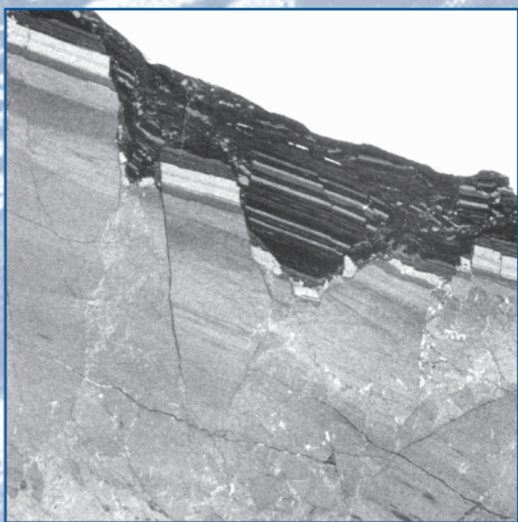
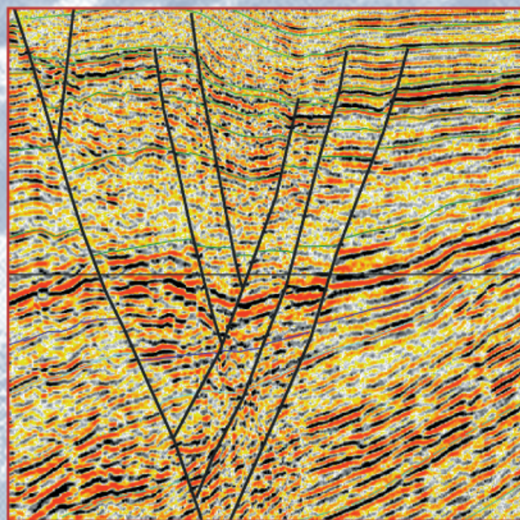
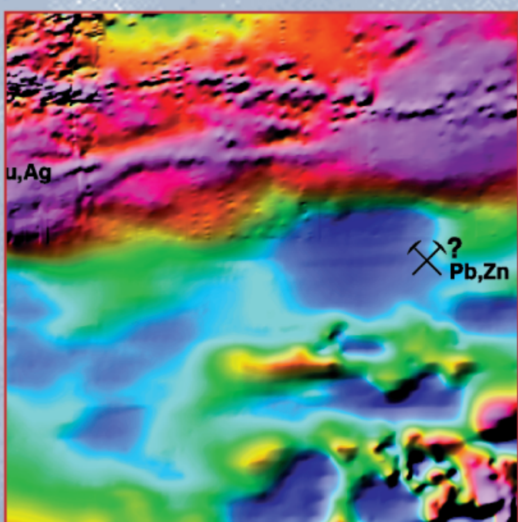
Elizabeth Creek Prospect:

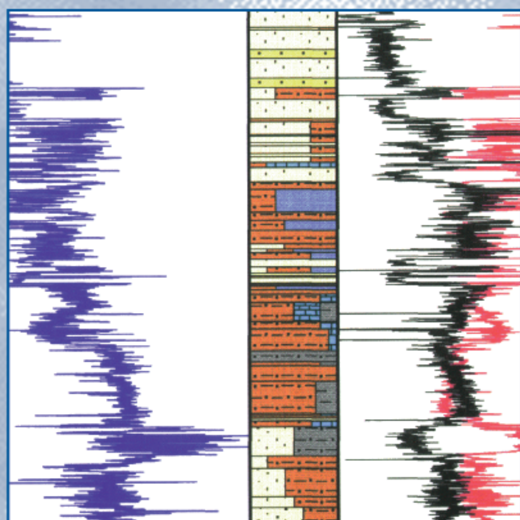
Buried mineral play in Century-equivalent strata, northern Lawn Hill Platform, Queensland

B.E. Bradshaw, D.L. Scott, A.A. Krassay, & P.N. Southgate









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ADDENDUM

Record 1998/4 was originally released in hardcopy format in May 1998 at a cost of $1150. It formed a data release to accompany declaration of Restricted Area 298 by the Queensland Government. The CD ROM version of this Record was released in September 2000. Initial circulation of the Record was restricted to major exploration companies. Re-release of the dataset in digital format, at a significantly reduced cost, will permit the dissemination of concepts developed in the Record to a wider client base.

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PLOT FILES						
(.tif) TIFF Files		**(.ps) Postscript files**				
Figure 01	Figure 08	Figure 07	Figure 16	Figure 22	Figure 28	Figure 35
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EXECUTIVE SUMMARY

This Record presents the results of integrated geoscientific investigations that significantly enhance the prospectivity of a portion of the northern Lawn Hill Platform (**Fig. 1**). Restricted Area 298 has been declared to permit the Commonwealth and Queensland Governments to release a data package that documents the prospective area while providing the exploration industry with sufficient time to digest the information and decide if further exploration is warranted.

