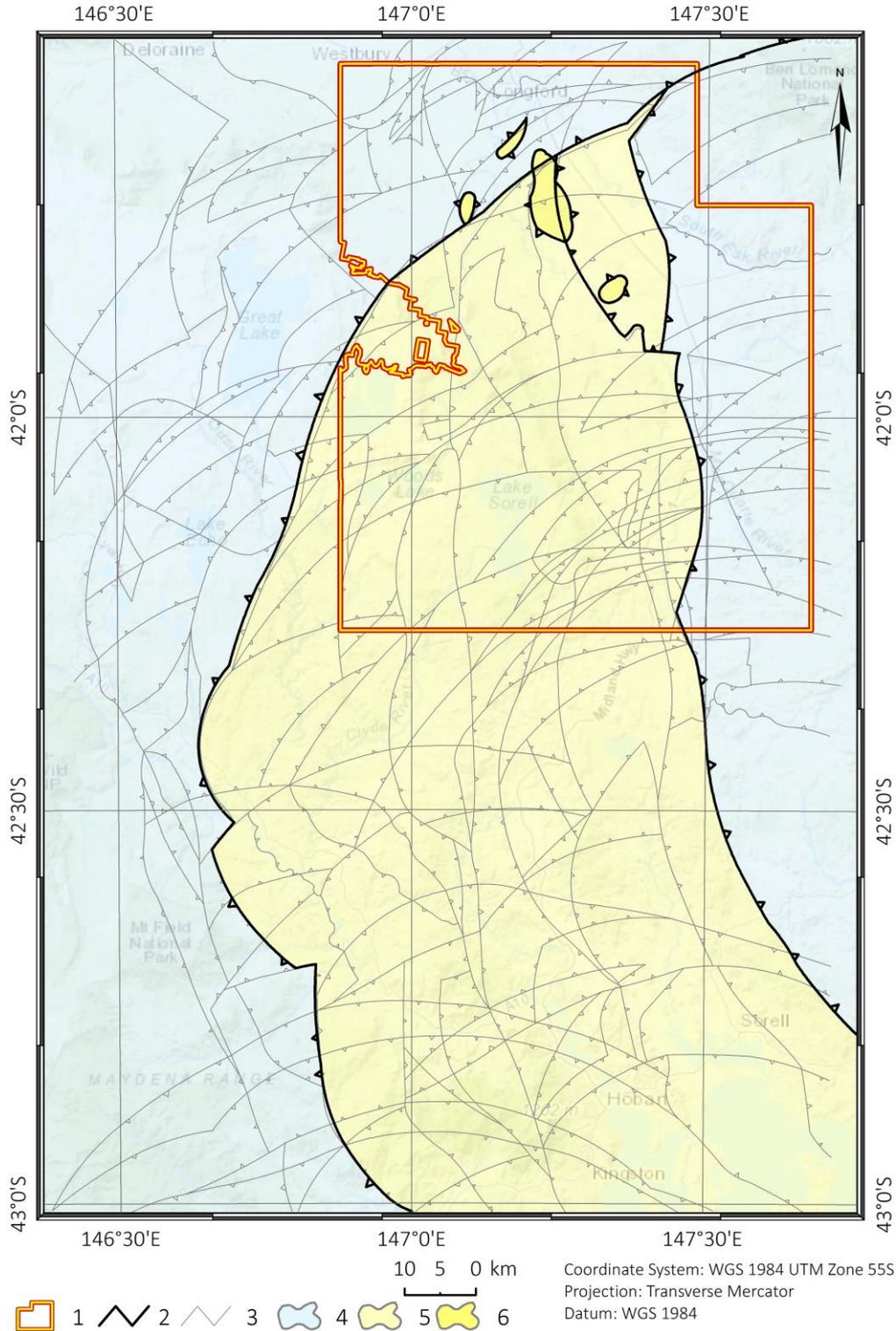


**Figure 86: Paleo-structural reconstruction of the development of the area attributed to Late Jurassic – Cretaceous. Second activation phase.**

1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 – subsidence; 5 - area of denudation-accumulation levelling

## Terra Tasmania Resources

The next phase of activation led to the uplifting of the central part of the Tasmanian basin, which likely served as the beginning for the extensive development of denudation and erosion processes (**Figure 87**).



**Figure 87: Paleo-structural reconstruction of the development of the area attributed to Late Jurassic – Cretaceous. Third activation phase.**  
 1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 – subsidence; 5 - area of denudation-accumulation levelling; 6 – area of uplifting



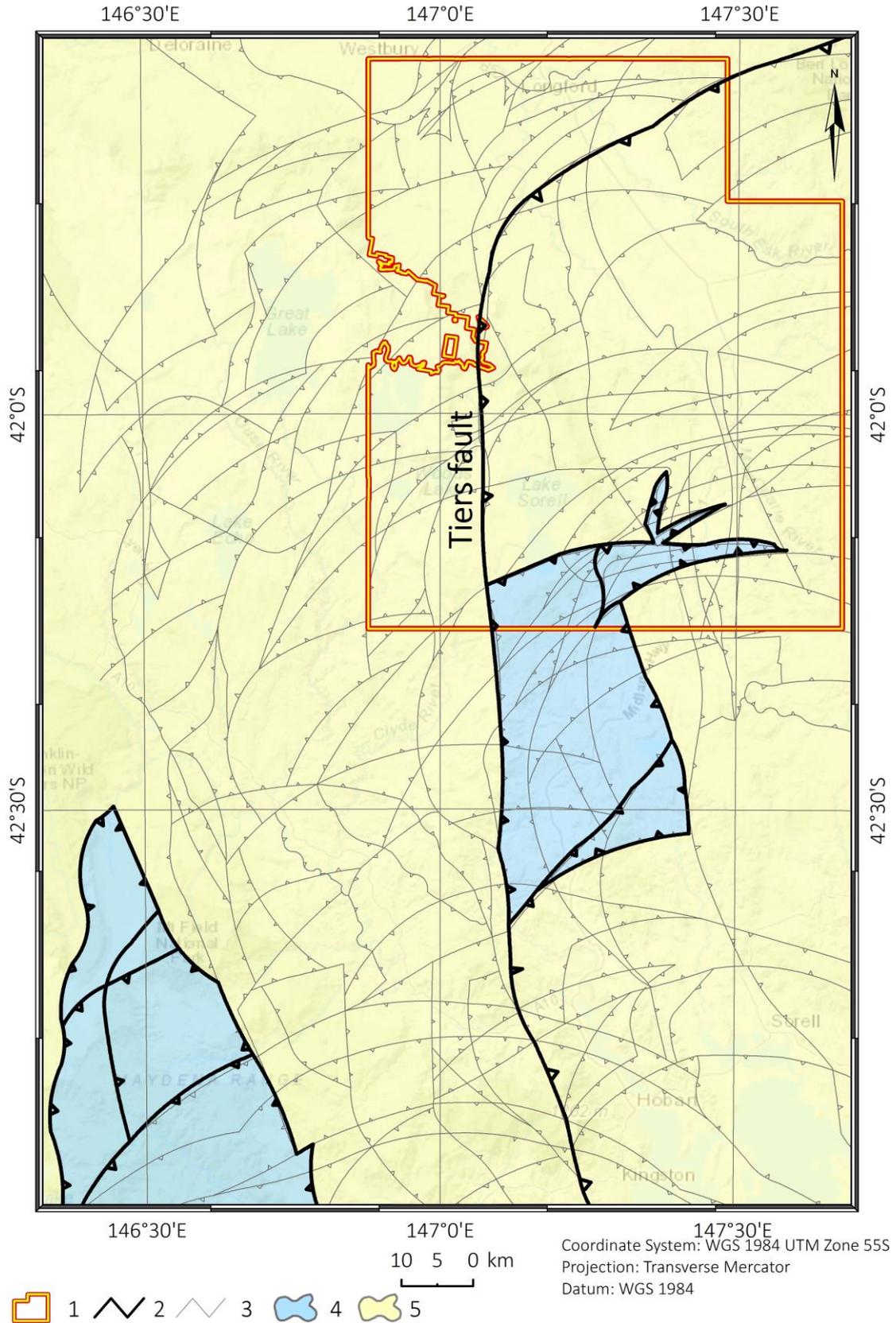
## Terra Tasmania Resources

### MIDDLE - LATE CRETACEOUS

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The formation of the delineated hydrocarbon deposits is associated with this stage. SMA distinguished the following three phases of tectonic activation:

1. **Figure 88** shows the phase of structural changes, when the regional Tiers Fault formed, which, according to the geological data, divides the Tasmanian basin into the eastern and western Terrane (**Figure 74**) and is the western boundary of the Tamar graben. On the paleo-structural schemes shown above, such an explicit boundary is not visible. The northeastern end of the tectonic ridge is the southern boundary of the Durroon Basin (**Figure 71**). Active formation of the Bass Basin is also associated with this stage due to the high rates of subsidence in the northern, offshore part of Tasmania. A trough zone can be distinguished on the eastern flank of the Tiers Fault; the most complete stratigraphic column, the presence and thickness of the continental sediments of the Middle and Late Cretaceous are all expected within this area. This is a favorable factor for the accumulation of hydrocarbons. In the middle-to-late Cretaceous, Tasmania experienced elevation of temperatures as well as the introduction of Cygnet intrusions. One of the hydrocarbon accumulation areas delineated using SMA is confined to this tectonic anomaly-depocenter.

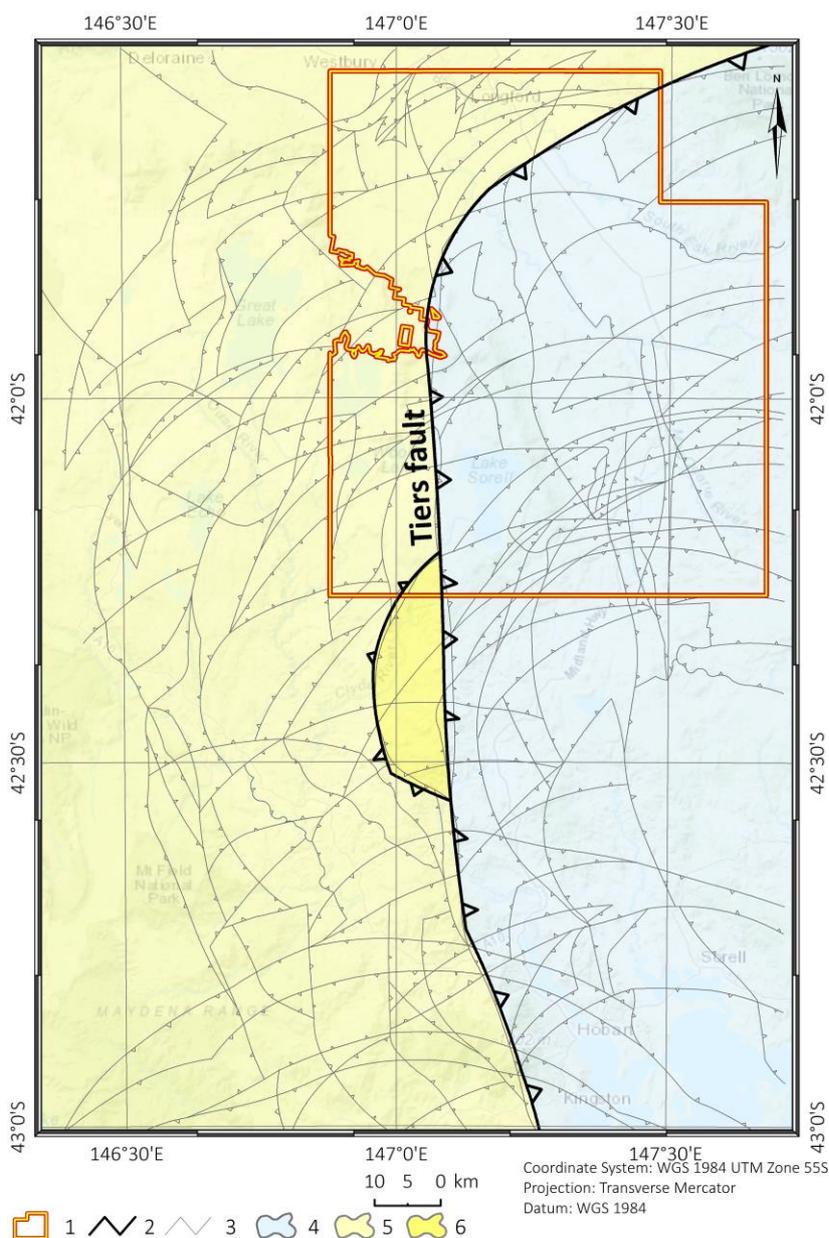


**Figure 88: Paleo-structural reconstruction of the development of the area attributed to Mid-to-Late Cretaceous. First activation phase.**

1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 – subsidence; 5 - area of denudation-accumulation levelling

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2. SMA constructs show the depocenter of the second activation phase is localized in the same section of the Tiers Fault as shown in **Figure 89**. At the same time, the area of activation shifted to the western, elevated fault block. Here, within the elevated wing, the anticlinal, meridionally-oriented structure formed. The formation of this uplift could be associated with the introduction of a small extruded body of syenites. In the eastern, lowered zone of the Tasmanian basin, sedimentation continues against the backdrop of regional leveling. The intensity of sedimentation is assumed to have been rather high, as the zone of the deflection that formed during the previous activation phase was completely leveled by that time.



