PART 2

BE08 MORANBAH SEISMIC SURVEY

SEISMIC SURVEY REPORT

ATP 814P – QUEENSLAND

Lines
BE08-05
BE08-06
BE08-09
BE08-10

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1.0 INTRODUCTION

During the period from the 31st of August to the 3rd of September in 2008 Terrex Seismic of Bibra Lake, WA, acquired 21.61km of seismic data consisting of four lines. The data was recorded using a 7.5m station interval and 240 live channels. Vibroseis was used as the data source and these conducted sweeps between pegs at every second station creating 60 fold data. This seismic was the initial phase of seismic acquired by Blue Energy Limited in ATP 814P "West Block" Area.

Surveying, chaining and pegging was conducted by Dynamic Satellite Surveys of Yeppoon Qld between the 24th and 25th of August. They have forwarded an operations report which has been included as Appendix A of this report

The survey was processed by Fugro Seismic Imaging Pty Ltd., 69 Outram Street, West Perth WA 6005 between November 2008 and January 2009.

2.0 LOCATION

The survey is located to the north east of Moranbah within 25km of the town, which is approximately 200km by road south west of Mackay in North Queensland. The survey area overlies a portion of the northern Bowen Basin. It lies within the Nebo Synclinorium.

The main objective of the survey is to determine the depth and structure of the coals of the Rangal Coal Measures, Fort Cooper Coal Measures and if possible the top of the Moranbah Coal Measures.

3.0 GEOLOGY

The BE08 Moranbah Seismic Survey was conducted in the the Nebo Synclinorium of the northern Bowen Basin. The target is to determine the structure of the Rangal Coal Measures, the underlying Fort Cooper Coal Measures and Moranbah Coal measures when they are within 100m of the surface.

3.1 BOWEN BASIN SETTING

The Bowen Basin began in the Late Carboniferous to Early Permian as a north-south trending zone of extension, resulting from continent-ocean plate convergence (Veevers et al., 1982, Day et al., 1983, Murray 1985, Murray et al., 1987, Fielding 1990, Fielding et al., 1990b, Fielding et. al., 2000). This interpretation is based on the presence, in the Late Devonian to Carboniferous, from

west to east of a possible back-arc (Drummond Basin), volcanic arc (Connors-Auburn Volcanic Arc), a forearc (the Yarrol Basin), and an accretionary wedge complex (Wandilla Slope and Basin) which was succeeded in the Early to Late Permian by the formation of an extensional back-arc (Bowen Basin) and Arc (Camboon Volcanic Arc).

This intial phase of extension in the Bowen is marked by the grabens and half grabens on the western side of the Bowen Basin, including the Denison and Arbroath Troughs(Brakel et al 2009). This period of extensions has been interpreted as the transition from an active continental accretion process at the end of the Carboniferous to either active margin extension or passive margin extension in the Late Permian (Holcombe et. al., 1997).

These changes in the tectonic setting influenced the palaeogeography and depositional environment of the Bowen Basin (Fielding et.al., 2000). Early Permain extensional subsidence and magmatic activity resulted in a basin-and-range topography with infrabasins hosting thick accumulations of mainly non-marine, fluvial and lacustrine deposits with occasional marine incursions. The depositional environment was also influenced by the late Palaeozoic Gondwanan glaciation which is preserved in proglacial and varved lacustrine deposits of the Reids Doem Beds (Denison Trough), and coeval Joe Joe Group and lower Youlambie Conglomerate.

Later in the Early Permian, extensional subsidence slowed and the original basin-andrange topography filled. A transgression of the sea westwards allowed delta systems to develop around the western and northern margins of the basin which continued into the Late Permian (Fielding et al., 1990a). This period saw the deposition of the Cattle Creek Formation, the coastal plains sediments of the Collinsville Coal Measures, Blair Athol Coal Measures and Lower Aldebaran Sandstone predominantly sourced from uplifted terrains to the west (Fielding et. al., 2000).

By the end of the Permian, the tectonic setting had changed from one of extension to a regional thermal subsidence phase (Brakel et al 2009). The prograding deltas in-filled the remaining landlocked sea westward and mainly fine grained offshore marine sediments accumulated to form the Barfield Formation and Back Creek Group (Fielding et. al., 1997).

In the Late Permian, significant uplift occurred to the north and east (possibly east of the current coastline) of the Bowen Basin resulting in a shift in sediment source from the quartz-dominated provenance of the German Creek Formation (sourced from the west) to the volcanic lithic composition of the Moranbah Coal Measures (sourced from the Northeast) (Falkner & Fielding 1993, Fielding et. al., 2000). Volcanic fall-out beds become regionally abundant above the P-Tuff horizon (Fielding 2000).

This period of uplift and instability also resulted in submarine slope instability and resulted in deposits of the upper Barfield Formation, Flat Top Formation and equivalents (Fielding et. al., 1997). This uplift ultimately led to the development of an axial southerly prograding delta complex that filled much of the Late Permian Bowen Basin with coarse volcanic lithic detritus. This deltaic system resulted in the accumulation of sediments and led to the formation of the Moranbah and overlying Fort Cooper Coal Measures (Taroom Trough) and the Peawaddy Formation and Mantuan Formation (Denison Trough) to the south. The youngest marine fossils in the Bowen Basin are the thick accumulation of shells in the Mantuan Productus Beds which effectively mark

the end Permian global extinction event in the Basin.

By the end of the Permian, the southward prograding dispersal system had filled the Bowen Basin and the Basin was overlain in the south by fetid black mudrocks and tuffs of the Black Alley Shale, interpreted as a non-marine, inland flooding event.

The fetid lacustrine deposits of the Black Alley Shale pass northward into tuff-rich shallow lacustrine facies of the Burngrove Formation, and further north into fluvial facies of the Rangal Coal Measures (east of Comet Ridge) and equivalent Bandanna Formation (Denison Trough).

The southward dispersal system ultimately infilled these lacustrine environments and the entire Bowen Basin became an immense alluvial/coastal plain environment. The thick and extensive coal seams of the Rangal Coal Measures formed in this environment. The significant volcanic activity that is interpreted to have been coeval with deposition of the Black Alley Shale and equivalents waned during accumulation of the upper Rangal Coal Measures.