Three years of integrated studies of structure and sequence stratigraphy by the North Australian Basins Resource Evaluation project (NABRE) are providing a new chronostratigraphic framework for prospective rocks of Palaeoproterozoic age in northern Australia. In the upper McNamara Group these studies have led to a better understanding of host sediments for the Century zinc deposit. It is now possible to understand the regional setting and geometry of basins that developed in upper McNamara Group time. The NABRE investigations clarify the geometry of the sub-basin hosting the Century orebody and the architecture of its sediments, and establish its relationship to the basement template. Broadbent et al. (1996) have presented a fluid flow model to explain both the timing and processes of mineralisation at the Century ore body. By combining the new architectural stratigraphic information with the model for mineralisation, a better prediction of subsurface mineral plays is permitted.

Interpretation of a petroleum industry seismic grid to the north of Century has identified Century-age strata in the area imaged by the seismic profiles. Integrated seismic, drill core, outcrop, and well log analysis has identified a Century-age sub-basin, the Elizabeth Creek sub-basin, with near identical basin geometry and sediment architecture to that known at the Century orebody. Geopotential and seismic data provide the framework for deep structural interpretations. These data show the Elizabeth Creek sub-basin occurs adjacent to a deep seated fault system that displays multiple phases of reactivation and fracturing. The basement fault system and interconnected younger reactivation structures may have acted as a plumbing conduit for the movement of mineralising fluids into the prospective area. Thus, a potential new Zn-Pb-Ag prospect, 'the Elizabeth Creek Prospect', is predicted beneath 350 m of Mesozoic (Carpentaria Basin) cover. Although the prospective interval is estimated to occur at 350 m depth, its close proximity to power and pipeline infrastructure associated with the Century Mine Project and Gulf of Carpentaria shipping facilities enhances the economics of any potential minerals discovery.

1. INTRODUCTION

NABRE is a multidisciplinary National Geoscience Mapping Accord (NGMA) project. The north Australian Carpentaria-Cloncurry mineral belt is endowed with several world-class sediment-hosted lead-zinc-silver, copper and gold deposits. Current exploration models are based largely on interpretations of near-surface strata made from geological maps, geochemical databases, and potential-field data sets. A growing interest now exists in predicting the occurrence of potential exploration targets in areas within 500 m of subsurface cover. Traditional exploration strategies are unable to accurately predict such subsurface targets. Instead, a multidisciplinary regional basin analysis is required. State-of-the-art petroleum and mineral industry basin analysis exploration techniques are combined to evaluate the structure and sequence stratigraphic framework of these basins. In particular, seismic reflection profiles provide important details on the continuity of stratal surfaces, geometry and stacking patterns of sequences, burial history of strata, potential fluid-flow pathways, and the structural controls on basin evolution. As well as documenting a new prospect in the northern Lawn Hill Platform, this report provides an example of how integrated basin analysis techniques can be used to identify mineral plays beneath shallow cover.

Explorationists familiar with the Palaeoproterozoic stratigraphy of northern Australia will notice a new stratigraphic nomenclature in this Record. The NABRE stratigraphic subdivision is based on the identification and correlation of chronostratigraphic surfaces rather than diachronous lithostratigraphic rock bodies. The chronostratigraphic surfaces are identified at a number of scales and ultimately form a hierarchy of stratigraphic sequences. This Record presents the current status of the NABRE stratigraphic subdivision. Interim sequence stratigraphic correlations for the Surprise Creek Formation, McNamara, Fickling and Mt Isa Groups, and proposed correlations between the Peters Creek and Fiery Creek Volcanics were published in NABRE workshop proceedings (AGSO Record 1997/12) and summarised in the Event Chart. The Event Chart recognised eight chronostratigraphic surfaces, labelled A-H. Concurrent seismic stratigraphic studies identified five major seismic packages, PM, LM, RV, TL and WD.

Ongoing SHRIMP zircon age determinations and additional Apparent Polar Wander Path curve poles, facies information, and gamma ray data have enabled the project to correlate outcrop and subsurface data sets. Data set integration and interpretation since the March 1997 NABRE workshop allow the stratigraphic interval discussed above to be subdivided into nine Supersequences. Whereas the earlier Event Chart contained bounding time surfaces of mixed stratigraphic order (Surface C is now recognised as a third-order sequence boundary), we now believe that the revised nomenclature resolves the issue of sequence hierarchy. This Record focuses attention on the Lawn, Wide, and Doom Supersequences of the Lawn Hill Formation, upper McNamara Group.