**Figure 89: Paleo-structural reconstruction of the development of the area attributed to Mid-to-Late Cretaceous. Second activation phase.**

1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 – subsidence; 5 - area of denudation-accumulation levelling; 6 – area of uplifting

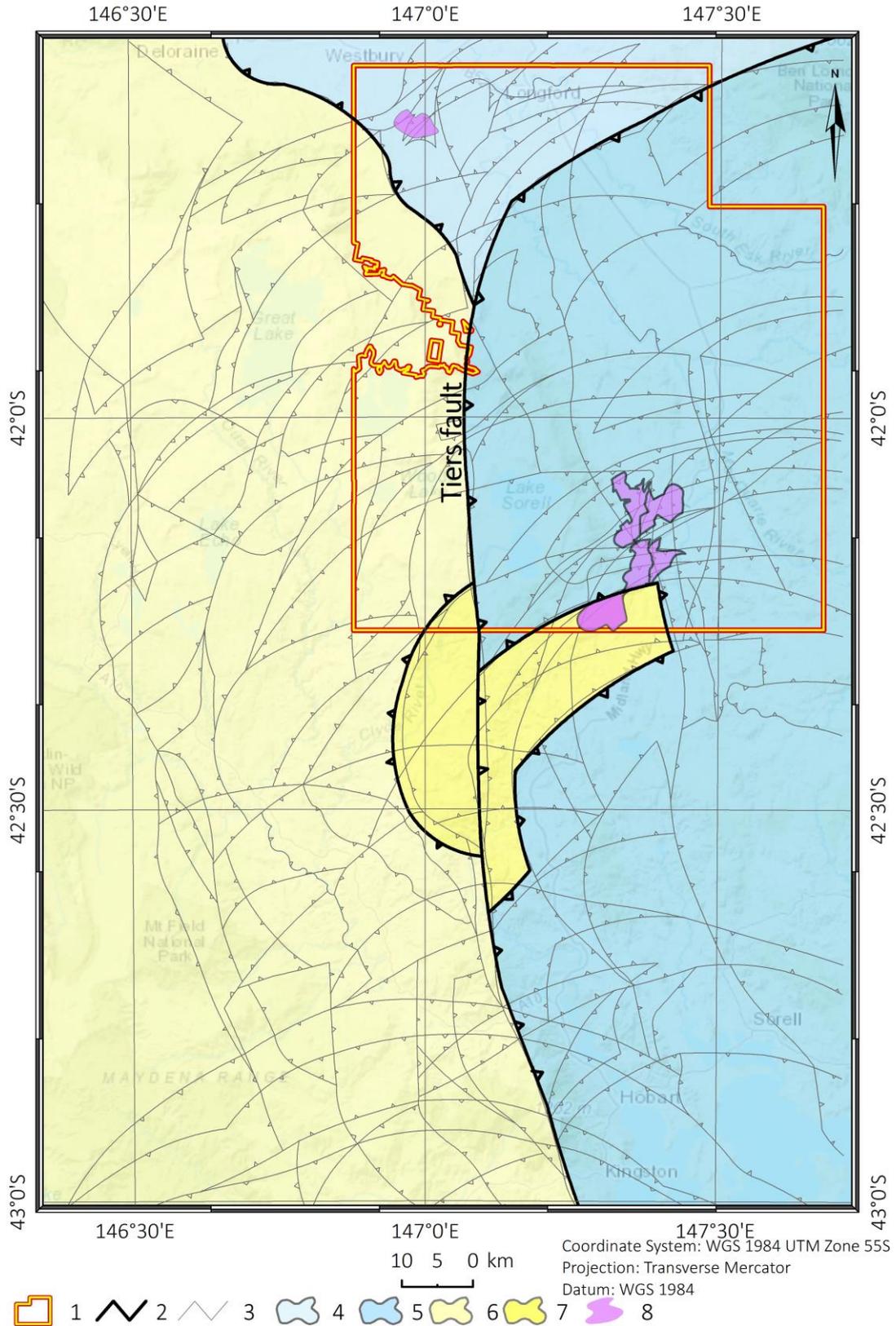


## Terra Tasmania Resources

3. The third and final phase of activation is the main one in this sequence, as this stage is attributed to the formation of the predicted hydrocarbon deposits according to SMA (**Figure 90**). The characteristic feature of the development of the central part of the Tasmanian basin at this stage is the separation of a stable zone of tectonic activity - a depocenter in the central part of the Tiers Fault of the Longford sub-basin. According to the geological data, the fault, oriented northwest, is defined as the western boundary of the Tamar graben, which contains several hundred meters of sediments from Late Cretaceous to Tertiary continental. The final phase of the development of the selected structural anomaly was manifested in the formation of the uplift in the central part of the Tiers Fault (**Figure 90**), which was formed due to the inversion of movements in the area of the identified depocenter. During this phase of development, the fault itself remained passive, non-activated. Except for the delineated uplift, the rest of the territory at that time was accumulating synchronous continental, low-thickness sediments.

As a result of multidirectional movements of the basement in the Tiers Fault zone, the anticlinal HC trap covering approximately 108 km<sup>2</sup> formed in the northeastern wing of the uplift (presumably consisting of the late Cretaceous sediments).

In the north of the said area, at this time, the expansion of the sedimentation area (associated with the development of the Tamar Graben and the offshore part of Bass Basin) led to another hydrocarbon accumulation in Middle to Late Cretaceous sediments and covering 16 km<sup>2</sup>. Thus, within the analyzed territory, we identified two major sites that have the conditions for the formation of hydrocarbons deposits (they are located on the western side of Tamar graben).



**Figure 90: Paleo-structural reconstruction of the development of the area attributed to Mid-to-late Cretaceous. Third activation phase.**  
 1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 – area of shallow subsidence; 5 – area of deep deflection; 6 – area of denudation-accumulation levelling; 7 – area of uplifting; 8 – HC accumulation



## Terra Tasmania Resources

### EARLY TERTIARY STAGE

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SMA distinguishes two phases of activity associated with the formation of the eastern boundary of the graben – Castle Carey Fault, which separates eastern Terrane from the western. According to SMA, the formation of the graben occurred progressively, in a wave-like fashion. At first, the western border of the graben was formed in the middle-to-late Cretaceous, then the eastern side in the early Tertiary stage. This fact, as previously noted, indicates that the development of the territory of Tasmania is consistent with the stationary tectonic model. Vertical movements were dominant in this area. In this case, it is not entirely correct to associate the features of the geological structure of Tasmania and its oil-bearing potential with the movements of the Australian Plate.

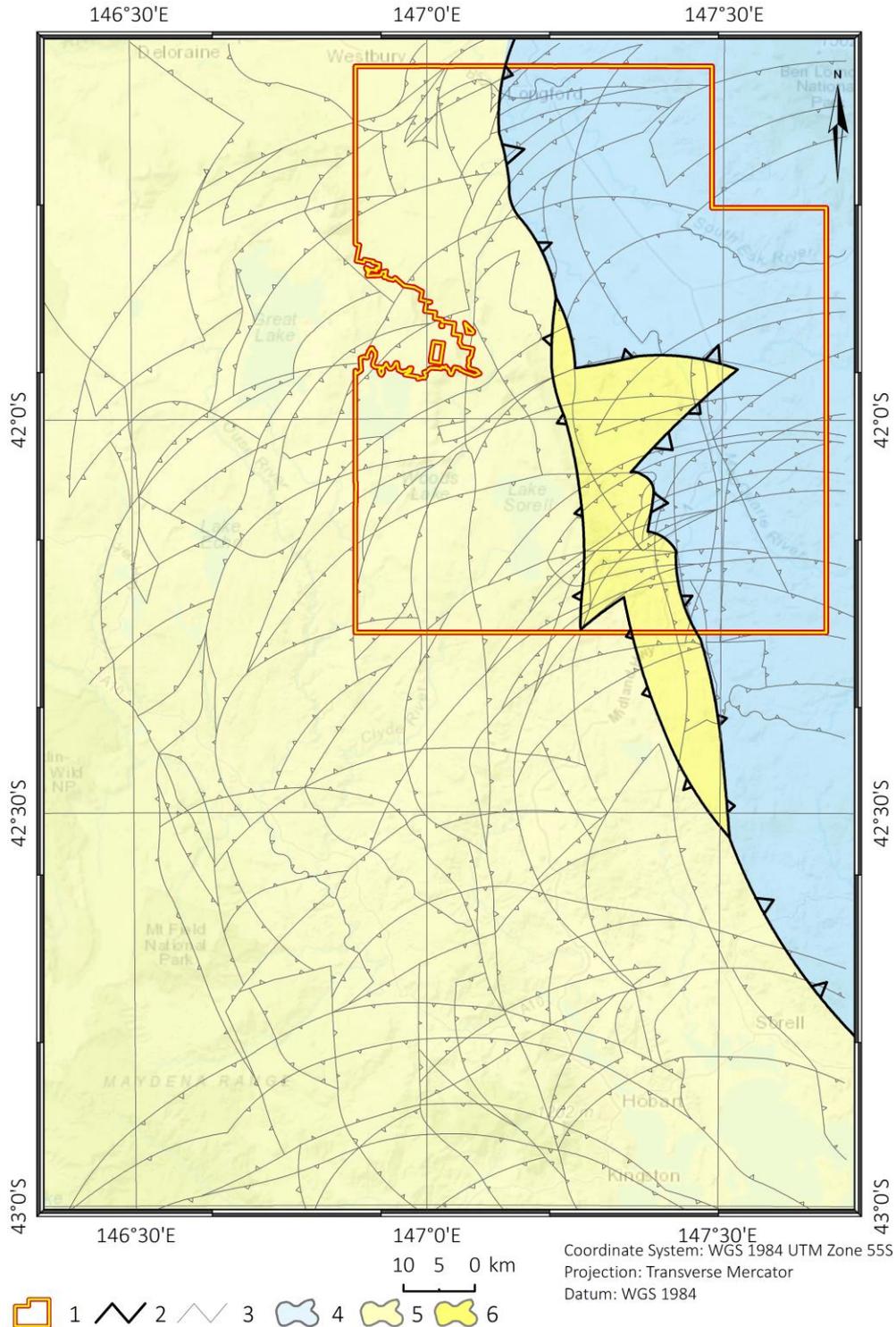
SMA data indicates that the development of Tasmania proceeded according to a structural plan that entailed formation of the island-type continental crust indirectly-associated with Australian continent. **Figure 91** shows the SMA vision of the first phase of early-tertiary activation that manifested itself in the formation in the central part of the Tamar graben of an uplift of NNW stretch. The western boundary of the graben, which is conventionally associated with the Tiers Fault, lost its significance in this phase of activation; sedimentation regime was established in its place, and tectonic activity shifted eastward to the area of the emerging uplift. The final activation phase (**Figure 92**) is associated with the further advance of tectonic activity to the east and the final formation of the eastern border of the Tasmanian basin. The eastern, coastal structure-formational zone of Tasmania, as well as the western one, are characterized by a different basement structure than the Tasmanian central basin itself.

