DEPARTMENT OF
PRIMARY INDUSTRIES

Bendigo Zone 1:250 000 scale serial sections & accompanying notes

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Introduction

This document contains metadata-like information about each of the serial cross-sections created as part of the Bendigo Zone basement 3D modelling program. Discussions of constraints such as the biostratigraphy are included as are notes on issues that arose as a result of the construction of these sections and any modifications of the base maps that resulted. The serial sections are included with all the associated potential field datasets that were used to constrain them as A4 pdf's as well as in dxf format for import into the 3D software of your choice. The full size 1:250000 sections and potential field and mapping datasets are available on request but these are very large files and so are not available for download.

3D Modelling workflow

GeoScience Victoria's 3D modelling team have developed a model building workflow, that is applicable to both onshore and offshore model building as well as integration modelling between basement and basin blocks, based on the flowing steps:

- integrate all available surface mapping, drilling constraints, potential field datasets, 3D inversion models, seismic data, and other 2D and 3D datasets into a 3D storage and visualisation environment
- define an agreed stratigraphy for the model region
- construct serial cross sections based on surface geology and geophysical constraints perpendicular to major structural trend with some tie sections parallel to trend if there is sufficient structure to constrain the geometry in this direction.
- Serial sections were then digitised into a 2¾D potential field forward modelling package. Application of common rock property attributes (density and magnetic susceptibility) to the units in the sections and forward modelling of the interpreted geometries then allows a first order assessment of the validity of the starting geometry.
- Serial sections are then "hung" in Gocad and visualised with any appropriate datasets and surfaces were constructed to represent the major crustal basement blocks (Selwyn Block and Delamarian cratonic margin), basement to basin regions and all of the major faults and appropriate tops of major chrono-stratigraphic units.

Geophysical Notes

The majority of the geophysical interpretation is based on gravity data. This was particularly the case in the north where the turbidite basement lies beneath Murray Basin cover, and in the south where recent basalt flows have masked much of the bedrock.

Typically, gravity forward models along serial sections within the Bendigo Zone consist of four main units:

1) Selwyn Block – metamorphosed continental crust, increasing in depth from ~15km in the east to ~40km in the west across the Bendigo Zone. A density of 2.78 T/m^3 has been used to model this unit.
2) Cambrian Volcanics – bounded in the east by the Mount William Fault. The unit is interpreted to consists of a dense mafic sequence (modelled densities of 2.80 to 2.81 T/m^3), which has been over-thrust in the west by a less dense sequence of interlayered mafic rocks and mafic sediments (modelled densities of 2.74 to

2.80 T/m^3). The approximate boundary between these two units is the Campbelltown Fault.

3) Cambrian turbidites (St Arnaud Group) – a folded and faulted sequence, thickening from south to north. Densities used to model this unit range between 2.66 to 2.68 T/m^3 west of the Whitelaw Fault, and 2.65 to 2.67 T/m^3 east of the fault.

4) Ordovician turbidites (Castlemaine Group) – a folded and faulted turbiditic sequence with modelled densities ranging between 2.64 to 2.66 T/m^3.

Depending on the specific section, other bodies modelled include granites, Permian rocks, Cainozoic cover sequences, basalt flows and Silurian rocks within the Melbourne Zone to the east.

Regional Removal

A regional gravity field was approximated using a 3rd order polynomial based on all Bendigo Zone serial sections. The regional response was removed from the terrain corrected Bouguer gravity and the residual field forward modelled.

Fault Interpretation

Fault traces were interpreted primarily from terrain corrected Bouguer gravity data, enhanced by mathematical filtering and image enhancement. Gravity “worms” were also utilized in the interpretation. Previously mapped faults and those interpreted from the T13 seismic data were extrapolated along gravity trends. Where appropriate new faults were interpreted based on gravity data and/or biostratigraphy. Reduced to pole magnetic data was also interrogated during fault interpretation.

Assumptions

- Forward modelling of gravity used to determine large scale structures and geometries.
- Major geometries and structures interpolated north and south from seismic lines have been constrained by surface mapping and geophysical trends.
- In order to fit the observed data with the modelled response a background density of 2.70 T/m^3 was needed to enable a realistic range of rock densities to be used.
- Densities of major units are assumed to remain relatively constant throughout the Bendigo Zone.
- Small scale structures were not considered an important factor in the modelled gravity response. Lithological boundaries were also generalised for the modelling process.
- Where large off-section granites are assumed to influence the gravity response along the section, bodies approximating the intrusions have been included in the modelling of the sections (not displayed in serial section images).

Magnetics

The magnetic data has predominantly been used for interpreting intrusives, Heathcote Fault Zone volcanics and the location of basalt flows. The limited use of magnetic data is the result of a general lack of medium to large wavelength anomalies. The majority of the response is short wavelength anomalies, derived from shallow or surface bodies (eg. basalt). The physical limit of the depth of investigation due to the Curie point (~15-20km) also limits the usefulness of magnetic data.

Density Values

Section Name	Selwyn Block	Mafic Volcanics	Interlayered Sediments/ Volcanics	Cambrian turbidites west of Whitelaw Fault	Cambrian turbidites east of Whitelaw Fault	Ordovician turbidites	Silurian turbidites	Intrusives	Off-line intrusives	Permian	Newer Volcanics	Cover
Bendigo 1	2.78	2.81	2.74	2.67	2.66	2.65	–	2.59–2.6	2.6	2.45	–	2.5
Bendigo 2	2.78	2.81	2.74	2.66	2.65	2.65–2.66	2.65	2.58–2.6	2.59	2.5	–	2.55
Bendigo 3	2.78	2.81	2.74	2.66–2.67	2.67	2.65	2.65	2.57–2.58	2.59	–	–	2.5
Bendigo 4	2.78	2.81	–	2.67	2.67	2.64–2.65	2.64	2.56–2.6	–	2.55–2.56	–	–
Bendigo 5	2.78	2.81	2.74	2.67	2.67	2.65	2.64	2.6	2.6	2.5	–	–
Bendigo 6	2.78	2.81	2.74	2.67	2.66	2.65	2.64	2.6–2.62	–	–	–	–
Bendigo 7	2.78	2.81	2.74	2.67	2.67	2.64–2.65	2.63	2.59–2.61	2.59–2.62	–	–	–
Bendigo 8	2.78	2.81	2.74	2.68	2.65	2.65	2.64	2.59–2.6	2.6	–	2.6–2.7	–
Bendigo 9	2.78	2.8	2.74	2.67	2.66	2.65	2.65	2.59	–	2.56	2.5–2.55	–
Bendigo 10	2.78	2.8	2.74	2.67	2.67	2.65–2.66	2.65	2.59–2.6	2.59	2.3	–	2.45
Bendigo 11	2.78	2.81	2.74	2.67–2.68	2.66	2.65	2.64	2.6	–	2.1	–	–
Bendigo 13	–	2.81	–	2.67	–	2.65	–	2.6	–	–	–	2.5–2.55
Bendigo 14	2.78	2.81	–	2.67	2.66	2.65	–	2.57–2.6	–	–	–	2.55
Bendigo 15	2.78	2.7–2.81	–	–	2.65–2.66	2.65–2.66	–	–	–	2.4	–	2.55
Bendigo 16	–	2.81	2.74	2.66	2.66	2.65	–	2.6	2.6	–	–	–
Bendigo 17	2.78	2.81	2.74	2.67	–	2.65	–	2.58–2.59	2.6	–	–	–
Bendigo 18	2.78	2.81 (2.61)	–	–	2.67	2.65	2.64	–	–	2.56	–	–
Bendigo 19	2.78	2.81	–	2.67	–	2.65	–	2.59	–	2.56	–	2.5

Table 1. Density values (T/m^3) used in forward modelling of serial sections.

Section name Line 1

End point coordinates

Geological section MGA 189306/6000000–307150/6000000, zone 55.

Geophysical section MGA 180100/6000000–320000/6000000, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Wedderburn 1:100,000; St Arnaud 1:250,000; Bendigo 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation

This serial section is 100% undercover. All fold axes, biostratigraphy and structural relationships have been projected from lines 2, 3 and 4. There exists a large amount of unconstrained interpretation in this section due to the extensive cover.