2. DATABASE

Between 1986 and 1991 Comalco Aluminium Ltd acquired approximately 1000 km of reflection seismic profiles and drilled 4 petroleum wells (Argyle Creek#1, Desert Creek#1, Egilabria#1, and Beamesbrook#1) within Proterozoic strata of the northern Lawn Hill Platform (**Fig. 1**). The seismic data grid straddles the boundary of the 1:250 000 Westmoreland (Grimes & Sweet, 1979) and Lawn Hill (GSQ, 1983) map sheets, which comprise the study area for this report. Rationale behind the exploration program are described by McConachie et al. (1993). Well-completion and VSP reports (Dunster et al., 1989, 1993a,b,c) are readily available through the Geological Survey of Queensland (GSQ). Digital copies of the original final stack Comalco seismic lines were obtained from GSQ and migrated by Jim Leven, AGSO. Three outcrop gamma-ray curves from Gorge Creek were obtained using a hand held spectrometer (Scintrex GRS-500). Natural radioactivity readings were taken over 10-second periods at 0.5 m intervals of true thickness. Western Mining Corporation (WMC) provided open-file drill-hole data from the Walford Prospect (WFDD#17) on the southern Murphy Inlier. Regional gravity and magnetic data for the two 1:250 000 sheet areas were extracted from the AGSO national data sets (Murray, 1997; Tarlowski et al., 1996), reprocessed, and interpreted using both image analysis (Tarlowski & Scott, 1997) and profile modelling.

3. GEOLOGICAL SETTING

The Comalco seismic grid provides subsurface data on Proterozoic intracratonic basins within the northern Lawn Hill Platform study area (**Fig. 1**). Outcrop exposures surrounding the northern Lawn Hill Platform confirm that initiation of intracratonic basins date back to around 1900 Ma when much of the Australian continent underwent widespread extension (Etheridge et al., 1987; Etheridge & Wall, 1994). Subsequent deformation during the Barramundi Orogeny between 1870 and 1840 Ma established the metamorphic basement for the region. The northern extent of the seismic grid impinges on the Murphy Inlier (**Fig. 1**), an approximately east-west basement outcrop belt comprising the Murphy Metamorphics (>1900 Ma), the Nicholson Granite Complex and Cliffdale Volcanics (c.1850 Ma), and the post-Barramundi Peters Creek Volcanics (PCV).

Post-Barramundi Orogeny rocks are divided by Blake (1987) into three "coversequences" separated by regionally evident angular unconformities. The subdivision is widely used, but misleading, as strata within at least the two younger cover sequences contain evidence of several tectonic events. South of the study area, in the eastern part of the Mt Isa terrain, O'Dea et al. (1997) support a single episode of rifting, which they term the Leichhardt Rift, corresponding to Blake's (1987) "Coversequence 2". The stratigraphy includes a 6 km thick package of continental flood basalts (Eastern Creek Volcanics, ECV) with no known associated felsics (Bain et al., 1992), and several kilometres of carbonate and siliciclastic sediments. However, Eriksson et al. (1993) provide convincing evidence for a series of rift-sag events within the same stratigraphic interval. It is likely that a series of stacked basins exists within "Coversequence 2", which we term the Leichhardt Super Basin (LSB; **Fig. 2**).

McConachie et al. (1993) introduced the term "Mount Isa Basin" for all Proterozoic strata imaged within Comalco seismic reflection profiles to acoustic basement. This package of rocks is now known to be equivalent to Coversequence 3 of Blake (1987) and the Neoproterozoic South Nicholson Basin (SNB). However, the term "Mount Isa Basin" is considered inappropriate as the interpretation presented here supports the existence of a series of stacked sedimentary basins, some bounded by major angular unconformities which represent major time breaks (up to 100 m.y.). Furthermore, outcrop relationships, geochronological data, and the seismic data provide ample evidence that the Palaeoproterozoic and Neoproterozoic stratigraphies are neither spatially nor temporally linked. Both our sequence stratigraphic and structural interpretations favour distinct transtensional to extensional and inversion structural events punctuating periods of regional subsidence. In this report, the term Isa Super Basin (ISB) is used to more appropriately describe the Palaeoproterozoic series of stacked intracratonic basins (**Fig. 2**).

The ISB has been divided by NABRE into a series of 9 supersequences spanning a period of ~150 m.y. (**Fig. 3**). Each supersequence represents a major phase of basin evolution. The first ISB basin phase, the Big Supersequence, comprises the fluvial (conglomeratic) Bigie Formation, and the bimodal Fiery Creek Volcanics (FCV). A local unconformity forms the base of the overlying, shallow marine, clastic-dominated Prize Supersequence. A major unconformity associated with a 25 m.y. depositional hiatus and incision occurs above the Prize Supersequence. Marine carbonates of the Lower McNamara Group form a ~1500 m thick southward thickening ramp within the Gun and Loretta Supersequences. The Upper McNamara Group contains up to 7000 m of marginal to deep marine clastics deposited in the final 50-60 m.y. of the ISB. Five supersequences are present; the River, Term, Lawn, Wide, and Doom Supersequences. The Fickling Group is a thin basin margin equivalent of the ISB on the southern Murphy Inlier, which contains the upper eight supersequences. The lowermost Big Supersequence occurs within the underlying PCV (**Figs 2, 3**).