Fielding et al, 2000 interpreted the Black Alley Shale flooding event as a consequence of flexural subsidence induced by the loading of the crust in the Gogango Overfolded Zone and environs immediately to the east of the Basin as a result of the thin skinned thrusting in this region (Holcombe et. al., 1997). In the latest Permian to Early Triassic, the lacastrine, swampy environment that led to the formation of coals of the Rangal Coal Measures and Bandanna Formation was replaced by mainly fine grained, well drained, alluvial systems subject to extensive oxidation which resulted in the formation of the “red beds” (red, green or brown coloured) of the Rewan Formation (Fielding et. al., 2000). The onset of this alluvial environment was diachronous as the basal Rewan Formation in the central part of the Basin is of Permain age but elsewhere a disconformity separates Permian coal measures from the Triassic Rewan Formation.

Deposition of the Rewan Formation continued until Mid Triassic times when the fine grain alluvial setting was succeeded by a coarser, sand dominated, alluvial setting that led to the formation of the Middle Triassic Clematis Formation which consists mainly of quartzose sandstone. This compositional change reflects a change in provenance with sediments being sourced predominantly from the uplifted western craton instead of the arc to the east (Fielding et al, 1990a). The Showgrounds Sandstone is the subsurface equivalent of the upper Clematis Group on the western side of the Bowen Basin (Butcher, 1984) and shows
evidence of being deposited in a standing body of water like a lake or sea.

The Mid-Triassic Moolayember Formation represents a return to deposition of fluvial and lacustrine sediments, including the marginal marine Snake Creek Mudstone Member located at the base of the formation. Fielding et. al. (2000) interpreted the Snake Creek Mudstone Member flooding event to have been driven by rapid flexural (foreland) subsidence associated with tectonic forces in the orogen to the east.

3.1.1 Rangal Coal Measures

The Rangal Coal Measures were deposited in the northern Bowen Basin in a deltaic system and is the equivalent to the Baralaba Coal Measures in the southeast of the Bowen Basin and the Bandanna Formation in the Denison Trough and Roma Shelf areas. It consists of dominantly labile

sandstone and coal with interbeds of siltstone and mudstone, ranging between 50 to 100m thick in the west but thicken toward the east to 200m at the Codrilla and Picardy coal deposits. The basal part of the formation is finer grained, coarsening upward to predominantly sandstone and, finally, coal (Exon, 1976).

The Rangal Coal Measures conformably underlies the Late Permian to Early Triassic Rewan Group. The Rewan Group consists of labile and sublabile sandstones, siltstones and mudstones. It characteristically is devoid of high amplitude reflections. It can readily be distinguished from the high amplitude reflections generated by the acoustic impeadance contrast of the coal within the Bandanna Formation.

The Rangal Coal Measures overlies the Black Alley Shale and Burunga Formation (Brakel et al 2009), In the most part it seems conformable however in the Wallumbilla- Namarah area there are indications that fault affected the marine Black Alley Shale but not he overlying coal measures indicating a sequence boundary. Seismic amplitudes are reduced within the Black Alley Shale compared to the Bandanna formation although higher than the Rewan Group.

3.1.2 Fort Cooper Coal Measures

The Fort Cooper Coal Measures were deposited in the northern part of the basin and is equivalent to the Fair Hill and Burngrove Formations in the central area of the basin and the Black Alley Shale and the upper part of the Peawaddy formation in the south. There is a marine transgression in the base of the Burngrove Formation and there is greater marine influence to the south. The Black Alley Shale and underlying Mantuan Productus Beds represent a marine transgression.

This was a period of major volcanism from the east and the Fort Cooper Coal Measures contain numerous tuff beds. The top of the Fort Cooper Coal measures is marked by the appearance of the Yarrabee Tuff. Above this tuff layer the coals of the Rangal Coal Measures are devoid of tuffs.

Brakel et al 2009 examined the seismic sequence stratigraphy of the southern Bowen Basin equivalents and correlate the Fort Cooper Coal Measures to between the B55 and B65 seismic horizons and thus includes the B60 seismic. The B60 seismic horizon represents a transgression event at the top of the Peawaddy.

3.1.3 Moranbah coal Measures

The Moranbah Coal Measures are found in the north of the Bowen Basin north of Peak Downs representing coastal plains deposits. The section thickens toward the east indicating the onset of Foreland loading. Further to the south the formation grades through the German Creek Coal Measures into the Peawaddy Formation

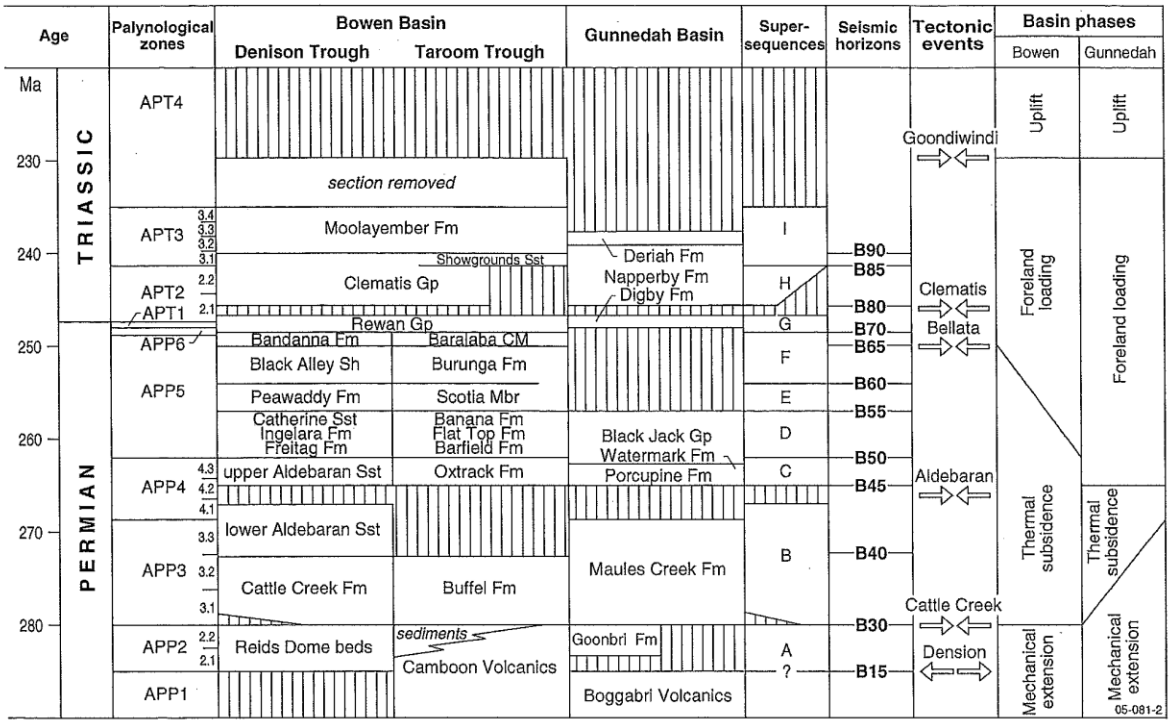


Figure 1 Stratigraphy of the Bowen Basin (Brakel et al 2009)