Previous interpretation

Cross sections from reference mapsheets are shallow, largely diagrammatic and missing biostratigraphic information. No structural information exists in the area of this section due to cover.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults, biostratigraphy and fold axes locations have been directly projected from sections further south. Fault trends have been determined form regional gravity data. The depth to Cambrian volcanics and shape of intrusive bodies has been calculated from gravity forward modelling.

Geological assumptions

Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping project and are missing from this version of Line 1.

Identified problems

- 100% of this section lies beneath cover.
- Poor control over fold axes, fault trends and biostratigraphy.
- The regional structural architecture on all reference mapsheets is largely uninterpreted.

Biostratigraphic control

Biostratigraphy has been correlated with lines 2, 3 and 4. Fold axes have been projected from the south and fold plunges estimated between 10–30 degrees, with numerous reversals between sections. Enveloping surfaces were inferred to dip at shallow angles. Cross-sections were then drawn to refine the inferred biostratigraphy.

Notes on the geophysical interpretation

Major geophysical features

Major features include;

- A broad gravity high (up to -25 $\mu m/s^2$) in the western half of the section.
- A Large gravity low (-240 $\mu m/s^2$) in centre of section, corresponding to the Pyramid Hill granite.
- An increased gravity response (-55 $\mu m/s^2$) in the west related to thickened Cambrian volcanics at depth due to an antiformal stack.
- A magnetic profile that shows little variation along the section. A low response (60600 nT) at the western margin is associated with an increased volume of sediment interlayered Cambrian volcanics and Stawell Zone granites. East of the Mount William Fault (Melbourne Zone) the response increases from 60730 to 60765 nT.

Gravity forward modelling

Forward modelling of Line 1 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. A background density of 2.7 T/m^3 was used. Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large wavelength anomalies associated with deeper, larger scale relationships of major units. A close match of modelled to observed was not attempted east of the Mount William Fault.

Modelled results suggest;

- A Cainozoic cover ranging in thickness from 30 m in the west to 400 m in the east.
- Permian rocks (associated with minor localised negative anomalies) with thicknesses up to 400 m.
- Off-section granite bodies at MGA 226900/6008200 and MGA 170000/6000000.

Geophysical assumptions

- Small scale structural detail at lithological boundaries has been simplified to only reflect the regional trend of the boundary.
- The gravity anomaly associated with the Heathcote Fault Zone is off-set to the east relative to the magnetic anomaly and mapped fault trace.
- Non-magnetic or low-magnetic Cambrian volcanics at depth are interpreted as the source of the gravity anomaly.

Section name Line 2

End point coordinates

Geological section MGA 180000/5980000–311500/5980000, zone 55.

Geophysical section MGA 180100/5980000–330000/5980000, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Tongala 1:50,000; Wedderburn 1:100,000; St Arnaud 1:250,000; Bendigo 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation

This serial section is 85–90% undercover. It has been directly correlated with the T13 seismic transect, from which most of the structural relationships have been derived. Fold axes have been projected from lines further south and constrained by only a limited amount field data. There exists a large amount of unconstrained interpretation in this section due to extensive cover.

Previous interpretation

Cross sections from reference mapsheets are shallow, largely diagrammatic and missing biostratigraphic information. Only a limited amount of structural information exists in the area of this section.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults, biostratigraphy and fold axes locations have been directly projected from sections further south. Fault trends have been determined form regional gravity data. The depth to Cambrian volcanics and shape of intrusive bodies has been calculated from gravity forward modelling.

Geological assumptions

Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping

project and are missing from this version of Line 2.

Identified problems

- 85–90% of this section lies beneath cover.
- Poor control over fold axes, fault trends and biostratigraphy.
- The regional structural architecture on all reference mapsheets is largely uninterpreted.
- Folds east of the Redesdale Fault appear more open due to a change in regional strike across the section.

Biostratigraphic control

Biostratigraphy has been correlated with lines 3, 4 and 5. Fold axes have been projected from the south and fold plunges estimated between 10–30 degrees, with numerous reversals between sections. Enveloping surfaces were inferred to dip at shallow angles. Cross-sections were then drawn to refine the inferred biostratigraphy.

Notes on the geophysical interpretation

Major geophysical features

Major features include;

- Large gravity lows of up to -170 $\mu m/s^2$ in the west of the section.
- A relatively constant (-80 $\mu m/s^2$) gravity response in the centre of the section with superimposed short wavelength, small amplitude anomalies.
- A high gravity response (-4 $\mu m/s^2$) in the west related to a Cambrian volcanic antiformal stack at depth.
- A decreased gravity response (-120 $\mu m/s^2$) in the Melbourne Zone.
- A Magnetic profile with a high response (60900 nT) in the west over the magnetic phase of the Wedderburn Granite. In the east a broad anomaly (60780 nT) is likely associated with thickened Cambrian volcanics at depth. A sharp, small wavelength, high amplitude (60860 nT) anomaly in the east indicates the presence of highly magnetic Cambrian volcanics near surface.

Gravity forward modelling

Forward modelling of Line 2 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. A background density of 2.7 T/m^3 was used. A close match of modelled to observed was not attempted east of the Mount William Fault. Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large wavelength anomalies associated with deeper, larger scale relationships of major units.

Modelled results suggest;

- A Cainozoic cover up to 250 m thick.
- Permian rocks to a depth of 530 m east of the Wedderburn Granite
- An off-section granite body at MGA 213000/5967700.

Assumptions

- Small scale structural detail at lithological boundaries has been simplified to only reflect the regional trend of the boundary.
- The gravity anomaly associated with the Heathcote Fault Zone is off-set to the east relative to the magnetic anomaly and mapped fault trace.
- Non-magnetic or low-magnetic Cambrian volcanics at depth are interpreted as the source of the gravity anomaly.

Section name Line 3

End point coordinates

Geological section MGA 185000/5955000–302300/5955000, zone 55.

Geophysical section MGA 185000/5955000–320000/5955000, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Rheola 1:50,000; Inglewood 1:50,000; Raywood and part of Dingee 1:50,000; Huntly and part of Kamarooka 1:50,000; Avonmore 1:50,000; Colbinabbin1:50,000; Wedderburn 1:100,000; St. Arnaud 1:250,000; Bendigo 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation

This serial section has been directly correlated with the T13 seismic transect, from which most of the structural relationships have been derived. Previous mapping and limited biostratigraphy has also been used to constrain the section. Fold axes were projected from lines further south and constrained by field data.

Previous interpretation

Due to limited outcrop most previous cross-section interpretations are largely diagrammatic. Detailed structural information is common on the Rheola and Inglewood 1:50,000 sheets, and in southern and eastern regions of the Raywood and Huntly 1:50,000 sheets.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults has been directly interpreted from the T13 seismic transect, which this line sub parallels. Smaller faults have been interpreted from the gravity data and field relationships. Fault trends have largely been determined form previous mapping and refined using regional gravity data. The depth to Cambrian volcanics, shape of intrusive bodies and thickness of Permian rock has been estimated from the seismic transect and gravity forward modelling.

Geological assumptions and identified problems

Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and

Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping project and are missing from this version of Line 3.

Biostratigraphic control

Numerous graptolite localities on both the Raywood and Huntly 1:50, 000 mapsheets have provided good biostratigraphic control south of this line.

Notes on the geophysical interpretation

Major geophysical features

Major features include;

- Large gravity lows of -225 $\mu m/s^2$ and -155 $\mu m/s^2$ in the west of the section.
- A relatively flat Bouguer gravity response in the central section of around -100 $\mu m/s^2$. The high pass image in this region shows along strike linear features consistent with faults identified in the seismic transect.
- A peak gravity response of 6 $\mu m/s^2$ in the east of the section indicating the presence of near surface Cambrian volcanics. The profile quickly decreases to -120 $\mu m/s^2$ in the Melbourne Zone.
- A magnetic response that is generally flat along the section, averaging around 60660 nT. Three large anomalies in the west (correlating with gravity lows) indicate the presence of magnetic granites. A sharp, small wavelength, high amplitude (61000 nT) anomaly in the east indicates the presence of highly magnetic Cambrian volcanics near surface. The high frequency, low amplitude anomalies in the data indicate the presence of magnetic material in sedimentary cover sequences.

Gravity forward modelling

Forward modelling of Line 3 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. A background density of 2.7 T/m^3 was used. Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large wavelength anomalies associated with deeper, larger scale relationships of major units. The thin Cainozoic cover sequences have not been included in the forward model for this section (typically ≤ 50m).