The base of the western coastal part of Tasmania is composed of Early Proterozoic sediments covered by fragments of the Cambrian, Ordovician, and Devonian. The basement of the eastern part is mainly represented by the Mathinna orogenic formation of the Devonian age, characterized by a prehnite-pumpellyite degree of metamorphism with local zones of the greenschist facies.

The basement rocks are covered with a thin cover of Jurassic sediments. Both tectonic zones are characterized by highly elevated basement rocks, which fundamentally limit the possibility of formation of oil source rock formations in those areas, except for certain individual deflections with increased sedimentary cover, similar to the Tamar graben or the Maydena-National Park structure.

## Terra Tasmania Resources

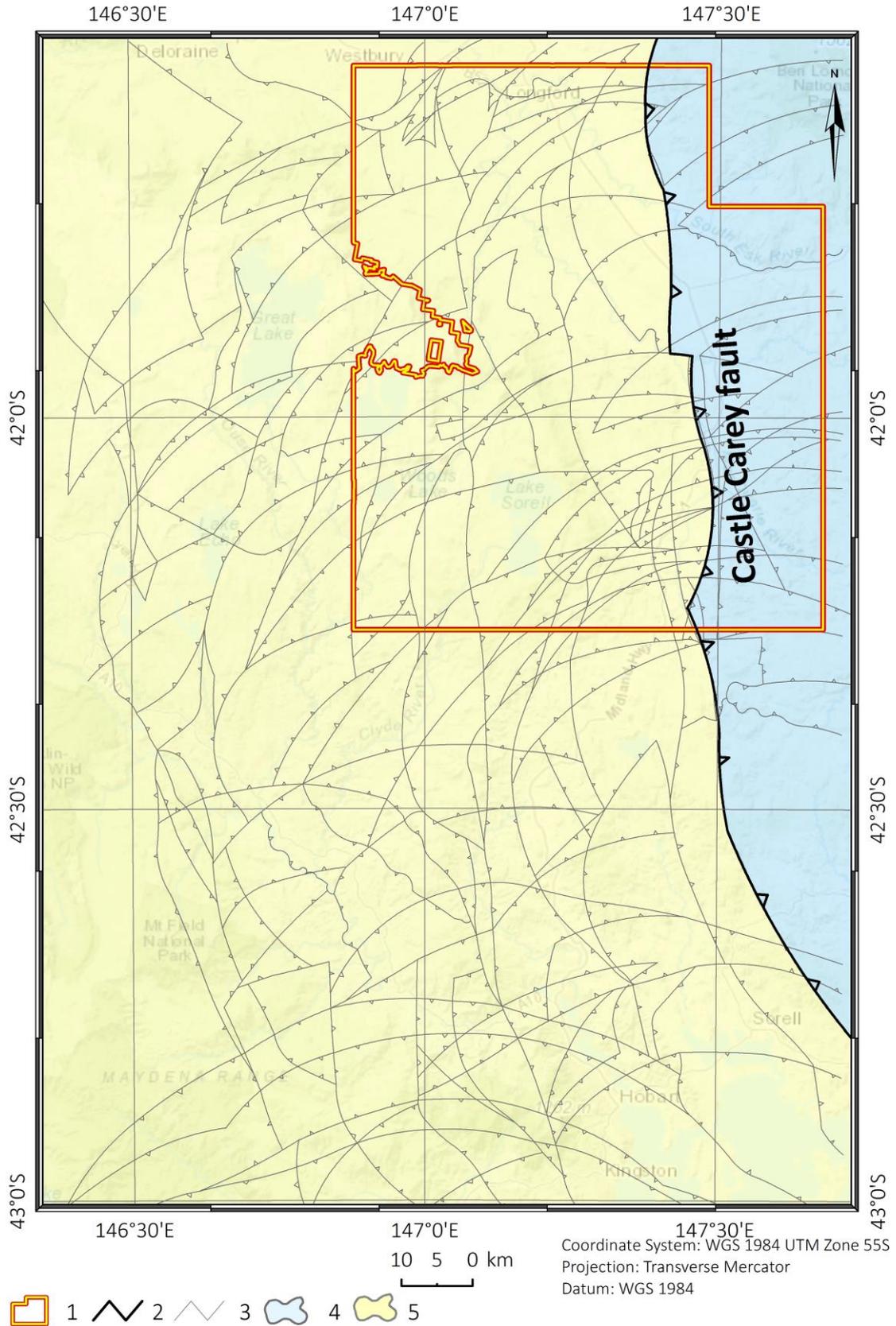
The final phase of the early Tertiary stage according to SMA is associated with the activation of the Castle Carey Fault, which is the eastern boundary of the Tasmanian basin (Figure 92) and dips to the east. The rest of the Tasmanian basin and the coastal part at this time was an area of accumulation of the early tertiary sediments, which led to regional leveling.



**Figure 91: Paleo-structural reconstruction of the development of the area attributed to Early Tertiary. First activation phase.**  
 1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 – subsidence; 5 - area of denudation-accumulation levelling; 6 – area of uplifting



# Terra Tasmania Resources



**Figure 92: Paleo-structural reconstruction of the development of the area attributed to Early Tertiary. Second activation phase.**  
 1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 – subsidence; 5 – area of denudation-accumulation levelling



## Terra Tasmania Resources

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### 2.3.3 SMA RESULTS

SMA accepts the geological information, that the oil source formations of the Tasmanian basin are in the Parmeener Supergroup. This formation is widely distributed throughout the Tasmanian basin, and the maximum sediment thickness is confined to the zones of deflections that developed as inherited from the Cambrian and to the Upper Cretaceous (including it). The Longford sub-basin is certainly promising in terms of its hydrocarbon potential, because the regional NNW-trending structure of Tamar Graben crosses the entire continental part of Tasmania, connecting in the north with the offshore part of the trough of the Bass Basin and in the south with the Derwent graben. This entire zone of deflection has the maximum sediment thickness of the Parmeener supergroup. The inherited graben structure has developed from the Lower Paleozoic to the early Tertiary period. In the previous sections of the report, we showed the paleo-reconstructions, which reflect the main stages of the development of the graben, including the formation of the predicted hydrocarbon deposits.

This section shows the results of the detailed SMA of two areas recommended for priority exploration. These prospective areas were selected based on the preliminary regional analysis conducted earlier. The detailed analysis was carried out at a scale of 1:5,000.

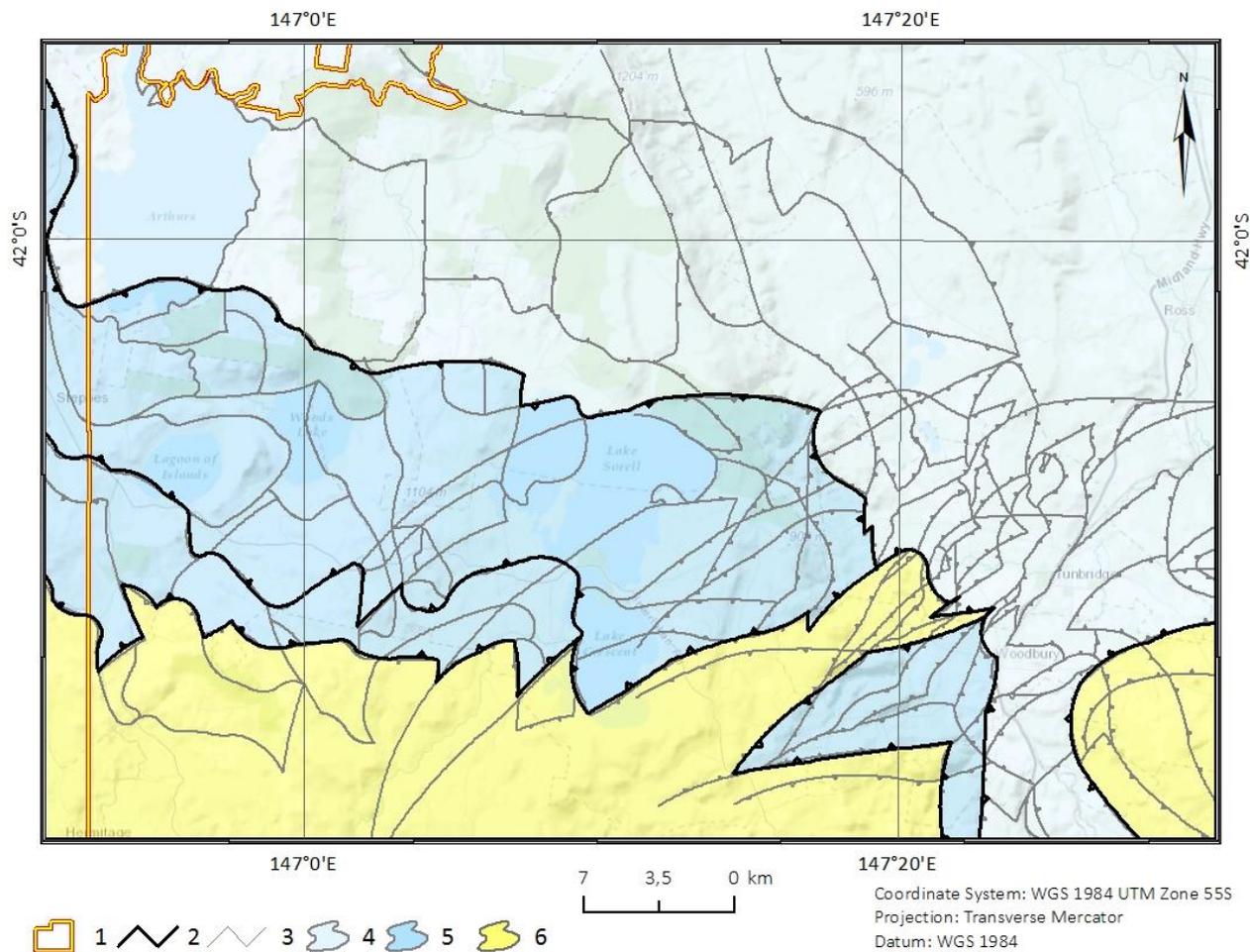
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#### 2.3.3.1 TARGET 1

The largest HC-bearing structure covers approximately 108 km<sup>2</sup>. It is located in the zone of the Tamar Graben in the hanging wall of the Castle Carey Fault ([Figure 94](#), [Figure 95](#)).

