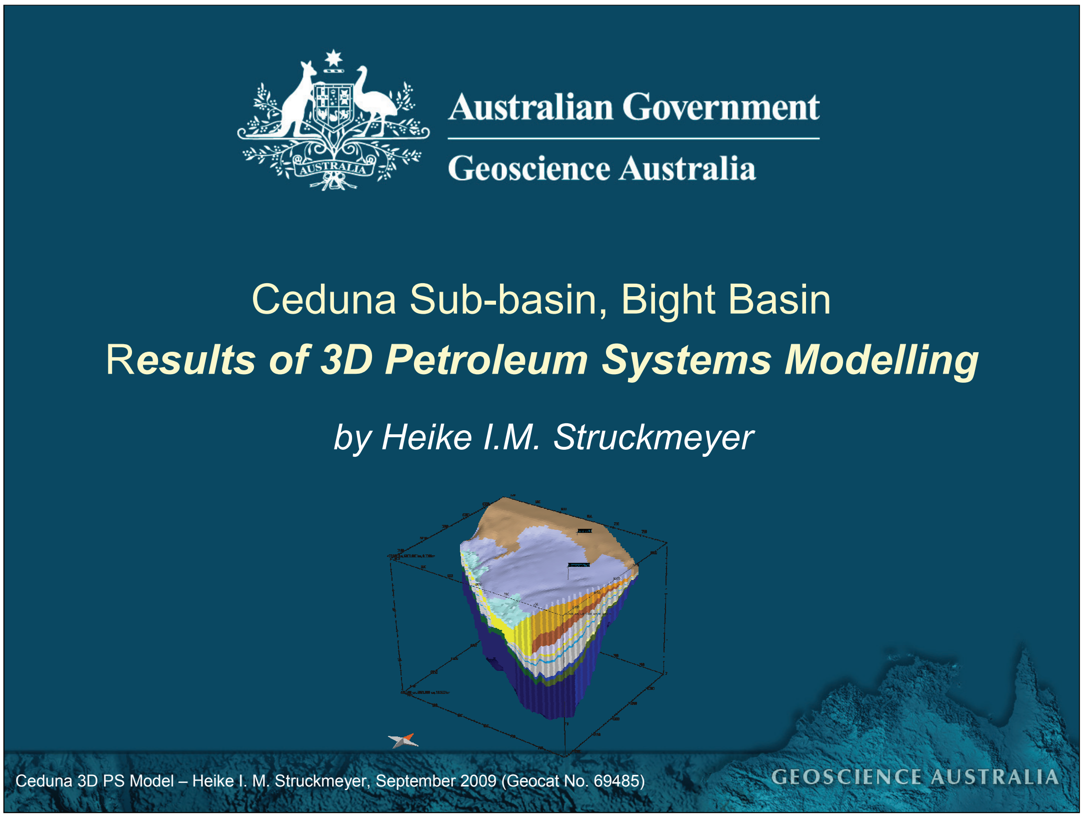

This presentation summarises results of 3D petroleum systems modelling of the northwestern Ceduna Sub-basin, using Schlumberger Petromod software. The model builds on two 2D-models for the northern and central Ceduna Sub-basin (Totterdell et al., 2008).

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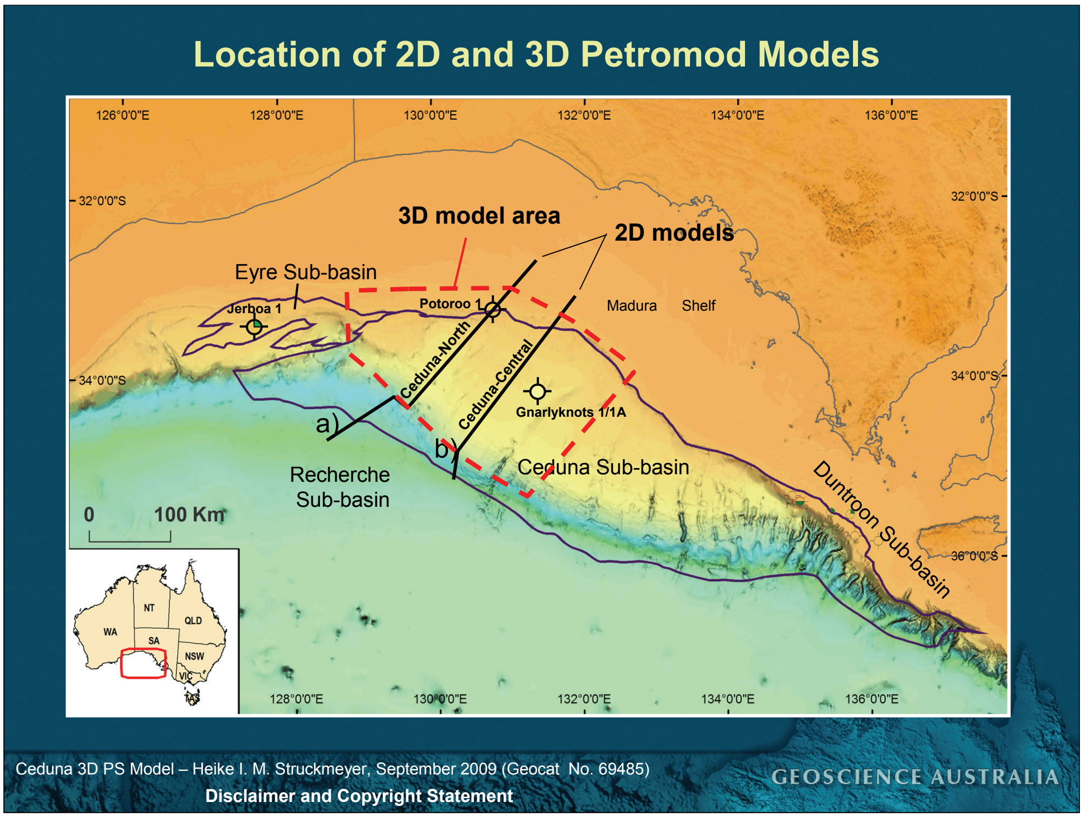
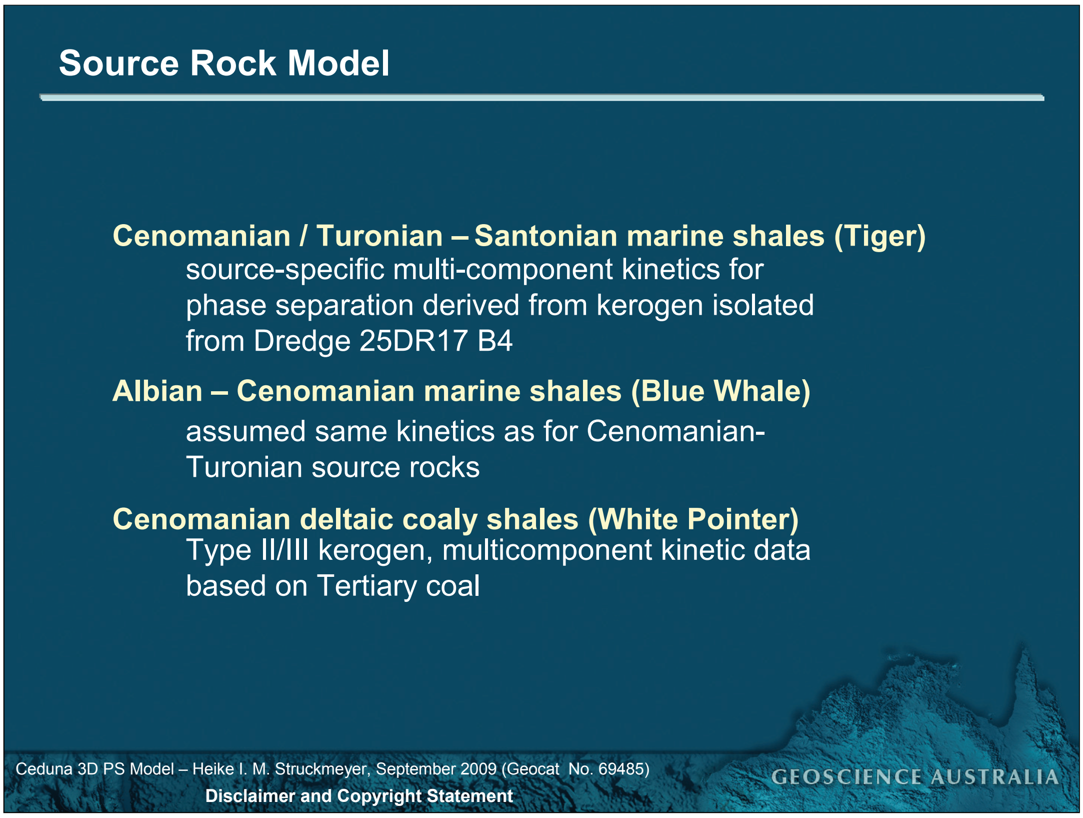
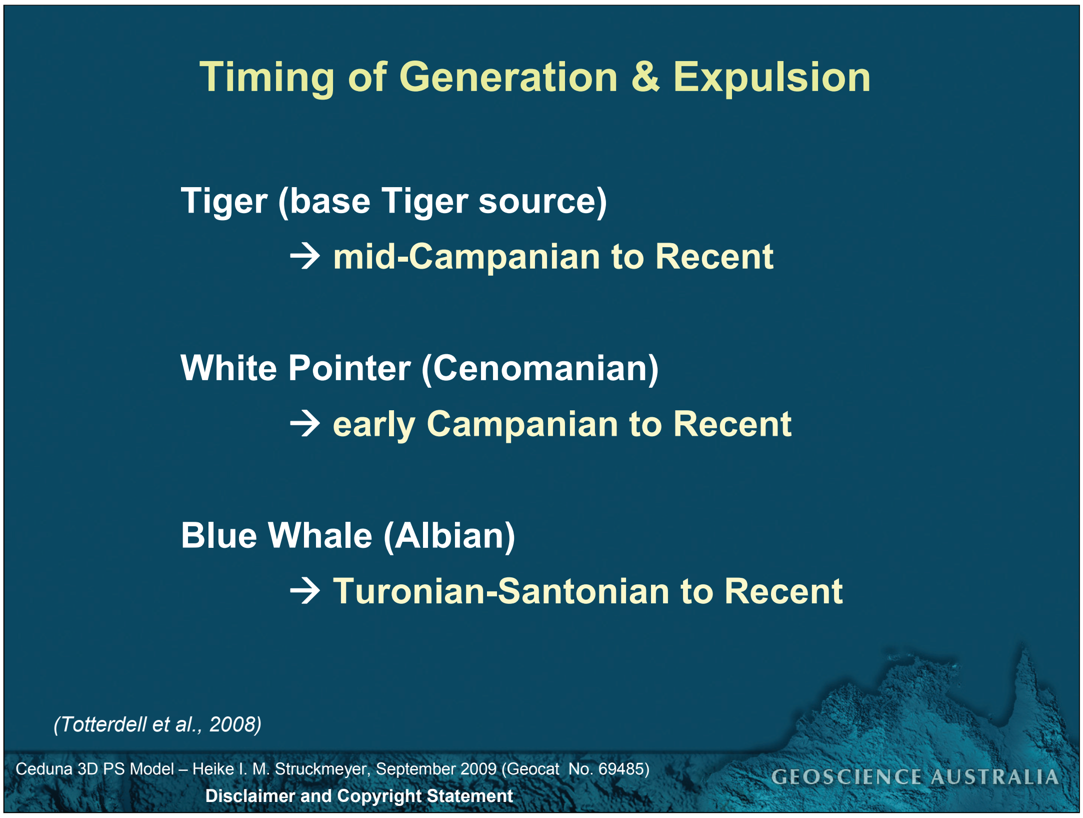


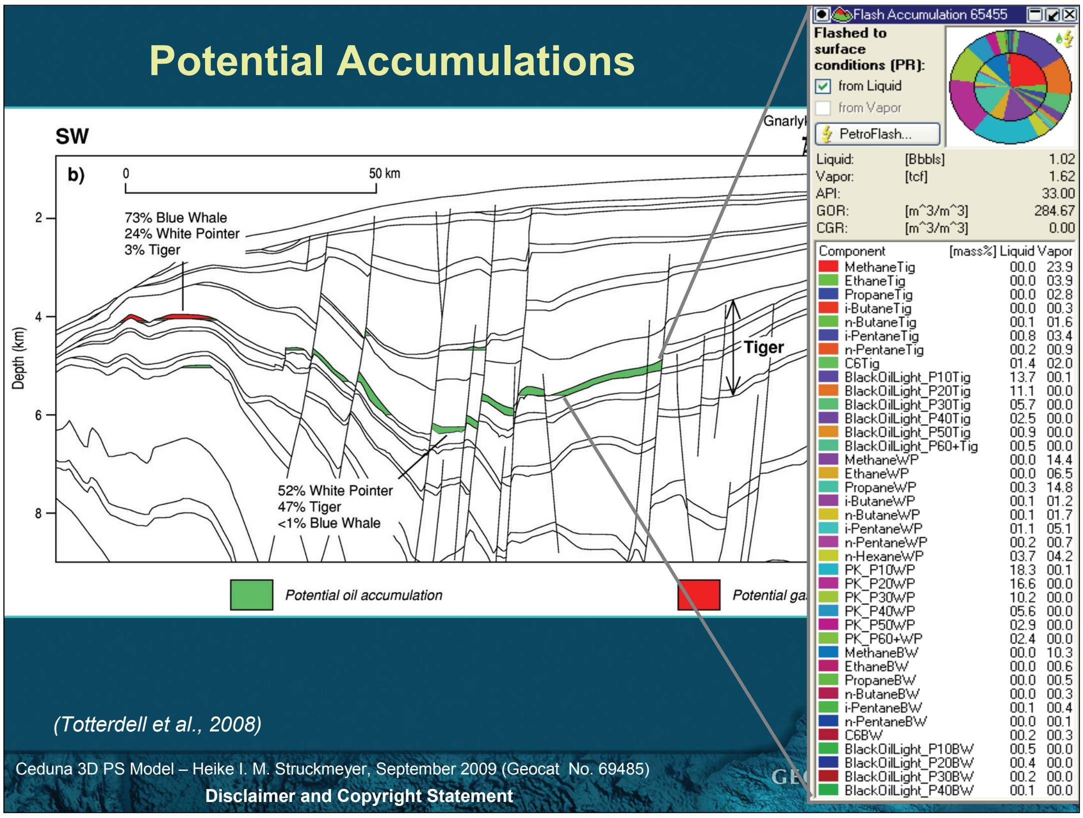
This slide shows the location of the two 2D models (Totterdell et al., 2008), and the 3D model area.



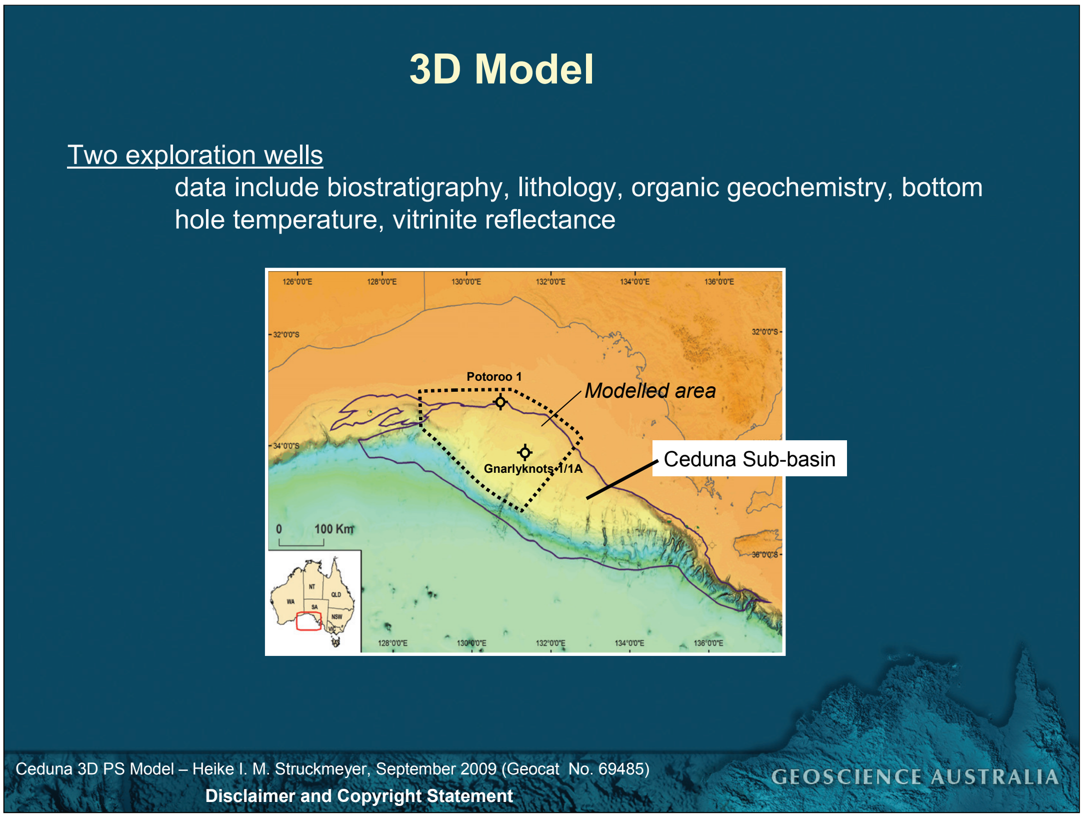
Three major source rock units were used in the 2D models − marine shales in the Albian to Cenomanian Blue Whale Supersequence and the Turonian to Santonian Tiger Supersequence, and deltaic coaly shales in the Cenomanian upper White Pointer Supersequence.



Results from the 2D models indicated that generation and expulsion from these source rocks occurred from the Turonian onwards, with expulsion occurring in response to deposition of the thick Hammerhead delta.



The 2D models also showed that potential oil and gas accumulations could be present in the central and outer basin, with varying contributions from the three modelled source rock units.



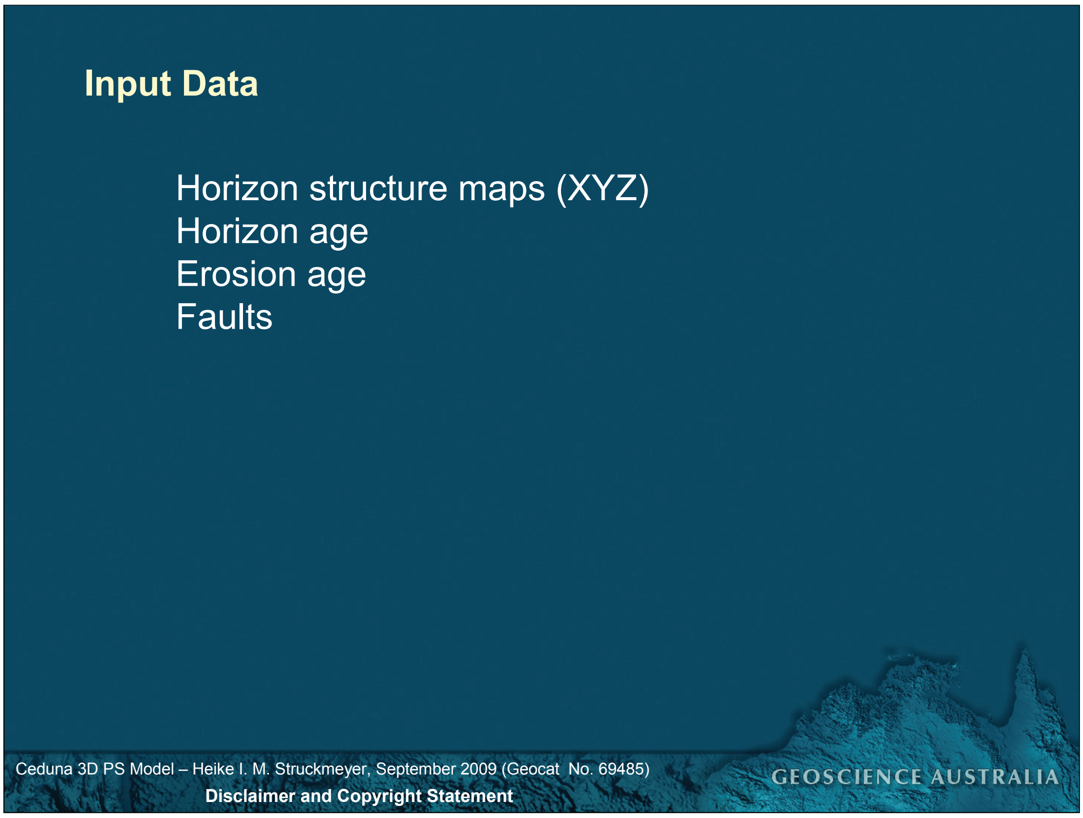
•2D and 3D petroleum systems models are usually constrained by the composition and maturity of recovered hydrocarbons in a basin, i.e. if the geochemistry and other parameters of reservoired oil or gas are matched by those modelled, the model is well-constrained and the confidence level is high.

•In the case of frontier basins, particularly those with a complex tectonostratigraphic history, such as the Bight Basin, petroleum systems models are only constrained by a "best-fit" between measured and modelled data, or in the case of no available data, by analogue to other basins or regional knowledge. As this best-fit can be arrived at by varying a number of possible parameters, the level of confidence in these models has to be low. For example, in the Ceduna Sub-basin, one of the key uncertainties is the depth conversion of seismic data or maps derived from seismic data, with only two control points at Potoroo-1 and Gnarlyknots-1, and an overall sedimentary thickness very likely exceeding 15 km.

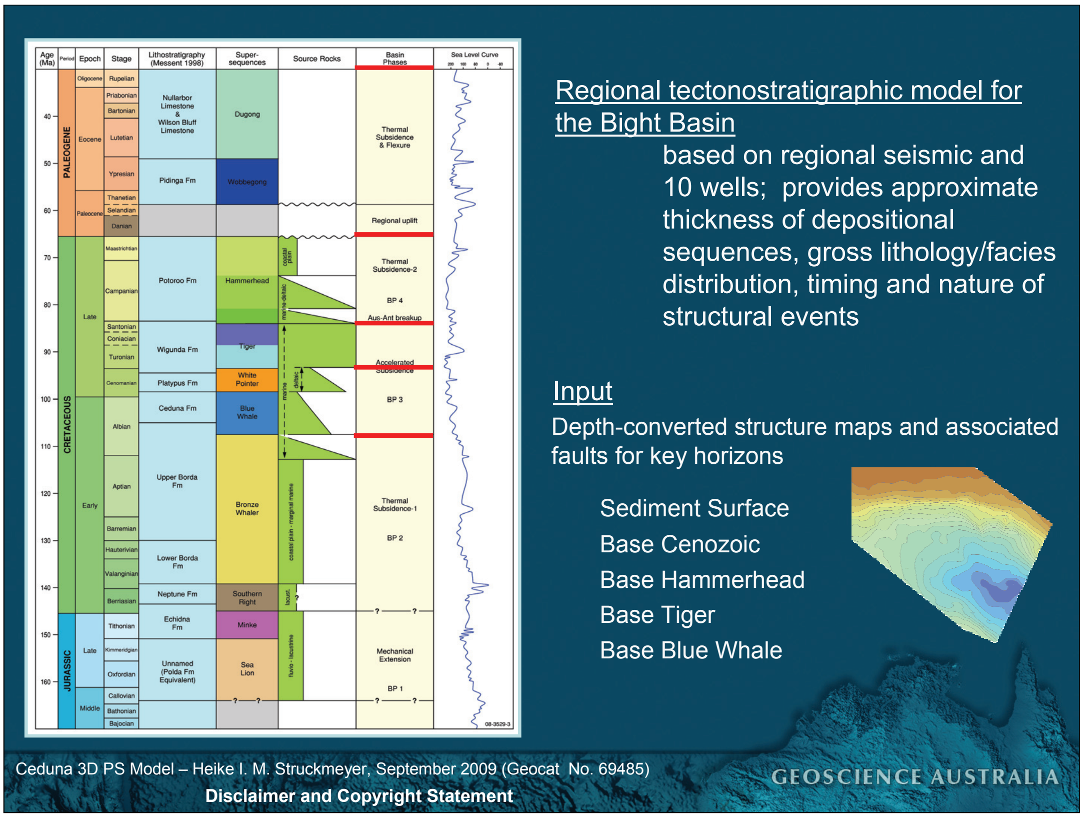
•The model discussed here is constrained by some data from the Gnarlyknots and Potoroo wells, and is based on good regional knowledge. It is therefore considered to be a reasonable attempt at modelling potential petroleum systems operating in the basin, however, it presents only one possible scenario. Variations in input and boundary parameters will result mostly in differences in timing and volume of generated hydrocarbons.