Modelled results suggest;

- Permian rocks to a depth of 250 m west of the Heathcote Fault Zone
- An off-section granite body at MGA 213000/5967700

Geophysical assumptions

- Permian sediments are assumed to lie beneath Cainozoic cover near the eastern margin of the Bendigo Zone
- The modelled Mt William Fault lies to the west of the previously mapped fault trace, possibly indicating the presence of lower density Cambrian volcanics or metasediments in its hanging wall. This has not been included in the forward model.

Section name Line 4

End point coordinates

Geological section MGA 212800/59655000–302000/5954750, zone 55.

Geophysical section MGA 212800/5965500–316549/5952994, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Raywood and part of Dingee 1:50,000; Huntly and part of Kamarooka 1:50,000; Avonmore 1:50,000; Colbinabbin1:50,000; Wedderburn 1:100,000; St. Arnaud 1:250,000; Bendigo 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation

This serial section approximates the line of the T13 seismic transect and has provided the basis for many of the structural relationships in this, and on adjacent, serial sections. Previous mapping and biostratigraphy has also been used to constrain the section. Fold axes were projected from lines further south and constrained by limited field data.

Fault Interpretation

Drummartin Fault
West dipping reverse fault, identified from the seismic transect and gravity data. Fault interpreted as a splay from the Redesdale Fault.

Fosterville Fault
West dipping reverse fault. Controlled to 5940000 mN by mining at Fosterville. Northern projection to seismic line constrained using gravity data. Southern trace reinterpreted and currently believed to diverge from previous interpretations at 5927000 mN. Gravity data suggests the Fosterville Fault represent a splay from the Redesdale Fault.

Heathcote Fault
West dipping reverse fault. Seismic data and forward modelling indicate a 60–70 degree dip. Fault trend largely determined from previous mapping.

Meadow Valley Fault
West dipping reverse fault. Dip direction inferred from gravity data (previous mapping had fault dipping opposite direction). Trend remains largely unaltered, although the northern extent of the fault has been greatly reduced.

Mt William Fault
West dipping reverse fault. Seismic data and forward modelling indicate a 60–70 degree dip. Fault trend largely determined from previous mapping.

O'Dwyers Fault
Small west dipping reverse fault. Originally Interpreted form the Avonmore 1:50 000 mapsheet.

Mount Pleasant Creek Fault
Identified from geophysics only. The fault dip and trend was interpreted from previous mapping and gravity data. This fault has been truncated prior to intersecting the seismic line by a previously unmapped fault. The fault is now interpreted as a west dipping, north northwest striking splay from the Heathcote Fault Zone.

Redesdale Fault
West dipping reverse fault. Inferred from graptolites and bedding trend changes on the Redesdale 1:50,000 mapsheet and extended to seismic line using gravity data.

Sebastian Fault
East dipping reverse fault interpreted from previous mapping. Surface trace altered north of 5944000 mN (after fault and graptolite control becomes masked beneath basalt) using gravity data.

Selwyn Block
Depth and shape interpreted form gravity modelling and seismic data.

Whitelaw Fault
West dipping reverse fault. Graptolite control to 5942000 mN. Interpreted from previous mapping and projected north using gravity data.

Previous interpretation

Due to extensive cover most previous cross-section interpretations are largely diagrammatic. Detailed structural information is common on the Rheola and Inglewood 1:50,000 sheets, and in southern and eastern regions of the Raywood and Huntly 1:50,000 sheets.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults has been directly interpreted from the T13 seismic transect, which this line parallels. Smaller faults have been interpreted from the gravity data and field relationships. Fault trends have largely been determined form previous mapping and refined using regional gravity data. The depth to Cambrian volcanics, shape of intrusive bodies and thickness of Permian rock has been estimated from the seismic transect and gravity forward modelling.

Geological assumptions and identified problems

Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping

project and are missing from this version of Line 4.

Biostratigraphic control

Numerous graptolite localities on both the Raywood and Huntly 1: 50,000 mapsheets have provided good biostratigraphic control south of this line.

Notes on the geophysical interpretation

Major geophysical features

Major features include;

- A Large gravity low of -290 $\mu m/s^2$ at the western margin of the section which continues off-section.
- A gravity response of around -100 $\mu m/s^2$ in the central region of the section, with minor variations (+/- 20 $\mu m/s^2$), interpreted as the influence faulting and the presence of Permian rock.
- A peak gravity response of 2 $\mu m/s^2$ in the east indicating the presence of outcropping Cambrian volcanics.
- A decreased gravity response to around -195 $\mu m/s^2$ in the Melbourne Zone
- A magnetic response that is generally flat along the section, averaging around 60660 nT. A large anomaly in the west (correlating with the gravity low) indicates the presence of a magnetic granite (with non-magnetic inner phase). A sharp, small wavelength, high amplitude (60995 nT) anomaly in the east indicates the presence of highly magnetic Cambrian volcanics at surface. The high frequency, low amplitude anomalies in the data indicate the presence of magnetic material in sedimentary cover sequences.

Gravity forward modelling

Forward modelling of Line 4 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. The turbidite – volcanic boundary was based on seismic interpretation. A background density of 2.7 T/m^3 was used. Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large wavelength anomalies associated with deeper, larger scale relationships of major units. The thin Cainozoic cover sediments have not been included in the forward model for this section (typically ≤ 50m).

Modelled results suggest;

- The Wedderburn Granite consists of a less dense (2.56 T/m^3) inner phase and denser (2.60 T/m^3) outer phase.
- Permian rocks to a depth of 550m.
- An off-section granite body at MGA 234400/5953300.

Seismic

Line 4 is a straight line approximation of line 2 of the T13 seismic transect. The previous interpretation of the seismic section shows a turbidite sequence extending from surface to a depth of between 15 km and 19km. Underlying the turbidites is a sequence of overthrust mafic volcanics which thicken to the west. In the east the volcanics daylight in the hanging wall of the Mount William and Heathcote faults. A wedge of continental crust (Selwyn Block) underlies the volcanics and Melbourne Zone rocks in the east of the line. The Selwyn Block thickens to the east. The Moho is interpreted at a depth of approximately 40 km.

Geophysical assumptions

- Permian sediments are assumed to lie beneath Cainozoic cover near the east and west margins of the Bendigo Zone
- The modelled Mt William Fault lies to the west of the previously mapped fault trace, possibly indicating the presence of lower density Cambrian volcanics or metasediments in its hanging wall. This has not been included in the forward model.

Section name Line 5

End point coordinates

Geological section MGA 190185/5940000–299200/5940000, zone 55.

Geophysical section MGA 190000/5940000–330000/5940000, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Rheola 1:50,000; Inglewood 1:50,000; Raywood and part of Dingee 1:50,000; Huntly and part of Kamarooka 1:50,000; Avonmore 1:50,000; Colbinabbin1:50,000; Wedderburn 1:100,000; St. Arnaud 1:250,000; Bendigo 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation

This serial section has been correlated with the T13 seismic transect, Line 3, Line 4 and previous geological mapping. Biostratigraphy has been used heavily to determine structural trends and geometry. Fold axes were constrained by field data.

Previous interpretation

Due to cover most cross sections from reference mapsheets are largely diagrammatic, however, detailed structural information is common on the Rheola and Inglewood 1:50,000 mapsheets, and in areas south of Bendigo on the Raywood and Huntly 1:50,000 mapsheets.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults has been directly projected from the T13 seismic survey, Line 3 and Line 4. Fault trends have largely been determined form previous mapping and refined using regional gravity data. The depth to Cambrian volcanics, shape of intrusive bodies and thickness of Permian rock has been estimated from the seismic transect and gravity forward modelling.

Geological assumptions and identified problems

Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible

Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping project and are missing from this version of Line 5.

Biostratigraphic control

Numerous graptolite localities on both the Raywood and Huntly 1:50,000 mapsheets have provided good biostratigraphic control south of this line.