## Terra Tasmania Resources

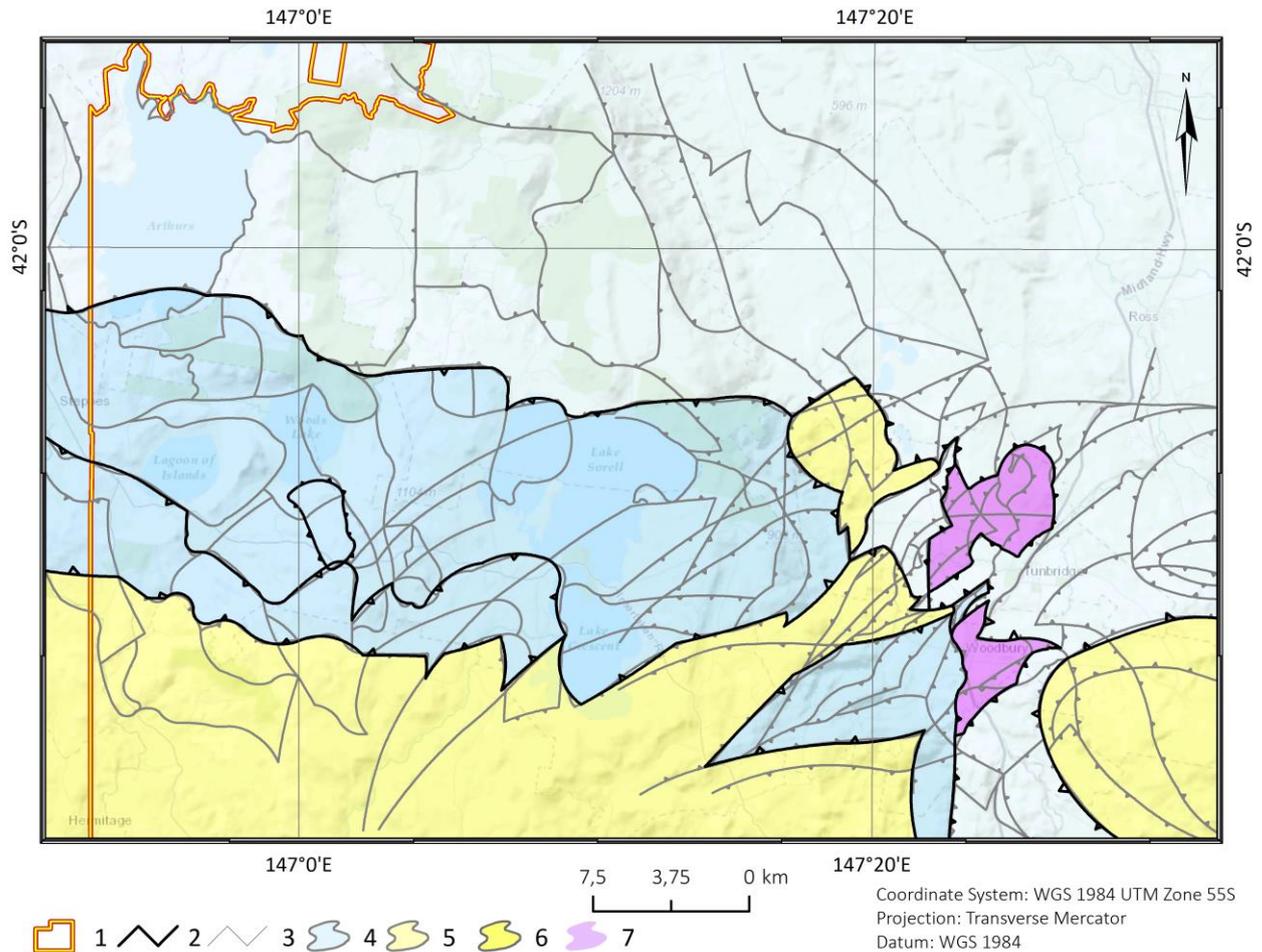
A latitudinal elevated region formed with a narrow graben-like rupture in its southeastern part at the first stage of the formation of the potential oil and gas structure (Figure 93). The rest of the area was in the accumulation zone.



**Figure 93: Target 1. Stage of formation – 1.**

*1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 – zone of shallow sagging; 5 - zone of medium-depth deflection; 6 - zone of uplifting*

The second stage of the area's development is characterized by a slight reduction of the zone of uplifting and, accordingly, by the expansion of the sedimentation area (Figure 94). The trough located in the southeastern part of the area experienced an inversion of movements resulting in a formation of an uplift, which SMA classifies as a structural trap for HC accumulation (highlighted in pink). This stage of the formation of hydrocarbon deposits is associated with a fairly significant restructuring of the area.

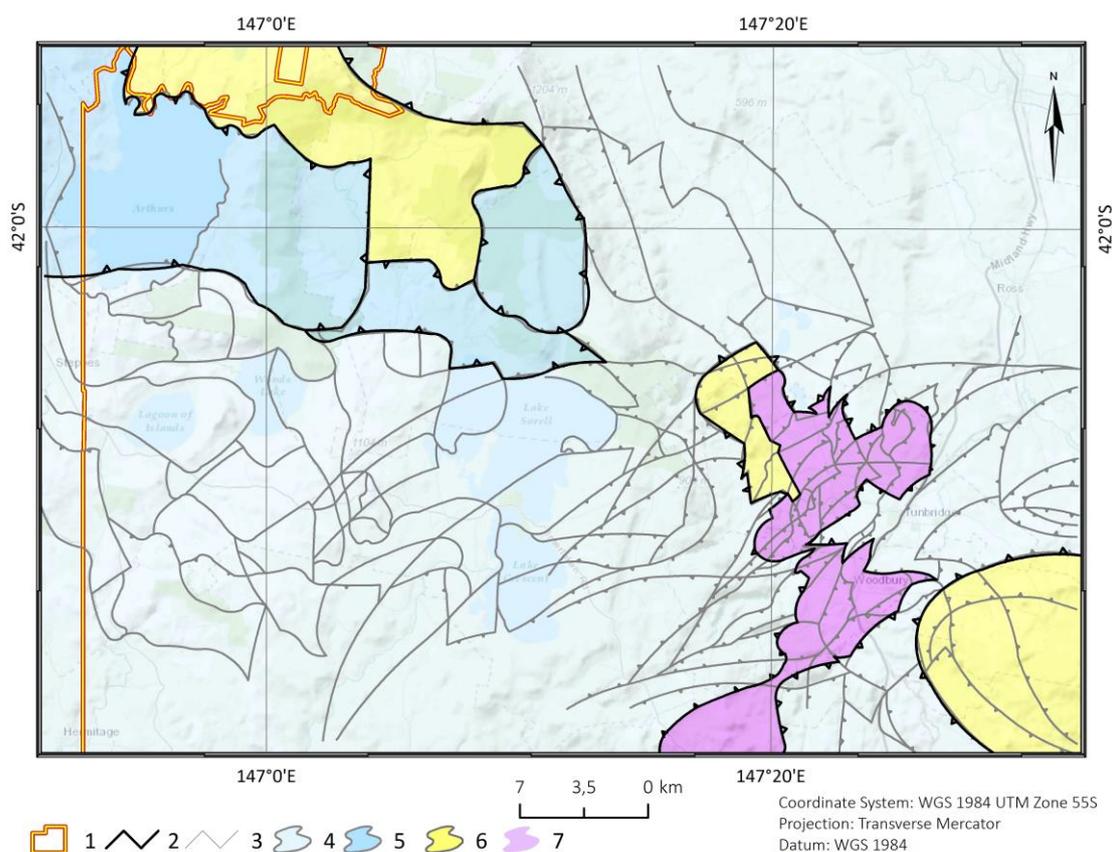


**Figure 94: Target 1. Stage of formation – 2.**

*1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 – zone of shallow sagging; 5 - zone of medium-depth deflection; 6 - zone of uplifting; 7 - potential hydrocarbon deposit*

## Terra Tasmania Resources

The next paleo-reconstruction shown in **Figure 95** reflects the stratigraphically overlying layer and shows that the direction of the axial part of the uplifts, which formed as a result of regional compression, changed from the latitudinal to NNW-orientation. This fact indicates a high degree of intensity of tectonic activity during the formation of these oil deposits. As a result of the inversion of movements, three isolated uplifts formed. The central one, according to SMA, trapped HC's. The formation of the hydrocarbon structure occurred against the backdrop of a regional accumulation and general leveling of the territory in the middle-to-late Cretaceous, which created conditions for the sealing and preservation of hydrocarbon deposits.

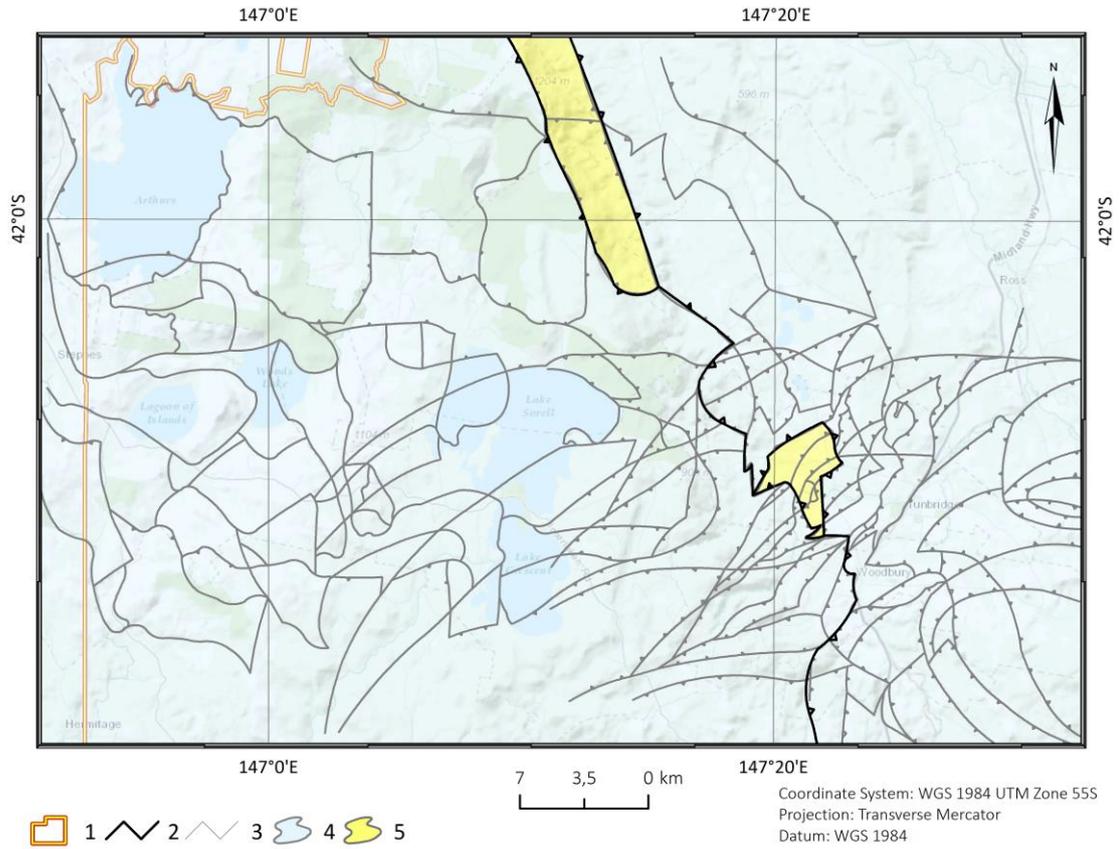


**Figure 95: Target 1. Stage of formation – 3.**

*1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 – zone of shallow sagging; 5 - zone of medium-depth deflection; 6 - zone of uplifting; 7 - potential hydrocarbon deposit*

The final stage of the hydrocarbon deposits' formation shown in **Figure 96** is characterized by the almost complete leveling of the territory. The tectonic activity shifted eastward from the previously formed zone of uplifting forming a zone of NNW-oriented disturbance with two small uplifts, which, according to SMA, are not hydrocarbon traps.