Evolution of the Palaeoproterozoic ISB was terminated by widespread shortening and metamorphism during the Isan Orogeny between 1585 and 1500 Ma (Blake, 1987; O'Dea et al., 1997). The SNB formed above a regional angular unconformity following the Isan Orogeny. Recent SHRIMP zircon dates of 1480 Ma (Page pers. comm.) from the correlative Roper Group in the McArthur Basin confirm this large time gap between the ISB and the SNB. Strata within the SNB are dominantly quartz sandstone, conglomerate, siltstone, shale, and ironstone, of fluvial to shallow marine origin (Sweet & Hutton, 1982). The SNB crops out extensively northwest of the Lawn Hill Platform. Northernmost outcrops of the SNB occur on the southwestern margins of the Murphy Inlier. Proterozoic strata are overlain by an eastward thickening sequence of Mesozoic Carpentaria Basin cover.

Most of the Proterozoic sedimentary rocks that span the nearly 400 Ma of the above discussion are marine in origin. However, the existence of rocks with an oceanic crust affinity anywhere in the outcrop belt remains controversial, with the bulk of the evidence supporting an underlying continental lithosphere since at least c. 1900 Ma (cf Ellis et al., 1984; Taylor, 1997; Wyborn et al., 1988).

3.1. Geology of the Wide and Doom Supersequences

The sediment-hosted Century ore body occurs in the upper parts of unit Pmh4 (also known as the H4s member) of the Lawn Hill Formation (**Fig. 4**). Member H4s occurs at the base of the Wide Supersequence from the ISB (**Fig. 3**). Andrews (1996) describes H4s as a generally 100 m thick unit of laminated to massive siltstones, shales, minor sandstones, and tuffaceous siltstones. The basal contact of H4s is abrupt and represents a major basin event surface (H surface). Beneath the H4s member is a 750 m succession of carbonaceous shales, fine-grained siltstones, and interbedded siltstones and shales of member H4r from the Lawn Supersequence (**Figs 3, 4**; Krassay et al., 1997; Andrews, 1996). H4s is interpreted by Andrews (1996) as a distal turbidite that locally thickens in close proximity to turbidite distributary channels. The Century ore body occurs within a carbonaceous shale interval that forms where the H4s member thickens to 300 m (**Figs 4, 5**; Andrews, in press). The thickening of H4s occurs at the intersection of the NW-SE-trending Termite Range fault zone and several NE-SW-trending faults. A potential Century-equivalent prospect in the NLHP region requires a similar tectonostratigraphic architecture; namely a major fault system into which the H4s member thickens to at least 300 m so that a host carbonaceous shale interval is present.

Overlying H4s is a thickly bedded, medium to fine-grained, feldspathic, micaceous quartz arenite and arkose, referred to as the Widdallion Sandstone (member H5s). A basal conglomerate containing clasts of the underlying H4s commonly occurs at the base of H5s, suggesting the H5s/H4s contact is locally unconformable (Krassay et al., 1997). Widdallion Sandstones are interpreted as high concentration turbidites deposited in prograding (basin floor) turbidite fans (Andrews, 1996; Krassay et al., 1997). The Widdallion Sandstone is widespread throughout the Lawn Hill region.

The Doom Supersequence is poorly exposed and its contact with the underlying Wide Supersequence uncertain. However, regional outcrop trends and drill-hole information suggest that the Widdallion Sandstone rapidly fines upwards into the interbedded siltstone and very fine-grained sandstone of member H6r (Krassay et al., 1997). Member H6r facies probably represent finer grained, distal equivalents of the H5s turbidite fans (Krassay et al., 1997).

South of the seismic grid, member H6r is the youngest preserved strata of the Upper McNamara Group. Significant incision at the base of the SNB suggests that younger strata were deposited in the ISB and subsequently removed by erosion. Current outcrop trends and SHRIMP zircon dates within the basal conglomerate of the SNB (Page, 1997) suggest that sedimentation within the ISB ceased at about 1585 Ma. This coincides with the first evidence of metamorphism in the Eastern Fold Belt (Page & Sun, in press) at 1584 Ma. Initiation of the Isan Orogeny therefore appears to have reduced accommodation within the ISB, and eventually deformed and eroded the original basin geometry.

3.2. Seismic Stratigraphy of the Isa Super Basin

Well-preserved sediment architecture and basin geometry in the NLHP result from a lack of significant D2-D3 deformation in this part of the ISB. Consequently, seismic reflection profiles provide important details regarding the stacking patterns, internal and lateral geometry, and structural controls on the upper part of the ISB. Supersequences from the ISB have previously been integrated with seismic interpretations by Scott & Bradshaw (1997) and Bradshaw & Scott (1997). The reflective package imaged in the Comalco seismic grid corresponds to lithostratigraphic Palaeoproterozoic units ranging in age from c.1710 Ma to c.1585 Ma (Page & Sweet, 1997; Page, 1997, Page, pers. comm.).