Presentation Outline

- Input Data
- Boundary Conditions
- Simulation
- Calibration
- Results



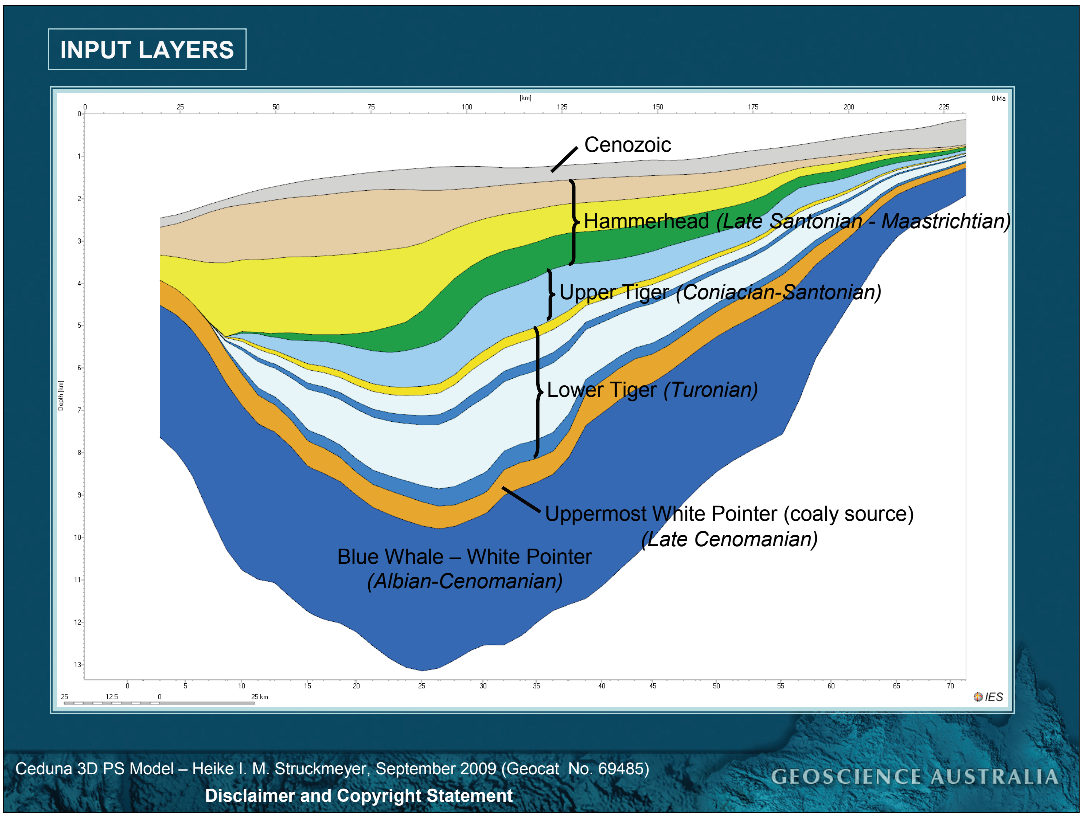
Input data for the 3D model firstly include horizon structure maps, age of deposition, erosion and associated faults.



The main input data for this 3D model are depth-converted structure maps. These maps were generated as part of a regional tectonostratigraphic study of the Bight Basin, which was based on regional seismic coverage and 10 wells (Totterdell et al., 2000). This also provided input data for lithologies, facies distributions, structural events, etc. The key input surfaces are sediment surface, base Cenozoic, base Hammerhead, base Tiger, and base Blue Whale.

The section underlying the Blue Whale Supersequence was not modelled in the 3D study because

- pre-Albian units could only be seismically mapped in the northern and northeastern part of the basin, and
- if present, would not be relevant to maturation of the younger source rocks; the base Blue Whale is therefore taken as the base of the modelled section.



The input model is somewhat less detailed than that of the 2D models. However, additional layers were added to the 4 input sequences to delineate the previously modelled source and reservoir layers. Most of these additional layers were added as a percentage of the parent layer.

INPUT LAYERS

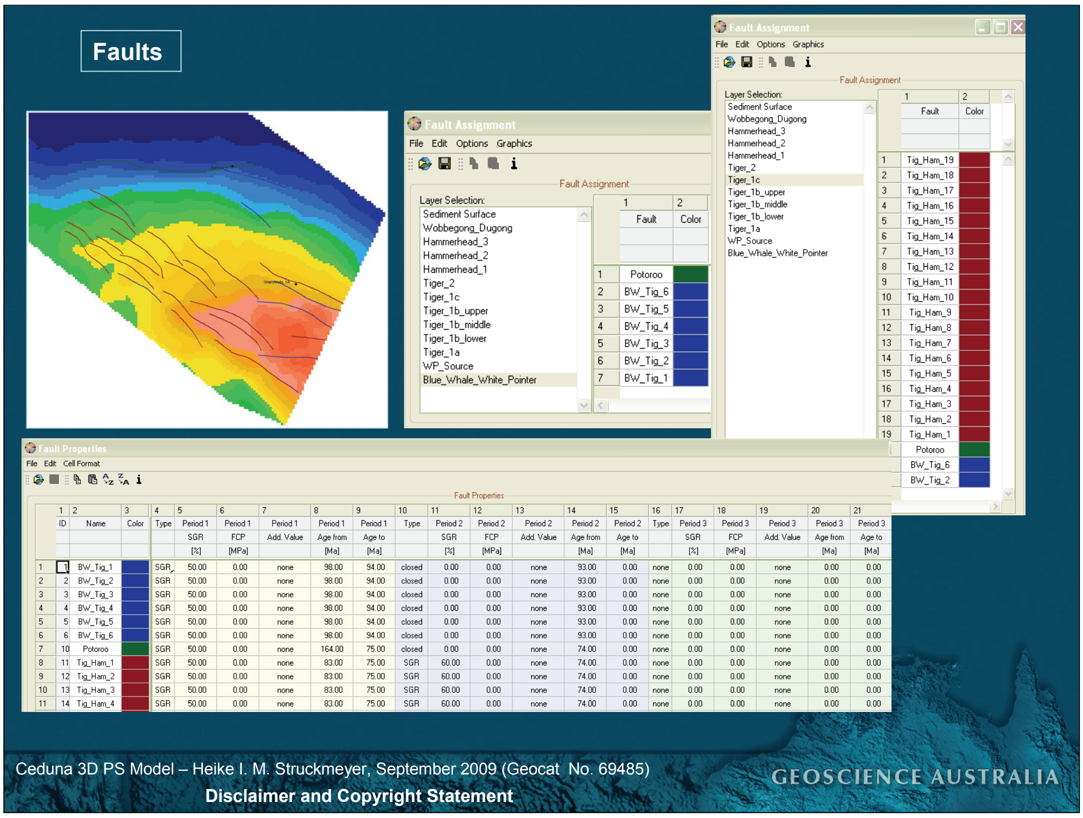
Name	Color	Deposition Age from [Ma]	Deposition Age to [Ma]	Erosion Age from [Ma]	Erosion Age to [Ma]	Max. Time Step Duration [Ma]
Wobbegong_Dugong		58.00	0.00	0.00	0.00	10.00
Hammerhead_3		74.00	65.00	0.00	0.00	10.00
Hammerhead_2		81.00	74.00	0.00	0.00	10.00
Hammerhead_1		83.00	81.00	0.00	0.00	10.00
Tiger_2		86.00	83.00	0.00	0.00	10.00
Tiger_1c		86.50	86.00	0.00	0.00	10.00
Tiger_1b_upper		88.00	86.50	0.00	0.00	10.00
Tiger_1b_middle		89.00	88.00	0.00	0.00	10.00
Tiger_1b_lower		92.50	89.00	0.00	0.00	10.00
Tiger_1a		93.50	92.50	0.00	0.00	10.00
WP_Source		95.00	93.50	0.00	0.00	10.00
Blue_Whale_White_Pointer		107.00	95.00	0.00	0.00	10.00

After the additions, the model comprises 12 layers. No erosion was modelled, because the bulk of erosion occurred on the Madura Shelf and in the Eyre Sub-basin, both of which were not the focus of the modelling.

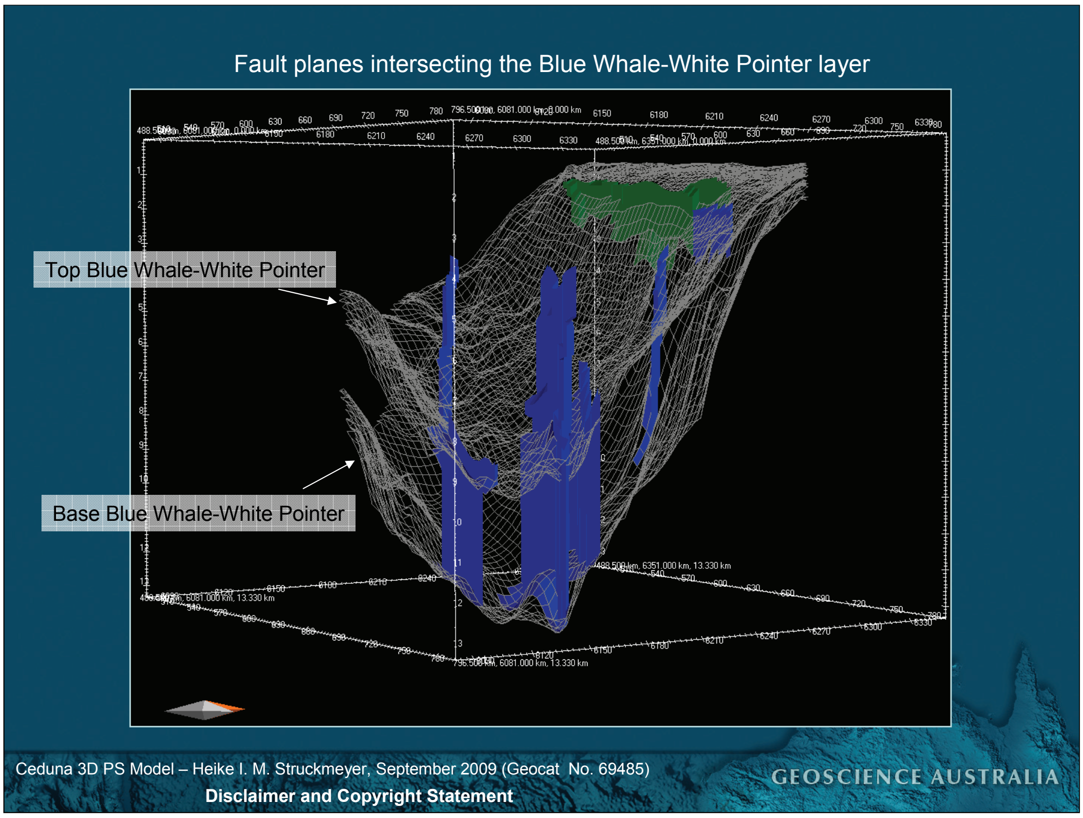
Input Data

- Horizon structure maps (XYZ)
- Horizon age
- Erosion age
- Faults

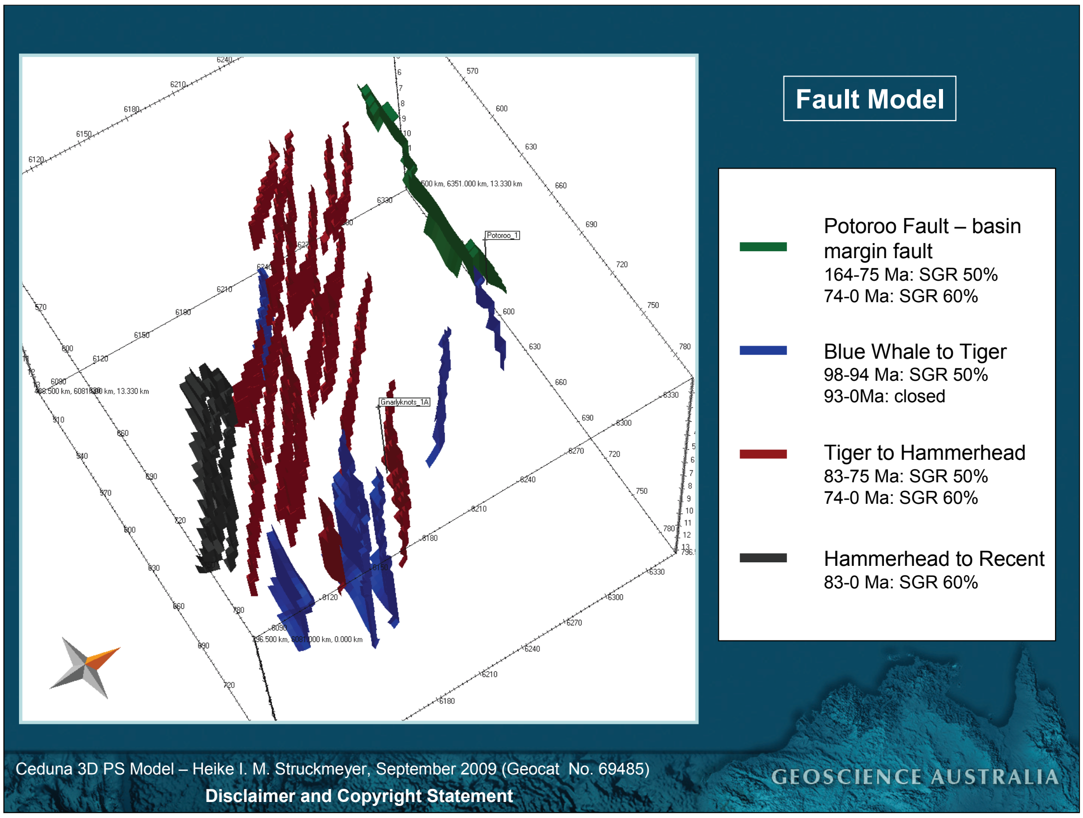
→ Input Layers with assigned ages & faults



Imported faults are assigned to the individual layers. Properties of individual faults are defined, e.g. if it was open or closed to fluid flow, or alternatively different shale gauge ratios or values of fault capillary pressure can be defined. This is one of the more tenuous input parameters in a frontier basin, because very little is generally known about fault behaviour. In the final model the choice of fault behaviour influences mainly the size of the modelled accumulations.



This slide shows, as an example, fault planes intersecting the Blue Whale-White Pointer layer in 3D view.



This slide illustrates all the faults used in the model. The colours indicate major faults intersecting layers of different age. Basically, all faults were modelled to have a Shale Gauge ratio between 50 and 60%. This is a highly simplified model to reduce complexity and processing time.

Input Data

- Horizon structure maps (XYZ)
- Horizon age
- Erosion age
- Faults

→ Input Layers with assigned ages

→ Facies Definition and Assignment to Layers
  - Lithology
  - TOC, HI and Kinetics for source rock layers

INPUT LAYERS – FACIES DEFINITION

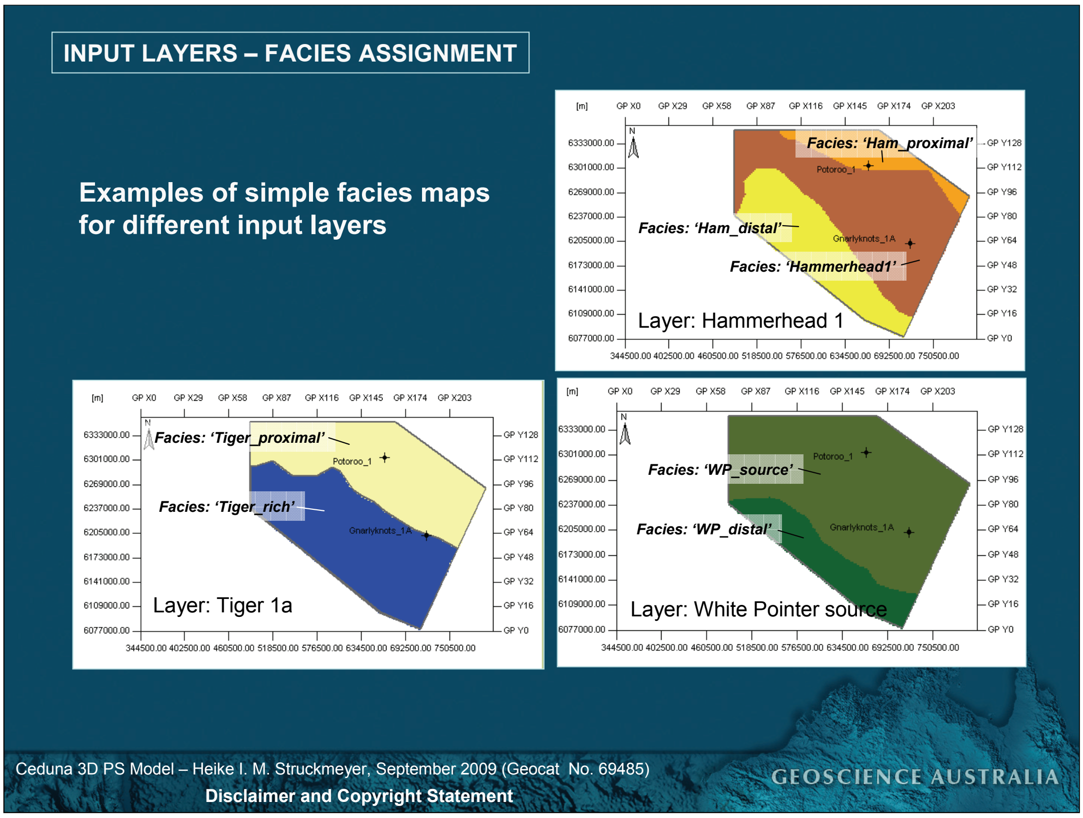
Layer/Facies	PSE	Lithology	Kinetics	TOC	HI
Wob-Dug – typical	Seal/OB	lst 40, marl 10, sst (qtz) 20, siltst 10, sh 20	-	0	0
Wob-Dug – distal	Seal/OB	sh 60, chalk 30, lst 10	-	0	0
Ham – proximal	Res/OB	sst (qtz) 45, sst 40, sh 12, coal 3	-	0	0
Ham - distal	Seal/OB	sh 40, siltst 30, sst (qtz) 15, sst 15	-	0	0
Ham3 – typical	Res	sst (qtz) 40, sst 40, siltst 18, coal 2	-	0	0
Ham2 – typical	Res	sst (qtz) 40, sst 40, siltst 17, coal 3	-	0	0
Ham1 – typical	Res	sst (qtz) 35, sst 35, siltst 27, coal 3	-	0	0
Tiger 2	Seal	sh 75, siltst 20, sst 5	Tiger-specific 14-component	2	500
Tiger rich	Source	sh (3%TOC) 50, sh 30, siltst 15, sst (qtz) 5	Tiger-specific 14-component	6	500
Tiger medium	Source	sh (3%TOC) 50, sh 30, siltst (15, sst (qtz) 5	Tiger-specific 14-component	3	500
Tiger poor	OB/Seal	sh (3%TOC) 50, sh 30, siltst 15, sst (qtz) 5	Tiger-specific 14-component	2	500
Tiger - proximal	OB/Res	sh 50, sst (qtz) 35, sst 15	-	0	0
White Pointer typical	Source	sst 35, siltst 35, sh 20, coal 10	IES_Tertiary_coal-BH393_crack	3	300
White Pointer distal	OB/Seal	Sh 50, siltst 30, sst 18, coal 2	-	0	0
Blue Whale typical	Source	Sh 60, siltst 40,	Tiger-specific 14-component	2	500
Blue Whale rich	Source	Sh 60, siltst 40,	Tiger-specific 14-component	4	500
reservoir	Res	Sst (qtz) 45, sst 25, sh 30	-	0	0
seal	Seal	Sh 75, siltst 20, sst 5	-	0	0

Overall, 18 different facies were defined and assigned to layers for different areas of the basin (the terms rich and poor refer to relative source richness; Res= reservoir; OB = overburden). The term facies in Petromod software includes

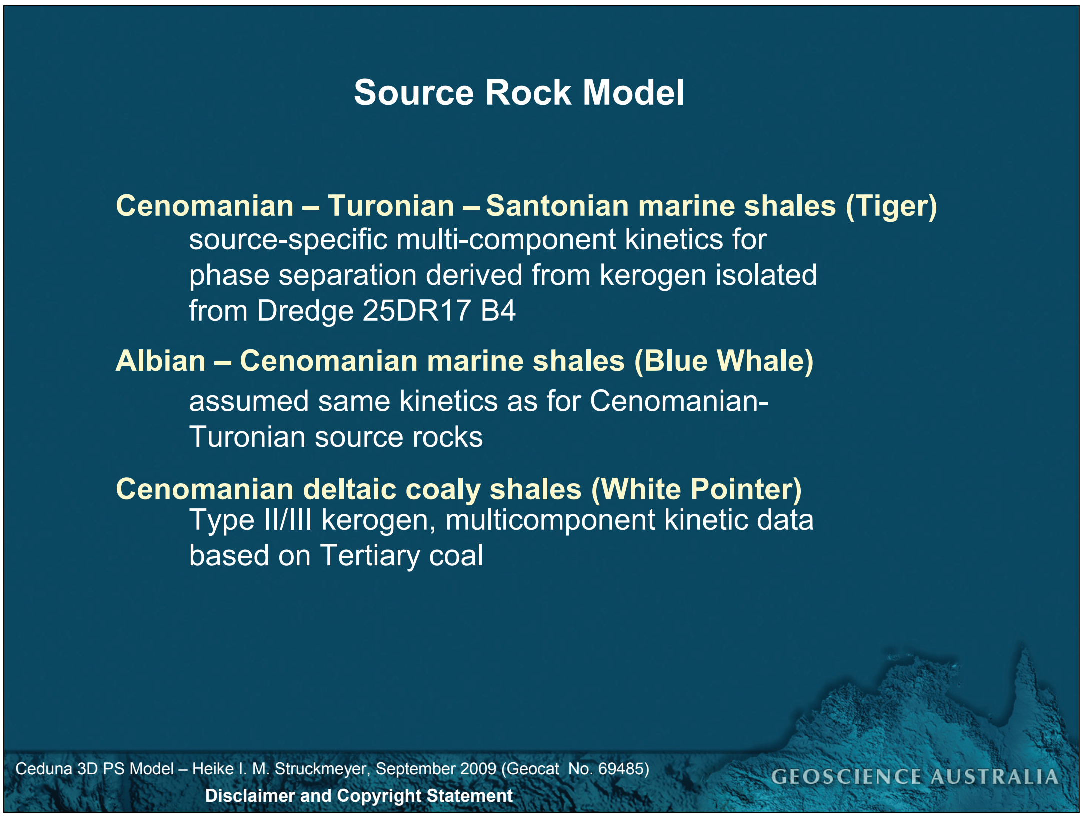
a) different lithology mixes (in %), defined for this study from the software-based library of lithologies,

b) an assigned TOC (total organic carbon) value and an ‘initial’ HI (Hydrocarbon Index) value, (initial meaning at an immature level); these values can be either average measured values from immature source rocks or assumed values based on data from mature source rocks.

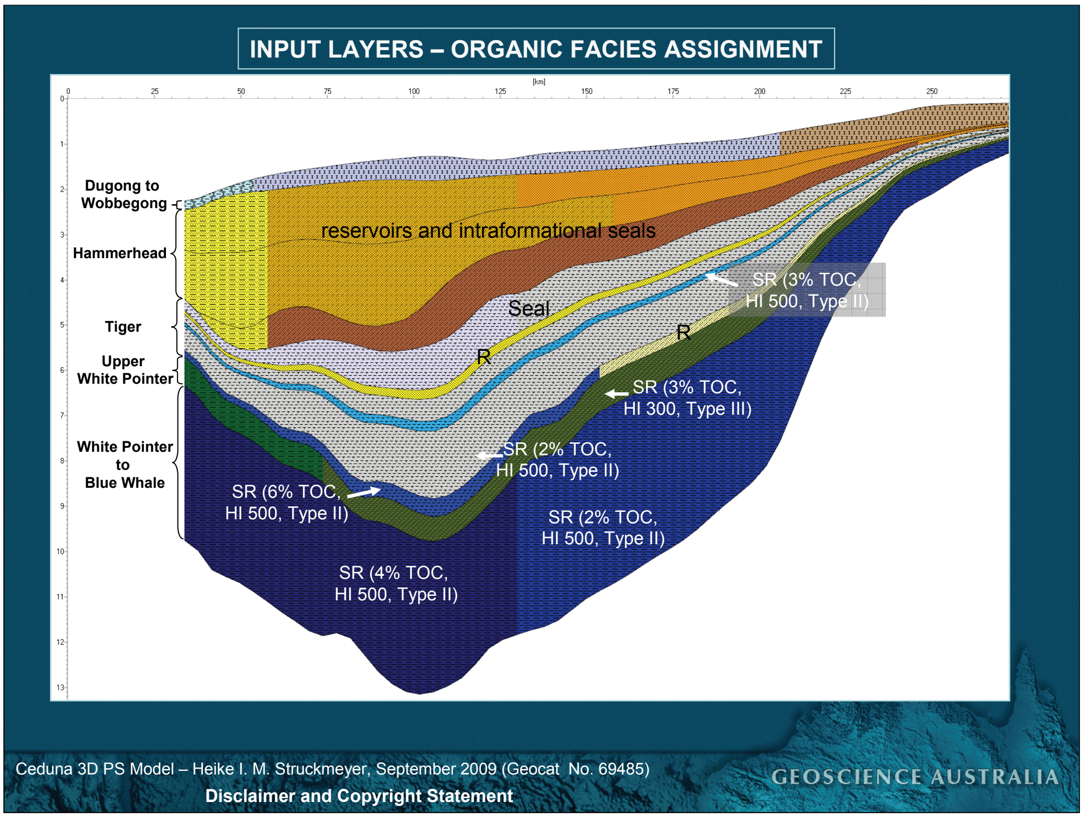
c) an assigned kinetics file.