# Terra Tasmania Resources



**Figure 96: Target 1. Stage of formation – 4 (final).**

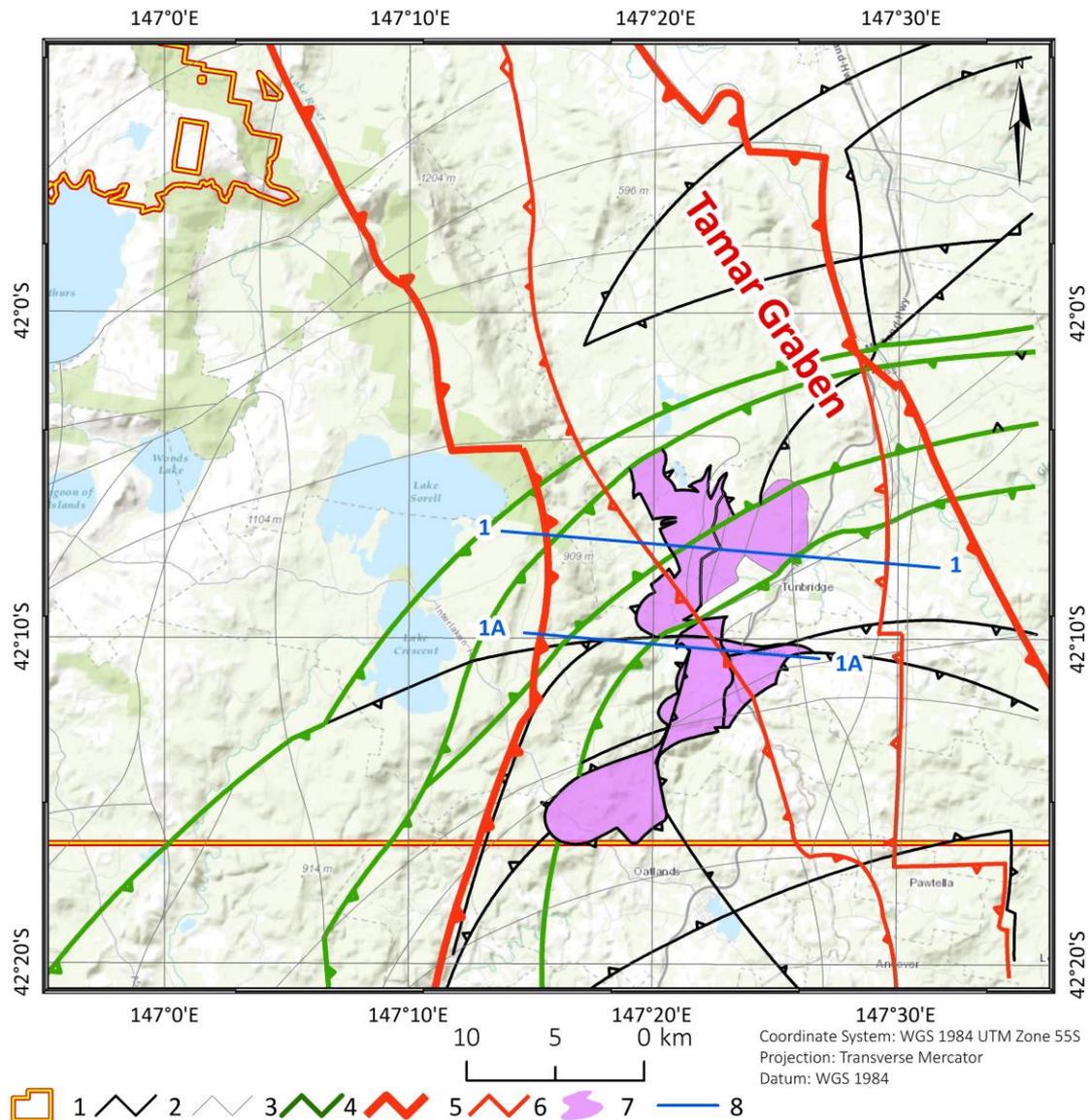
*1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 – zone of shallow sagging; 5 - zone of uplifting*

Stress fields characterize the structural and material composition of a territory for a certain geological period.

## Terra Tasmania Resources

**Figure 97** presents the vector diagram of stresses in the final stage of the formation of Target 1. Stress vectors show the main structural directions that control the areas of accumulation of hydrocarbons.

According to the presented stress pattern, the large prospective oil deposit covering 108 km<sup>2</sup> seems to coincide with a tectonic depression formed at the junction of two regional tectonic trends: the NNW fragment of the Tamar Graben (highlighted in red) and the younger, regional, northeast-trending fault system cutting the graben (highlighted in green).



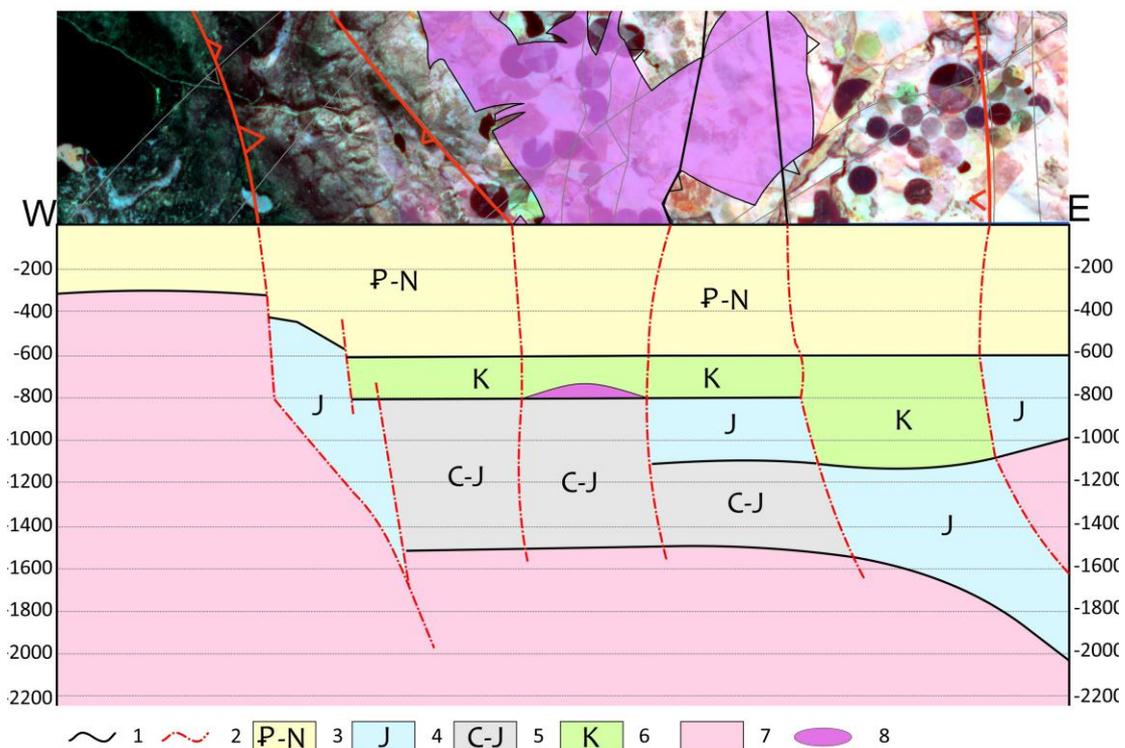
**Figure 97: Stress field scheme during the formation of Target 1 (middle-late Cretaceous).**

*1 – EL30; 2 – rank-one stress field; 3 – rank-two/three stress field; 4 - layered faulting system; 5 – border of Tamar graben; 6 – внутренние тектонические зоны Тамар грабена; 7 - hydrocarbon deposit; 8 - position of structuremetric cross-section*

## Terra Tasmania Resources

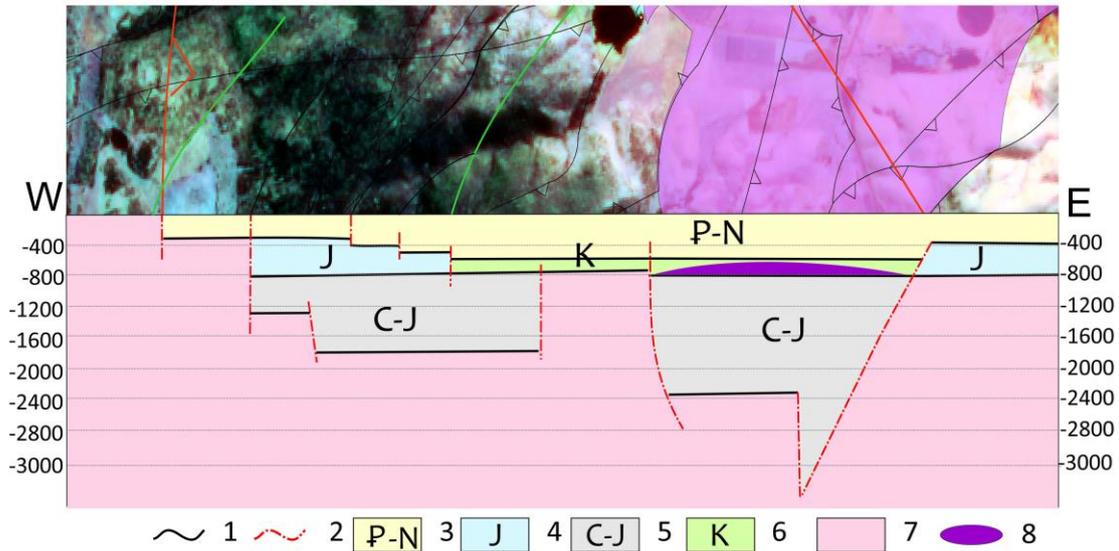
**Figure 98** shows the structural profile through the predicted HC-bearing structure. The proposed hydrocarbon deposit is localized in Cretaceous sediments at the contact with the top of the source-rock Parmeener formation, referred herein as C–J age (highlighted in gray). On both sides, the deposit is limited by steeply dipping, sealing faults. The depth of the productive horizon, according to SMA, is in approximately -800 m. **Figure 100** shows the recommended, priority exploratory wells.

**Figure 98** and **Figure 99** show, using SMA profiling, the northern part of the deposit in the downthrown graben block is controlled from the east and west by the sealing zones of dislocations, and is deposited on top of the Carbon-Jurassic part of the cross section, in turn sealed by sediments of the Middle Cretaceous age. The deposit is confined to a zone of decompaction, formed at the border of two stratigraphic horizons, which indicates for a “structural pinch out” type of a trap.



**Figure 98: Structuremetric cross-section through line 1-1.**

*1 - stratigraphic boundary; 2 - zone of tectonic disturbance; 3 - complex of Paleogene-Neogene deposits; 4 - Jurassic complex; 5 - Cretaceous sediment complex; 6 - Carbon Jurassic complex; 7 - basement; 8 - predicted hydrocarbon deposit*



**Figure 99: Structuremetric cross-section along line 1a-1a.**

*1 - stratigraphic boundary; 2 - zone of tectonic disturbance; 3 - complex Paleogene-Neogene deposits; 4 - Jurassic complex; 5 - Cretaceous sediment complex; 6 - Carbon Jurassic complex; 7 - basement; 8 - predicted hydrocarbon deposit*