Notes on the geophysical interpretation

Major geophysical features

Major features include;

- A low gravity response of around -150 $\mu m/s^2$ in the western part of the section increasing to -75 $\mu m/s^2$ before gradually decreasing to -135 $\mu m/s^2$ toward the east.
- A peak gravity response of -28 $\mu m/s^2$ in the east indicating the presence of Cambrian volcanics at or near the surface. Minor variations of +/- 20 $\mu m/s^2$ correlate with faults.
- A variable gravity response in the Melbourne Zone. The response drops to around -265 $\mu m/s^2$ adjacent to the Heathcote Fault Zone before increasing to -210 $\mu m/s^2$ at the eastern end of the section.
- A magnetic response that is generally flat along the section, averaging around 60650 nT. The response increases to around 60720 nT in the west, peaking at 60830 nT. Sharp, small wavelength, high amplitude (~60990 nT) anomalies in the east indicates the presence of highly magnetic Cambrian volcanics near surface. Small, high frequency, low amplitude anomalies indicate presence of basalt flows and magnetic material in sedimentary cover sequences.

Gravity forward modelling

Forward modelling of Line 5 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. A background density of 2.7 T/m^3 was used. Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large wavelength anomalies associated with deeper, larger scale relationships of major units. A close match of modelled to observed was not attempted east of the Mount William Fault. Thin Cainozoic cover sediments have not been included in the forward model for this section (typically ≤ 50m).

Modelled results suggest;

- Permian rocks to a depth of 50 m west of the Heathcote Fault Zone.
- Off-section granite bodies at MGA 210250/5957050, 200400/5945500, and 234000/5952600.

Geophysical assumptions

- Small scale structural detail at lithological boundaries has been simplified to only reflect the regional trend of the boundary.
- In the west of the section a larger volume of granite was modelled than has been mapped and may indicate a greater lateral extent of intruded granite below surface.
- Permian sediments are assumed to lie beneath Cainozoic cover near the eastern margin of the Bendigo Zone
- The modelled Mt William Fault lies to the west of the previously mapped fault trace, possibly indicating the presence of lower density Cambrian volcanics or metasediments in its hanging wall. This has not been included in the forward model.

Section name Line 6

End point coordinates

Geological section MGA 190000/5907000–299800/5907000, zone 55.

Geophysical section MGA 190000/5907000–330000/5907000, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Dunolly 1:50,000; Laanecoorie 1:50,000; Lockwood 1:50,000; Bendigo 1:50,000; Heathcote 1:50,000; Costerfield and part of Pyalong 1:50,000; St. Arnaud 1:250,000; Bendigo 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation

This serial section has been correlated with Line 5 and previous geological mapping both to the north and south. Biostratigraphy has been used heavily to determine structural trends and geometry. Fold axes were constrained by field data.

Previous interpretation

Good quality cross-section interpretations and detailed structural information common on all mapsheets used.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults has been projected from sections further north. Fault trends have been determined from previous mapping and refined using regional gravity data. The depth to Cambrian volcanics, shape of intrusive bodies and thickness of Permian rock has been estimated from gravity forward modelling.

Geological assumptions and identified problems

Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping

project and are missing from this version of Line 6.

Biostratigraphic control

Numerous graptolite localities and detailed bio-zones on the Lockwood, Bendigo, Malmsbury, Castlemaine and Redesdale 1:50,000 mapsheets have provided excellent control on this line.

Notes on the geophysical interpretation

Major geophysical features

Major features include;

- A gravity profile dominated by low responses (up to -300 $\mu m/s^2$) associated with granite intrusions and a number of minor variations (+/- 10 $\mu m/s^2$) related to major faults.
- A variable gravity response in the Melbourne Zone. The response drops to around -300 $\mu m/s^2$ adjacent to the Heathcote Fault Zone before increasing to -260 $\mu m/s^2$ at the eastern end of the section.
- A magnetic response that is generally flat along the section, averaging around 60650 nT. Localised high frequency anomalies, predominantly in the west, correlate with basalt flows. An anomaly over the Harcourt Granite corresponds with the magnetic phase of the batholith. The magnetic response in the Melbourne Zone drops away slightly to around 60630 nT.

Gravity forward modelling

Forward modelling of Line 6 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. A background density of 2.7 T/m^3 was used. Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large wavelength anomalies associated with deeper, larger scale relationships of major units. A close match of modelled to observed was not attempted east of the Mount William Fault.

Modelled results suggest;

- The Cambrian metavolcanics in the Heathcote Fault Zone are thin and lie at a substantial depth (~ 5 km).

Geophysical assumptions

- Small scale structural detail at lithological boundaries has been simplified to only reflect the regional trend of the boundary.
- The central Harcourt Granite has been modelled with a larger lateral extent than mapped at surface, indicating granite at shallow depths proximal to the known contact.
- The Permian rocks in the east of this section have not been included in the forward model since no significant response was observed.

Section name Line 7

End point coordinates

Geological section MGA 194000/5885000–306150/5885000, zone 55.

Geophysical section MGA 194000/5885000–330000/5885000, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Maryborough 1:50,000; Campbelltown 1:50,000; Castlemaine 1:50,000; Malmsbury 1:50,000; Redesdale and part of Pyalong 1:50,000; Ballarat 1:250,000; Melbourne 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation

This serial section has been correlated with Line 6 and previous geological mapping. Biostratigraphy has also been used heavily to determine structural trends and geometry. Fold axes were constrained by field data.

Previous interpretation

Excellent cross-section interpretations and extremely detailed structural information common on all mapsheets used.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults has been directly projected from sections further north. Fault trends have been determined form previous mapping and refined using regional gravity data. The depth to Cambrian volcanics and shape of intrusive bodies has been estimated from gravity forward modelling.

Geological assumptions and identified problems

Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping project and are missing from this version of Line 7.

Biostratigraphic control

Numerous graptolite localities and detailed bio-zones on the Malmsbury, Castlemaine and Redesdale 1:50,000 mapsheets have provided excellent control on this line.

Notes on the geophysical interpretation

Major geophysical features

Major features include;

- A gravity profile decreasing from around -150 $\mu m/s^2$ in the west to around -300 $\mu m/s^2$ to -350 $\mu m/s^2$ in the east (Melbourne Zone).
- Gravity lows correlating with intrusions and number of minor variations (+/- 10 $\mu m/s^2$) related to major faults.
- An increased gravity response over the Cobaw Batholith suggesting the presence of high density volcanics beneath the granite.
- A magnetic response that is generally flat along the section, averaging around 60650 nT. Localised high frequency anomalies correlate with basalt flows.

Gravity forward modelling

Forward modelling of Line 7 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. A background density of 2.7 T/m^3 was used. Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large wavelength anomalies associated with deeper, larger scale relationships of major units. A close match of modelled to observed was not attempted east of the Mount William Fault.

Modelled results suggest;

- Off-section granite bodies at MGA 204200/5863700, 265100/5897300 and 284800/5877800.

Geophysical assumptions

- Small scale structural detail at lithological boundaries has been simplified to only reflect the regional trend of the boundary.
- The Tullaroop Granite (in west part of section) has been modelled with a larger lateral extent than mapped at surface, indicating granite at shallow depths proximal to the known contact.

Section name Line 8

End point coordinates

Geological section MGA 195000/5864000–304570/5864000, zone 55.

Geophysical section MGA 195000/5864000–330000/5864000, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Waubra 1:50,000; Creswick 1:50,000; Daylesford 1:50,000; Trentham 1:50,000; Lancefield 1:50,000; Kilmore 1:50,000; Ballarat 1:250,000; Melbourne 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation:

This serial section has been correlated with Line 7 and previous geological mapping. Biostratigraphy has been used to determine structural trends and geometry in the central portion of the section. Fold axes were projected from lines further north and constrained by only a limited amount field data. There exists a large amount of unconstrained interpretation both in the west and east of this section.

Previous interpretation

Excellent cross-section interpretations and extremely detailed structural information common on all mapsheets, excluding Lancefield.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults has been directly projected from sections further north. Fault trends have been determined form previous mapping and refined using regional gravity data. The depth to Cambrian volcanics and shape of intrusive bodies has been estimated from gravity forward modelling.

Geological assumptions

- The enveloping surface must flatten out rapidly to produce the large exposures of Darriwilian (Ocd) mapped south of the Cobaw Batholith. This is likely due to the inferred northern extension of the Djerriwarrh Fault.
- Due to the flat nature of the enveloping surface east of the Whitelaw Fault and its steepening adjacent to the Mt William Fault, it seems unlikely the sequence from Cambrian to upper Ordovician exposed at Mount

William is conformable. If this were the case the Heathcote Volcanics would flatten out and sit approx 8 km below the surface directly west of the Heathcote Fault Zone. Neither gravity, magnetic or seismic data (from further north) suggests this is the case, therefore it seems more likely the sequence is imbricated by steep dipping faults hidden below the Cainozoic cover.

– Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping project and are missing from this version of Line 8.

Identified problems

– **Waubra and Creswick 1:50,000 mapsheets**. Little structural control due to extensive basalt cover, most fold axes extended south from Maryborough and Campbelltown 1:50,000 mapsheets.

– **Kilmore 1:50,000 mapsheet**. Good bedrock mapping with many fold axes previously interpreted, mapsheet however, only covers a small portion of the Bendigo Zone.

– **Daylesford and Trentham 1:50,000 mapsheets**. Excellent bedrock mapping with little cover. Regional structural trends, fold axes and biostratigraphy easily interpreted and projected on to section.

– **Lancefield 1:50,000 mapsheet**. Structural interpretation of Lancefield during original mapping never fully completed, leaving fold styles and geometries largely unknown. The area is overprinted by Tabberabberan folding causing bedding trends to vary markedly. There exists only a limited amount of structural data available (most on old stable bases). Projecting fold axes south from more northern mapsheets difficult due to the Cobaw Batholith and an increasing Palaeozoic–Cainozoic cover. The location of the Middle and Upper Ordovician contact is poorly constrained. Furthermore, the nature of this contact is largely unknown. This problem is exacerbated by isolated outcrops of Middle Ordovician rocks with apparently no exposure of overlying contacts.

Biostratigraphic control

Numerous graptolite localities and detailed bio-zones on the Daylesford and Trentham 1:50,000 mapsheets have provided excellent control in these areas. Biostratigraphy south of Line 8 awaiting graptolite sample identification from mapping earlier in 2008. Currently, no attempt has been made to interpret the biostratigraphy east of the Whitelaw Fault on this section.

Notes on the geophysical interpretation

Major geophysical features

Major features include;

- A decreasing gravity profile from around -150 $\mu m/s^2$ in the west to around -240 $\mu m/s^2$ in the east (Melbourne Zone).
- A large gravity low (-350 $\mu m/s^2$) in the west of the section correlating with an outcropping intrusion.
- A smaller amplitude gravity low (-270 $\mu m/s^2$) in the east of the section.
- A 40 $\mu m/s^2$ positive gravity anomaly in the east indicating the presence of Cambrian volcanics below surface. Minor variations of +/- 15 $\mu m/s^2$ across the section correlate with major faults.
- A magnetic response that is generally flat along the section, averaging around 60650 nT. Localised high frequency anomalies correlate with basalt flows.

Gravity forward modelling

Forward modelling of Line 8 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. A background density of 2.7 T/m^3 was used. Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large wavelength anomalies associated with deeper, larger scale relationships of major units. A close match of modelled to observed was not attempted east of the Mount William Fault.

Modelled results suggest;

- Off-section granite body located at MGA 205000/5851900. A close match of modelled to observed was not attempted east of the Mount William Fault.

Geophysical assumptions

- Small scale structural detail at lithological boundaries has been simplified to only reflect the regional trend of the boundary.
- A small area of outcropping Permian on this section is has been ignored for the purpose of gravity forward modelling.
- The Ercildoun Granite (in west part of section) has been modelled with modelled with a larger lateral extent than mapped at surface, indicating granite at shallow depths proximal to the known contact.
- A gravity low directly west of the Mount William Fault has been interpreted as an intrusion approximately 1.5 km below surface, probably related to the Barringo Granodiorite outcropping further to the south.

Section name Line 9

End point coordinates

Geological section MGA 200000/5840000–300800/5840000, zone 55.

Geophysical section MGA 200000/5840000–330000/5840000, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Linton 1:50,000; Ballarat 1:50,000; Ballan 1:50,000; Bacchus Marsh 1:50,000; Sunbury 1:63,360; Ballarat 1:250,000; Melbourne 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation

This serial section has been correlated with Line 8 and previous geological mapping. A biostratigraphic interpretation has been undertaken, but is missing from this version the line. A large portion of this section lies beneath basalt. Fold axes were projected from lines further north and constrained by field data. There exists a large amount of unconstrained interpretation in this section due to extensive cover and missing biostratigraphy.

Previous interpretation

Cross-section interpretations and structural information good on all reference mapsheets, although large scale structures poorly understood due to basalt cover. Previous mapping provided good control for depth to basement estimates and graben architecture.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults has been projected from sections further north. Fault trends have been determined from previous mapping and refined using regional gravity data. The depth to Cambrian volcanics, shape of intrusive bodies and thickness of Permian rock has been estimated from gravity forward modelling. Depth to basement in graben areas has been further refined using structural readings and Permian thicknesses at surface.

Geological assumptions

Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and

Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping project and are missing from this version of Line 9.

Identified problems

- Although previously mapped as a normal fault, field relationships and gravity data suggest the Rowsley Fault is west dipping with a reverse sense of movement.
- Good bedrock mapping with detailed structure on all reference mapsheets, however, bedrock windows are small and discontinuous.
- Poor control over fold axes trends.
- Regional structural architecture largely uninterpreted on all but the Ballarat and Linton 1:50,000 mapsheets.

Biostratigraphic control

Although numerous fossil sights exist on previous maps, biostratigraphy was never fully completed. GSV geologists conducted fieldwork during the 2008 season to infill the missing bio-zones, but results at this time are pending.

Notes on the geophysical interpretation

Major geophysical features

Major features include;

- Gravity lows (-320 $\mu m/s^2$) associated with subsurface granite in the western part of the section.
- A gravity high of -60 $\mu m/s^2$ in the centre of the section, likely due to thickened volcanics at depth. The response quickly decreases to -190 $\mu m/s^2$ at the eastern end of the section.
- A magnetic response that is generally flat along the section, averaging around 60700 nT. Localised high frequency anomalies correlate with basalt flows. An increased response (~ 60780 nT) coincides with the increased gravity response in the central part of the section.

Gravity forward modelling

Forward modelling of Line 9 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. A background density of 2.7 T/m^3 was used. Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large wavelength anomalies associated with deeper, larger scale relationships of major units. A close match of modelled

to observed was not attempted east of the Mount William Fault.

Modelled results suggest;

- No significant response over the Mount William Fault suggests Cambrian Volcanics must lie at depth.
- An off-section granite body at MGA 205000/5851900.

Geophysical assumptions

- Small scale structural detail at lithological boundaries has been simplified to only reflect the regional trend of the boundary.
- Basalt flows have been assigned a relatively low density (2.5 – 2.55 T/m^3) and modelled as approximately 50 m thick.
- The increased gravity and magnetic response in the central part of the section may be due to the presence of extension related subsurface dykes at this location – these have not been modelled.
- The northern margin of the Ballan Graben was modelled as a depression filled with Permian rocks to a thickness of 1.2 km. A density of 2.56 T/m^3 was used for Permian rocks.

Section name: Line 10

End point coordinates

Geological section MGA 195000/5823000–295750/5823000, zone 55.

Geophysical section MGA 195000/5823000–305000/5823000, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Linton 1:50,000; Ballarat 1:50,000; Ballan 1:50,000; Bacchus Marsh 1:50,000; Sunbury 1:63,360; Ballarat 1:250,000; Melbourne 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation

This serial section has been correlated with Line 9 and previous geological mapping. A biostratigraphic interpretation has been undertaken west of the Rowsley Fault, but is missing from this version of the line. A large portion of this section lies beneath cover. Fold axes and biostratigraphy were projected from lines further north and constrained by only a limited amount field data. There exists a large amount of unconstrained interpretation in this section due to extensive cover and missing biostratigraphy.

Previous interpretation

Previous cross-section interpretations and structural information good on all reference mapsheets, although large scale structures poorly understood due to basalt cover. Previous mapping has provided good control for depth to basement estimates and graben architecture.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults has been projected from adjacent sections. Fault trends have been determined from previous mapping and refined using regional gravity data. The depth to Cambrian volcanics, shape of intrusive bodies and thickness of Permian rock has been estimated from gravity forward modelling. Depth to basement in graben areas has been determined by structural readings, Permian thicknesses at surface and forward modelling of gravity data.

Geological assumptions

Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and

Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping project and are missing from this version of Line 10.

Identified problems

- More than half of this section lies beneath cover.
- Biostratigraphy north of this line largely missing and the interpretation south is incomplete.
- Good bedrock mapping with detailed structure on all reference mapsheets, however, bedrock windows are small and discontinuous.
- Poor control over fold axes trends.
- Regional structural architecture largely uninterpreted on all but the Ballarat and Linton 1:50,000 mapsheets.
- Although previously mapped as a normal fault, field relationships and gravity data suggest the Rowsley Fault is west dipping with a reverse sense of movement.