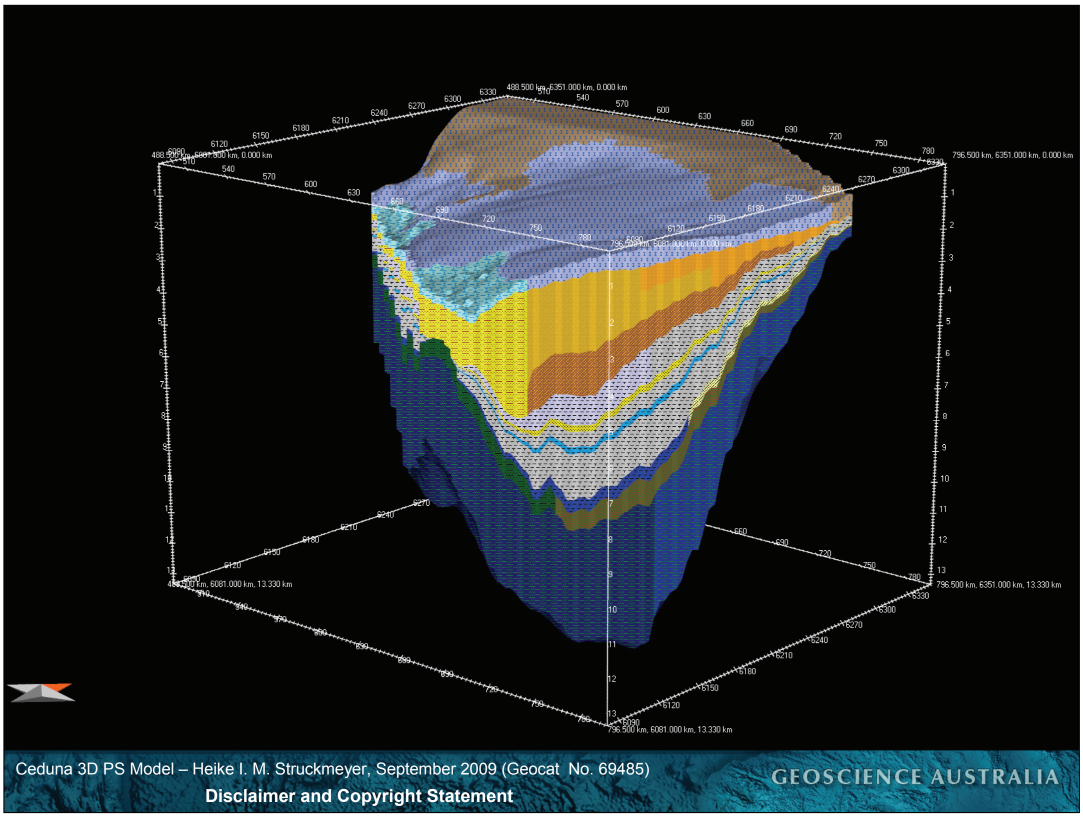
These three diagrams show examples of the simple facies distribution maps used for different input layers in this study. They roughly reflect fluvio-deltaic, shallow marine and deeper marine deposition based on estimates of location of shelf edge, base of slope, etc.



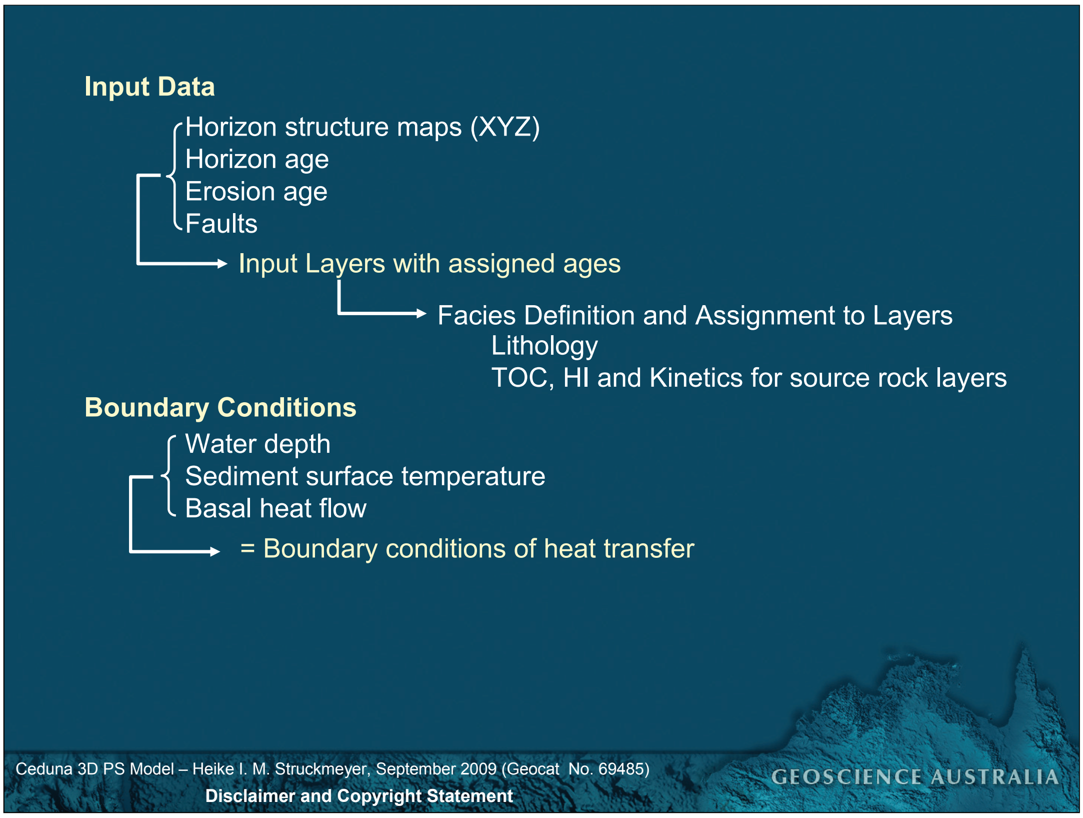
The parameters used for the three modelled source rock units include source-specific kinetics (DiPrimio & Horsfield, 2008) derived from organic-rich Turonian marine shales dredged from the northwestern margin of the Ceduna Sub-basin (Totterdell et al., 2008). Kinetic data based on a Tertiary coal (provided by the software) was used for the upper White Pointer source unit.



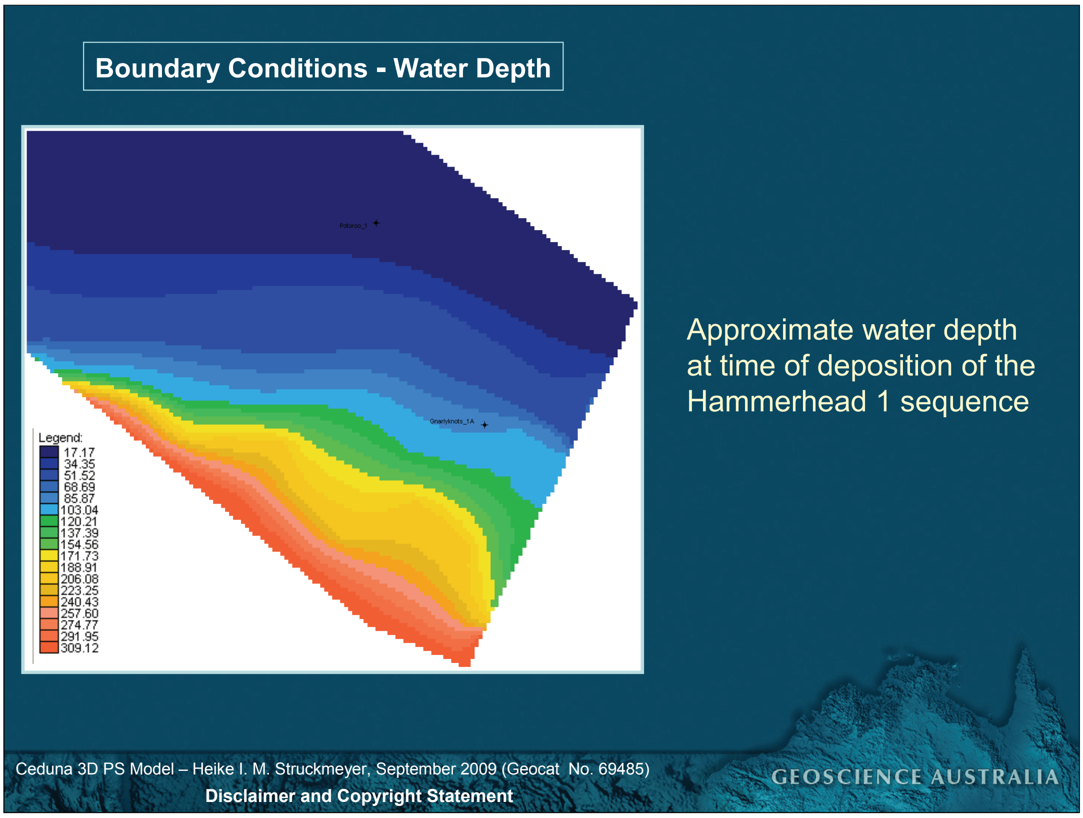
Based on the regional source rock and facies model, every point in the model has an assigned facies. In the case of the source rocks, this includes an initial TOC and HI value and a kinetics file which determines parameters such as activation energy, transformation ratio from kerogen to oil and gas, cracking, etc. For this model, all source rock kinetics are compositional for phase separation with secondary cracking, i.e. reaction kinetics describing the generation of individual hydrocarbons in the gas range and hydrocarbon groups in the oil range. Products from each source rock can be tracked through time.



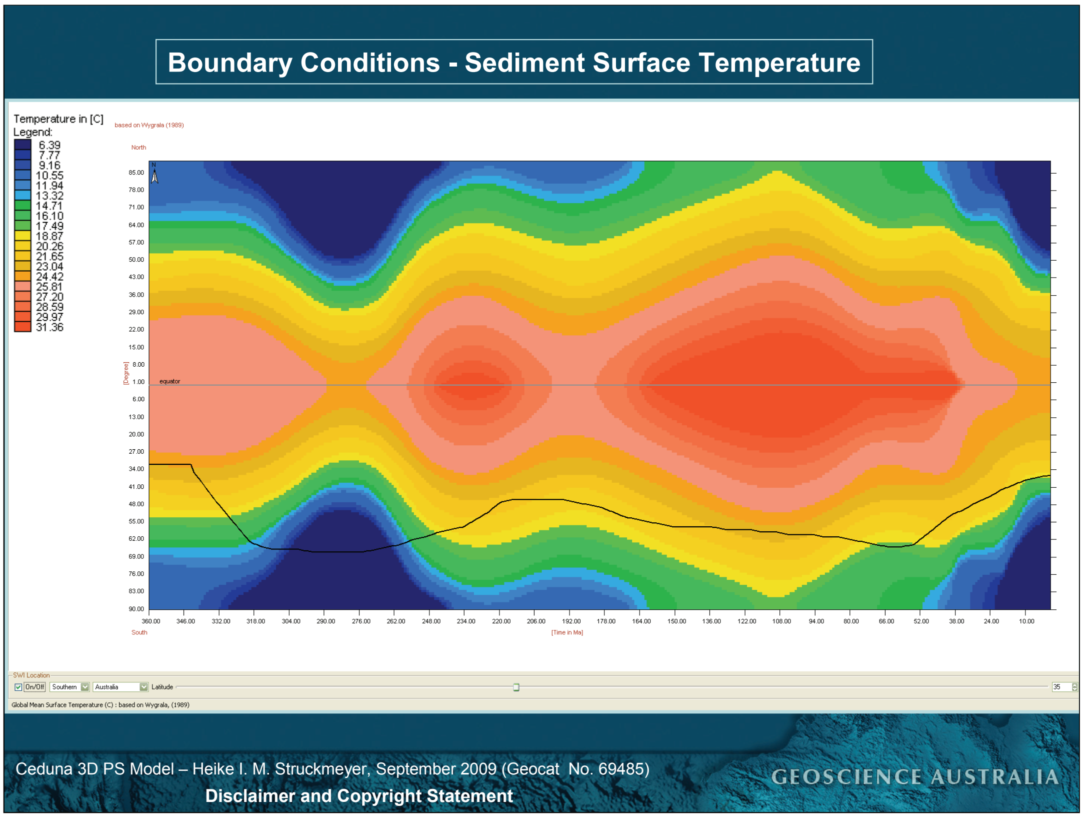
Following definition of the input layers boundary conditions for the model are constructed.



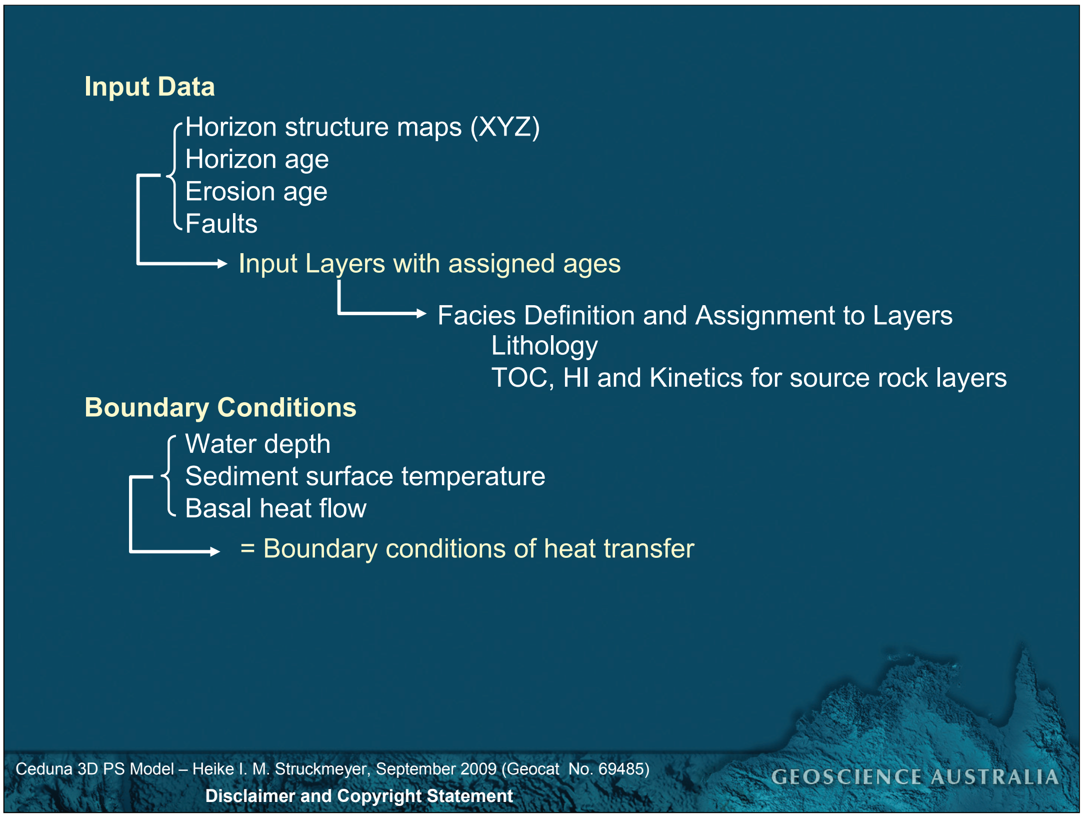
To be able to calculate heat transfer in basin fill, the physical and thermal conditions at the base and the top of the sedimentary basin need to be considered. The upper boundary condition is determined by the temperature at the surface of the sedimentary package. This requires knowledge of water depth, palaeogeographic position of the basin and prevailing global oceanic currents through time.



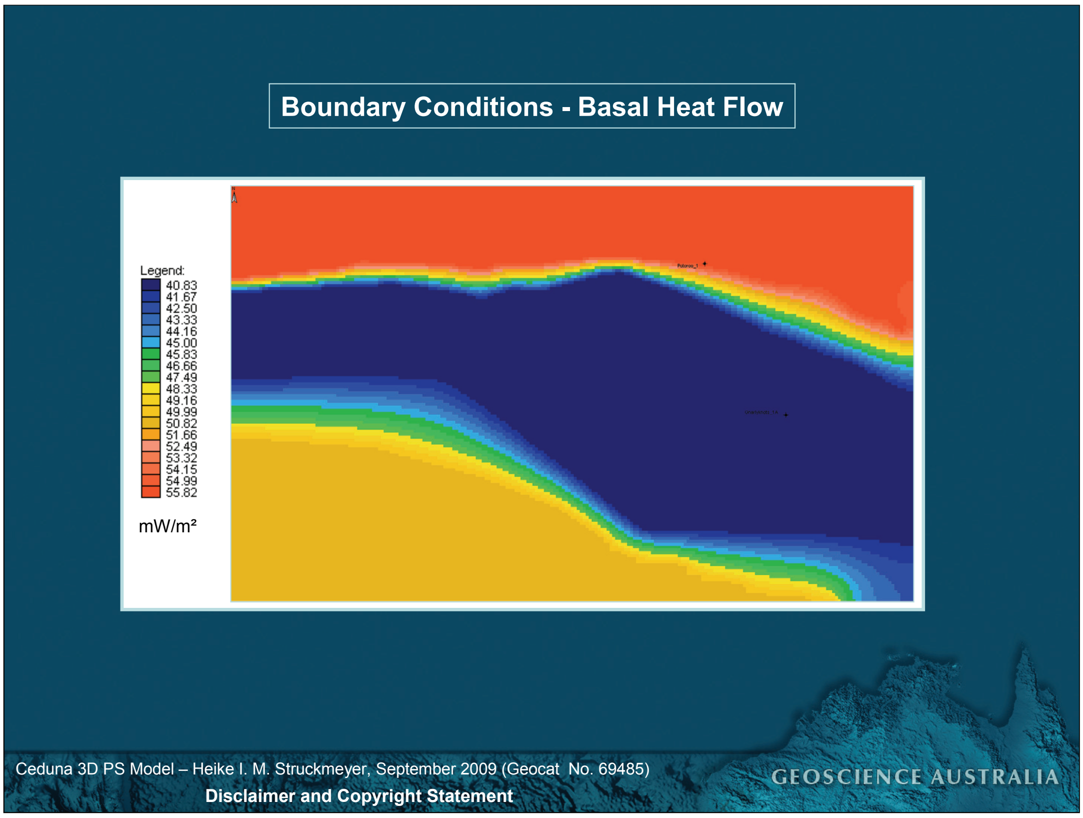
Estimated palaeo-water depths for each modelled layer are an important constraining parameter. In this case, they are based on the regional sequence stratigraphic model, and a number of simple palaeo-water depth maps were constructed. These were then assigned to specific time intervals. The example here shows approximate water depths at the time of deposition of the lower Hammerhead Supersequence.



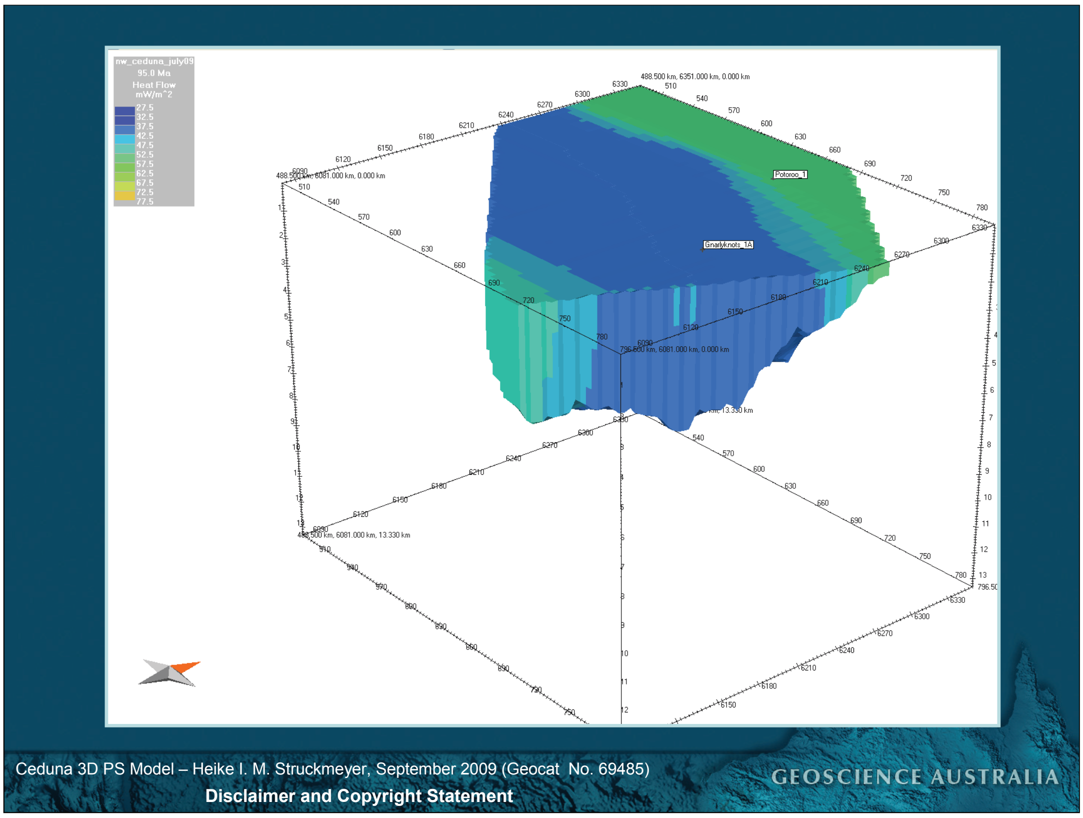
Petromod provides an automated estimate of the sediment surface temperature based on a plot of surface temperatures vs latitude vs geological time (Wygrala, 1989; Poelchau et al., 1997). The black line shows the latitudinal position of the present day location of 35 degrees South through time; the calculated temperature is shown in colour.



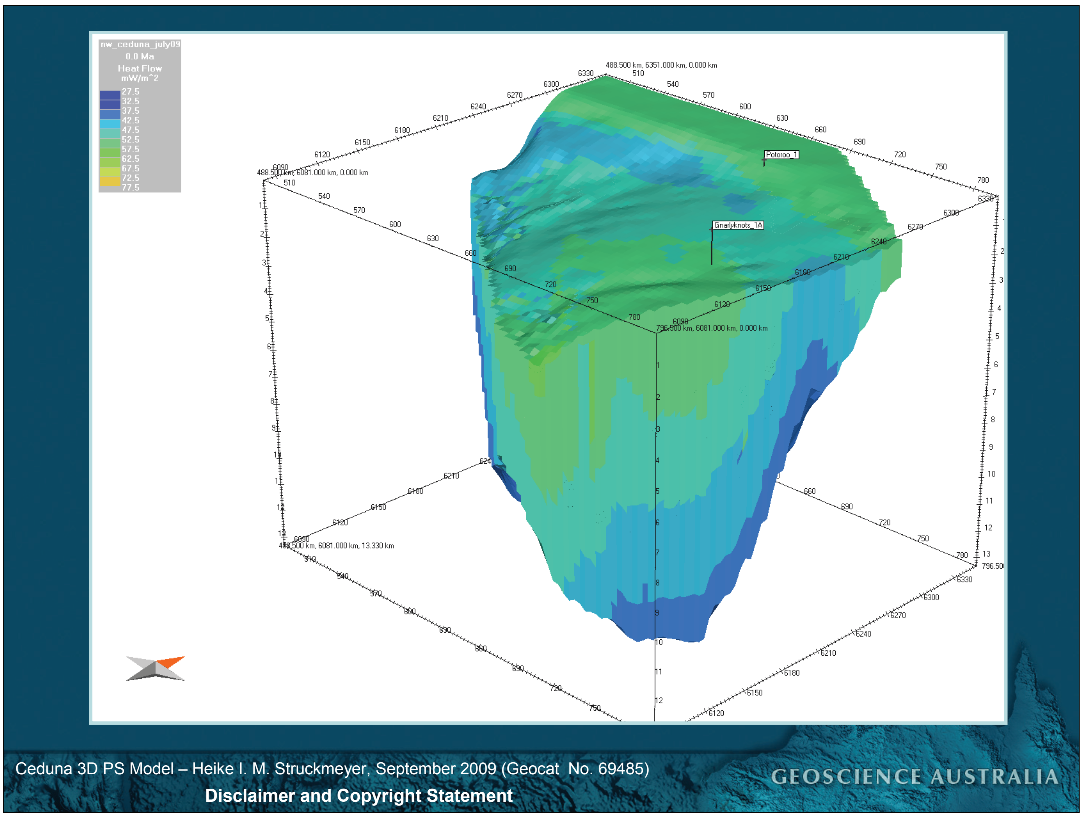
Basal heat flow is a very important constraint. In the case of the Ceduna Sub-basin model, only sequences from the post-rift section were modelled, when thermal effects from the earlier Jurassic rifting event would have dissipated. Observed temperature and vitrinite reflectance data from the two wells, Potoroo and Gnarlyknots, calibrate with a constant basal heat flow of 55 milliwatts per square meter above shallow granitic basement along the basin margin, to about 40 mW/m^2 within the depocentre, and increasing again to about 50 mW/m^2 towards the outer margin.