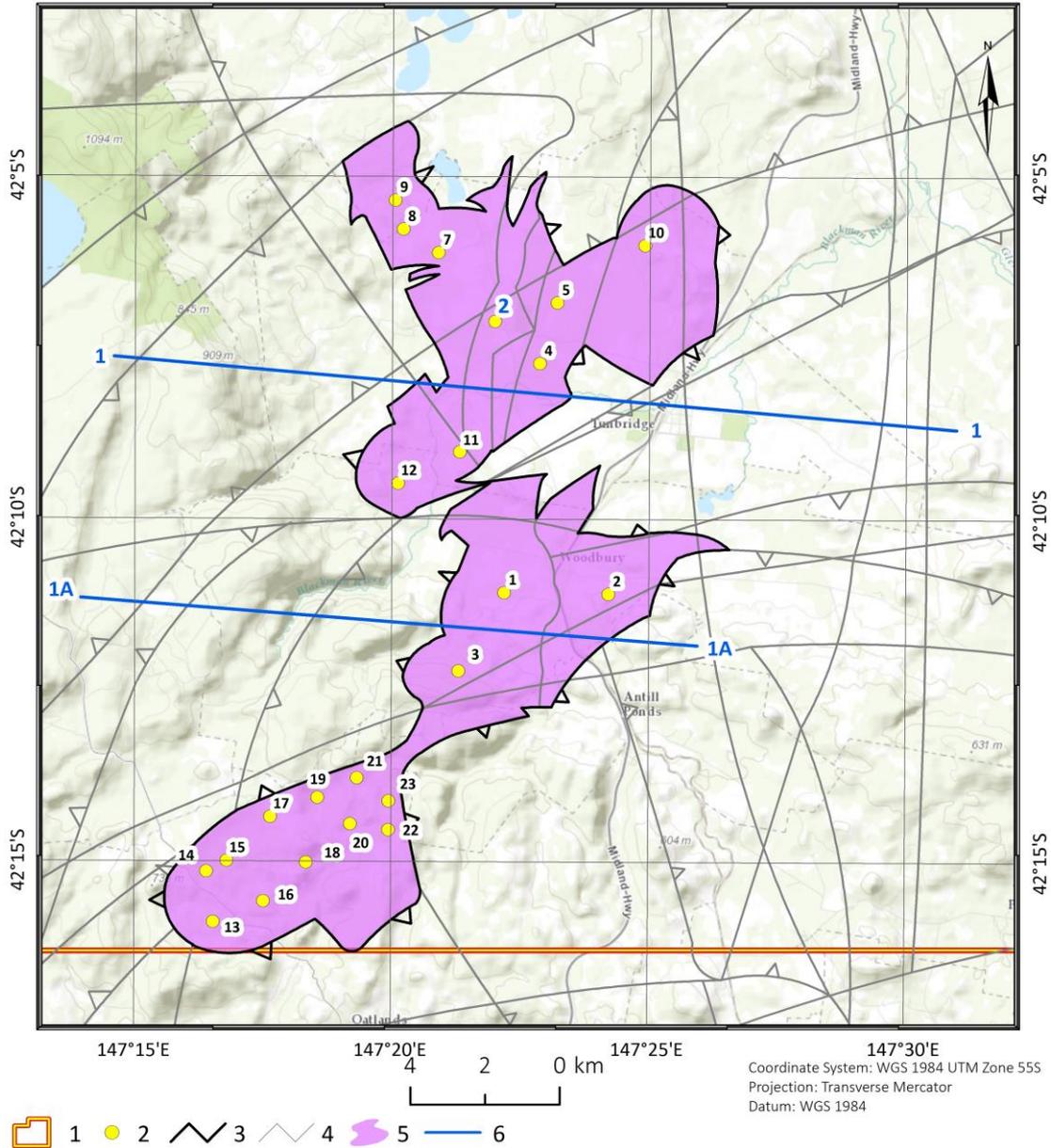
Section 1a-1a (**Figure 99**) intersects the western flank of the graben, which in this location is more tectonically defragmented and divided into separate tectonic blocks. The lateral stratigraphic horizons pinch out: the Jurassic horizons pinch out and are replaced by the Cretaceous horizons. This indicates for significant movement amplitudes of the individual blocks. At the western flank of the predicted reservoir, the basement sharply drops along its displacement zones. The top of the basement here is at approximately -800 meters. The hydrocarbon deposit itself is confined to the most lowered part of the graben. Here we see an increase of thickness of Carbon-Jurassic. The deposit is confined to the top of the Carbon-Jurassic part as well, as shown in the cross-section 1-1 (-700 to -800 meters). The deposit is localized in sediments of the middle-to-late Cretaceous. The thickness of the Cretaceous deposits closely matches the same in the cross-section 1-1.

From the east and west, the reservoir is limited by the sealing displacement zones, directed towards each other and forming a wedge-shaped, pop-up tectonic block. The eastern wing of the projected reservoir is characterized by the elevated basement block. The top of the basement is at around -800 meters covered with Jurassic sediments. Cretaceous deposits in the east wing of the structure, are likely absent on the 1a-1a cross section.

The deposit's position within the context of the general graben structure (at the cross-section) occupies a fairly "expected" position due to: (i) the increased thickness of the Carbon-Jurassic oil-bearing source rocks; and (ii) the flanks of the graben characterized by a substantially uplifted basement.



# Terra Tasmania Resources



**Figure 100: Test drilling locations on Target 1.**

*1 – EL30; 2 – location of high-priority well; 3 – rank-one stress field; 4 – rank-two stress field; 5 - predicted hydrocarbon deposit; 6 – position of structure metric cross-section*



## Terra Tasmania Resources

**Table 1: Test drilling locations coordinates on Target 1.**

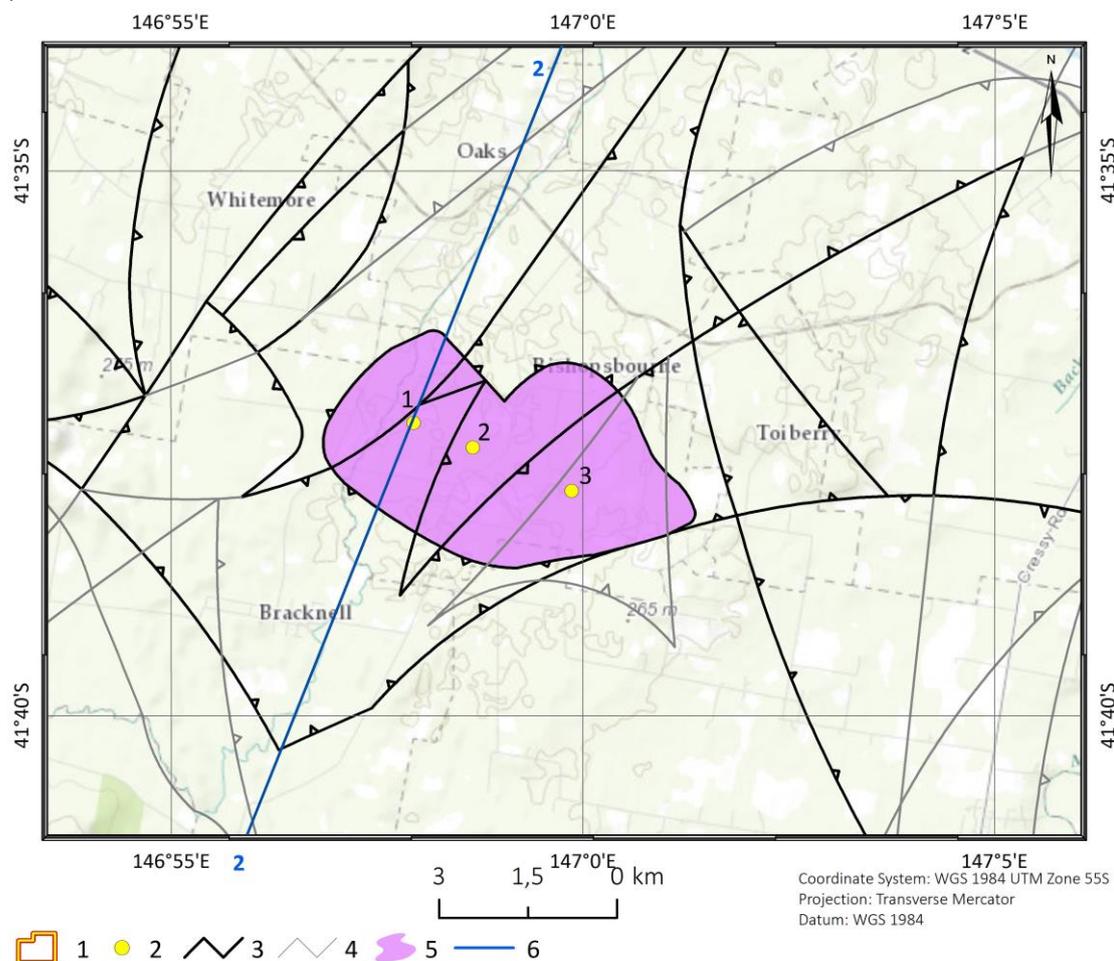
N°	Latitude	Longitude
1	42° 11' 4,686" S	147° 22' 11,188" E
2	42° 11' 5,733" S	147° 24' 12,821" E
3	42° 12' 13,142" S	147° 21' 18,183" E
4	42° 7' 43,949" S	147° 22' 51,902" E
5	42° 6' 50,658" S	147° 23' 12,033" E
6	42° 7' 7,155" S	147° 21' 59,340" E
7	42° 6' 7,050" S	147° 20' 53,497" E
8	42° 5' 46,467" S	147° 20' 12,464" E
9	42° 5' 21,136" S	147° 20' 2,960" E
10	42° 6' 0,250" S	147° 24' 54,036" E
11	42° 9' 1,406" S	147° 21' 19,276" E
12	42° 9' 29,100" S	147° 20' 7,295" E
13	42° 15' 53,259" S	147° 16' 32,433" E
14	42° 15' 9,041" S	147° 16' 24,607" E
15	42° 14' 59,626" S	147° 16' 48,230" E
16	42° 15' 34,965" S	147° 17' 31,141" E
17	42° 14' 21,216" S	147° 17' 39,197" E
18	42° 15' 1,090" S	147° 18' 20,985" E
19	42° 14' 4,341" S	147° 18' 34,067" E
20	42° 14' 27,205" S	147° 19' 12,341" E
21	42° 13' 46,917" S	147° 19' 20,150" E
22	42° 14' 32,466" S	147° 19' 57,019" E
23	42° 14' 7,228" S	147° 19' 57,268" E

### 2.3.3.1 TARGET 2

Target 2 covers 16.2 km<sup>2</sup> and is located on the northwestern side of Tamar Graben, at the upthrown wall of the Tiers Fault (**Figure 90**).

## Terra Tasmania Resources

**Figure 101** shows the stress-field diagram at the time of the formation of the structure. Morphologically, it is a gentle brachy-anticlinal uplift, limited peripherally by dislocation zones. The map shows how the structure is completely “inscribed” into the system of stress vectors, which completely control the zones of migration and accumulation of hydrocarbons. According to the structuremetric cross-section (**Figure 102**), the depth of the productive horizon is -600m.



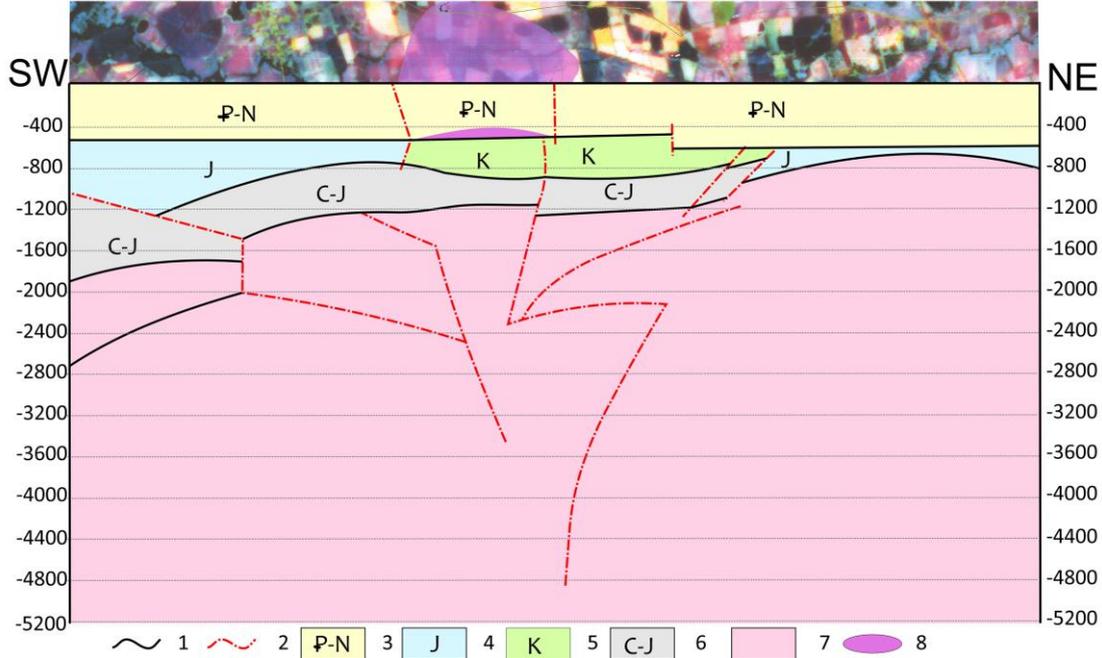
**Figure 101: Stress field scheme during the formation of Target 2 (middle-late Cretaceous).**