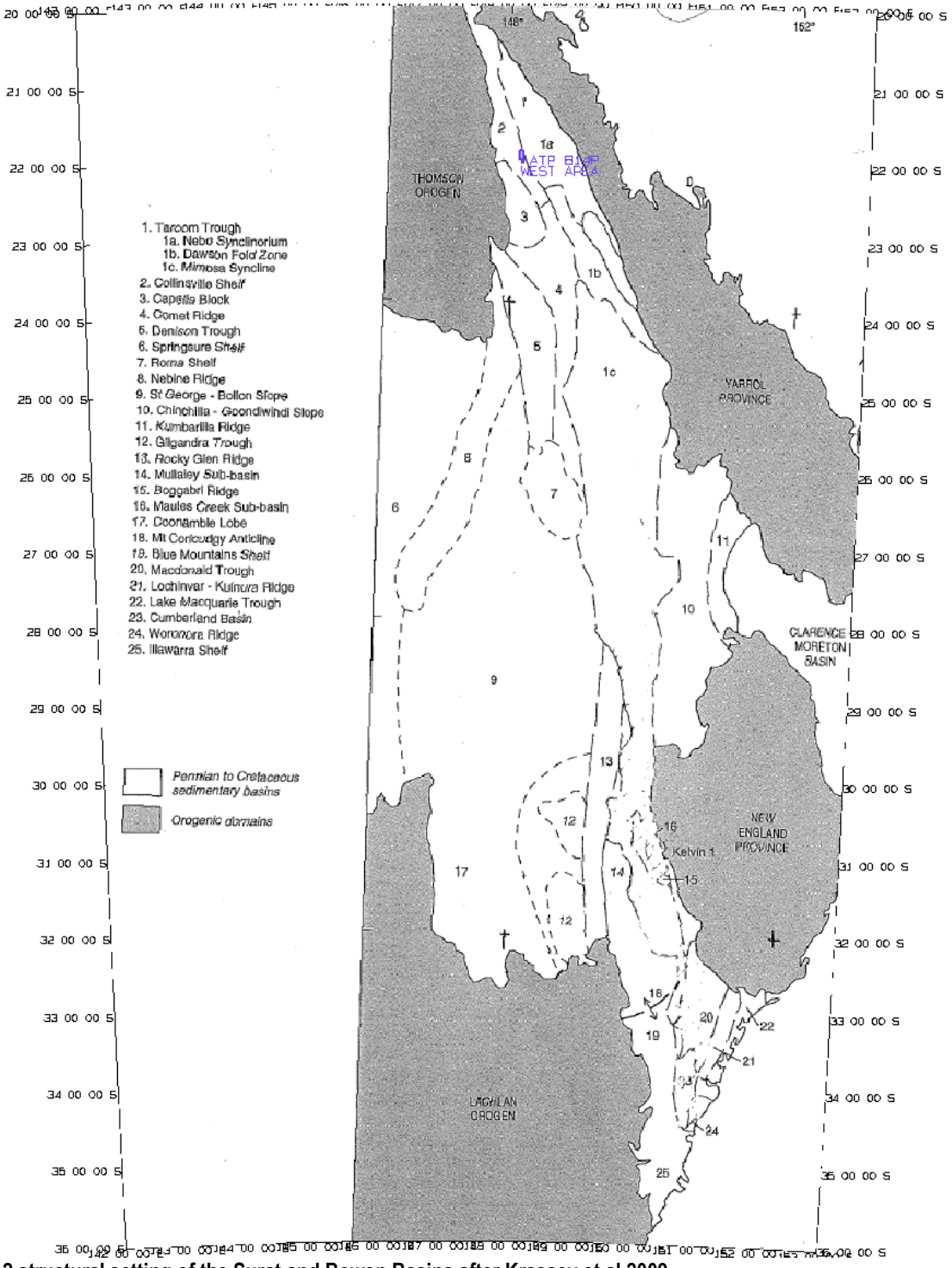


Figure 2 structural setting of the Surat and Bowen Basins after Krassey et al 2009