The geometry of the reflective package is a southward-thickening megawedge (**Fig. 6**). The northern limit of the megawedge is approximately 1.1 km thick and corresponds to the Fickling Group, which outcrops on the southern edge of the Murphy Inlier. At the southern limit of the seismic grid, over a distance of ~50 km, the wedge has thickened to approximately 10 km and corresponds to the McNamara Group. The ISB megawedge was originally divide into five seismic surfaces (PM1, LM1, RV1, TL1, and WD1) by Scott & Bradshaw (1997) based on criteria of major baselap or toplap. Each seismic surface is a regional unconformity used to define an overlying seismic package (e.g. the WD1 surface forms the base of the WD seismic package; **Fig. 7**). The megawedge is now subdivided into nine seismic surfaces (PM1, PM2, LM1, RV1, TL1, TL5, WD1, and WD4) which are correlated to the nine basin event horizons of the ISB (**Figs 3, 6**). The intervening seismic packages correspond to the supersequences of the ISB. Each of the nine seismic supersequences is subdivided into third-order seismic sequences based on the same criteria (**Fig. 6**).

“Acoustic basement” (PM1) of the megawedge is correlated to the top of a mafic unit (FCV/PCV4-6 ; **Fig. 6**). However, the megawedge package may locally sit directly on the older LSB. Two seismic packages are occasionally imaged beneath “acoustic basement”, corresponding to the Big Supersequence and the LSB. The geometry of the LSB varies from the eastern to the western half of the Comalco grid. In the west, the LSB appears relatively conformable with the ISB (**Fig. 6**). However, much of the upper LSB strata is eroded, with only a thin remnant (max. 700 m of Wire Creek Sandstone and Buddawadda Basalt) present on the Murphy Inlier (Rawlings, Jackson & Scott, pers comm). In the east, the LSB forms a marked angular unconformity with the ISB (**Fig. 7**). LSB strata dip northwards and probably preserve younger upper Haslingden Group strata. These marked contrasts in the geometry of the LSB from west to east indicate a polarity switch in an underlying extensional system.

The geometric relationship of the Big Supersequence to the rest of the ISB megawedge also varies from the western half to the eastern half of the Comalco grid. At the northern limit of lines which impinge on the Murphy Inlier, Big Supersequence reflections are terminated or merge to the south, while overlying sequence reflections terminate to the north. The reflection geometry terminations may represent doming by the late-stage Big Supersequence (c.1720-1710 Ma) felsic intrusions with subsequent, or possibly contemporaneous onlap by overlying sequences. Outcrop and map relationships on the Murphy Inlier support this late-stage doming model in the PCV pile. In the east where reflections of the Big Supersequence are discernible, they are broadly conformable with the base of the Prize Supersequence (PM1). We interpret the Big Supersequence to represent a 1600 m thick interval of volcanics and underlying siliciclastics (FCV and Bigie Fm). Although poorly constrained in the seismic data, this unit records a period of major tectonism and magmatism in the initial stages of the ISB (Fig. 8; Betts et al., 1996; Scott et al., 1996; O’Dea, 1997).

The basal unit of the megawedge package is a distinct seismic package (the PM package) corresponding to the Prize and Gun Supersequences. The PM package maintains a constant thickness throughout the grid, except at the northern ends of seismic lines. Adjacent to the Murphy Inlier, the entire package thins rapidly from 2000 m to 0-300 m through toplap truncation beneath a major unconformity (**Fig. 7**). Locally, thinning of the PM package by onlap onto the Big Supersequence (upper PCV) supports the interpretation of an underlying dome as discussed above (**Fig. 6**). A prominent incision surface (PM2) with up to 100 m relief and 7.5 km wide channels is present (**Fig. 6**). The PM2 surface records a regional basin event within the PM package, separating it into the Prize and Gun Supersequences. The PM package is interpreted as the northern continuation of the clastic/carbonate ramp which overlies the Big Supersequence in outcrop to the south (Fig. 8; Sami et al., 1997).

The LM package is the seismic expression of the Loretta Supersequence. LM is lithologically constrained by wells as shallow marine dolomitic limestones and dolarenites, with minor mixed sandy limestone, siltstone, and carbonaceous shale. Argyle Creek #1 penetrates to within 100 m of the base of the LM package and can be confidently correlated with outcrops of the Walford Dolomite (c.1649 Ma) on the Murphy Inlier. The LM package thins northward from >800 m to <100 m mainly by truncation from the overlying RV1 surface (**Figs 6, 7**). Overall, the geometric relationship between the LM and PM packages in the NLHP is one of low-angle angularity. Regional tilting generated a relatively flat planation surface beneath which erosion of PM increased northwards. The LM package is interpreted to be a thick southeast-facing carbonate ramp blanketing the Lawn Hill Platform during a period of relative quiescence (**Fig. 8**).

The RV seismic package (River Supersequence) thins irregularly northwards from ~2300 m to only 300 m on the southern edge of the Murphy Inlier. The northward thinning of RV is mainly through onlap of basal reflections (1700 m) and some upper truncation (300 m). Distinguishing features of the RV package are the presence of tectonic wedges within south and southeast-dipping tilt blocks, and syndepositional growth against north and northwest-dipping faults (**Figs 6, 7**). Both the Desert Creek #1 and Argyle Creek #1 wells record the RV package as dominated by siltstones and shales, with subordinate dolomitic limestones and fine-grained sandstones. Samples from the correlative outcropping Mt Les Siltstone have been U-Pb SHRIMP zircon dated at c.1640 Ma (Page & Sweet, 1998). The tectonic activity recorded during the River Supersequence coincides with an end to the carbonate ramp-dominated sedimentation of the lower McNamara Group and the beginning of clastic-dominated sedimentation in the upper McNamara Group (**Fig. 8**).