*1 – EL30; 2 - location of high-priority well; 3 - rank-one stress field; 4 – rank-two stress field; 5 - predicted hydrocarbon deposit; 6 – position of structuremetric cross-section*

# Terra Tasmania Resources

**Table 2: Test drilling locations coordinates on Target 2.**

N°	Latitude	Longitude
1	41° 37' 18,991" S	146° 57' 56,795" E
2	41° 37' 32,424" S	146° 58' 39,924" E
3	41° 37' 56,386" S	146° 59' 51,721" E



**Figure 102: Structuremetric cross-section of the line 2-2**

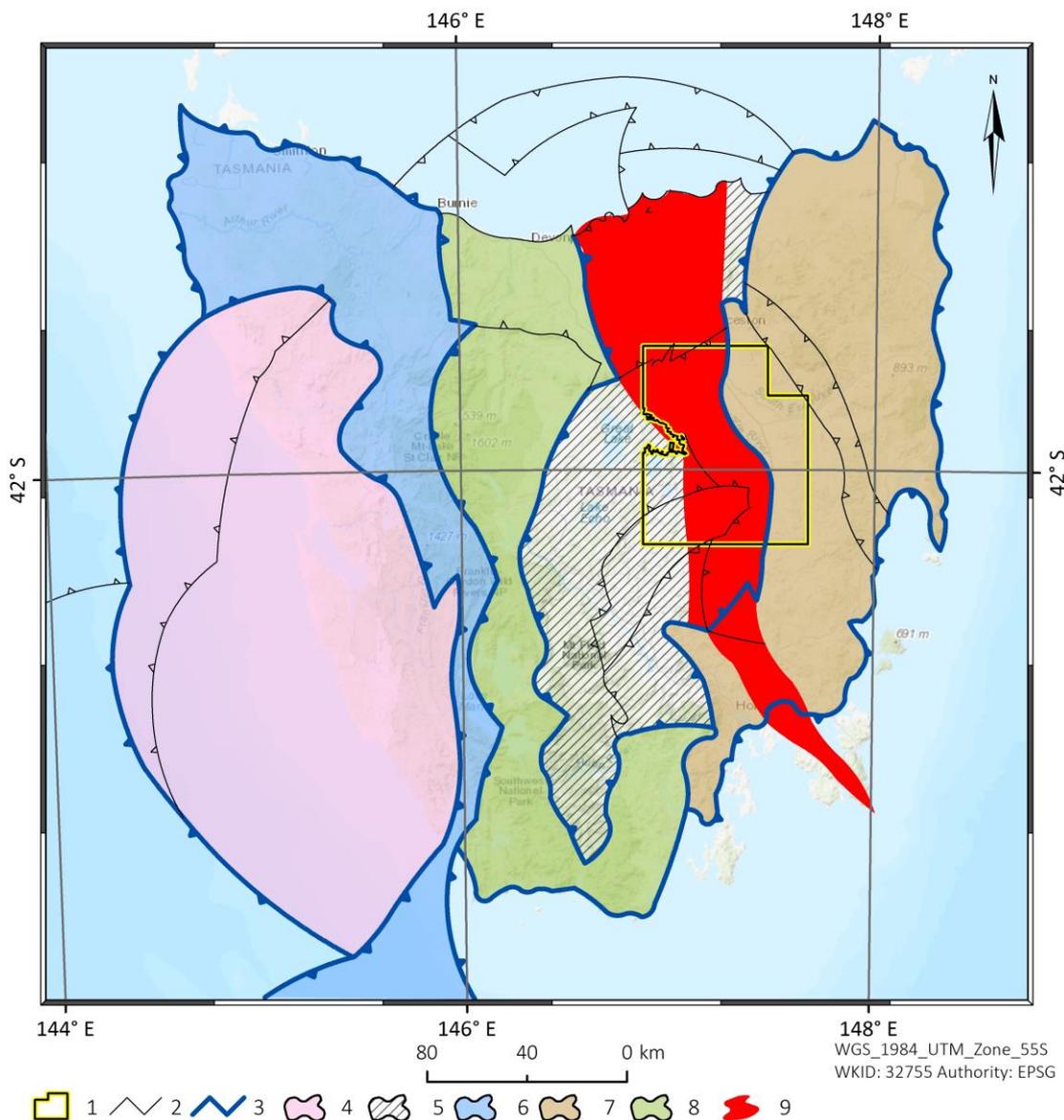
1 - stratigraphic boundary; 2 - zone of tectonic disturbance; 3 - Paleogene-Neogene deposits; 4 - Jurassic complex; 5 - Cretaceous sediment complex; 6 - Carbon Jurassic complex; 7 - basement; 8 - predicted hydrocarbon deposit

Structure 2 is in the northwestern part of the graben (**Figure 104**). According to the SMA cross-section, it is located inside a lowered tectonic block with a highly elevated basement block in the eastern boundary of the trough. The central part of the trough is likely filled with Carbon-Jurassic and Cretaceous deposits. Near the flanks of the trough, Carbon-Jurassic deposits pinch out and are replaced by Jurassic sediments. The deposit is tectonically trapped (stratigraphic pinch-out) by zones of dislocation from east and west. According to SMA, it consists of the middle-to-late Cretaceous sediments and is confined to a stratigraphic boundary. The depth is approximately -500 to -600 meters (to be confirmed).

SMA concluded the Tasmanian basin is of a pronounced cyclical character with prevalent vertical movements.

## Terra Tasmania Resources

**Figure 103** depicts of a diagram of the basement blocks. Boundaries of these blocks are of primary importance, as they control varying areas of the Paleozoic and Meso-Cenozoic sedimentation.



**Figure 103: The structuremetric scheme of the basement blocks.**

*1 – EL30; 2 - stress vectors; 3 - boundary of the basement blocks; 4 - Paleoproterozoic basement block; 5 - border of the Tasmanian basin; 6 - Neoproterozoic basement block; 7 - Devonian basement; 8 - Cambrian-Ordovician basement; 9 – Tamar graben*

The presented scheme presents the basement blocks of four geological ages:

1. The Paleoproterozoic block occupies the western continental and partly coastal part of Tasmania. The eastern part of Tasmania did not exist at that time.
2. The Neoproterozoic block is distinguished in the northwestern and western continental parts of Tasmania - Wickham orogenesis. It is relatively thin and covers the Paleoproterozoic basement. It is also missing in eastern Tasmania.
3. Cambrian-Ordovician block frames the western, southern and eastern parts of the Tasmanian basin and is represented by the Tyennan orogenic formations.



## Terra Tasmania Resources

4. Devonian – orogenic block that is the basement for the Tasmanian Basin (shown by hatching), lies at the base of the source rock, Parmeener Supergroup, and forms the central, northern and eastern coastal continental parts of Tasmania.

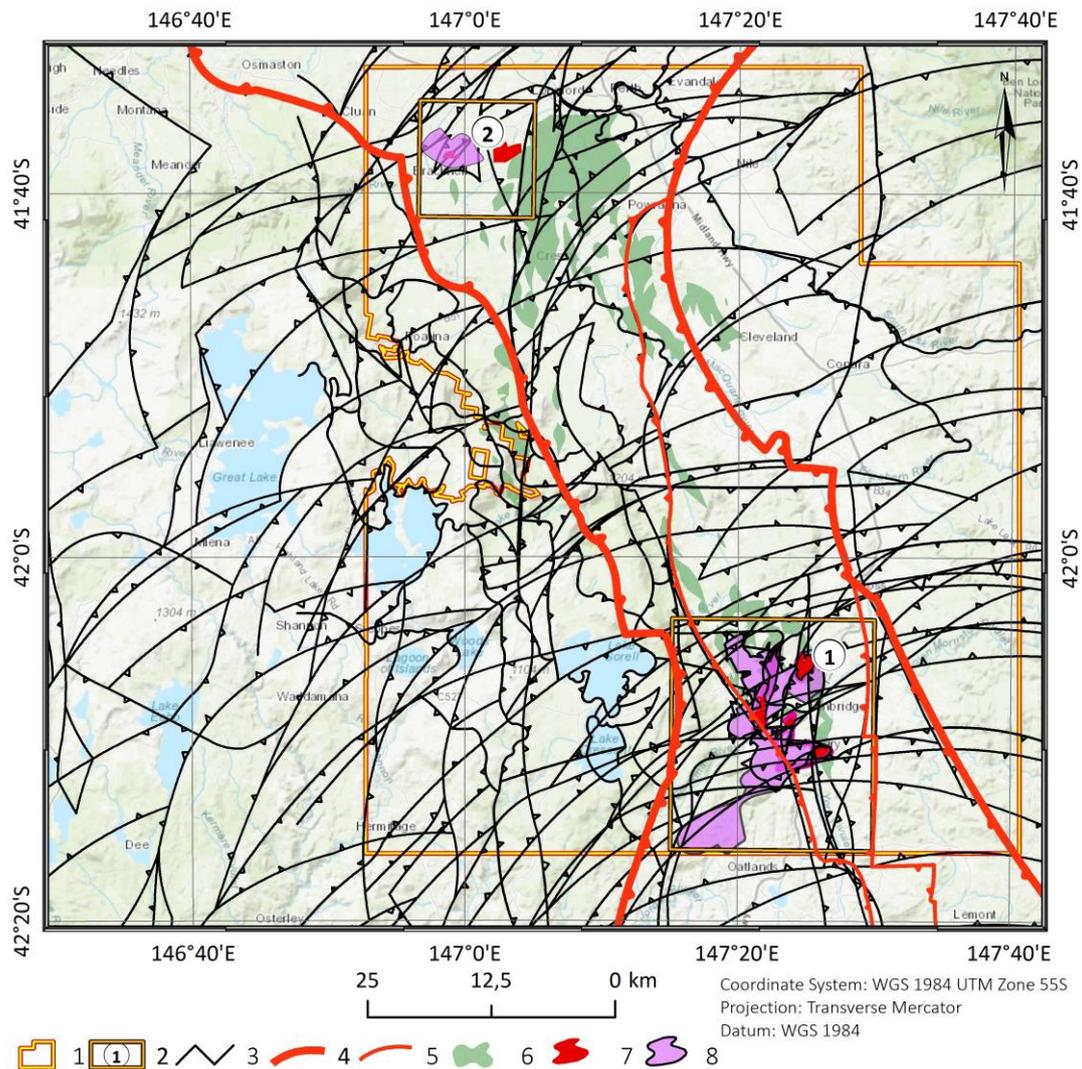
According to SMA, the continental development of Tasmania occurred cyclically and with the general trend of tectonic activity in the Neoproterozoic and Paleozoic stage of development being directed toward the center of the Tasmanian basin. In the Mesozoic stage, the tectonic activity began to shift to the eastern part of Tasmania, which led to the formation of the Tamar Graben structure, highlighted red.

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# Terra Tasmania Resources

## 2.3.3.3 CONCLUSION

The diagram presented in **Figure 104** shows the sequence of the study and the SMA results. The early stage of the analysis included the results at scale of 1: 25,000, which result allocated certain prospective areas (shown in green on the presented map). The second stage of the analysis included preliminary delineation of HC-prospective areas at the scale of 1: 5,000 (shown in red). The final localization of hydrocarbon accumulations and the mapping of the oil-bearing contours with recommendations for further exploration were carried out within the prospective areas delineated at the scale of 1:2,000 (shown in magenta). In summary: at this stage, two areas have been allocated for exploration.