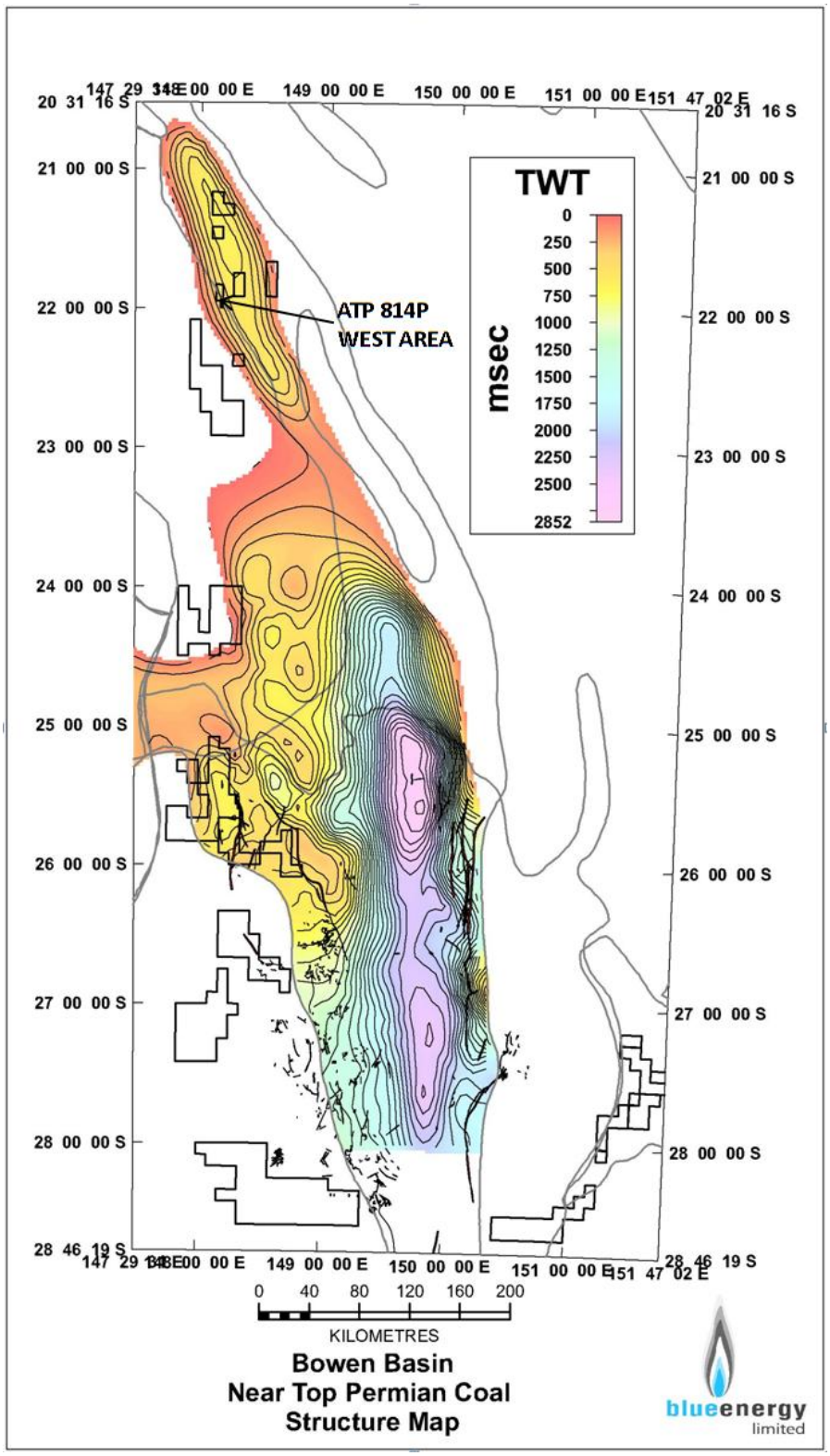


Figure 3 Bowen Basin time structure map of the top coal

4.0 ATP 814P

The BE08 Moranbah Seismic Survey consisted of four lines and was conducted in the "West Block" portion of ATP 814P.

The "West Block" portion of ATP 814P consists of 27 graticular sub-blocks or 76km^2 and was granted to Blue Energy as the sole title holder, for a twelve year term in February 2006. The acquisition of the BE08 Glenden Seismic Survey complies with a work commitment made under ATP814P to the Queensland Department of Mines and Energy to undertake 150km of seismic survey.

4.1 PREVIOUS SURVEYS

The northern Bowen Basin is largely devoid of conventional oil and gas exploration. Previous seismic recorded in this part of the basin was by Mitsubishi Gas Corporation resources Australia in their search for Coal Seam Methane. They recorded regional seismic lines to determine the structure of the Bowen Basin:

The earlier MGCRA seismic surveys were recorded using Japanese patented weight drop and the data was shipped back to Japan to be processed. Unfortunately it was processed with limited band width and as such is very difficult to interpret reliably. Electronic versions of the completed sections are now unavailable. The only sections available are tiff images of depth converted sections which do not appear to be of good quality. As the field data and support data has been shipped overseas it is also impossible to reprocess this data. The later surveys (1993 and 1994) were recorded by Australian seismic contractors and are generally of better condition.

Unfortunately the quality of the seismic data does not allow a comparison between those lines examined by Brakel et al 2009.

Year	Survey	Prefix	Operator
1990	MGCRA	MGC90	MGCRA
1991	MGCRA	MGC91	MGCRA
1992	MGCRA	MGC92	MGCRA
1993	MGCRA	MGC93	MGCRA
1994	MGCRA	MGC94	MGCRA

Table 1 previous seismic surveys

4.2 WELL CORRELATION

There were no conventional or coal bed methane wells drilled within the Mt Hillalong permit area. There are several coal bed methane exploration wells and some GSQ stratigraphic wells drilled in areas adjacent to the permit

MGC Moranbah 1 was drilled to 636m depth to intersect the Moranbah Coal Measures at 283m and the upper Fort Cooper Coal Measures at 18m. This well was drilled as a coal bed methane

well. A sonic log was run from 60m to 634m and density from surface to a similar depth. The well is on seismic line MGC92-5 at station 3142.

MGC Moranbah 2 was drilled to 525m depth to intersect the Moranbah Coal Measures at 198m and the Fort Cooper Coal Measures at surface. This well was drilled as a coal bed methane well. A sonic and density log was run from 74m to 525m. The well is on seismic line MGC94-2 at station 337.

MGC Smokey Creek 1 was drilled to 1107m depth to intersect the Rangal Coal Measures which were encountered at 224m, The Fort Cooper Coal Measures at 315m and the Moranbah Coal Measures at 773m. This well was drilled as a coal bed methane exploration well. The well was drilled near station 600 on seismic line MGC91-8. A sonic log was run from 99 to 1105m and density log was run from 4 to 1102m and a vertical seismic profile was shot.

CH4 AN009 was drilled to 400m depth to intersect the Rangal Coal Measures at 180m, the Fort Cooper Coal measures at 330m. The well was a coal bed methane exploration stratigraphic well. The well is located near station 289 on seismic lineMGC93-2. A density log was run.

CH4 AN012 was drilled to 362m depth to intersect the Rangal Coal Measures at 272m. The well was a coal bed methane exploration stratigraphic well. The well is located near station 401 on seismic lineMGC91-C. A density log was run.