Biostratigraphic control

Although numerous fossil sights exist on previous map, biostratigraphy was never fully completed. GSV geologists conducted fieldwork during the 2008 season to infill the missing bio-zones, but results at this time are pending

Notes on the geophysical interpretation

Major geophysical features

Major features include;

- A generally increasing Bouguer gravity response from west to east. This trend is interrupted by lower responses (up to -160 $\mu m/s^2$) in the central region of the section. These anomalies are attributed to the Ballan Graben and subsurface granites.
- A magnetic response that gradually increases to the east, averaging from 60620 to 60680 nT. Localised high frequency anomalies correlate with basalt flows. The response is contaminated by cultural noise east of approximately 281000E.

Gravity forward modelling

Forward modelling of Line 10 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. A background density of 2.7 T/m^3 was used.

Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large

wavelength anomalies associated with deeper, larger scale relationships of major units. A close match of modelled to observed was not attempted east of the Mount William Fault.

Modelled results suggest;

- Permian rocks to a maximum depth of 450m within the Ballan Graben.
- Granite bodies at depths of 600m and 1750m.
- An off-section granite body at MGA 237100/5835800.

Geophysical assumptions

- Variations in Permian thickness modelled to reflect minor gravity anomalies in centre of section.
- Permian modelled with density of 2.3 T/m^3.
- Basalt flows not modelled on this section.
- Small scale structural detail at lithological boundaries has been simplified to only reflect the regional trend of the boundary.

Section name Line 11

End point coordinates

Geological section MGA 200280/5804000–295660/5804000, zone 55.

Geophysical section MGA 190000/5804000–305000/5804000, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Rokewood 1:50,000; Mercer 1:50,000; Meredith1:50,000; You Yangs 1:50,000; Melbourne 1:63,360; Ballarat 1:250,000; Melbourne 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation

This serial section has been correlated with Line 10 and previous geological mapping. More than 70% of this section lies beneath cover. Fold axes and biostratigraphy have been projected from lines further north and constrained by only a limited amount of field data. A biostratigraphic interpretation has been undertaken during this project, but is missing from this version of the line.

Previous interpretation

Cross sections from reference mapsheets are shallow, largely diagrammatic and missing biostratigraphic information. Structural information good on all reference mapsheets, although larger scale structures are poorly understood due to basalt cover. Previous mapping provided good control for depth to basement estimates and graben architecture.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults has been projected from sections further north. Fault trends have been determined from previous mapping and refined using regional gravity data. The depth to Cambrian volcanics and shape of intrusive bodies has been estimated from gravity forward modelling.

Geological assumptions

Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible

Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping project and are missing from this version of Line 11.

Identified problems

- 70% of this section lies beneath cover.
- Relationship between Rowsley Fault and G277 unknown, possibly coincident.
- Although previously mapped as a normal fault, field relationships and gravity data suggest the Rowsley Fault is west dipping with a reverse sense of movement.
- Previous biostratigraphic interpretation north and south of this line largely incomplete.
- Good bedrock mapping with detailed structure on all reference mapsheets, however, bedrock windows are small and discontinuous.
- Poor control over fold axes trends.
- Regional structural architecture largely uninterpreted on all but the Rokewood and Mercer 1:50,000 mapsheets.
- Numerous fossil localities on the You Yang 1:50,000 mapsheet are unclassified.

Biostratigraphic control

Although numerous fossil sights exist on previous maps, biostratigraphy was never fully completed. GSV geologists conducted fieldwork during the 2008 season to infill the missing bio-zones, but results at this time are pending

Notes on the geophysical interpretation

Major geophysical features

Major features include;

- A sharp rise in the gravity response (-100 $\mu m/s^2$ to 60 $\mu m/s^2$) at the eastern end of the section, marking the western boundary of the Bendigo Zone. East of this peak the response is relatively flat (~ 30 $\mu m/s^2$) with minor low amplitude anomalies.
- Two large gravity lows in the eastern part of the section, giving a response as low as -160 $\mu m/s^2$. The eastern most low is a north-west trending feature in plan, possibly a continuation of the Ballan Graben.
- A magnetic response that gradually increases to the east averaging from 60620 to 60680 nT. Localised high frequency anomalies correlate with basalt flows. The magnetic response is contaminated by cultural noise east of approximately 281000E.

Gravity forward modelling

Forward modelling of Line 11 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. A background density of 2.7 T/m^3 was used. Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large wavelength anomalies associated with deeper, larger scale relationships of major units. A close match of modelled to observed was not attempted east of the Mount William Fault.

Modelled results suggest;

- No significant response over the Mount William Fault indicating Cambrian Volcanics must lie at depth, possibly below a Permian filled depression.
- The Selwyn Block shallowing to a depth of approximately 6 km, producing a high response at the eastern end of the section.

Geophysical assumptions

- Small scale structural detail at lithological boundaries has been simplified to only reflect the regional trend of the boundary.
- Permian rocks are assumed to underlie basalt to a depth of ~ 650m in the east of the section, producing a low anomaly over Mount William Fault. Permian rocks are assumed to be coal rich[1] and assigned a density of 2.1 T/m^3.
- Basalt flows not modelled in this section.

[1] HOLDGATE G. R., GALLAGHER S. J. & WALLACE M. W. 2002. Tertiary coal geology and stratigraphy of the Port Phillip Basin, Victoria. *Australian Journal of Earth Sciences* **49**, 437–453.

Section name Line 13

End point coordinates

Geological section MGA 200000/6006000–240020/6044019, zone 55.

Geophysical section MGA 200000/6006000–240020/6044019, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Wedderburn 1:100,000; Swan Hill 1:250,000; St Arnaud 1:250,000; Deniliquin 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation

This serial section is 100% undercover. All fold axes, biostratigraphy and structural relationships have been projected from lines 1, 2 and 14. There exists a large amount of unconstrained interpretation in this section due to the extensive cover.

Previous interpretation

Cross sections from reference mapsheets are shallow, largely diagrammatic and missing biostratigraphic information. No structural information exists in the area of this section due to cover.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults, biostratigraphy and fold axes locations have been directly projected from sections further south. Fault trends have been determined form regional gravity data. The depth to Cambrian volcanics and shape of intrusive bodies has been calculated from gravity forward modelling.

Geological assumptions

Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping project and are missing from this version of Line 13.

Identified problems

- 100% of this section lies beneath cover.
- Poor control over fold axes, fault trends and biostratigraphy.
- The regional structural architecture on all reference mapsheets is largely uninterpreted.

Biostratigraphic control

Biostratigraphy has been correlated with lines 3, 4 and 5. Fold axes were projected from the south and fold plunges estimated between 10–30 degrees, with numerous reversals between sections. Enveloping surfaces were inferred to dip at shallow angles. Cross-sections were then drawn to refine inferred biostratigraphy.

Notes on the geophysical interpretation

Major geophysical features

Major gravity features include;

- A northeast–southwest trending gravity high response, with large gravity lows either side.
- A high, broad gravity response of up to 0 $\mu m/s^2$ in the southwest that drops to around -70 to -55 $\mu m/s^2$ in the centre of the section. The response decreases to -105 $\mu m/s^2$ in the northeast, before increasing to -30 $\mu m/s^2$ at the end of the section.
- A magnetic profile dominated by a broad high of around 60780 nT in the centre of the section. The response decreases to 60700 nT in the southwest and to 60680 nT in the northeast. A sharp, short wavelength anomaly in the southwest most likely indicates the presence of a mafic dyke. A slightly broader anomaly in the northeast may indicate a magnetic aureole surrounding the Pyramid Hill Granite.

Gravity forward modelling

Forward modelling of Line 13 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. A background density of 2.7 T/m^3 was used. Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large wavelength anomalies associated with deeper, larger scale relationships of major units.

Modelled results suggest;

- A Cainozoic cover of up to 440 m in the centre of the section.

Geophysical assumptions

- Small scale structural detail at lithological boundaries has been simplified to only reflect the regional trend of the boundary.

- Cambrian volcanics assumed to shallow southwest and northeast of section, producing gravity highs.
- Depth of Murray Basin sediments from borehole data estimated at approximately 180m in the northeastern end of section.