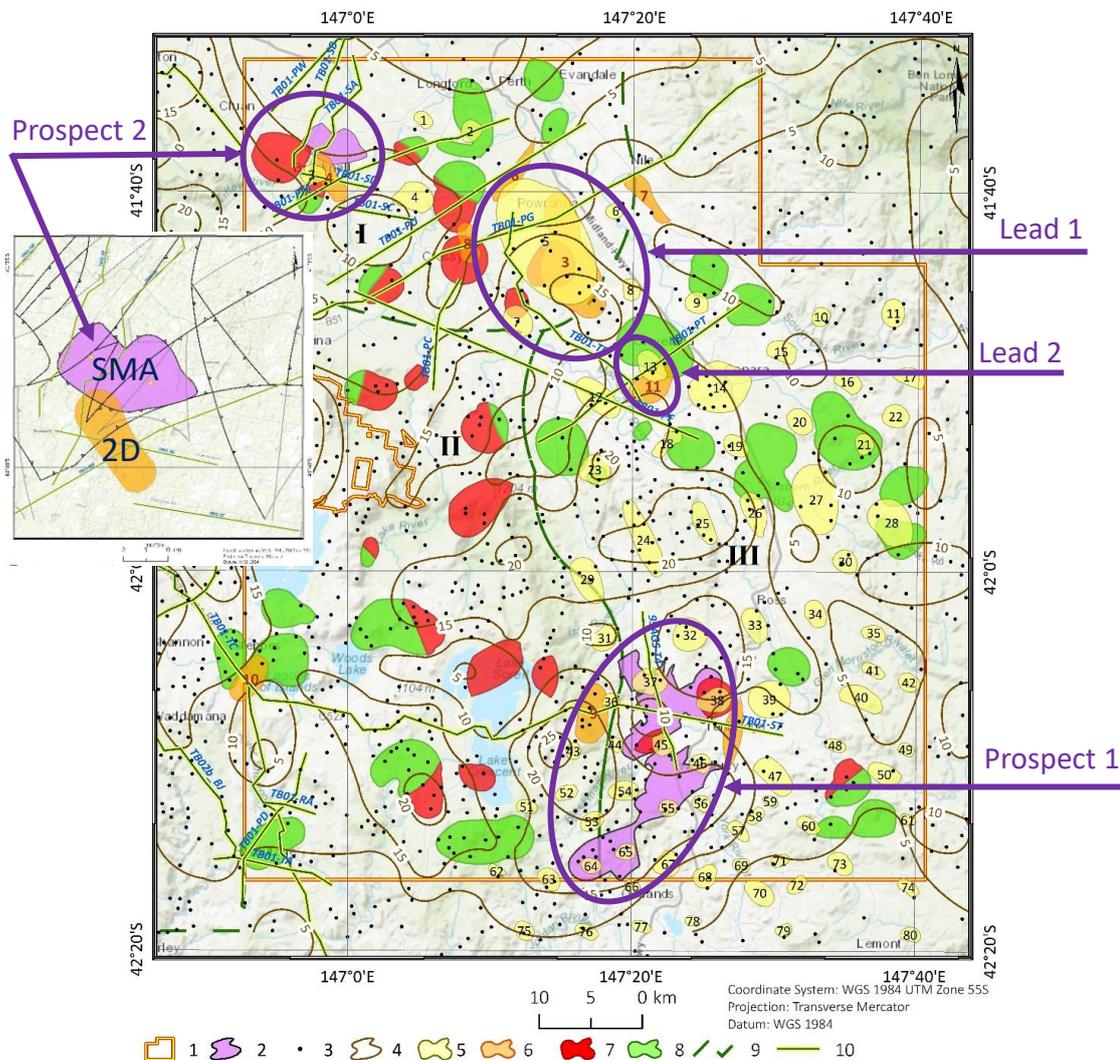


**Figure 104: Sequence of stages and SMA result.**

*1 – EL30; 2 - area of detailed SMA at 1: 2,000; 3 - stress vectors; 4 - boundary of Tamar graben; 5 - prospective area allocated at the scale of 1: 50,000 - 1: 25,000; 6 - prospective area allocated at 1: 5,000; 7 -prospective area identified at 1: 2,000*

## 2.4 STEP LEADS

Based on the STeP work and integration of all the datasets, the exploration targets have been allocated as shown in **Figure 105**.

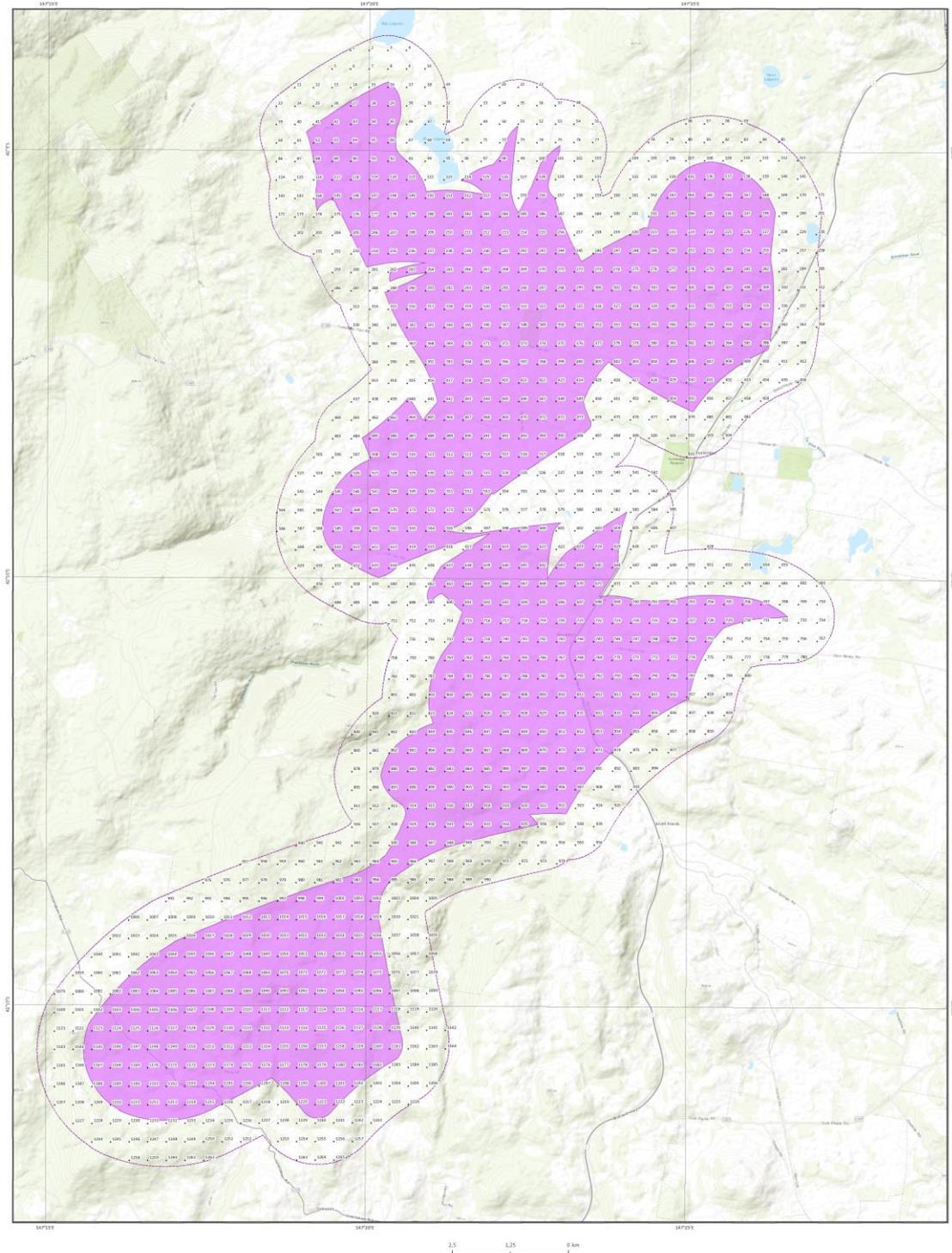


**Figure 105: Leads and prospects for further exploration.**

1 – EL30/2011; 2 – SMA; 3 – GDA node; 4 – GDA; 5 – PSA; 6 – 2D seismic; 7 – PRA; 8 – PRA; 10 – seismic line

## 2.5 RECOMMENDATIONS

Subject to the company’s decision regarding accessibility and prioritization of drilling locations, Prospect 1 is recommended for Natural Adsorbed Gas Survey sampling and geochemical analysis in part or fully as shown in **Figure 106**.

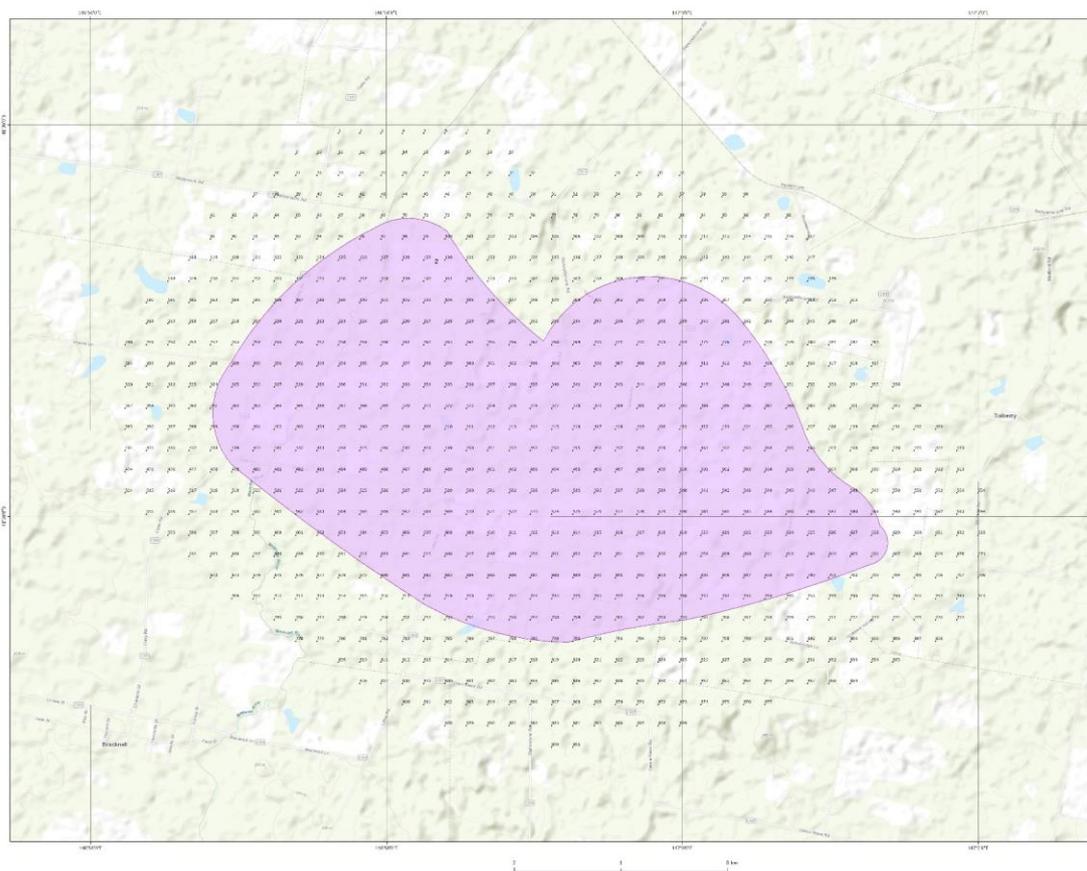


**Figure 106: Locations of geochemical sampling points on Prospect 1.**

A MS Excel file with coordinates of the sampling locations is available upon request.

## Terra Tasmania Resources

Prospect 2 is recommended for Natural Adsorbed Gas Survey sampling and geochemical analysis over the entire lead as shown in **Figure 107**.



**Figure 107: Locations of geochemical sampling points on Prospect 2.**

A MS Excel file with coordinates of the sampling locations is available upon request.