MGC Annandale 1 is a coal bed methane exploration well drilled near station 740 on seismic line MGC91-9. The well was drilled to intersect the Rangal Coal Measures at 396m and the Girrah Seam of the Fort Cooper Coal Measuresat 470m. A sonic and density log has been run from 100m to 698m. The well reached a depth of 703m.

MGC Annandale-3 is a coal bed methane exploration well drilled near station 376 on seismic line MGC91-1. The well was drilled to test the Rangal Coal Measuresat 321m and the Girrah Seam of the Fort Cooper Coal Measures at 456m. The well reached a depth of 471m. A density log has been run.

MGC Teviot Brook 1 is a coal bed methane exploration well drilled to test The Rangal Coal Measures from 60m, the Fort Cooper Coal Measures at 118m and the Moranbah Coal Measures at 547m. It is situated near station 473 on seismic line MGC92-T. A sonic log has been run from 500 to 798m and a density log has been run from 80m to similar depths.

BUL Sapphire 1 was drilled to 848m depth to intersect the Rangal Coal Measures at 160m, the Fort Cooper Coal Measures at 234m and the Moranbah Coal Measures at 570m. This well was drilled as a coal bed methane exploration well. A sonic log was run from 300m to 835m depthand a desity log was run from 10m to 832m. This well is situated near station 166 on line BE08-09.

5.0 OPERATIONS

5.1 ACQUISITION

The data was acquired by Terrex Seismic of Bibra Lake WA between the 31st of August and the 3rd of September 2008. They have provided an operations report which is included as part of Appendix E of this report.

Line	Start VP	End VP	Km	Dates Shot
BE08-05	100	1570	11.025	31st-2nd-
BE08-06	320	100	1.65	2nd
BE08-09	644	100	4.080	3rd
BE08-10	100	750	4.875	31st
TOTAL			**21.63**	

Table 2 line statistics

5.2 PROCESSING

The data was processed by Fugro Seismic Imaging Pty Ltd., 69 Outram Street, West Perth WA They have provided a processing report which is included as Appendix K of this report.

5.3 INTERPRETATION

Three time structure maps have been prepared; the top of the Rangal Coal Measures, the near top of the Fort Cooper Coal Measures and near the top of the Moranbah Coal Measures.

Previous seismic surveys are only available as tiff images of depth converted migrated stacks. The depth conversions have been performed using stacking velocities. Formation tops from the wells can be directly picked onto the depth sections. These depth sections can be correlated with care to the newly acquired time sections, given the poor quality of the depth sections due to excessive gain and limited band pass.

Static shifts were calculated for processing the data using a datum elevation of 250m with a replacement velocity of 2500m/sec. A bulk shift of 200msec was also applied to this data during processing. The BE08 Glenden Seismic Survey was corrected sea level to zero time, a shift of -.39 seconds was applied to achieve this.

5.3.1 The top of the Rangal Coal Measures

The top of the Bandanna formation is well defined. The Rangal Coal Measures contains thick coal seams where as the overlying Rewan Group sediments contain thick succession of often

homogeneous overbank deposits and poorly interconnected channel deposits. This boundary produces very strong reflection events (Brakel et al 2009). On the depth sections these coal measures form parallel reflectors with severe clipping of both peaks and troughs due to excessive gain. These are the strongest reflectors on the time sections of the BE08 Glenden Seismic Survey.

5.3.2 The near top of the Fort Cooper Coal Measures

Below the strong parallel reflectors representing the coal measure sequences of the Rangal Coal Measures is a zone of moderate parallel and subparallel and bifurcating reflectors of the Fort

Cooper Coal Measures. Any reflections from coals within the Fort Cooper Coal Measures have been filtered by the strong impedance contrast between the Rangal Coal Measures and Rewan Formation. The Fort Cooper Coal Measures contain numerous tuff bands throughout further subduing the seismic impedance contrast between the coals and surrounding sediment.

The reflectors representing the Fort Cooper Coal Measures occur below the B65 sequence boundary of Brakel et al 2009, and the B60 sequence boundary is above the base. The Fort Cooper Coal Measure sequence on seismic sections examined here represents a facies change from those seismic sections examined by Brakel et al 2009 and hence are expected to have a different seismic character. Unfortunately the previous seismic surveys have been "overprocessed" and appear unnaturally sublinear and "wormy". The BE08 Glenden Seismic Survey reveals these reflectors to be less distinct than the Rangal Coal Measures above but due to the multiple effect.

5.3.3 The top of the Moranbah Coal Measures.

The Moranbah Coal Measure lie beneath the Fort Cooper Coal Measures. Erosion and onlap are evident at the top of the Moranbah Coal Measures indicating a sequence boundary. There does not appear to be a seismic character change across the boundary although reflectors are becoming weaker and more discontinuous with depth as the affect of internal multiples increase.