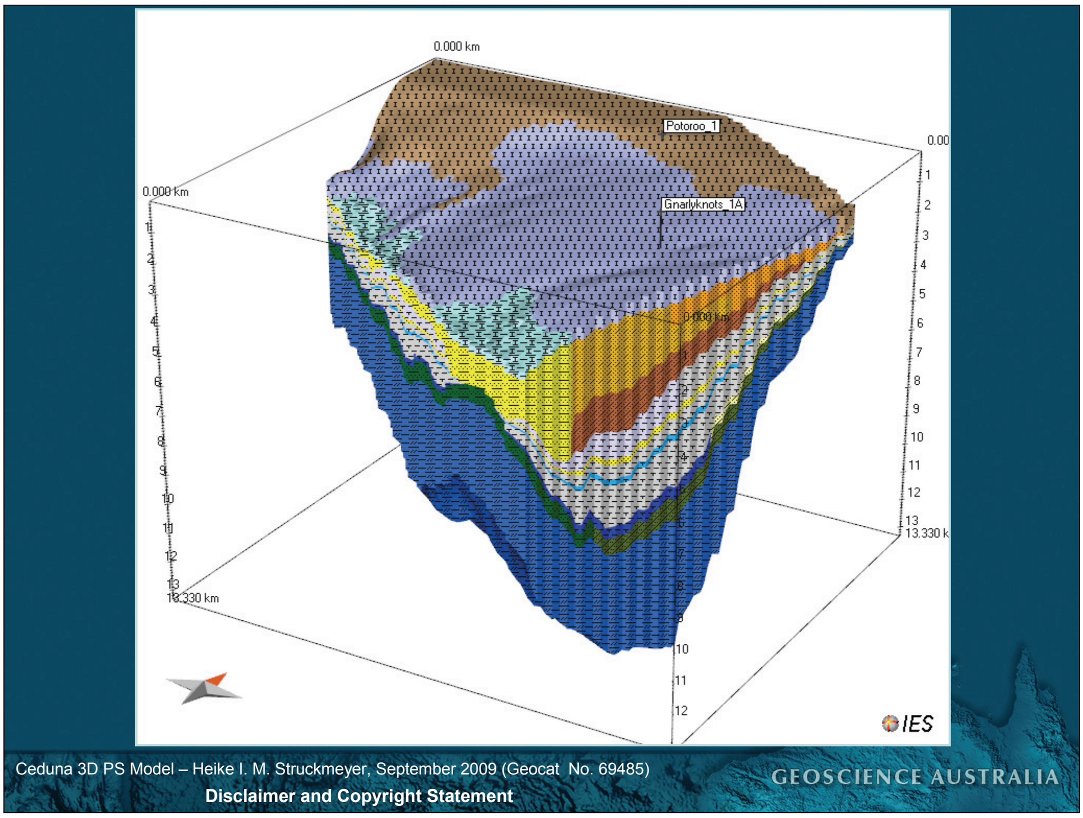
The resulting map was applied as a constant basal heat flow through time. This is a very simplistic model, however, in a frontier basin with very few hard data, keeping a model simple is probably preferable to potentially adding error to the model.



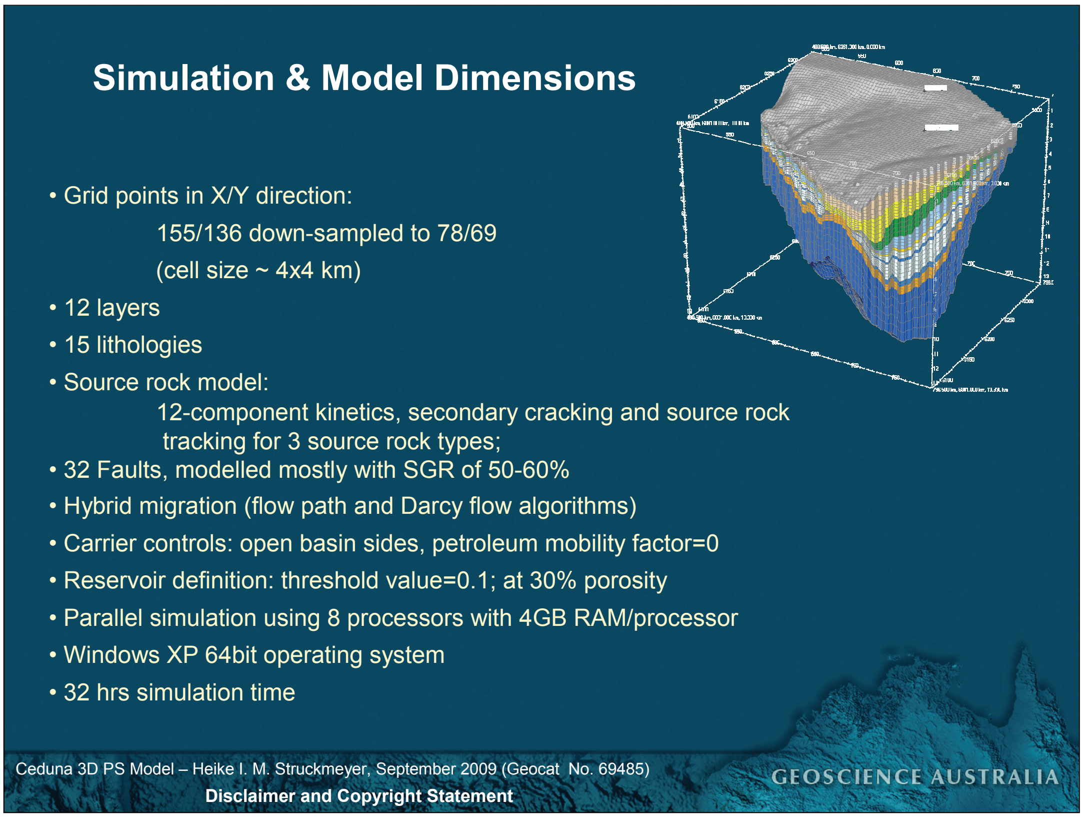
As an aside, this is an overlay of heat flow at 95 Ma, based on the input basal heat flow shown in the previous slide. It clearly reflects the input data.



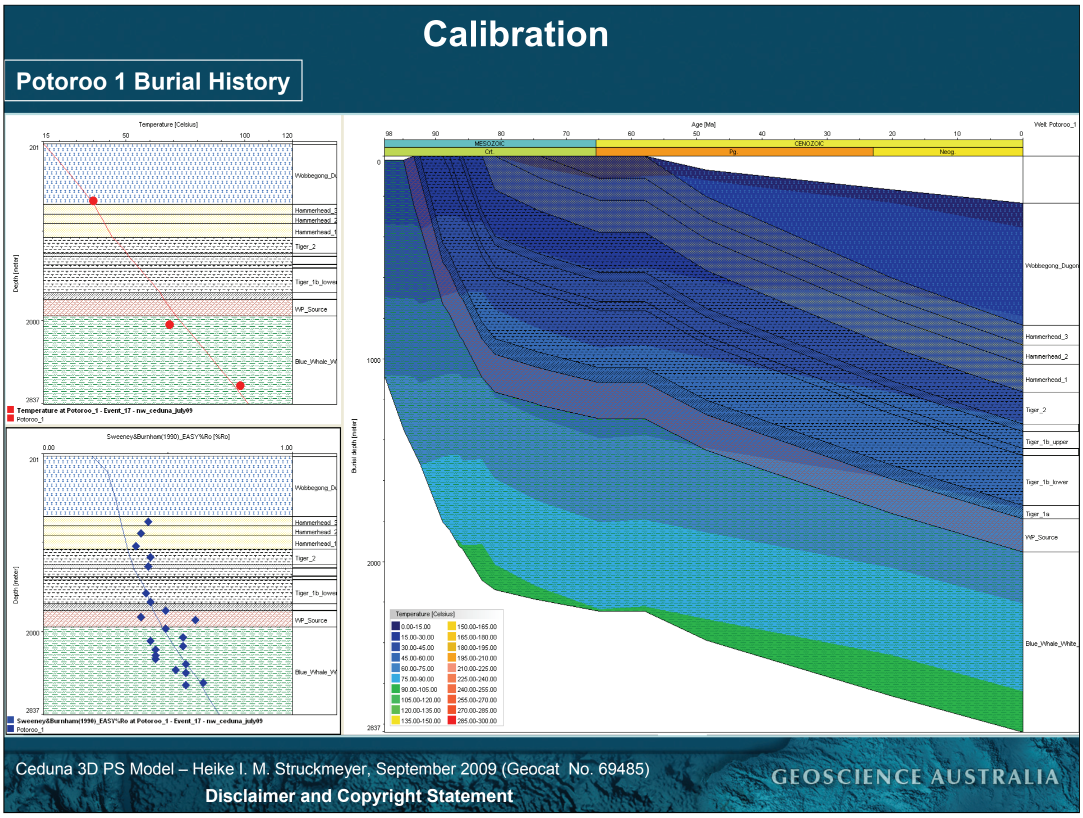
In comparison, this is the calculated present-day heat flow based on the input model; it shows the influence of the radiogenic heat production by the sediment pile. At the base of the section shows the basal, constant heat flow of 40 mW/m^2, whereas towards the top of the sedimentary section a heat flow of up to 59 mW/m^2 is reached. 1D models don't tend to take this into account (and 2D models only to a certain extent), which means that 1D models often require a higher heat flow to achieve calibration.



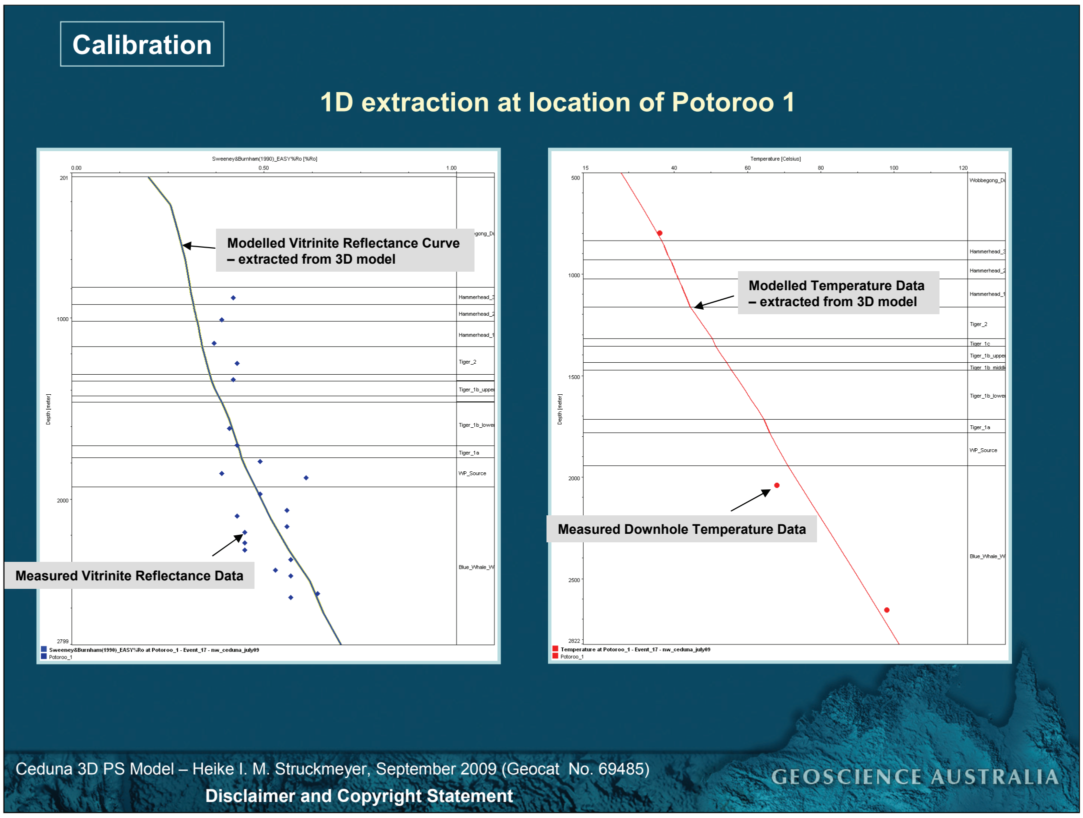
Finally, after definition of the input geological model, with layers, faults, facies and boundary conditions, the model is simulated.



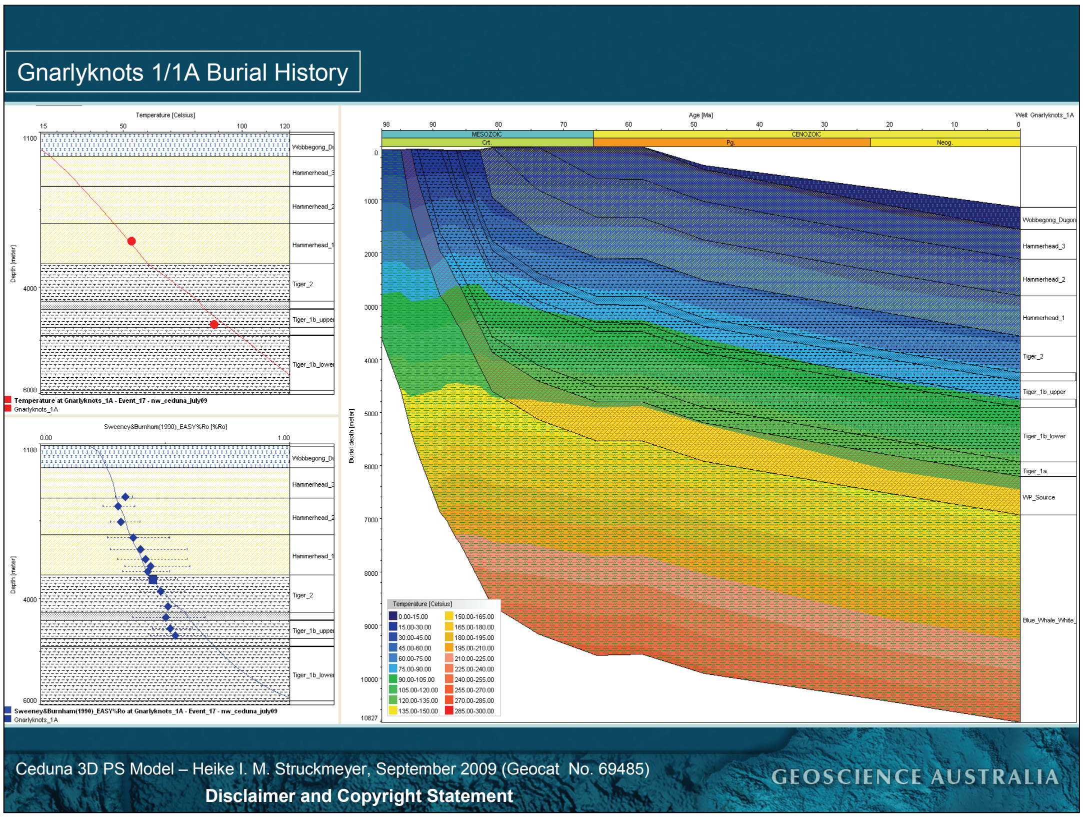
This slide summarises the input data and the parameters used for simulation of the Ceduna 3D model. Simulation is an iterative process that constructs the geological evolution of the basin through time.



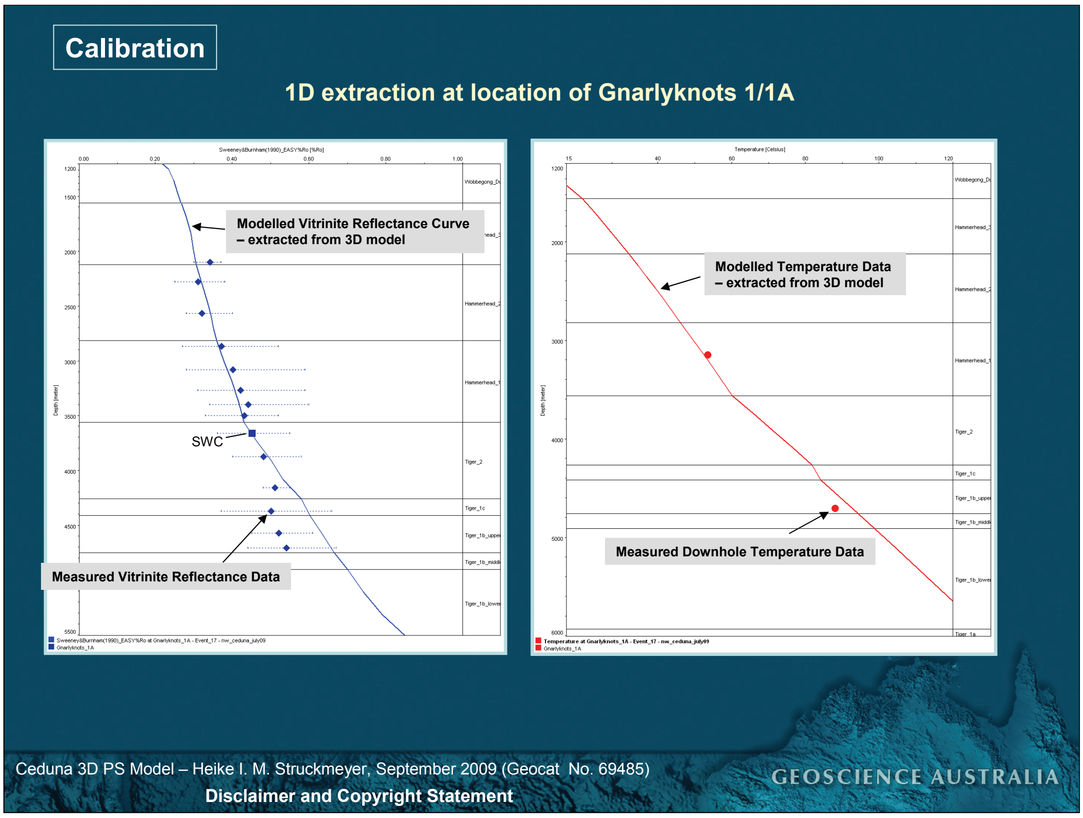
Basically, parameters are changed until there is a reasonable fit between measured and modelled data. This 1D depth extraction from the 3D model at the location of Potoroo 1 shows the burial history for the well location.



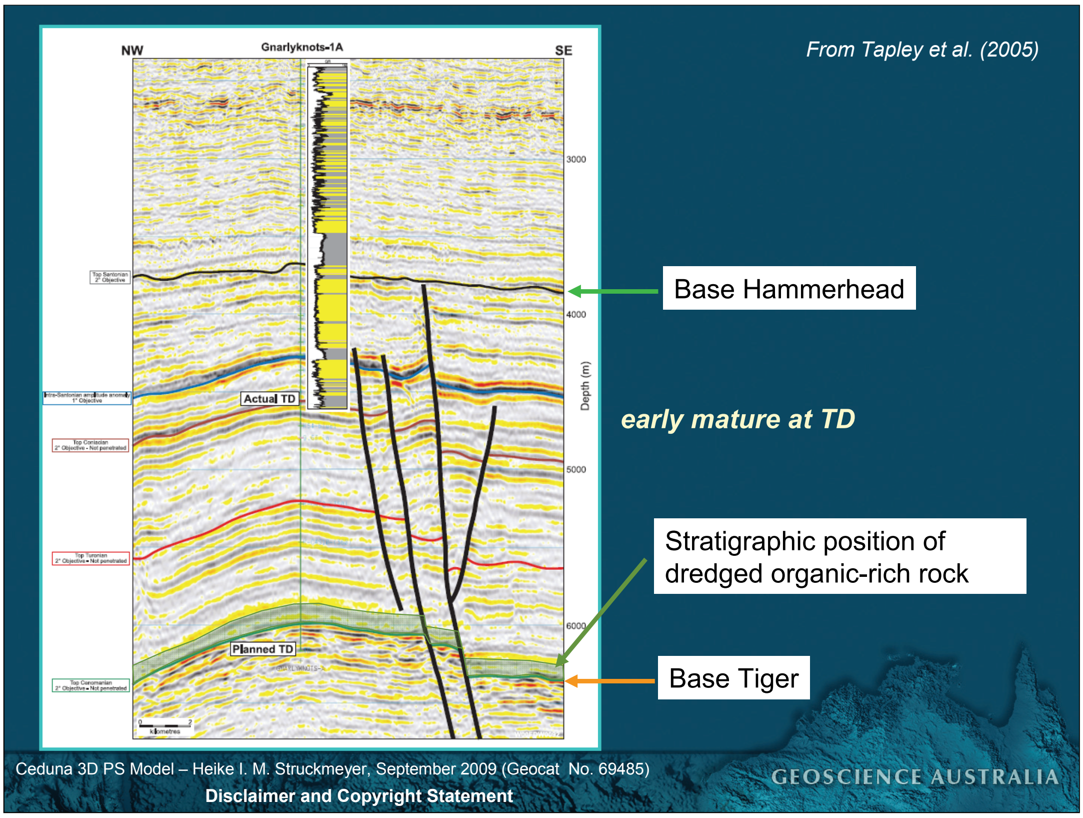
In more detail, the extraction shows that modelled vitrinite reflectance and temperature correlate well with measured downhole data.



This 1D depth extraction at the location of Gnarlyknots shows the burial history for this site, modelled down to the base of the Blue Whale Supersequence.



The detailed calibration plots show that there is also a good correspondence between measured and modelled data, at least in the upper part of the section down to about the mid-Tiger Supersequence. The modelled data then diverge and are slightly higher than the measured data. Overall, the calibration is better in the 3D model than in the 2D model. This may be due to the 2D line not being located directly through Gnarlyknots. The divergence within the Tiger SS could indicate that vitrinite reflectance in this marine shale may be suppressed, because the temperature data show relatively good calibration. The temperature value from the Tiger Supersequence at about 4700 m is Horner corrected.



The modelled and measured data both indicate an early mature section at the base of the well, suggesting that the organic-rich rocks of the basal Tiger Supersequence would be fully mature at this location.

Results

- **Maturity**
- **Kerogen transformation**
- **Timing of generation**
- Migration and accumulation

Ceduna 3D PS Model – Heike I. M. Struckmeyer, September 2009 (Geocat No. 69485)