The overlying TL seismic package has a broad wedge-shaped ramp geometry. The package, divided into the lower Term and upper Lawn Supersequences, thins rapidly from ~4000 m in the south to only 250 m on the southern edge of the Murphy Inlier. Only the upper two-thirds of the TL package is present in the Desert Creek #1 and Argyle Creek #1 wells. Lithologies represented in the wells are characterised by siltstones with minor sandstones and shales at lower intervals, changing to dominantly carbonaceous silty shales in upper sequences. Two distinct types of thinning occur, separated by the TL5 surface. The Term Supersequence thins mainly by reflections onlapping to the north, while the Lawn Supersequence thins primarily by erosional truncation (**Figs 6, 7**). The basin event at TL5 correlates to the base of the Bulmung Sandstone which has been U-Pb SHRIMP dated at 1615 Ma (Page, pers. comm.). No syndepositional faults are observed in the seismic data. The overall northward transgression of the margin during Term Supersequence time appears to be due to isostatic controls, possibly related to a flexure or hinge of the underlying River Supersequence (**Fig. 8**). Outcrop data in the south suggest that some syndepositional faulting was likely (Krassay et al., 1997).

The uppermost ISB seismic package is the WD package. The base of the WD package is an incision surface with clear evidence of channels and erosion of the Lawn sequences (e.g. **Fig. 7**, southern end). The WD package is separated into two supersequences, the lower Wide and upper Doom Supersequences. The Wide Supersequence is characterised by abrupt thickness variations and closely spaced onlap and complex reflection geometry bounded by faults. The geometry indicates that northwest-southeast-directed extension or strike-slip tectonism resulted in growth geometry in the Wide Supersequence at about 1595 Ma (**Fig. 8**). In contrast, ramp margin tabular geometry characterises the Doom Supersequence. Current geochronological data suggests that deposition of the upper Doom Supersequence continued to approximately 1585 Ma. The Doom Supersequence records a progressive decrease in accommodation, probably associated with the earliest phases of the Isan Orogeny (Blake, 1987; Stewart & Blake, 1992). Integrated seismic well-log sequence stratigraphic analyses of the Wide and Doom Supersequences are presented in subsequent sections of this report.

A prominent angular unconformity is apparent between the SNB and the ISB. Erosion of the underlying WD package is concentrated over folded and faulted anticlines (**Fig. 9**). Onlap geometry at the base of the SNB is locally preserved in synclines (**Fig. 10**). Erosion of the ISB increases to the southwest, where the SNB is the dominant outcrop (**Fig. 1**). An approximate age for initial deposition within the SNB is known from time-equivalent strata in the McArthur Basin Roper Group sediments (Dunn et al., 1966), which have been U-Pb SHRIMP dated at c.1480 Ma (Jackson & Sweet, pers. comm.). The current interpretation and geochronology suggest a 100 m.y. gap between deposition in the ISB and SNB. This extensive depositional hiatus makes the foreland continuum interpretation (McConachie et al., 1993; McConachie & Dunster, 1998) of these seismic data highly improbable. Both the ISB and SNB are eroded and overlain by the Mesozoic Carpentaria Basin, which forms a thin, eastward thickening cap throughout most of the seismic grid (**Fig. 7**). The Carpentaria Basin has been the subject of much interest to petroleum exploration (Smart et al., 1980; McConachie et al., 1997). However, the only significance of the Carpentaria Basin to mineral exploration is its eastward-thickening cover forming a potential economic limit to mineral exploration.

4. SEQUENCE STRATIGRAPHIC METHODOLOGY

Traditionally, exploration for sediment-hosted mineralisation in northern Australia has depended on lithostratigraphic concepts for regional correlations of strata. However, lithostratigraphic correlations are flawed by the time-transgressive nature of facies boundaries. Correlation techniques using unconformity-bounded stratigraphic sequences have been refined by petroleum exploration geologists over the past 30 years. Sequence stratigraphy now presents a viable alternative to lithostratigraphy for developing the chronostratigraphic framework for basins. Importantly, the surfaces that internally divide sequences into their component systems tracts (lowstand, transgressive, highstand and shelf margin systems tracts) and parasequences (progradational cycles bounded by marine flooding surfaces) are chronostratigraphic surfaces that cut across diachronous lithofacies boundaries (**Fig. 11**). The geometric arrangement and hierarchy of sequences reflect an interplay of fluctuations in basin accommodation versus sediment supply at a variety of scales.

Subsurface sequence boundaries are identified through analysis of seismic data and well logs. Wire-line logs such as gamma-ray curves provide high-resolution details on the stacking patterns of sedimentary cycles at a number of scales. Such detail is generally not observed through traditional lithostratigraphic techniques. Individual sedimentary cycles and groups of cycles can be correlated between different localities on the basis of their wireline-log patterns. Multi-channel seismic reflection data, by comparison, are generally acquired at a much coarser resolution than well logs. However, seismic reflections follow gross bedding and provide important details on geometry of sedimentary strata which can only be interpolated between wells.