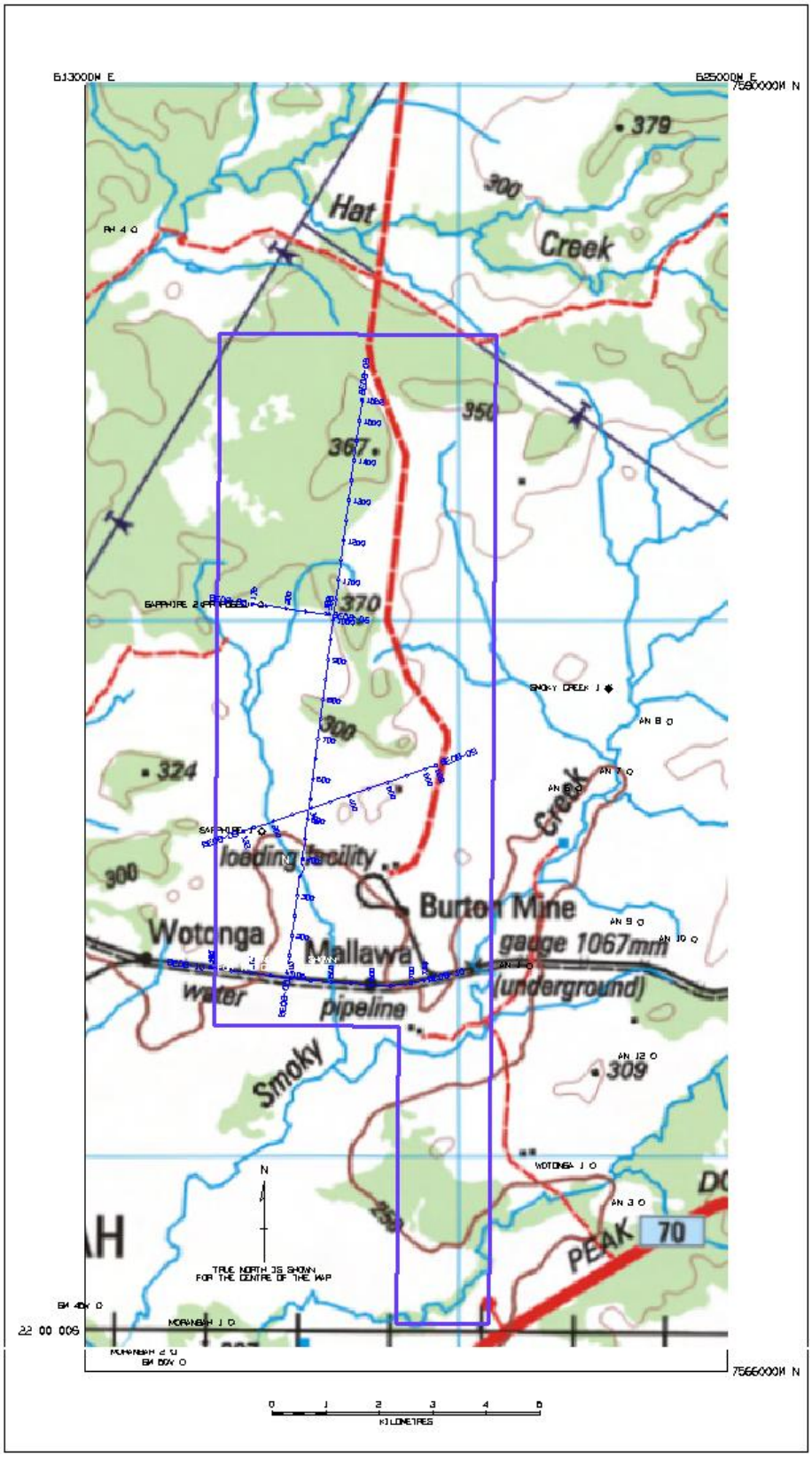
6.0 PROSPECTS AND LEADS

The survey is based on Coal Bed Methane exploration requirements where potential closures with potential for free flowing gas are not the targets. What is required is to determine the structural nature of the top coal surface.

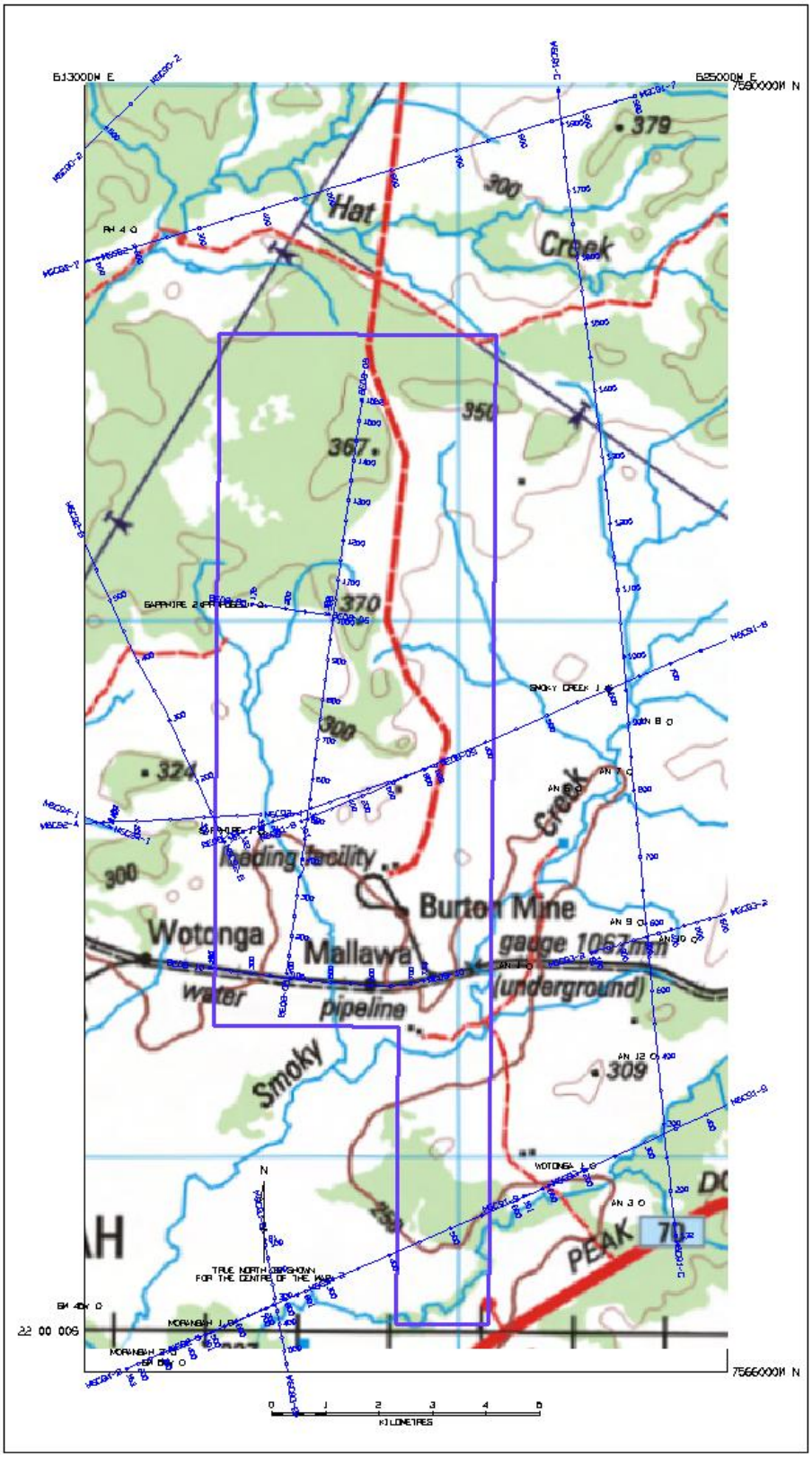
The BE08 Moranbah Seismic Survey reveals the structure of this area to contain a reverse fault on the western limb of the broad Nebo Synclinorium. The three interpreted surfaces are subparallel. The Top of the Fort Cooper Coal Measures lies about 150m below the top of the Rangal Coal Measures. The top of the Moranbah Coal Meaasures are about 500m below the top of the Fort Cooper Coal measures.