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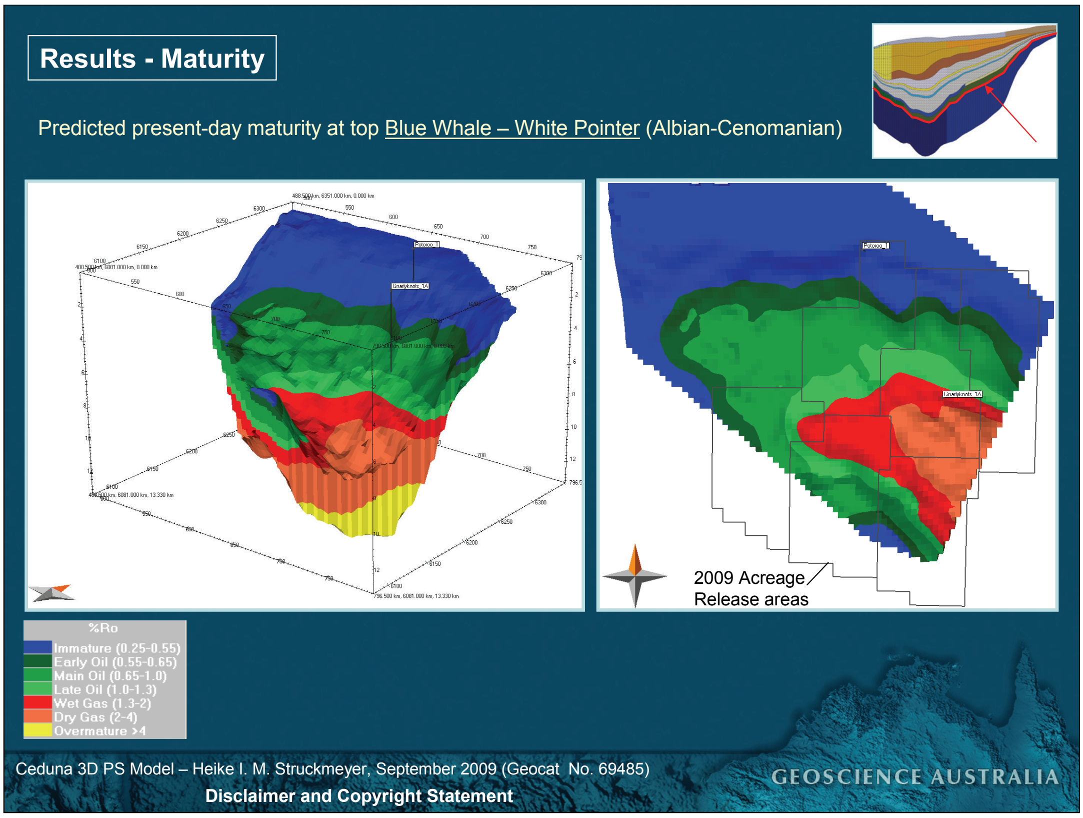
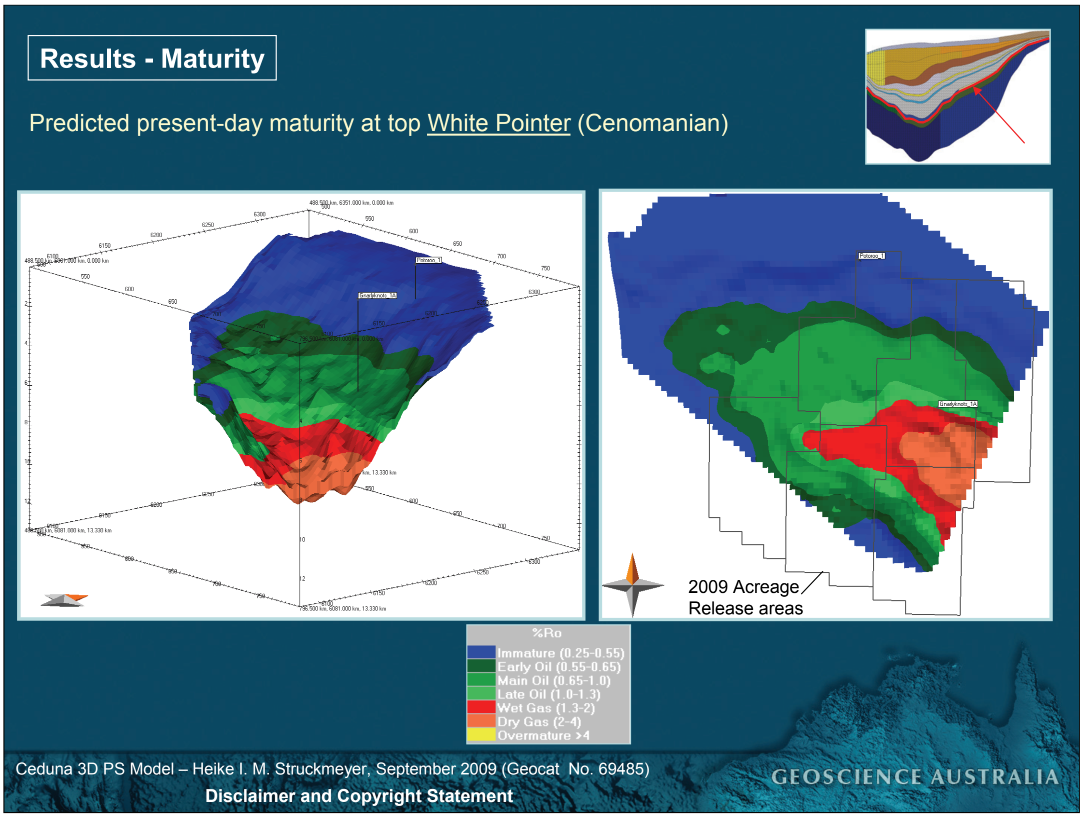
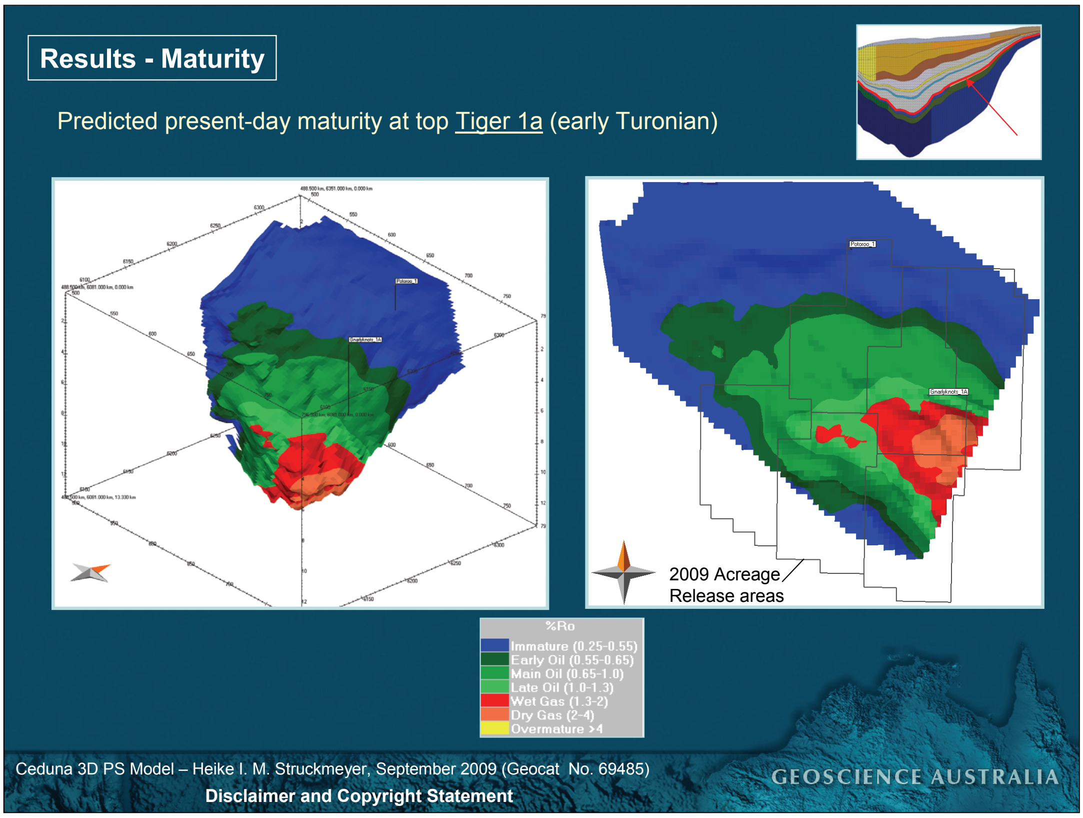


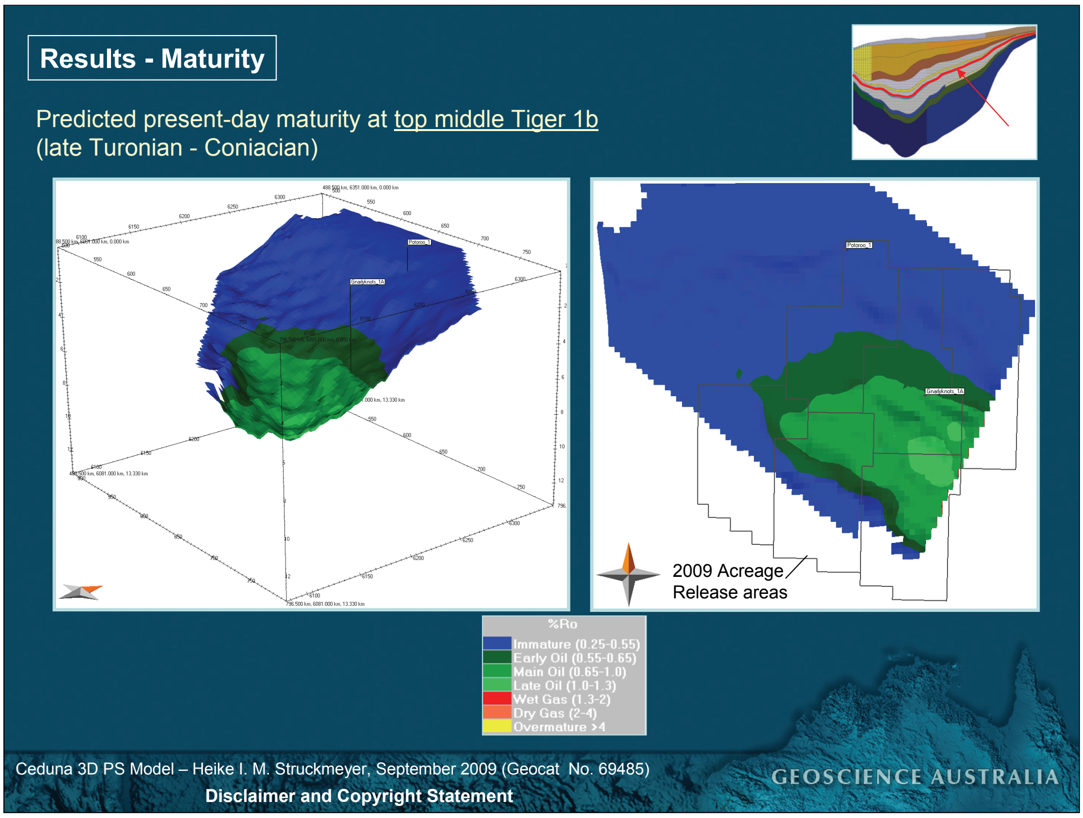
Predicted present-day maturity maps for the modelled source rock units illustrate the distribution of oil and gas mature source kitchens in the basin. This slide shows the predicted present-day maturity at the top of the Blue Whale to White Pointer unit. Potential source rocks of this unit are modelled to be oil to gas mature over a large area of the Ceduna Sub-basin.



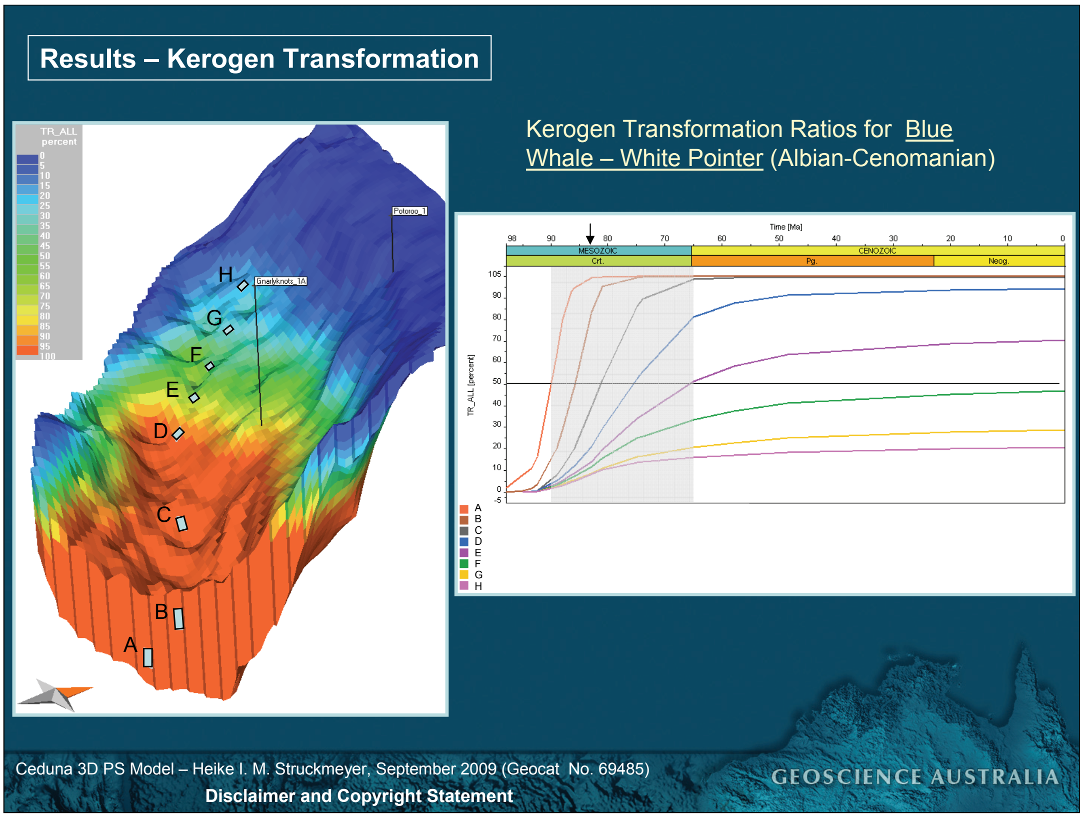
This is the predicted present-day maturity at the top of the White Pointer Supersequence.



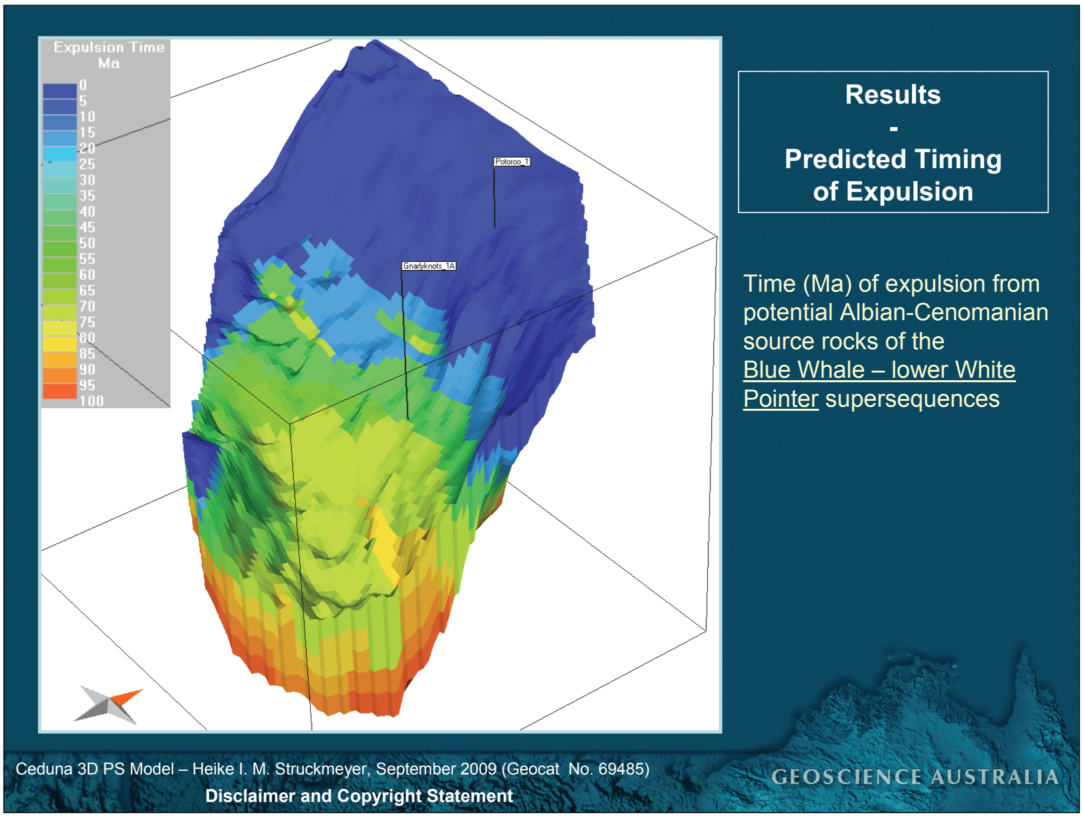
This is the predicted present-day maturity map for the top of the basal Tiger source unit, i.e. the unit containing Cenomanian/Turonian organic-rich rocks, again showing a large potential source kitchen across the central basin.



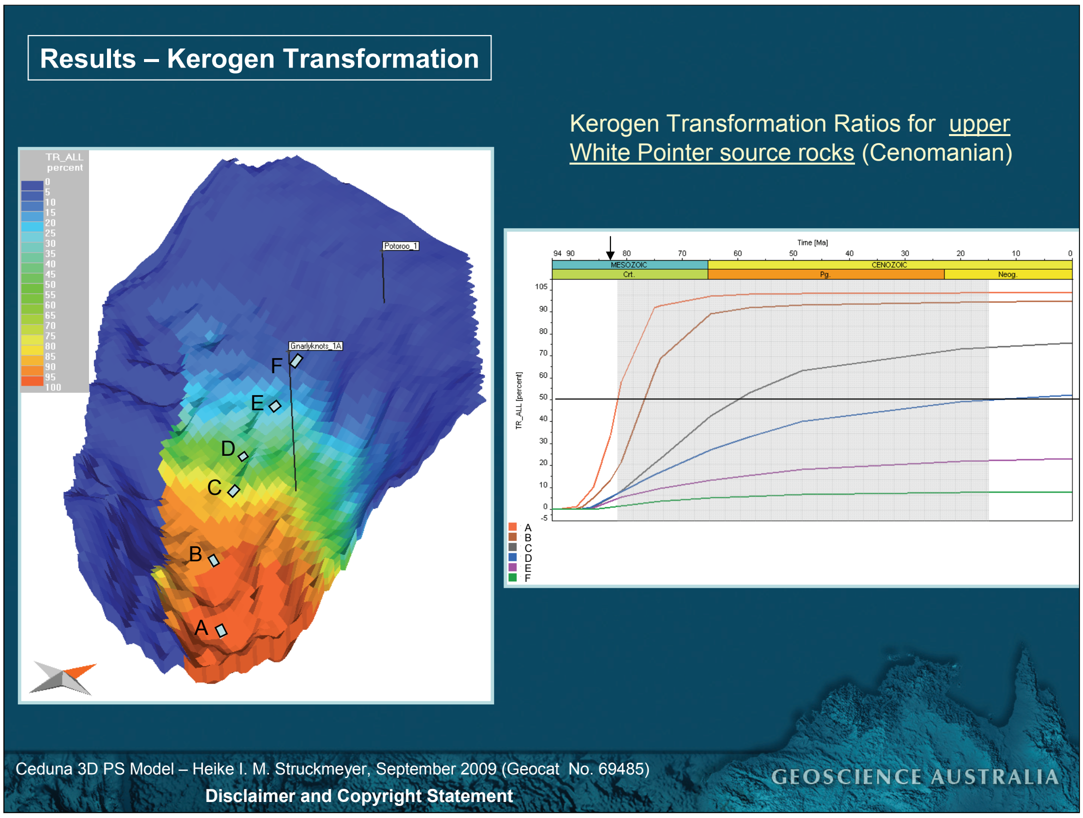
Younger potential source rocks of the Tiger SS are predicted to be oil mature only in the deepest part of the basin.



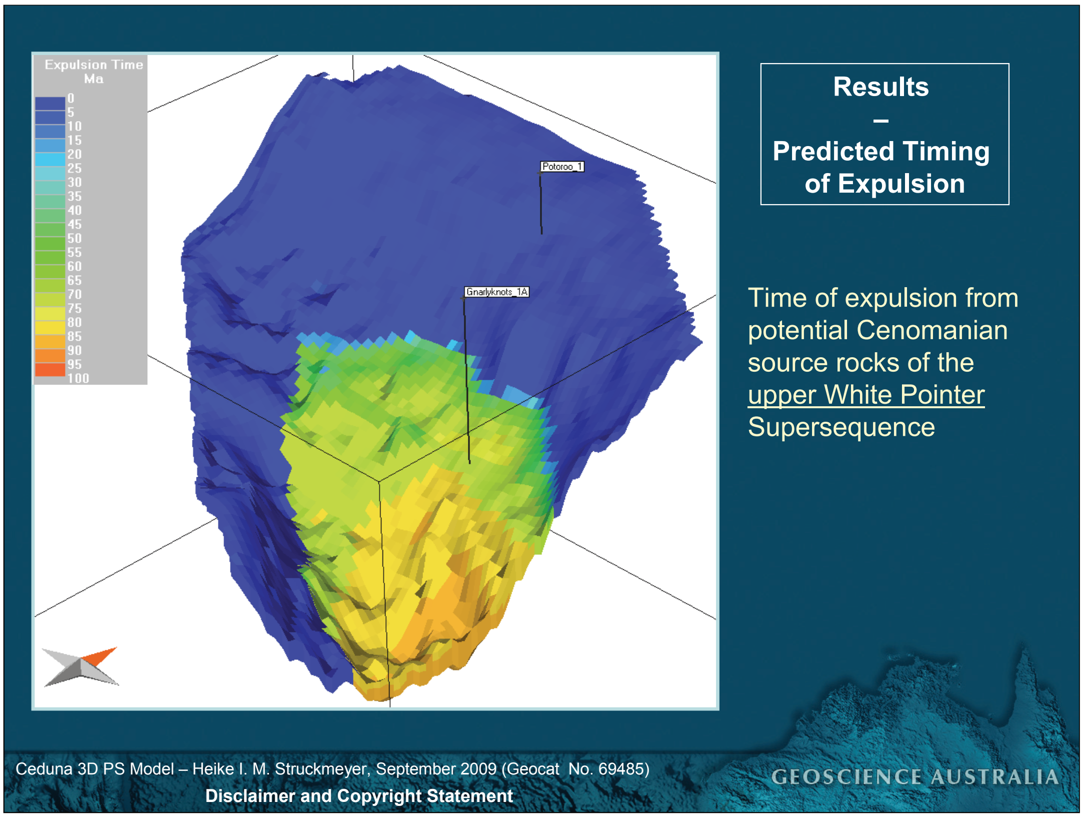
The left image shows present-day kerogen transformation of the Blue Whale to White Pointer layer and the location of 6 time extractions, mostly from the top of the layer. The latter are plotted on the right hand graph showing that, in the central depocentre (A to E), transformation ratios above 50% were reached between about 90 and about 65 my. This suggests that significant kerogen transformation in the layer occurred post-breakup (83 Ma) structuring (black arrow). Kerogen transformation continued to the present day where the layer is buried to shallower depths (e.g. locations F to H).



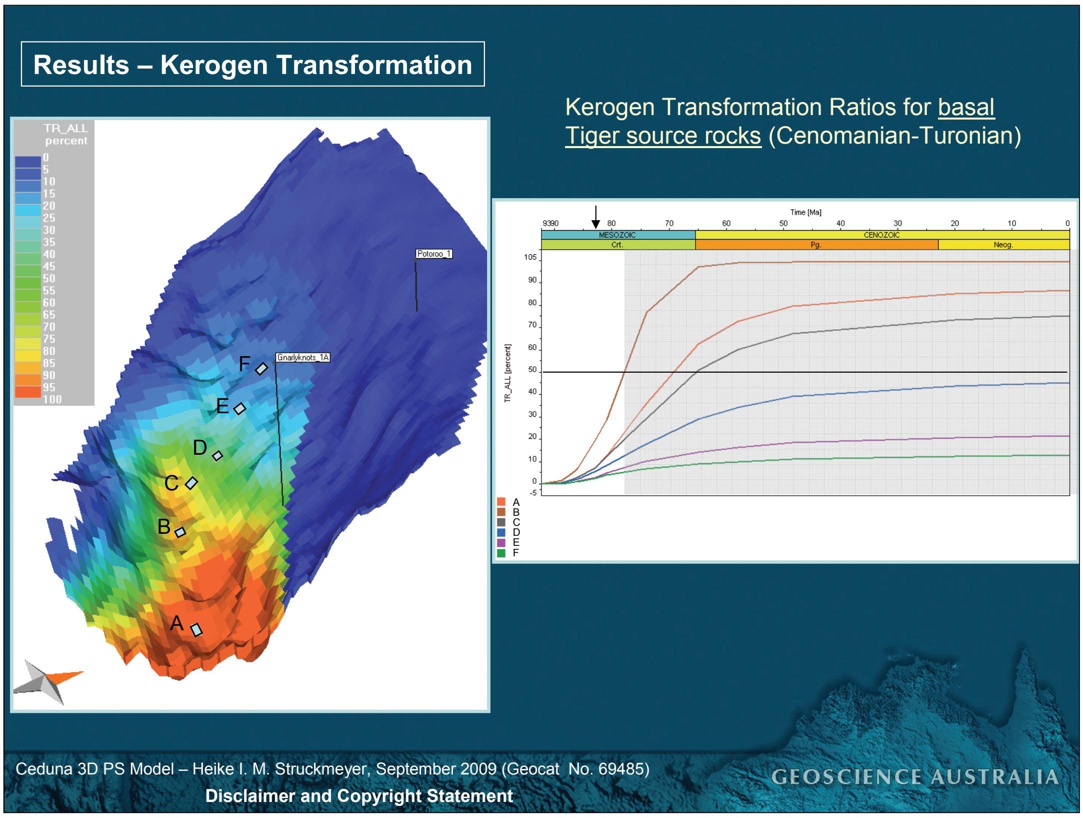
This image shows the predicted timing of expulsion form the same layer, confirming expulsion from Blue Whale to lower White Pointer is likely to have occurred between 95 to about 55 Ma in the basin depocentre and from 55 to Recent along the basin margins.



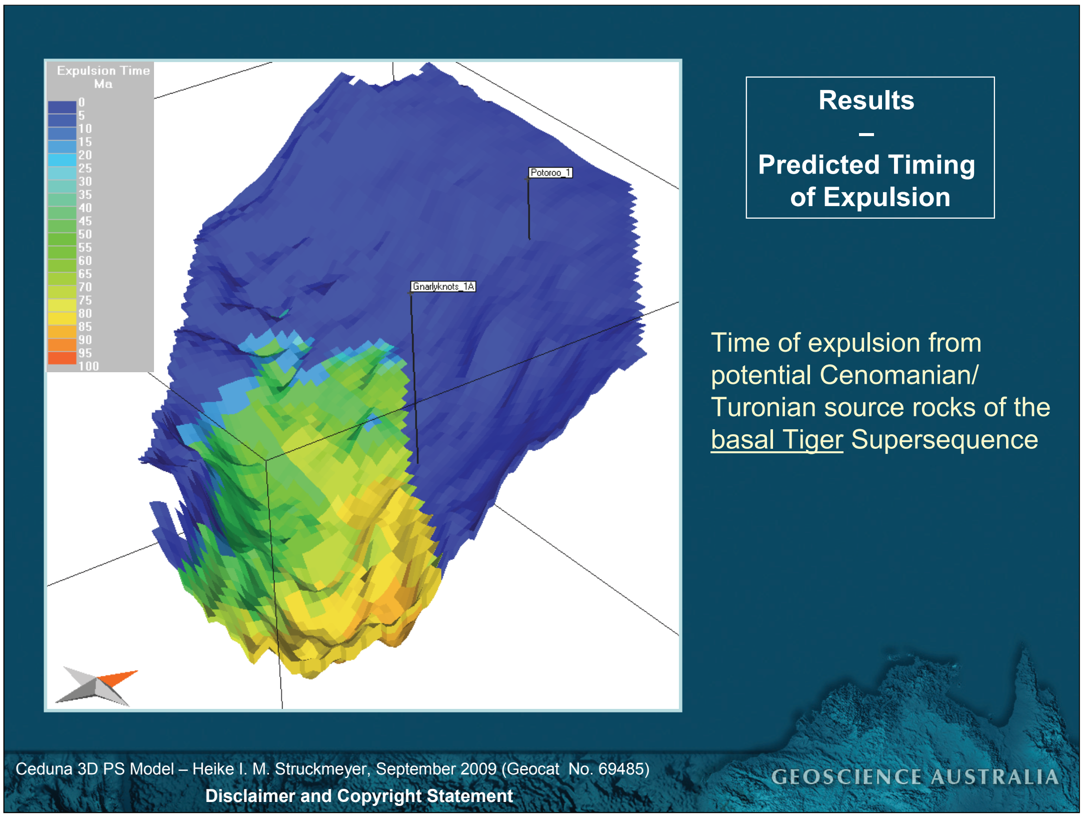
Kerogen transformation ratios for the upper White Pointer potential source rocks suggest that ratios above 50% were reached between about 82 and 15 Ma in the central depocentre (A to D), after the breakup event (black arrow).