4.1. Well-Log Trends & Sedimentary Cycles

Regional correlations of wireline curves are not based solely on identifying individual spikes on the curves. Instead, it is the broad, overall curve trends and associated lithofacies stacking patterns that allow accurate regional correlations. A wealth of literature exists on methods for interpreting sedimentary cycles in well logs (e.g. Rider, 1986, Emery & Myers, 1996). Most wireline logs are interpreted through the identification of five widely recognised trends, corresponding to individual sedimentary cycles (**Fig. 12**):

- Cleaning-up or funnel-shaped trends show an upward decrease in gamma counts, which commonly indicates an upward increase in depositional energy, upward shallowing, and upward coarsening related to progradation of a depositional system. Cleaning-up trends may occasionally result from a gradual change from clastic to carbonate deposition, or a gradual decrease in anoxity (Emery & Myers, 1996).
- A dirtying-up or bell-shaped gamma trend shows a progressive upward decrease in gamma readings, which commonly indicates overall fining-upward successions, typically within shale-prone intervals. Dirtying up trends are common in fluvial successions, tidal channels, and estuarine fills (Emery & Myers, 1996). In shallow marine settings, dirtying-up trends often indicate the retreat or abandonment of a shoreline-shelf system (Emery & Myers, 1996). In deep marine settings, the dirtying-up motif may record the waning/abandonment period of submarine fan deposition (Emery & Myers, 1996).
- Boxcar or blocky gamma-ray curve segments are sharp-based low-gamma units with internally relatively consistent gamma readings set within a higher gamma background. The sharp boundaries with overlying and underlying units imply the existence of an abrupt switching from high gamma fine-grained units to low gamma coarser units (Emery & Myers, 1996). Boxcar trends are commonly found in fluvial channel sands, turbidites, aeolian sands, and occasionally within evaporites (Emery & Myers, 1996).
- Bow or symmetrical trends consist of a cleaning-up trend overlain by a dirtying-up trend of similar thickness, with no significant break between the two (Emery & Myers, 1996). A bow trend is usually the result of a waxing and waning of clastic sedimentation rate in a basinal setting, where the sediments are unconstrained by base level, such as during the progradation and retrogradation of a mud-rich fan system (Emery & Myers, 1996).
- Irregular trends have no systematic change in either the sand base-line or shale base-line, and lack the clean character of the boxcar trend (Emery & Myers, 1996). Irregular trends generally represent aggradation of a shaly or silty lithology, and are typical of shelfal or deep water settings, a lacustrine succession, or muddy alluvial overbank facies (Emery & Myers, 1996).

4.2. Parasequences and Systems Tracts

The bounding surfaces of individual log trends often coincide with marine flooding surfaces associated with either fluctuations in sediment supply (e.g. avulsion and lobe switching) or high-frequency variations in sea-level (Emery & Myers, 1996). Units bound by these conformable marine-flooding surfaces are most common in shallow marine settings and are termed parasequences. Parasequences may, in turn, form distinct two-dimensional stacking patterns or parasequence sets (Fig. 11; Van Wagoner et al., 1990). Systems tracts represent larger scale, three-dimensional depositional units bounded by major sequence stratigraphic surfaces (sequence boundaries, transgressive surfaces, maximum flooding surfaces). The surfaces bounding systems tracts are associated with major increases and decreases in the accommodation history of sedimentary sequences (i.e. lowstands, transgressions and highstands; Van Wagoner et al., 1990). Systems tracts and parasequence sets are often synonymous, particularly in shallow marine settings. However, in areas of high subsidence and sediment input, more than one parasequence set may exist within a systems tract (Emery & Myers, 1996). When present, parasequence sets form three distinct stacking cycles within systems tracts:

- Stacking of progressively sandier cycles, which is related to shoaling/emergence of previous depositional environments and overall regressive sedimentation. Such a stacking pattern is termed progradational to denote the basinward movement of a theoretical ‘shoreline’ over time (Van Wagoner et al., 1990). Lowstand and highstand prograding wedges generally consist of progradational parasequence sets. Progradational parasequences are characterised on seismic sections by downlapping (clinoform) geometry. Lowstand systems tracts (LST) are generally succeeded by a sequence boundary and bounded above by a transgressive surface. Highstand systems tracts (HST) are bounded below by a maximum flooding surface and above by a sequence boundary (Emery & Myers, 1996).
- Stacking of progressively more shaly cycles (though each contains coarsening-up parasequences), which is related to drowning of previous depositional environments and overall transgressive sedimentation. Such a stacking pattern is termed retrogradational to denote the landward movement of a shoreline over time. The transgressive systems tract (TST) consists entirely of a retrogradational parasequence set bounded below by a maximum progradation surface (often coincident with the sequence boundary), and above by a maximum flooding surface (Emery & Myers, 1996). Retrogradational parasequences are identified on seismic sections by onlapping geometry.
- Stacking of fairly uniform cycles, which is related to progressive building up of the sediment pile over time. Such a stacking pattern is termed aggradational to denote no movement of a shoreline through time. Early phases of HST development and the upper part of LSTs are often characterised by aggradational parasequence sets (Emery & Myers, 1996; Van Wagoner et al., 1990). Aggradational parasequences are generally manifested on seismic sections as topset geometry with no associated clinoforms.