The Rangal Coal Measures and the Fort Cooper Coal Measures outcrop to the west of this area and dip east. Movement on the reverse fault has resulted in a fault induced anticline in the north

east of this area. The Fort Cooper Coal Measures outcrop in the core of this anticline and the Rangal Coal Measures outcrop to the east of these.



Shotpoint Base Map displaying nearby well positions and BE08 Moranbah Seismic Survey



Shot Point basemap showing BE08 Glenden and existing seismic surveys and wells near ATP 814P Mt Hillalong

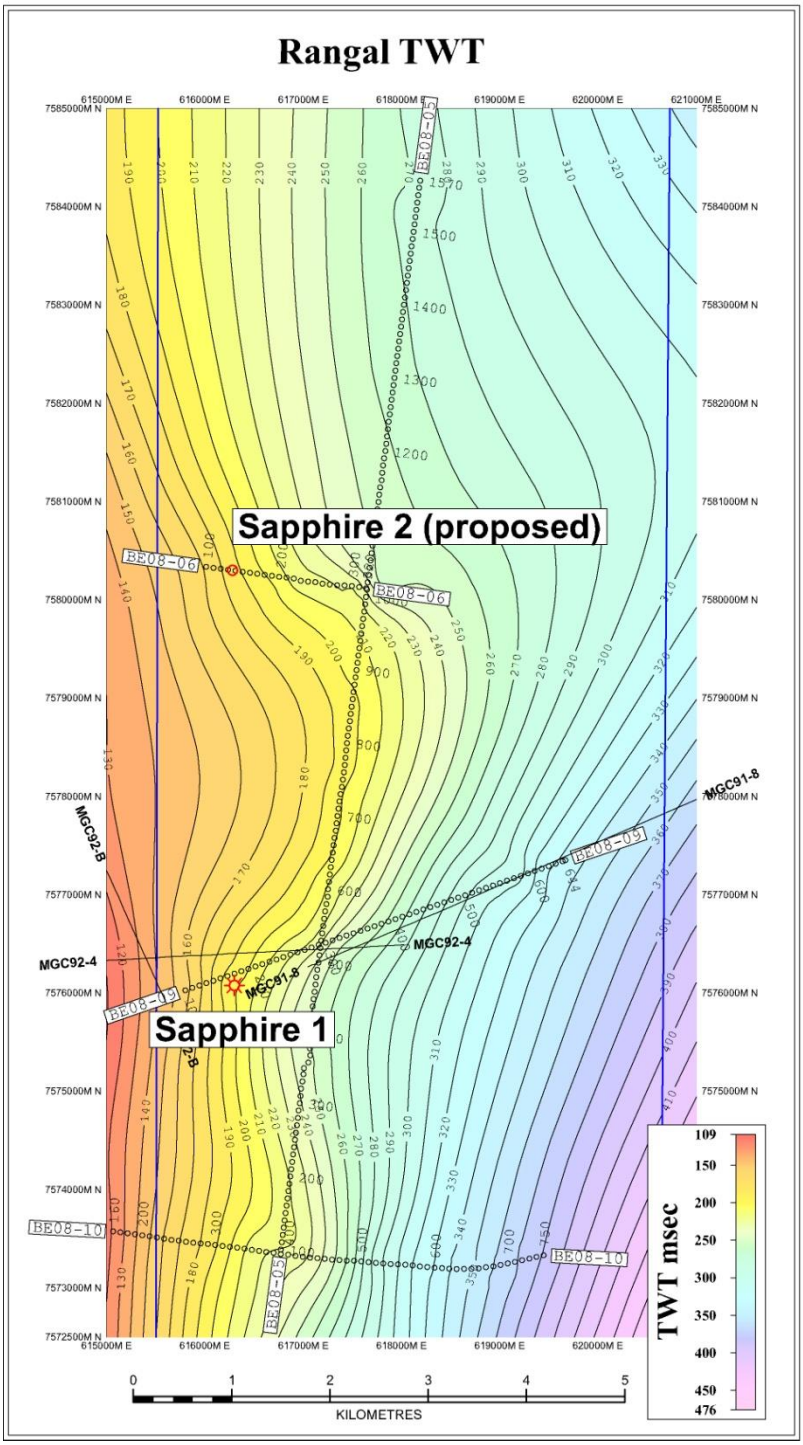


Figure 4 time structure map top of the Rangal Coal measures

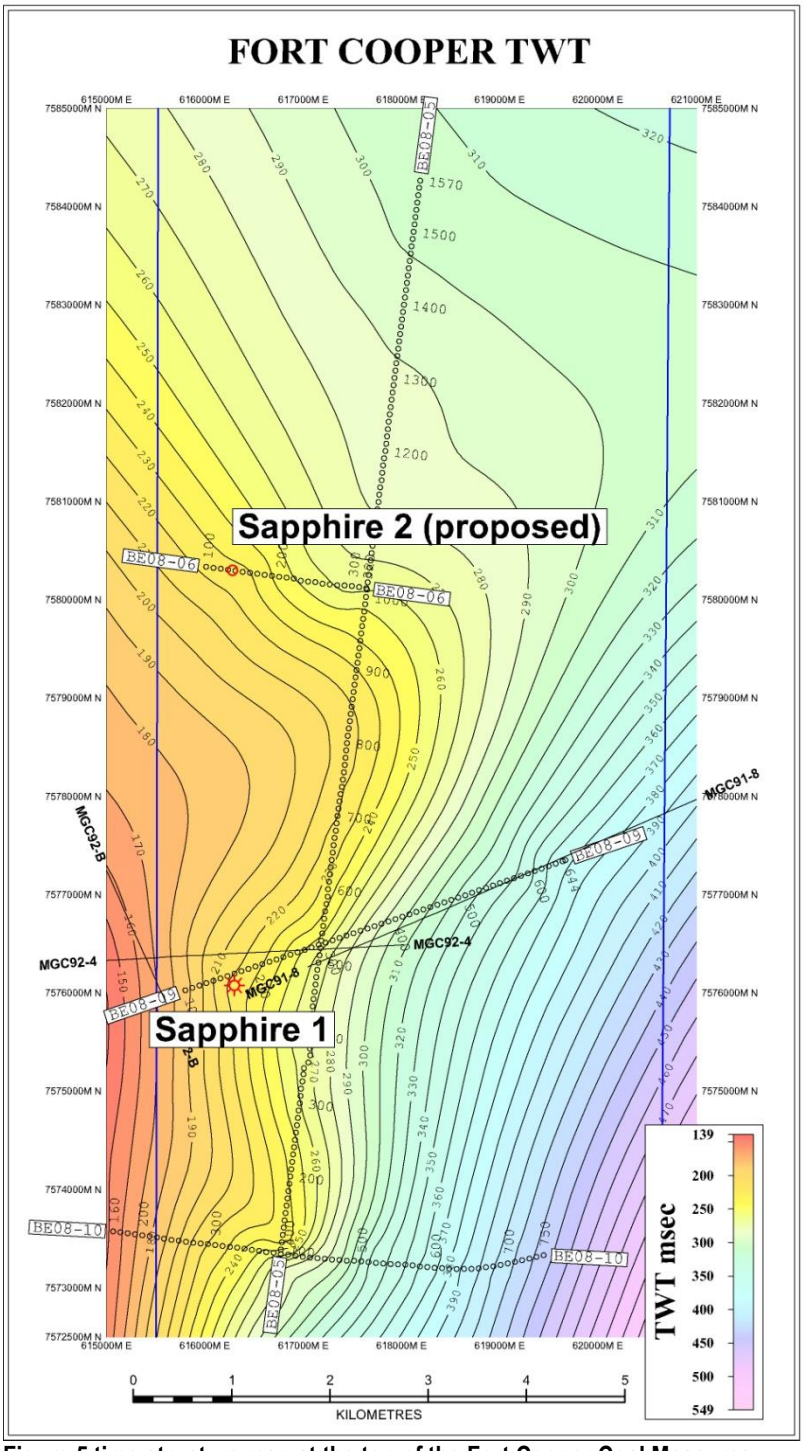


Figure 5 time structure map at the top of the Fort Cooper Coal Measures

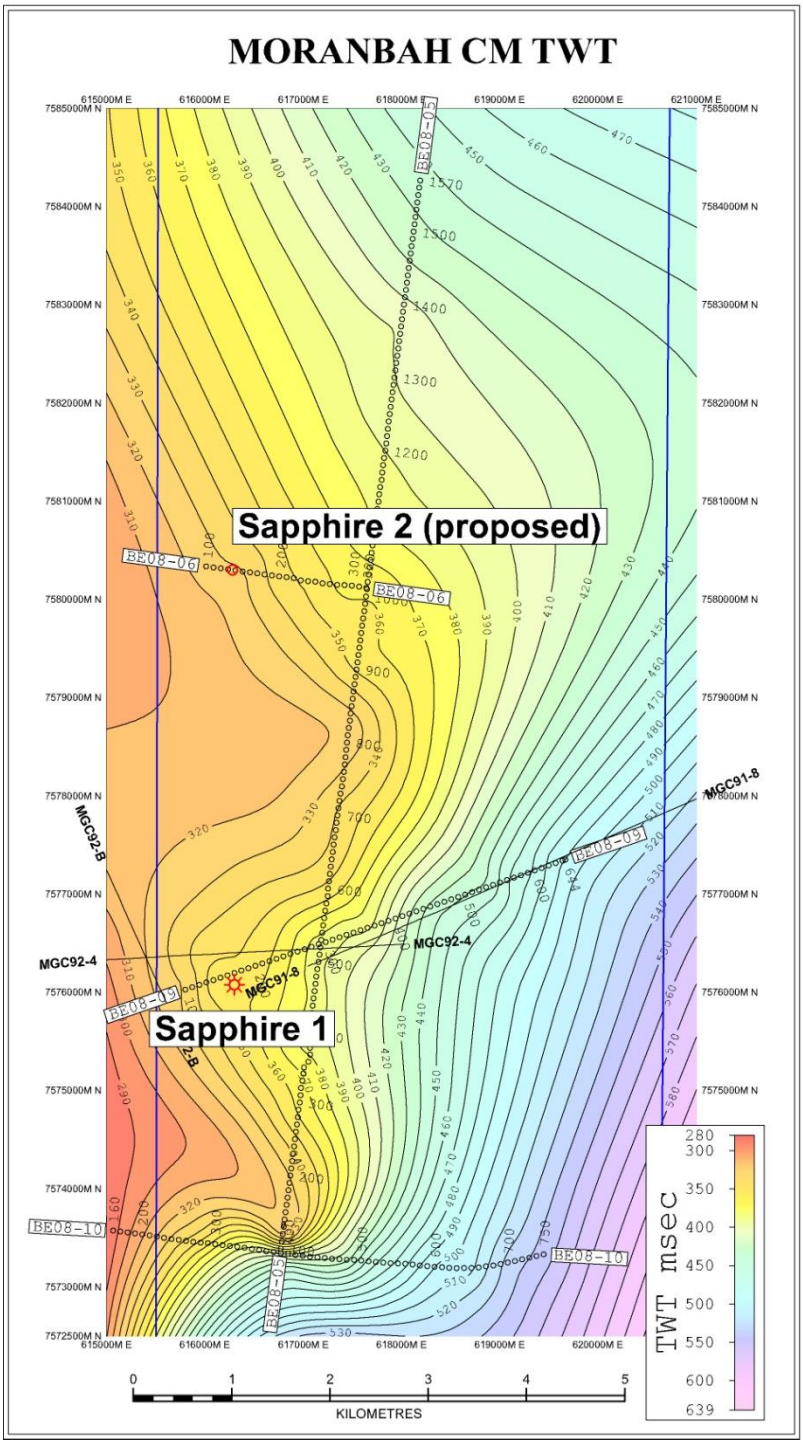


Figure 6 time structure map at the top of the Moranbah Coal Measures

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8.0 INTERPRETED SECTIONS