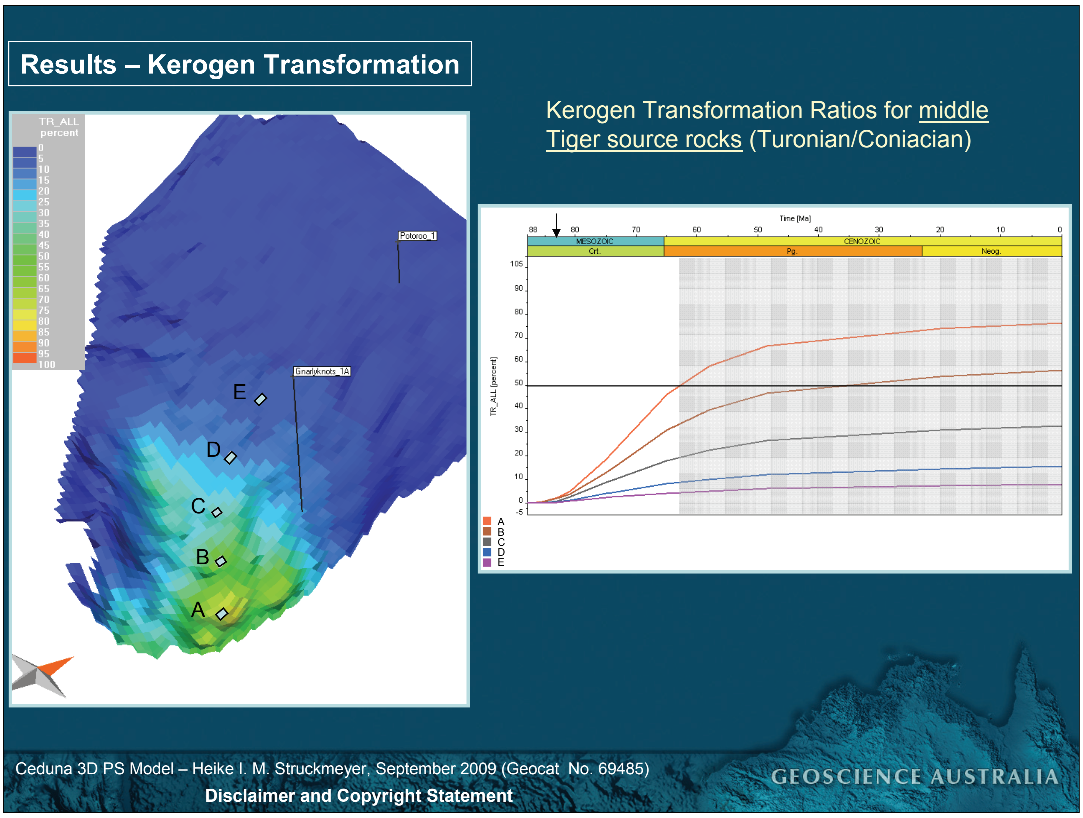
Expulsion from the coaly source rocks probably occurred from about 85 my onwards, but the significant phase of expulsion in the central basin is likely to have occurred between 80 and 15 Ma, i.e. post break-up related structuring.



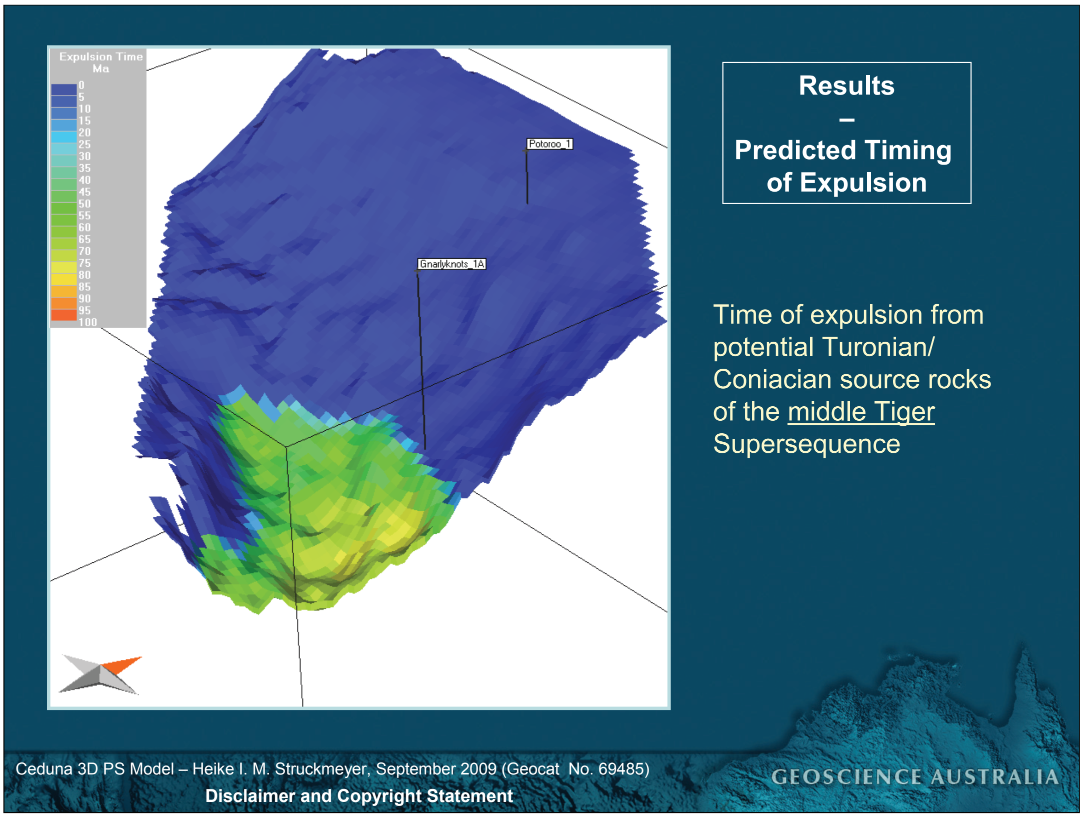
Kerogen transformation in the Cenomanian/Turonian organic-rich rocks of the basal Tiger Supersequence reached 50% from about 78 Ma onwards.



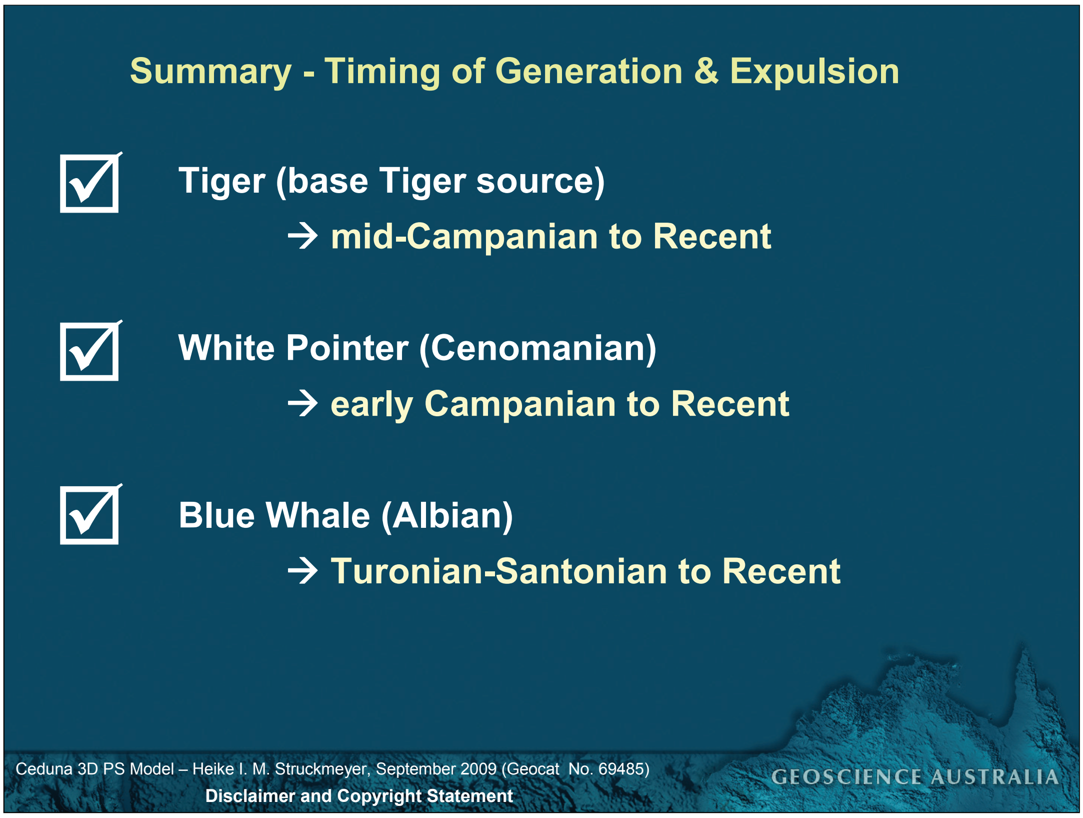
Predicted expulsion from this source rock occurred from about 80 Ma to 25 Ma in the central basin depocentre, i.e. all expulsion is likely to have occurred after structuring related to break-up.



Younger potential source rocks of the middle to upper Tiger Supersequence reached kerogen transformation ratios greater than 50% only in the deepest part of the depocentre (locations A and B) from about 65 to 35 Ma. Ratios are below 50% for the remainder of the basin.



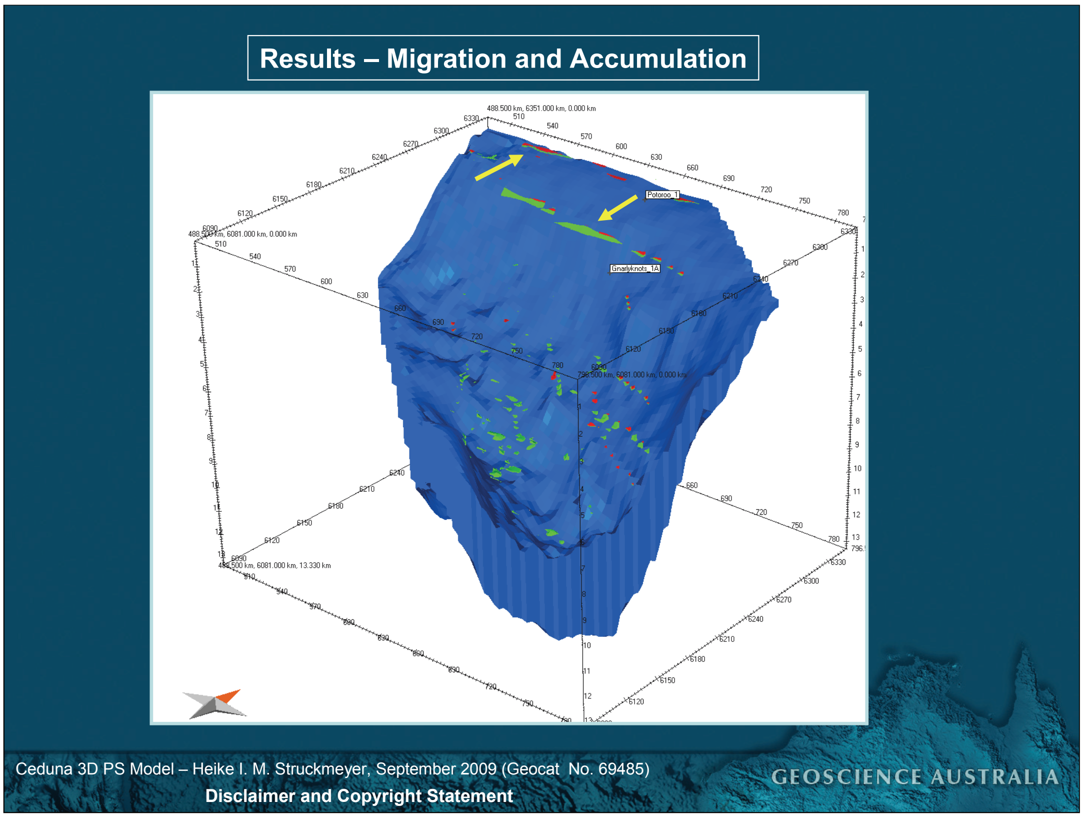
Predicted expulsion from these younger source rocks would have occurred from about 75 Ma onwards.



For all three modelled potential source rock units, the results from the 2D models described in Totterdell et al. (2008) are confirmed in the 3D model. Additional information is provided about the distribution of expulsion patterns across the basin. Most importantly, the results suggest that, with the exception of the Blue Whale and White Pointer source units in the deepest part of the basin, the bulk of expulsion from the three source units occurred after structuring related to break-up in the Santonian (83 Ma).

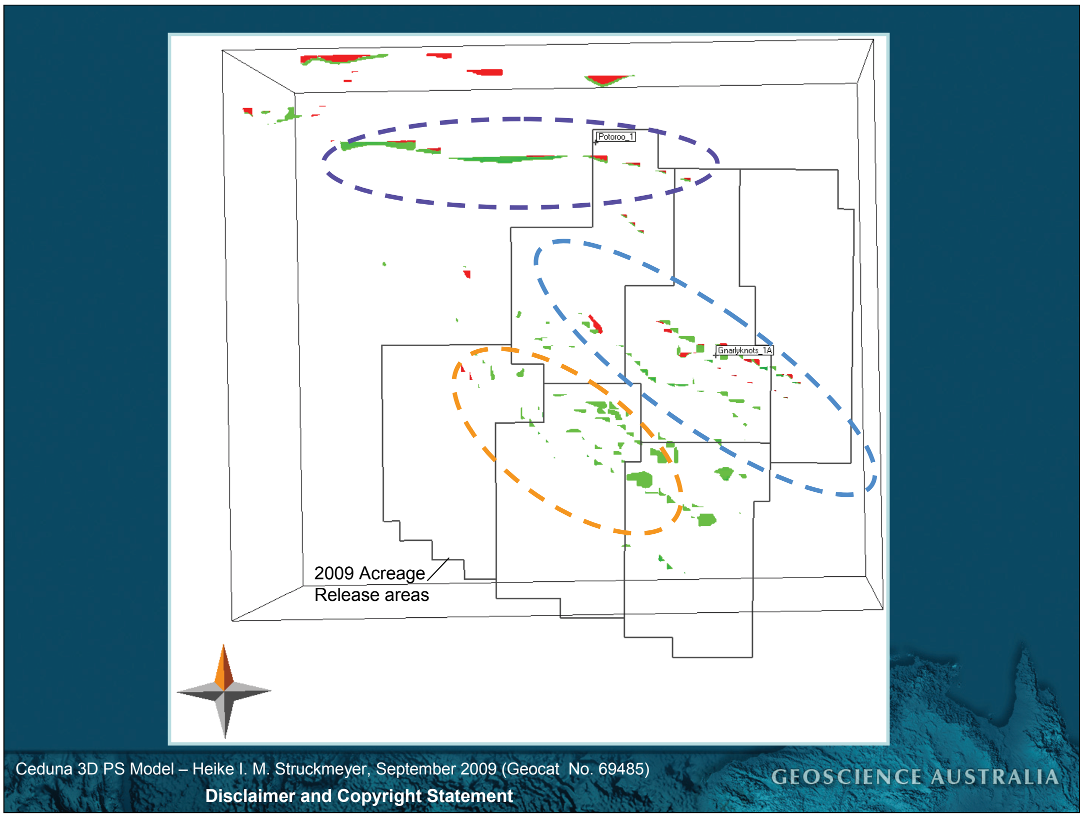
Results

- Maturity
- Kerogen transformation
- Timing of generation
- **Migration and accumulation**

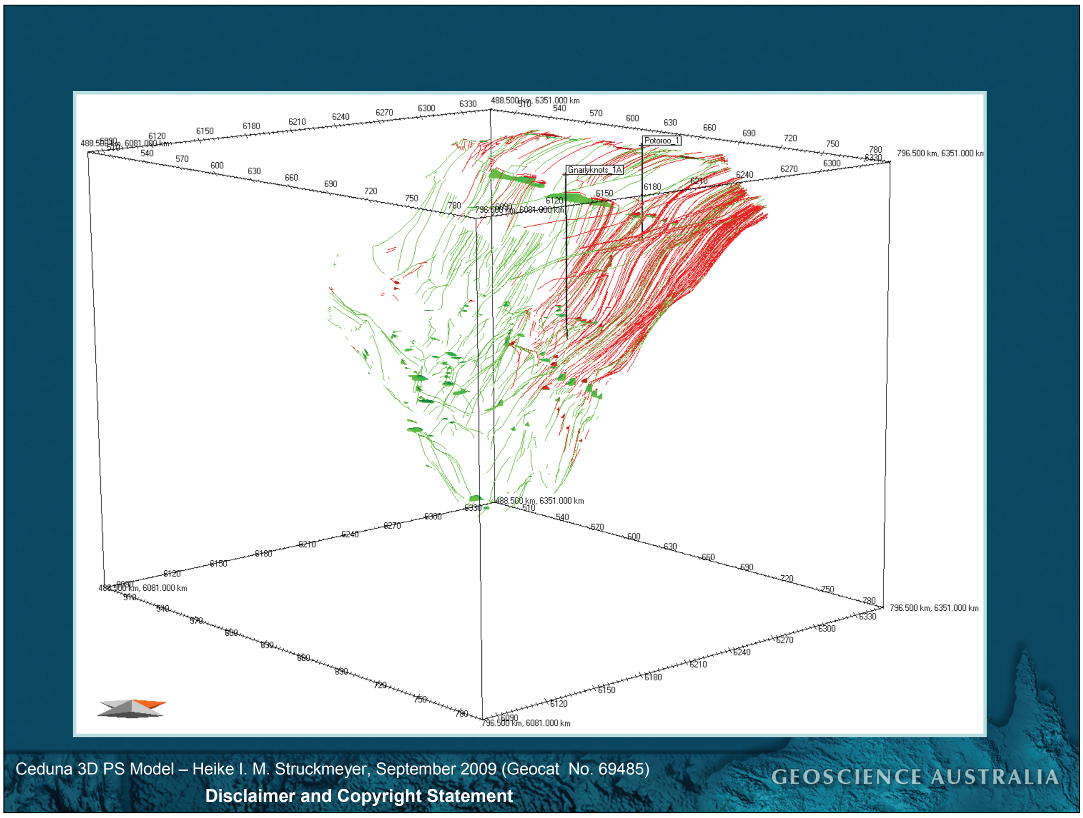


In a frontier basin such as the Ceduna Sub-basin, any attempt to model location and size of individual accumulations is tenuous, particularly when the model is highly schematic and down-sampled like this one. For example, individual structures in the model should not be seen as reflecting the actual location of such structures, but rather point to the possibility of such structures anywhere within the general trend. What is more important, is the overall expulsion amount and type of hydrocarbons and the possible general location in the basin of potential accumulations. Nevertheless, the modelled accumulations shown in this diagram (here plotted above the Blue Whale to White Pointer layer) tend to occur in several distinct trends.

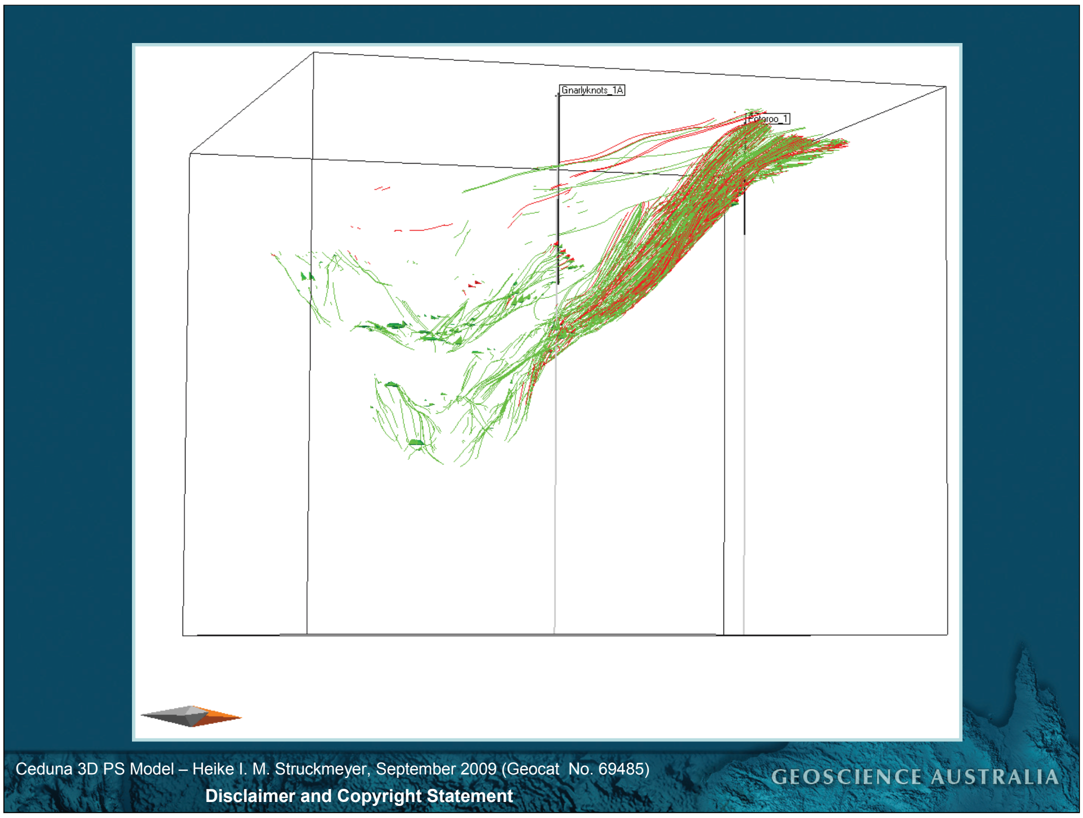
Overall, the model suggests about 29 Bbbl of liquid and over 50 Tcf of vapour to be available for accumulation, and the model shows where these accumulations could be located. There are some large modelled accumulations along the Potoroo Fault and near the edge of the model. They represent hydrocarbons caught along the migration pathways within this specific model geometry; "accumulations" along the edge of the actual model itself suggest the possibility of long-distance migration to shallow pinch-out stratigraphic traps.



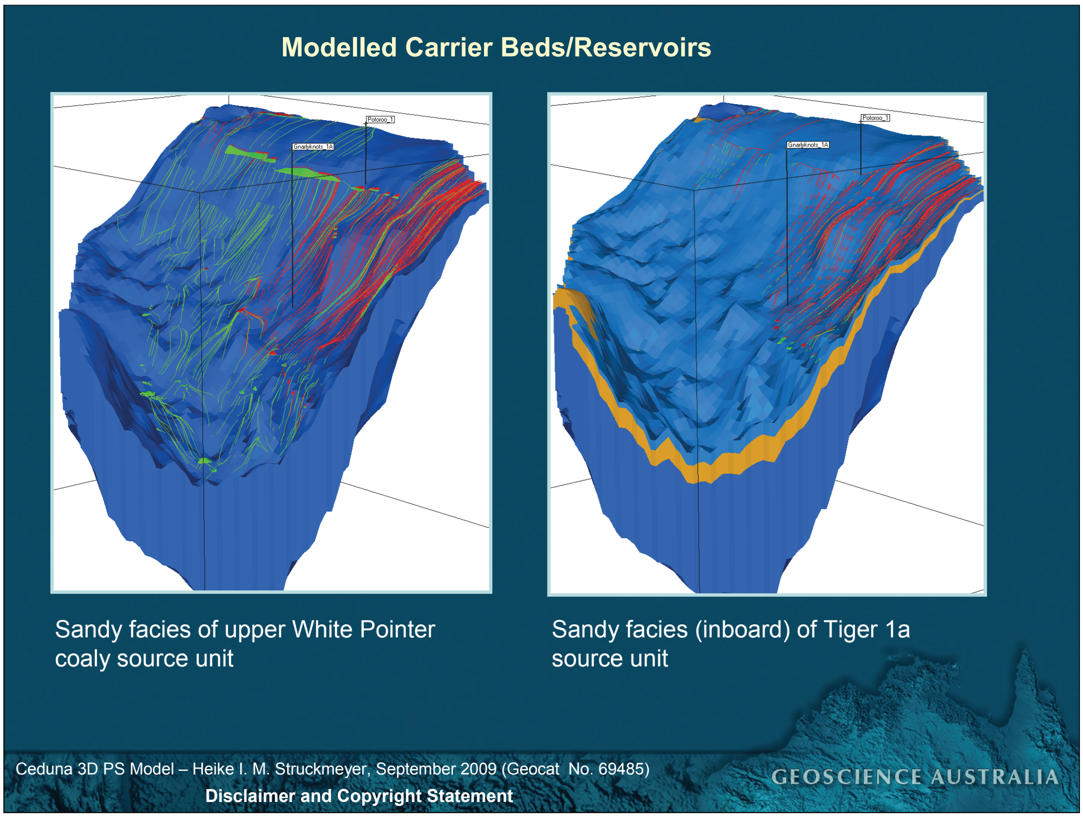
On plan view, the predicted location of potential accumulations very roughly correlates with the two lead trends identified by Woodside (Tapley et al, 2005), the inboard Gnarlyknots Trend (blue) and the outboard Springboard Trend (orange). A potential outer trend, as identified by 2D modelling (Totterdell et al., 2008) could also be present, but is beyond the extent of this 3D model. The northernmost accumulations may reflect outflow at the edge of the modelled area, whereas the trend along the Potoroo Fault (purple outline) may represent a further trend of potential accumulations related to pinch-outs of White Pointer sediments.