Section name Line 14

End point coordinates

Geological section MGA 235000/5990000–274500/6022350, zone 55.

Geophysical section MGA 235000/5990000–290028/6035023, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Bendigo 1:250,000; Deniliquin 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation

This serial section is 100% undercover. All fold axes, biostratigraphy and structural relationships have been projected from lines 1 and 2. There exists a large amount of unconstrained interpretation in this section due to the extensive cover.

Previous interpretation

Cross sections from reference mapsheets are shallow, largely diagrammatic and missing biostratigraphic information. No structural information exists in the area of this section due to cover.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults, biostratigraphy and fold axes locations have been directly projected from sections further south. Fault trends have been determined form regional gravity data. The depth to Cambrian volcanics and shape of intrusive bodies has been calculated from gravity forward modelling.

Geological assumptions

Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping project and are missing from this version of Line 14.

Identified problems

- 100% of this section lies beneath cover.
- Poor control over fold axes, fault trends and biostratigraphy.
- The regional structural architecture on all reference mapsheets is largely uninterpreted.

Biostratigraphic control

Biostratigraphy has been correlated with lines 2, 3, 4 and 5. Fold axes have been projected from the south and fold plunges estimated between 10–30 degrees, with numerous reversals between sections. Enveloping surfaces were inferred to dip at shallow angles. Cross-sections were then drawn to refine the inferred biostratigraphy.

Notes on the geophysical interpretation

Major geophysical features

Major features include;

- A gravity response decreasing from -60 $\mu m/s^2$ in the southwest to -260 $\mu m/s^2$ in the northeast and punctuated by two large low anomalies associated with granites.
- A magnetic response that gradually decreases from 60720 nT in the southwest to 60660 nT in the northeast. The profile peaks to 60790 nT over a magnetic phase of the Pyramid Hill Granite. Anomalies of approximately 20 nT in amplitude outline the aureole of the granite in the southwest and the Governor Fault in the north.

Gravity forward modelling

Forward modelling of Line 14 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. A background density of 2.7 T/m^3 was used. Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large wavelength anomalies associated with deeper, larger scale relationships of major units. Cainozoic cover was modelled over the entire section apart from outcropping granite in the southwest.

Modelled results suggest;

- A large intrusive body in the northeast dipping Governor Fault. Mafic volcanics were also interpreted as being thrust into the hanging wall of this fault.

Geophysical assumptions

– Small scale structural detail at lithological boundaries has been simplified to only reflect the regional trend of the boundary.

– Thickness of Cainozoic cover may be overestimated – borehole control very limited, particularly in northeast.

– Variations in Cambrian volcanics thicknesses were used to model the high response observed in the central and western parts of the section.

Section name Line 15

End point coordinates

Geological section MGA 270000/5965000–309000/5996200, zone 55.

Geophysical section MGA 270000/5965000–319976/6004980, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Huntly and part of Kamarooka 1:50,000; Bendigo 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation

This serial section is 100% undercover. All fold axes, biostratigraphy and structural relationships have been projected from lines 1, 2, 3 and 4. There exists a large amount of unconstrained interpretation in this section due to the extensive cover.

Previous interpretation

Cross-sections from reference mapsheets largely diagrammatic. No structural information exists in the area of this section due to cover.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults, biostratigraphy and fold axes locations have been directly projected from sections further south. Fault trends have been determined form regional gravity data. The depth to Cambrian volcanics and shape of intrusive bodies has been calculated from gravity forward modelling.

Geological assumptions

Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping project and are missing from this version of Line 15.

Identified problems

- 100% of this section lies beneath cover.
- Poor control over fold axes, fault trends and biostratigraphy.
- The structural architecture on reference mapsheets is largely uninterpreted, however, the Huntly and part of Kamarooka 1:50,000 mapsheet provides insights into the biostratigraphy of the region.

Biostratigraphic control

Biostratigraphy has been correlated with lines 3, 4 and 5. Fold axes have been projected from the south and fold plunges estimated between 10–30 degrees, with numerous reversals between sections. Enveloping surfaces were inferred to dip at shallow angles. Cross-sections were then drawn to refine the inferred biostratigraphy.

Notes on the geophysical interpretation

Major geophysical features

Major features include;

- A large, positive gravity anomaly with a maximum response of -15 $\mu m/s^2$.
- A decreased gravity response of -115 $\mu m/s^2$ over the Heathcote Fault Zone, before increasing to -75 $\mu m/s^2$ at the north-east end of the section.
- A magnetic response that gradually increases from 60680 nT in the west to 60720 nT in the east. The profile contains a long wavelength, low amplitude anomaly coinciding with the large gravity anomaly. A peak of 60805 nT marks the Heathcote Fault Zone.

Gravity forward modelling

Forward modelling of Line 15 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. A background density of 2.7 T/m^3 was used. Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large wavelength anomalies associated with deeper, larger scale relationships of major units.

Modelled results suggest;

- Cainozoic cover to a depth of 270m.
- The large anomaly in the centre of the section is related to a Cambrian volcanic antiformal stack at approximately 6 km depth.
- The low response over the Heathcote Fault is a slice of low density (2.7 T/m^3) interlayered Cambrian volcanics and metasediments below a Permian filled depression. The remainder of the Heathcote Fault Zone is likely a series of dense volcanic thrust sheets (2.81 T/m^3) also lying below Permian material.

Geophysical assumptions

- Small scale structural detail at lithological boundaries has been simplified to only reflect the regional trend of the boundary.
- Permian rocks (2.4 T/m^3) are assumed to underlie the Cainozoic cover in the east of the section.
- The gravity anomaly associated with the Mount William Fault is off-set to the east relative to the magnetic anomaly and mapped fault trace. Dense non-magnetic Cambrian volcanics at are interpreted as the source of the gravity anomaly.
- Volcanics were modelled at depth at the northeastern end of the section.

Section name Line 16

End point coordinates

Geological section MGA 189500/5963150–215002/5985001, zone 55.

Geophysical section MGA 180076/5955065–215002/5985001, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Wedderburn 1:100,000; St Arnaud 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation

This serial section has been correlated with lines 2, 3 and previous geological mapping. The section cross-cuts regional strike trends at approximately 40 degrees causing interlimb angles to appear more open. Fold axes were projected from lines further south and constrained by field data.

Previous interpretation

Cross-sections from reference mapsheets are shallow and largely missing detailed structural information. Excellent field data exists in the Wedderburn region of this section.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults has been directly correlated with the T13 seismic survey. Biostratigraphy and fold axes locations have been projected from sections both north and south. Fault trends have been determined from previous mapping and regional gravity data. The depth to Cambrian volcanics and shape of intrusive bodies has been estimated from gravity forward modelling.

Geological assumptions and identified problems

Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping project.

Biostratigraphic control

Only 2 graptolite localities on the Wedderburn 1:50,000 mapsheet constrain this section. Biostratigraphy has been correlated with lines 3, 4 and 5. Enveloping surfaces were inferred to dip at shallow angles. Cross-sections were then drawn to refine the biostratigraphy.

Notes on the geophysical interpretation

Major geophysical features

Major features include;

- A gravity response increasing from -270 $\mu m/s^2$ in the Stawell Zone to -90 $\mu m/s^2$ at the northeastern end of the section, between a large gravity high to the north, and a low to the south.
- A magnetic response dominated by high amplitude anomalies related to magnetic granites and their associated aureoles. A drop in response occurs across the Avoca Fault.

Gravity forward modelling

Forward modelling of Line 16 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. A background density of 2.7 T/m^3 was used. Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large wavelength anomalies associated with deeper, larger scale relationships of major units.

Modelled results suggest;

- An off-section granite body at MGA 210800/5967350.

Geophysical assumptions

- Small scale structural detail at lithological boundaries has been simplified to only reflect the regional trend of the boundary.

Section name Line 17

End point coordinates

Geological section (A[1]–B) MGA 193150/5933444–226027/5944005, zone 55.

Geophysical section (A–B) MGA 180098/5935019–226027/5944005, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Rheola 1:50,000; Inglewood 1:50,000; St Arnaud 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation

This serial section approximates the eastern part of line 1 of the T13 seismic transect, which has provided the basis for many of the structural relationships in this, and in adjacent serial sections. The section cross-cuts regional strike trends at approximately 70 degrees causing interlimb angles to appear slightly more open. Fold axes were projected from adjacent sections and constrained by field data.