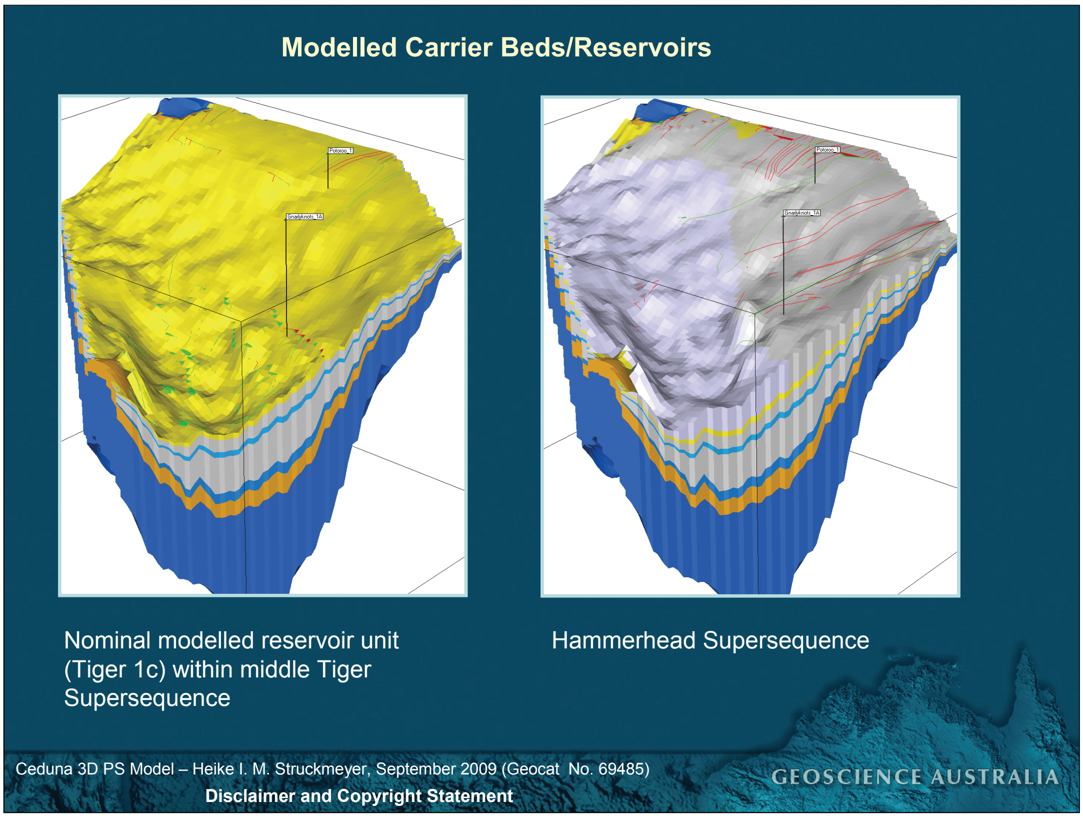
This slide shows the same accumulations in 3 dimensions together with related oil (green) and gas (red) flow paths. It is apparent that the current drainage is focussed towards the inboard margin of the basin, although there is also drainage towards the outer margin high.



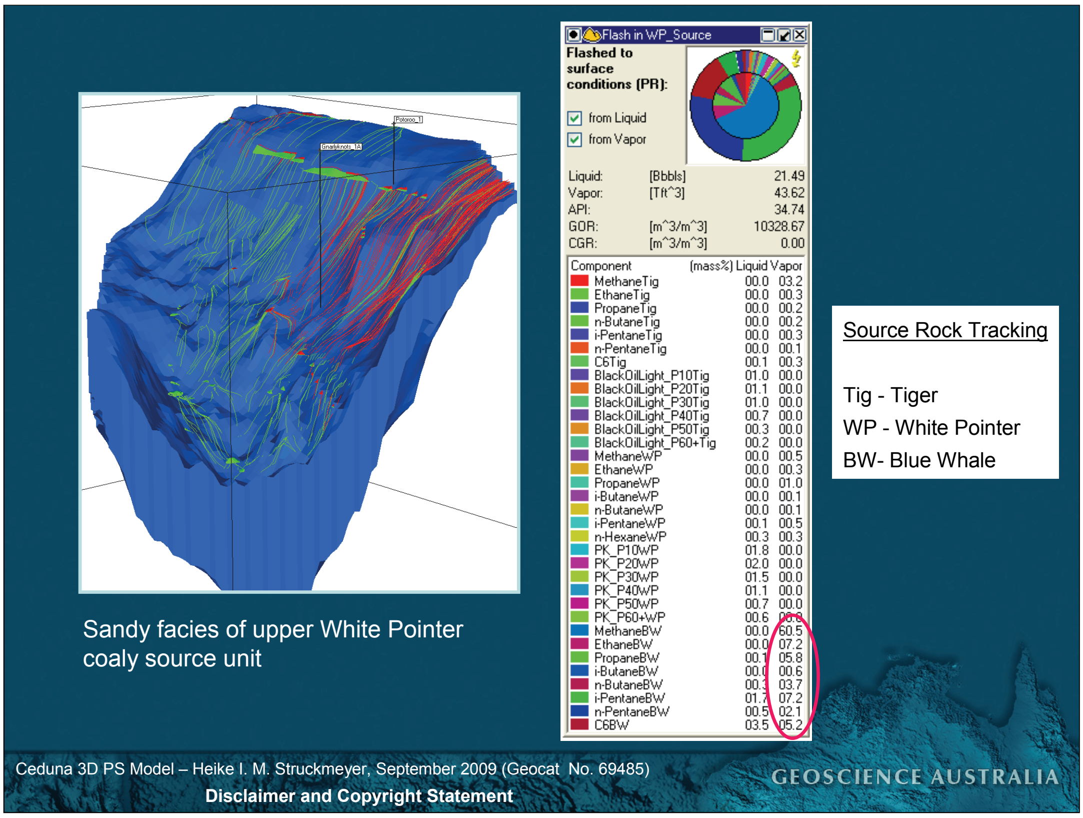
It is also apparent that the modelled accumulations occur at different stratigraphic levels. Again, because of the generalised geometry of the model and the nominal assignment of source and reservoir units, these are only possible accumulations.



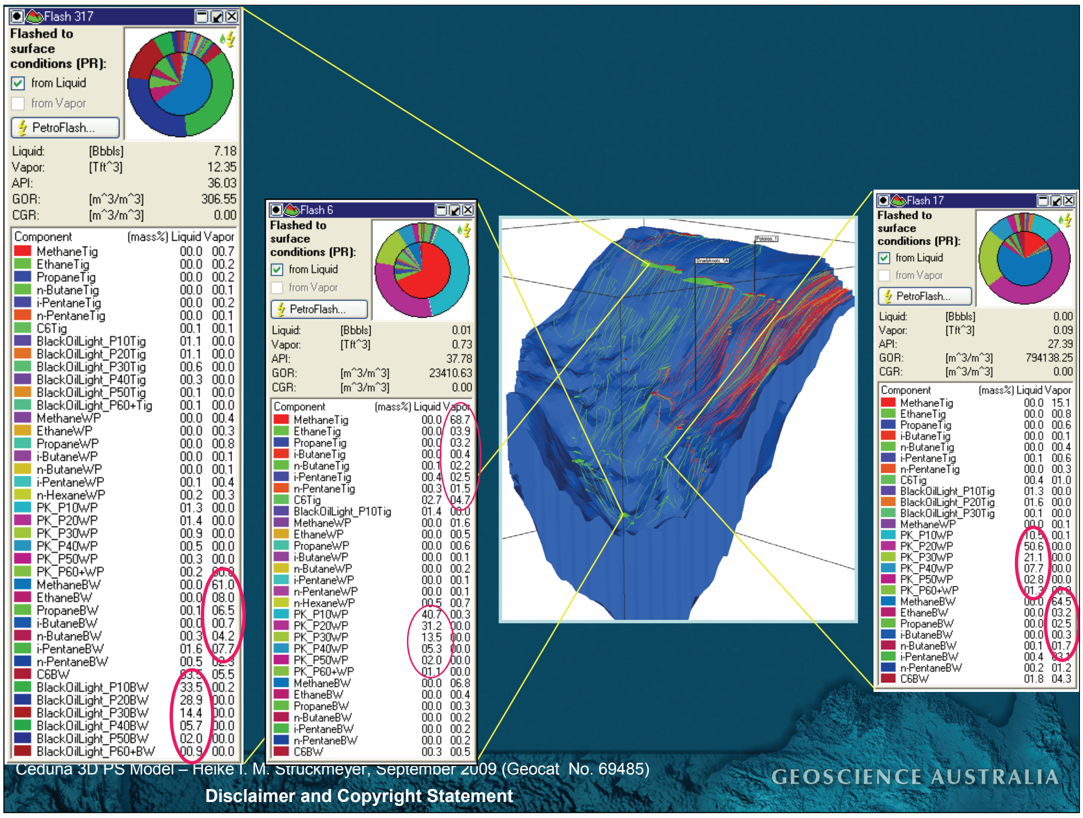
The 3D model calculated accumulations and flow paths of oil and/or gas in four major carrier/reservoir beds: These include the coarser facies of the upper White Pointer unit; the sandy, inboard facies of the Tiger 1a source unit,



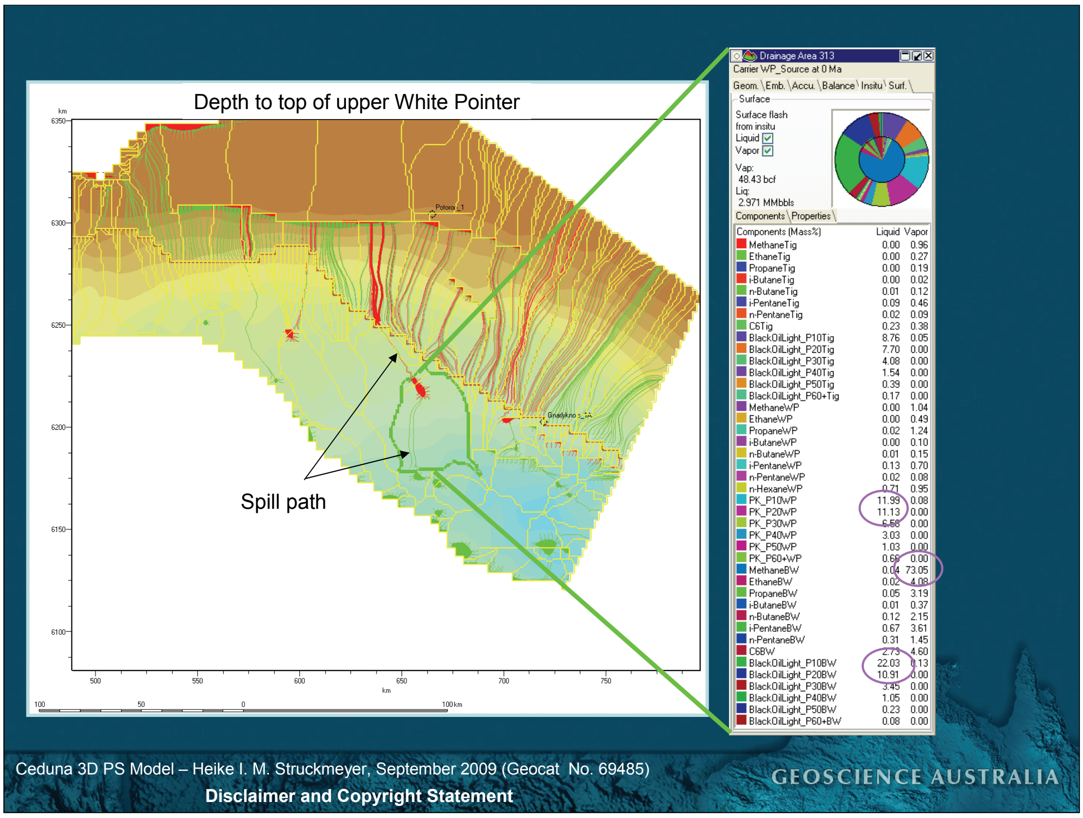
the nominal reservoir unit (Tiger 1c) in the middle Tiger Supersequence, and within the Hammerhead Supersequence. The latter is probably too pessimistic, because no seal was modelled specifically within this succession.



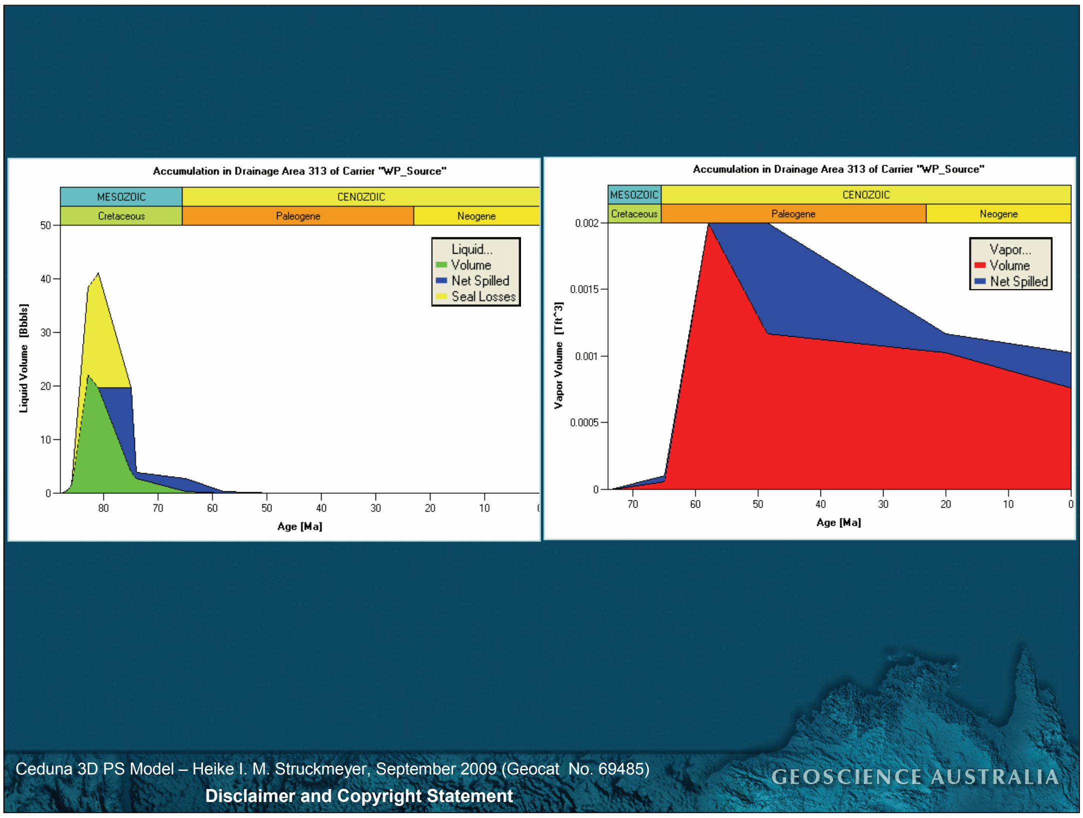
Two of these will be discussed in more detail in the following slides. Firstly, the upper White Pointer unit. The combined composition of all hydrocarbons modelled to be in this system suggests mostly vapor derived from the Blue Whale SS, with some liquids derived from the White Pointer and Tiger SS (the inner circle on the circular diagrams shows the vapor phase hydrocarbon components and the outer circle shows the liquid phase hydrocarbon components). In terms of volume, hydrocarbon volumes available for accumulation at this level are significant, with about 21 Bbbls of liquid and 43 Tcf of vapor, most of which is reservoired in the basin margin trend.



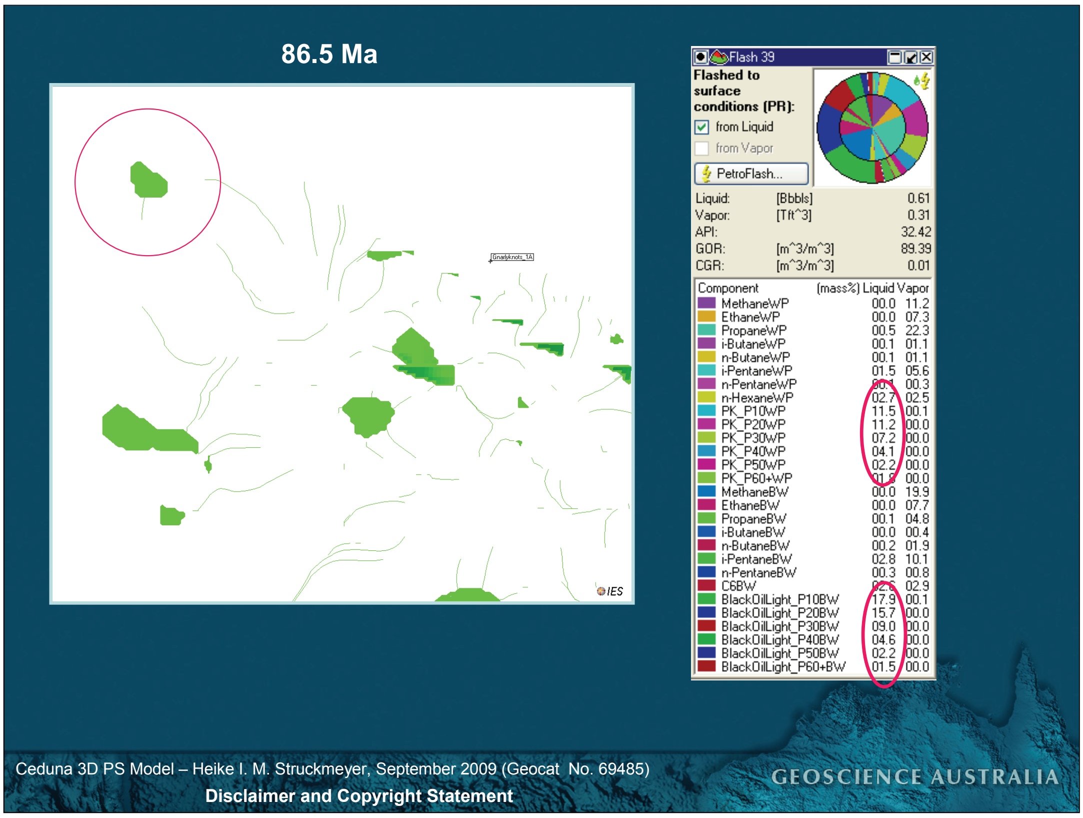
When examining individual modelled accumulations in more detail, quite a few differences in composition become apparent. The small liquid accumulations in the central basin are basically gas when flashed to surface conditions; they have a significant contribution from the White Pointer coaly source as well as the Tiger source in the outboard example, and the Blue Whale in the inboard example. The large modelled accumulations along the Potoroo Fault System appear to be both oil and gas, derived mostly from the Blue Whale SS.



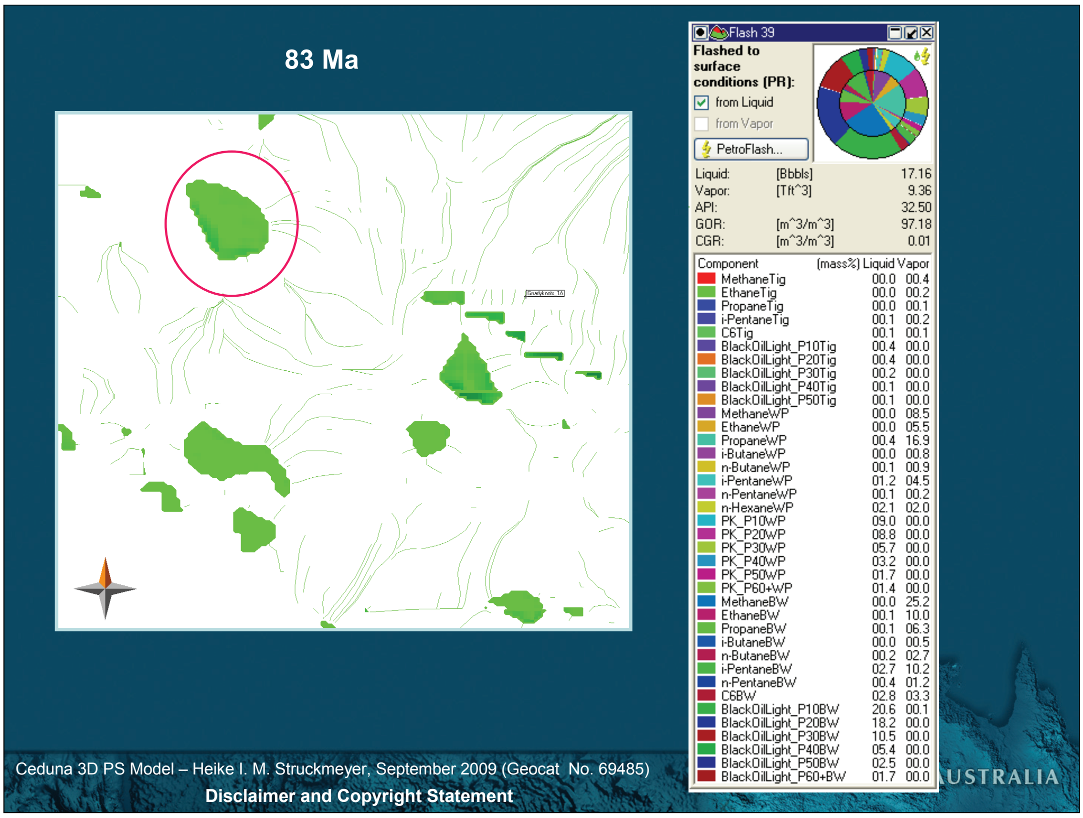
This image shows a map of depth to top upper White Pointer source unit. It shows drainage cells and possible flow paths as well as modelled accumulations. Again, the drainage towards the inner basin margin is evident, but there are also drainage paths to the outer edge of the basin. The highlighted drainage cell contains a small gas accumulations which was sourced mostly from the Blue Whale Supersequence with a small contribution by the White Pointer and Tiger source units. Analysis of this individual accumulation highlights



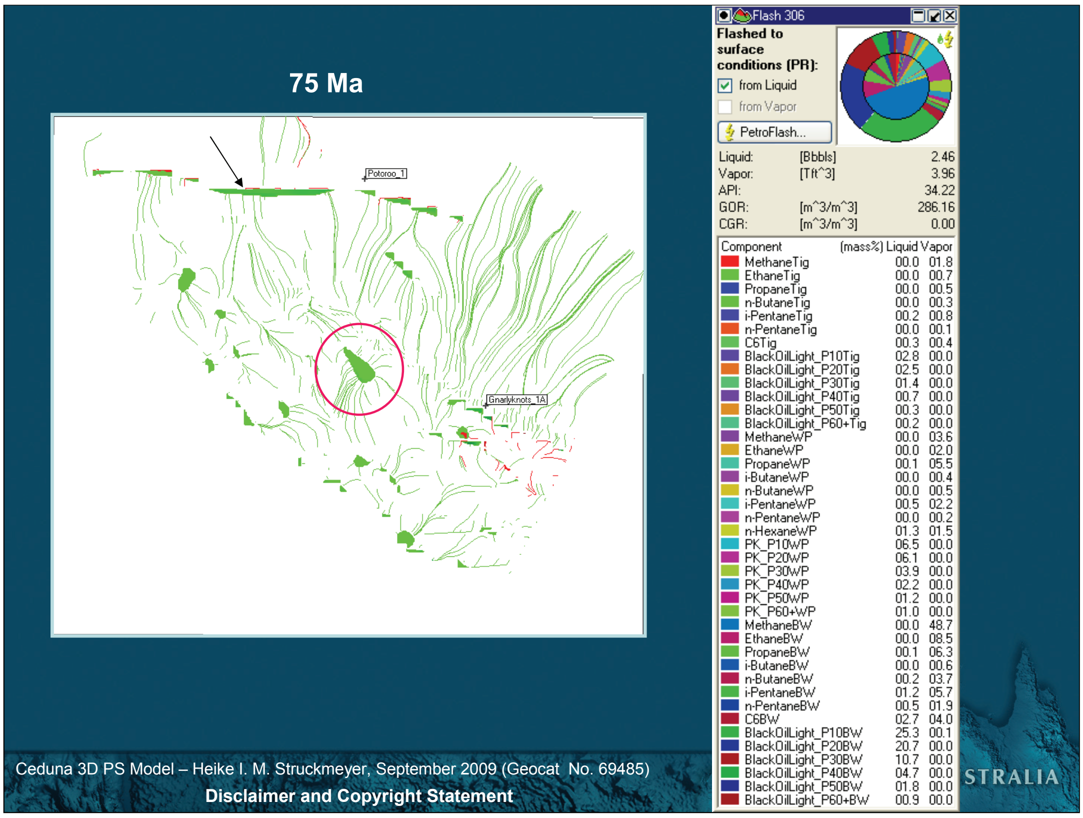
that liquids accumulated mostly between 85 and 75 Ma. A considerable amount of liquids were lost mostly through seal losses. Vapor was also spilled, but not to the extent of the liquids.



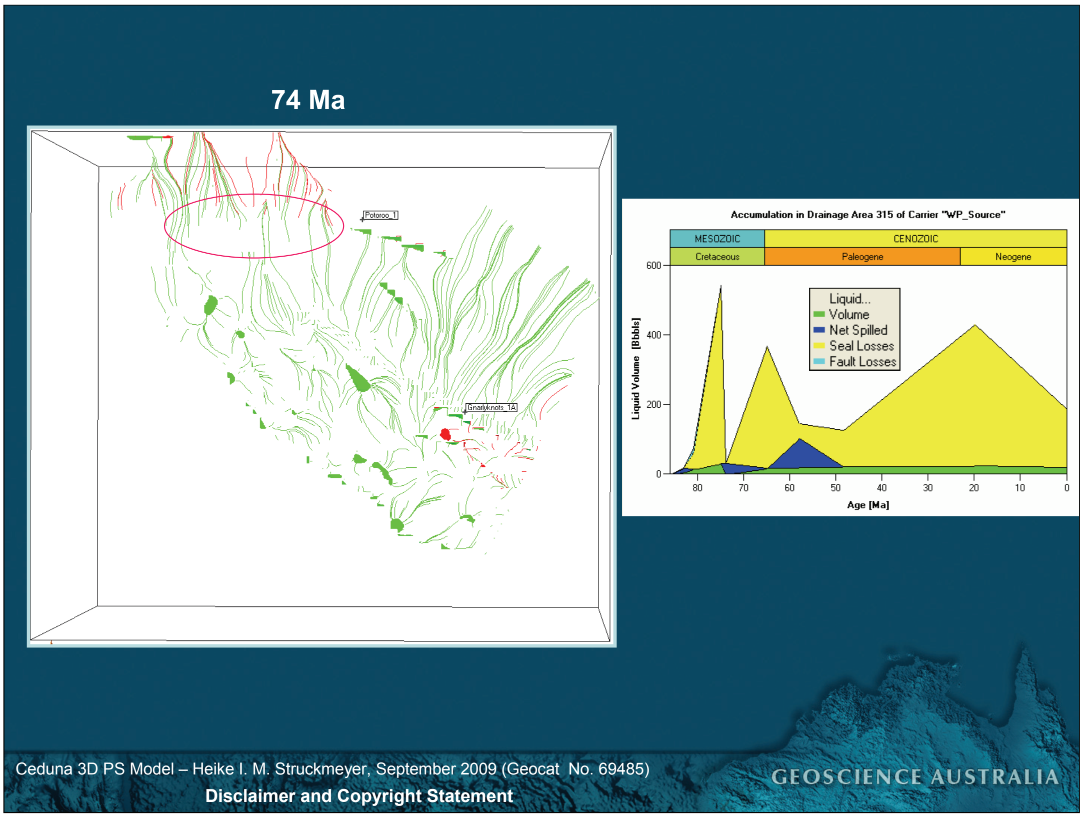
The structure (outlined in red) was filled initially at 88 Ma; this is a snapshot from 86.5 Ma showing that the oil was generated from Blue Whale and White Pointer sources and that there was already a considerably sized accumulation of 600 Mbbl, with the surrounding accumulations over 1 Bbbl in size.



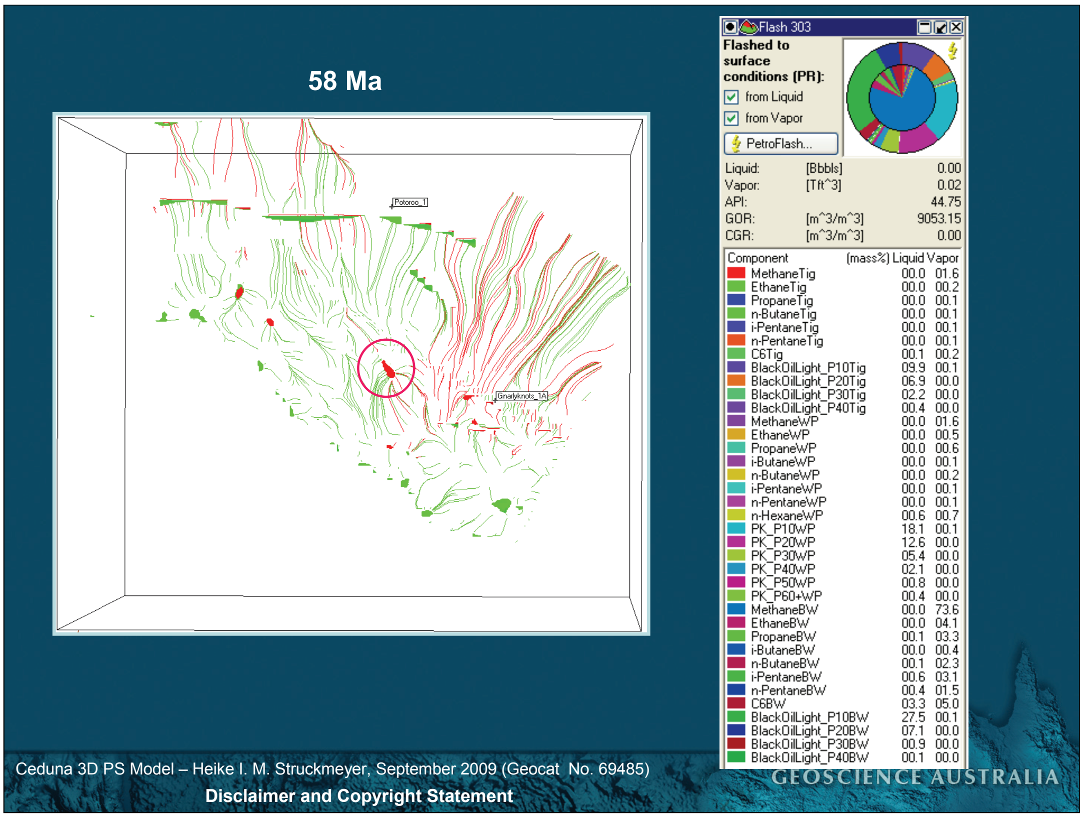
At the end of Tiger SS deposition, the accumulation had grown considerably.



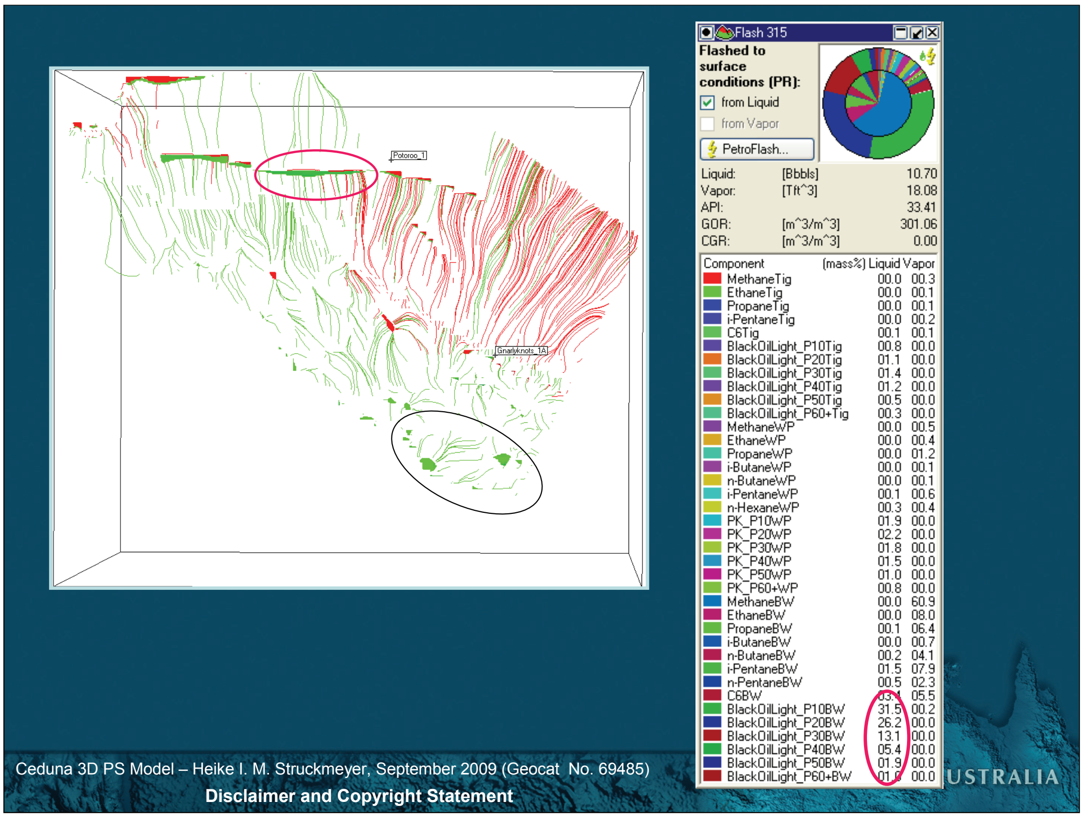
At the end of Hammerhead 2 deposition, at 75 Ma, the accumulation (now shown zoomed out) is much smaller with significant hydrocarbons lost, some of which possibly spilled to the inboard structures.



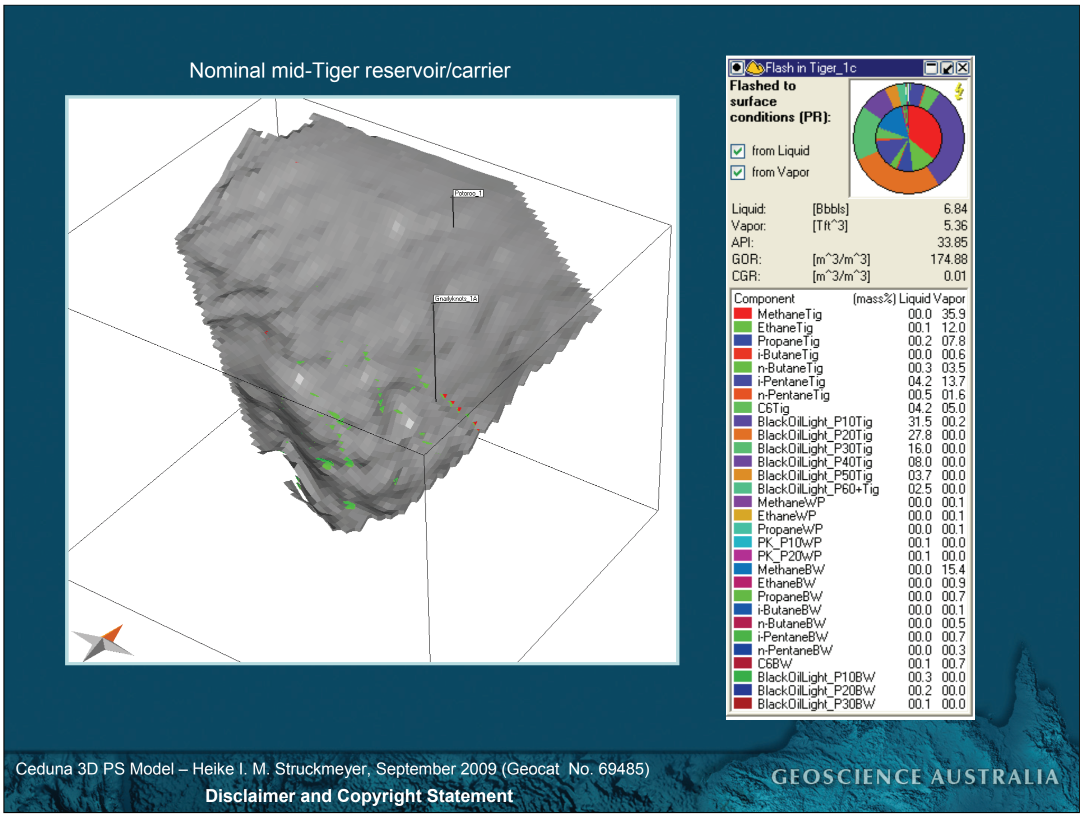
These inboard accumulations disappeared at 74 Ma. When examining the modelled accumulation history in this drainage area, it is apparent that there were several episodes of fill/spill, with the major issue probably seal capacity. However, considering the scale of the liquid volume modelled in these accumulations, there could still be very large amounts of hydrocarbons preserved.



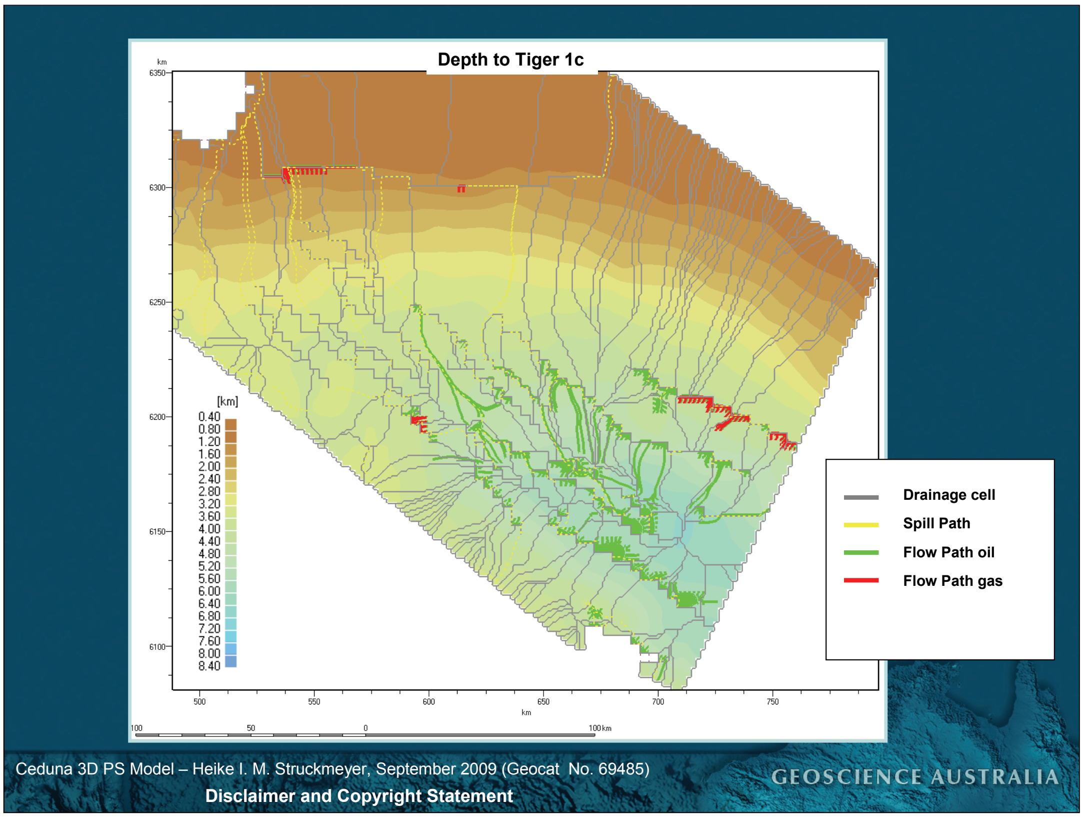
At 58 Ma, the outboard structures had filled again and the central basin accumulation now contained only about 20 Bcf of vapor and basically remained like this until present day.



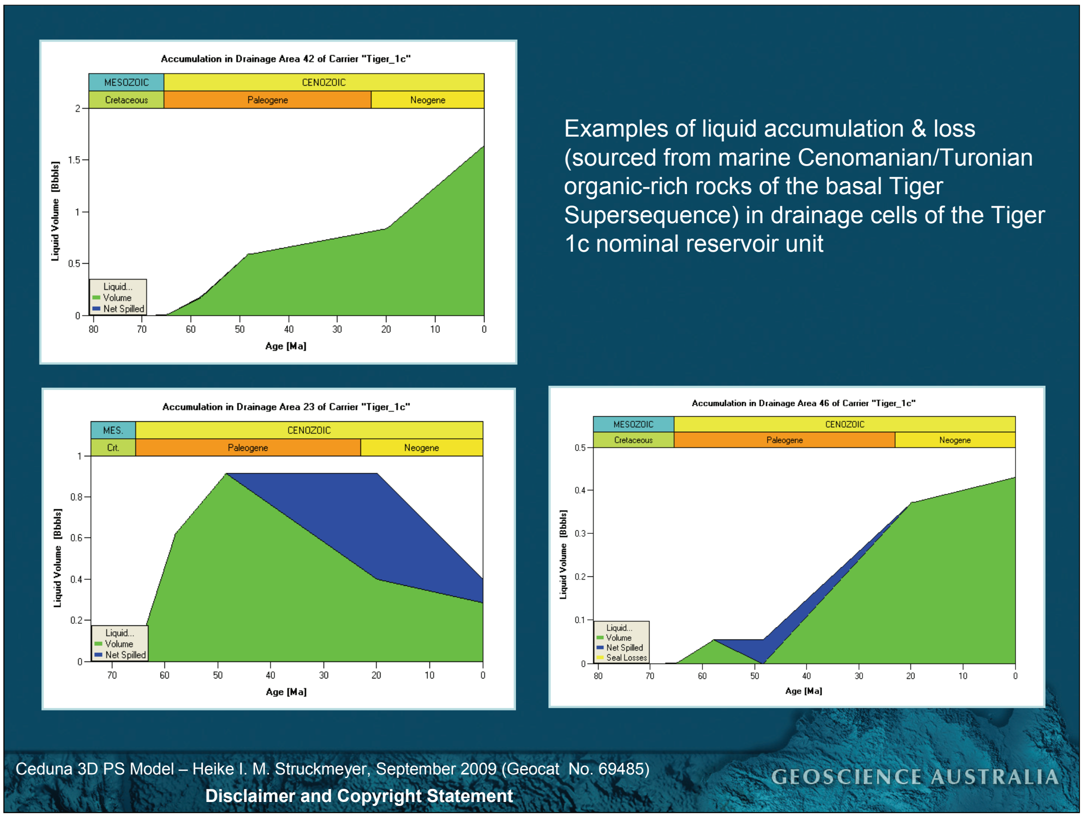
In contrast, the outboard accumulations are modelled to contain a significant amount of liquids and vapor, both mostly sourced from the Blue Whale SS since about 70 my ago. One important factor to point out is the drainage paths towards the outer basin margin in the area indicated by the black oval. This supports the suggestion of a potential outboard accumulation trend.



The second important carrier/reservoir unit is the nominal mid-Tiger reservoir. This shows a number of small and several larger accumulations, mostly liquids, all located in the central basin. When flashed to surface conditions, the total liquids available for accumulation are close to 7 Bbbls and around 5 Tcf for vapor. The data suggest that although there is some contribution from the Blue Whale SS, the majority of hydrocarbons in this unit are derived from the Tiger marine organic rich rocks.



The drainage cell map for the Tiger 1c carrier unit shows that spilling of accumulations has been much less extensive than in the White Pointer reservoir.



When examining individual drainage cells, it is evident that, typically, the main accumulation phase commenced in the early Cenozoic. In some accumulations, some spillage has occurred, but accumulation in reservoirs is continuing to the present day in other modelled accumulations.

Summary

• The 3D model suggests that the Ceduna Sub-basin has experienced several phases of hydrocarbon generation, expulsion and accumulation.

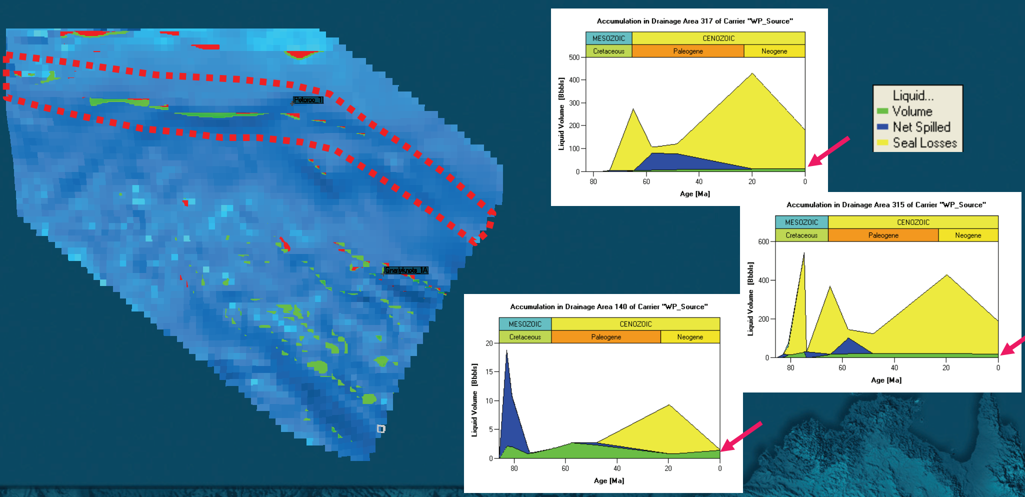
• Early generated and accumulated oil and gas from potential source rocks of the Blue Whale/White Pointer supersequences (Albian to Cenomanian) are likely to have spilled from earlier structures, but may have accumulated through remigration into structures along the basin margin.

• Late (Neogene) generated and accumulated oil and gas from the Blue Whale/White Pointer supersequences is potentially preserved in structures of the inboard and outboard parts of the basin.

• Generation and expulsion from early Turonian organic-rich rocks commenced in the Late Cretaceous, but accumulation of oil is unlikely to have occurred until the Cenozoic and is continuing to the present day. Potential accumulations related to this petroleum system probably occur in two major trends within the central Ceduna Sub-basin.

Potential for Accumulations

- inner basin margin trend, along main drainage paths, sourced from mostly Blue Whale and, locally, from White Pointer organic-rich rocks; these are likely to contain both light oil and gas accumulated during the Cenozoic, but may also contain some remnant hydrocarbons from earlier accumulation phases.



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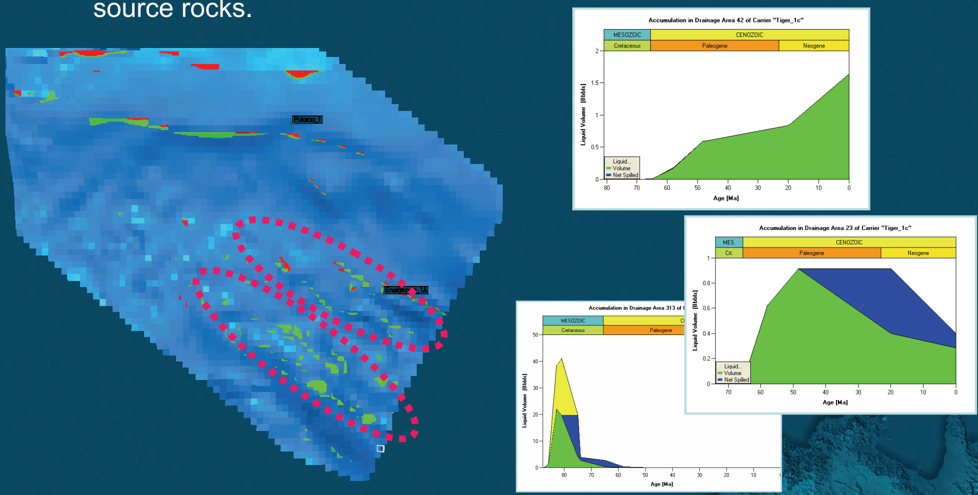
in the central basin, along two major trends (Springboard and Gnarlyknots trends), sourced mostly from Tiger organic-rich rocks; these are likely to contain light oil accumulated during the Cenozoic, as well as remnant oil and gas from earlier accumulations charged from Blue Whale and White Pointer source rocks.



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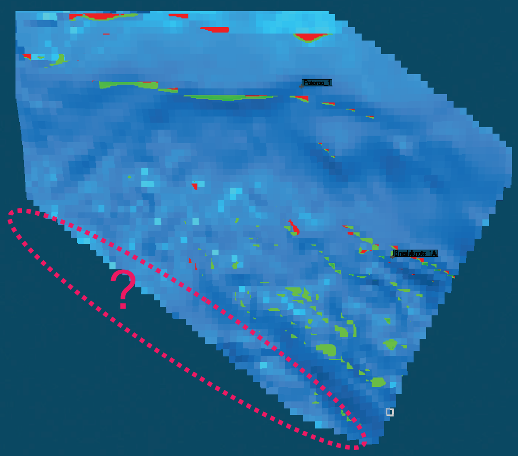
- along the outer margin, outside the area of this model, as indicated by flow paths and geometry of the basin; these are most likely to contain oil and gas from both Blue Whale and Tiger organic-rich rocks, accumulated during the Cenozoic. The main liquids charge for these accumulations is likely to have occurred from the Neogene to Recent.



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