Previous interpretation

Cross sections from reference mapsheets are shallow, largely diagrammatic and missing detailed structural information. Good field data exists on the in the Rheola and Inglewood 1:50,000 mapsheets.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults has been directly interpreted from the T13 seismic transect, which this line parallels. Smaller faults have been interpreted from the gravity data and field relationships. Fault trends have largely been determined form previous mapping and refined using regional gravity data. The depth to Cambrian volcanics and shape of intrusive bodies has been estimated from the seismic transect and gravity forward modelling.

Geological assumptions and identified problems

Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible

Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping project.

Biostratigraphic control

No fossil localities exist on the Rheola or Inglewood mapsheets. Biostratigraphy has been correlated with previous mapping and refined using adjacent sections where necessary.

Notes on the geophysical interpretation

Major geophysical features

Major features include;

- A gravity response increasing from approximately -180 $\mu m/s^2$ in west (Stawell Zone) to -70 $\mu m/s^2$ in the east.
- A gravity high in the east likely associated with both an increased thickness of mafic rocks at depth and greater rock densities in the contact aureole of the Tarnagulla Granite.
- Lower gravity responses in the west and centre of the section associated with granites.
- A magnetic response averaging around 60670 nT in the west and increasing easterly to 60720 nT in the region of the Tarnagulla Granite. The response peaks at 60830 nT in the centre of the section.

Gravity forward modelling

Forward modelling of Line 17 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. A background density of 2.7 T/m^3 was used. Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large wavelength anomalies associated with deeper, larger scale relationships of major units.

Modelled results suggest;

- Off-section granite body at MGA 196500/5934200.

Seismic

The seismic interpretation of the eastern end of T13 line 1 indicates a boundary at depth between intercalated mafic and metasedimentary rock, and highly reflective mafic volcanics. Numerous listric faults have been identified in section and correlated with faults mapped at surface. The Tarnagulla Granite and a number of subsurface granites are also recognisable.

The seismic interpretation of the eastern end of T13 line 1 indicates a boundary at depth between mafic volcanics and mafic volcanics with intercalated metasediments. Numerous listric faults have been identified in section and correlated with faults mapped at surface. The Tarnagulla Granite and a number of subsurface granites are also recognisable.

Geophysical assumptions

- Small scale structural detail at lithological boundaries has been simplified to only reflect the regional trend of the boundary.
- The boundary between mafic volcanics and mafic volcanics with intercalated metasediments obtained from the T13 seismic transect has been altered to produce a better fit to the gravity.
- The Tarnagulla Granite has been modelled with larger lateral extents than mapped at surface and interpreted in the seismic survey, indicating granite at shallow depths proximal to the known contact. Off-section granite bodies are also assumed to influence the response.
- Regional gravity data suggests the trace of the Avoca Fault lies 2.5 km west of its originally mapped position.

Section name Line 18

End point coordinates

Geological section MGA 275000/5905000–300000/5924000, zone 55.

Geophysical section MGA 275000/5905000–300000/5924000, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Bendigo 1:50,000; Heathcote1:50,000; Costerfield and part of Pyalong 1:50,000; Bendigo 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation

This serial section has been correlated with lines 5, 6 and previous geological mapping. Biostratigraphy has been used heavily to determine structural trends and geometry. Fold axes were projected from adjacent lines and constrained by field data.

Previous interpretation

Good quality cross-sections and detailed structural information common on all reference mapsheets.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults has been projected from adjacent sections. Fault trends have been determined from previous mapping and refined using regional gravity data. The depth to Cambrian volcanics and thickness of Permian rock has been calculated from gravity forward modelling.

Geological assumptions and identified problems

Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping project.

Biostratigraphic control

Numerous graptolite localities and detailed bio-zones on exist on all reference mapsheets and have provided excellent control.

Notes on the geophysical interpretation

Major geophysical features

Major features include;

- A high gravity response of -200 $\mu m/s^2$ in the south-east of the section decreasing to -280 $\mu m/s^2$ in the Melbourne Zone.
- A gravity anomaly of ~15 $\mu m/s^2$ west of the Mount William Fault.
- A magnetic response decreasing from 60670 nT in the west to 60610 nT at the Mount William Fault. High frequency, high amplitude negative anomalies in the west of the section correspond to basalt flows. East of the Mount William Fault the response increases to 60635 nT.

Gravity forward modelling

Forward modelling of Line 18 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. A background density of 2.7 T/m^3 was used. Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large wavelength anomalies associated with deeper, larger scale relationships of major units. A close match of modelled to observed was not attempted east of the Mount William Fault.

Modelled results suggest;

- Permian rocks to a depth of 650m west of the Mount William Fault.

Geophysical assumptions

- Small scale structural detail at lithological boundaries has been simplified to only reflect the regional trend of the boundary.
- A package of mafic volcanics with intercalated metasediments (2.61 T/m^3) was used to model the low gravity response associated with the Heathcote Fault Zone.
- Dense mafic volcanics were modelled to sit approximately 600 m below the surface.

Section name Line 19

End point coordinates

Geological section MGA 260000/5815000–267985/5839954, zone 55.

Geophysical section MGA 260000/5815000–267985/5839954, zone 55.

Authorship

Ben Williams and Phil Skladzien.

Reference mapsheets

Bacchus Marsh 1:50,000; You Yangs1:50,000; Melbourne 1:250,000; Victoria 1:1,000,000 Pre-Permian geology.

Notes on the geological interpretation

This serial section has been designed perpendicular to the structures of the Ballan Graben, It lies parallel to regional strike and has been correlated with lines 9, 10 and previous geological mapping.

Previous interpretation

Good quality cross-sections and detailed structural information common on all reference mapsheets. Previous mapping provided good control for graben architecture.

Changes made to the interpretation during section construction

The geometry and estimated depth of larger scale faults has been projected from adjacent sections. Fault trends have been determined from previous mapping and refined using regional gravity data. The depth to Cambrian volcanics, shape of intrusive bodies and thickness of Permian rock has been estimated from gravity forward modelling. Depth to basement in graben areas has been determined by structural readings, Permian thicknesses at surface and forward modelling of gravity data.

Geological assumptions

Biostratigraphy, inversion modelling and the T13 seismic transect suggest a large sediment volume problem in previous geological models for the Bendigo Zone. Therefore, it is assumed a folded and faulted Cambrian stratigraphy of approximately 5–8 km underlies the Ordovician Castlemaine Group west of the Whitelaw and Drummartin faults. This Cambrian package slowly wedges out toward the east before an imbricate system of southwest dipping thrust faults is inferred to account for a majority of the thickening. The faults are of possible Tabberabberan age. These are recently interpreted structural features from the Redesdale 1:50, 000 mapping project.

Identified problems

- Although previously mapped as a normal fault, field relationships and gravity data suggest the Rowsley Fault is west dipping with a reverse sense of movement.

Biostratigraphic control

Although numerous fossil sights exist on previous maps, biostratigraphy was never fully completed. GSV geologists conducted fieldwork during the 2008 season to infill the missing bio-zones, but results at this time are pending.

Notes on the geophysical interpretation

Major geophysical features

Major features include;

- A general gravity response increasing to the south.
- A low gravity anomaly of ~50 $\mu m/s^2$ over the Ballan Graben.
- A minor 15 $\mu m/s^2$ anomaly superimposed over the low response in the centre of the section.
- A magnetic response that is generally flat along the section, averaging around 60650 nT. Localised high frequency anomalies correlate with basalt flows.

Gravity forward modelling

Forward modelling of Line 19 was based on structural relationships interpreted on the T13 Seismic Transect. Assigned unit densities were kept relatively constant throughout the Bendigo Zone (Table 1), while geometries were adjusted to obtain a good fit of modelled to observed response. A background density of 2.7 T/m^3 was used. Little attention was paid to small, localised anomalies. Instead, the main focus of forward modelling was on large wavelength anomalies associated with deeper, larger scale relationships of major units. A close match of modelled to observed was not attempted at the section extremities.

Modelled results suggest;

- The northern margin of the Ballan Graben as a depression filled with Permian rocks to a maximum depth of 1.3 km.
- The Ingliston Granite has a larger lateral extent than mapped at surface, indicating granite at shallow depths proximal to the known contact.

Assumptions

- A density of 2.56 T/m^3 was used for Permian rocks in the graben.