4.3. Interpretation of Sequence Stratigraphic Surfaces

Sequence boundaries are unconformities and correlative conformities associated with subaerial erosion and in some places correlative marine erosion surfaces (Van Wagoner et al., 1990). A basinward shift in lithofacies is usually found above sequence boundaries. Sequence boundaries are interpreted in well logs where evidence exists for an abrupt fall in gamma-ray counts related to a sharp lithological break. In many cases, the gamma log trend immediately beneath a sequence boundary is progradational, indicating an underlying shoaling and coarsening-up event associated with a HST. The gamma-ray trend above a sequence boundary is progradational-aggradational if a LST is present, or retrogradational if immediately overlain by a TST. Seismic sequence boundaries are identified by terminations of seismic reflectors through either onlap and/or truncation.

A marine flooding surface shows evidence of an abrupt increase in water depth, commonly accompanied by minor submarine erosion or non-deposition (Van Wagoner et al., 1990). Marine flooding surfaces are usually interpreted where gamma values suddenly increase above a cleaning-up trend. The transgressive surface is the first significant marine flooding surface across the shelf within a sequence (Van Wagoner et al., 1990). Transgressive surfaces are indicated in gamma logs by a change from overall aggradation or progradation to retrogradation. In seismic profiles, the transgressive surface is identified as the major onlap surface.

The maximum flooding surface marks a change from retrogradation within the TST to progradation associated with the HST. On seismic sections, the maximum flooding surface is interpreted as the downlap surface above the TST. On well logs, the maximum flooding surface usually occurs at a major peak in gamma-ray counts between a retrogradational and progradational trend. Maximum flooding surfaces pass laterally into shelfal condensed intervals (Loutit et al., 1988). The gamma-ray maxima may relate to shale-prone, organic-rich intervals with anomalously high uranium and thorium contents, owing to the association of these elements with organic matter, or mineralised hardgrounds with anomalous concentrations of syndepositional manganese and phosphorous.

Minor gamma-ray spikes caused by bed-scale shale packages or individual 'hot' beds such as tuffs are distinguished from regionally significant maximum flooding surfaces by the lack of change in gamma-ray trend surrounding each minor 'spike'.

5. WELL-LOG SEQUENCE STRATIGRAPHY

As yet, the well-log sequence stratigraphy of the Century host strata remains confidential However, Andrews (in press) has published details on the lithofacies and thickness variations within the host H4s strata (**Figs 4, 5**), which allow comparisons to be made with open-file data through non-mineralised, potential H4s equivalents. The model for mineralisation at Century presented by Broadbent et al. (1996) proposes:

- Deep burial of Century host sediments beneath 800 to 3000 m of overburden.
- Subsequent hydrocarbon generation in an organic-rich shale interval.
- Hydrothermal fluid flow during a major basin inversion and regional deformation event on the Lawn Hill Platform.

Thus, an understanding of all Proterozoic sequences immediately below, within, and above the H4s-equivalent strata is important for the successful development of a potential Century prospect on the Comalco grid. Egilabria#1 (**Fig. 1**) is chosen as a type section for the well-log sequence stratigraphy of H4s and overlying Proterozoic strata. Egilabria#1 is ideal as it contains the greatest preserved thickness (1050 m) of the Wide and Doom Supersequences. All available well logs (composite neutron-density, gamma-ray, sonic, and resistivity) are integrated with lithologies from well cuttings to determine the sequence stratigraphy. Spontaneous potential logs are also shown, but have not been used in analysing the sequence stratigraphy, owing to their lower resolution compared to other logs. At least three Wide sequences (WD1, WD2, and WD3), and five Doom sequences (WD4, WD5, WD6, WD7, and WD8) are interpreted at Egilabria #1 based on an integrated analysis of well logs and lithological logs (**Fig. 13**). Reference is also made to the same well-log suite from Beamesbrook#1 (**Fig. 14**) to provide additional insight into the sequence stratigraphy and potential mineralisation of the H4s equivalent strata.

5.1. Lawn Supersequence

Sequence TL7: The base of Egilabria#1 (**Fig. 13**) penetrates 250 m of black carbonaceous siltstones, which probably correlate to the upper one-third of the H4r interval. A third-order sequence boundary (G3.0) is interpreted at 1763 m, where a sudden change in all log trends occurs. At Egilabria#1, the increase in density and gamma and decrease in sonic velocity and resistivity is uncertain, given that no change in lithology was noted by Dunster et al. (1993a). However, at Beamesbrook#1 a sharp lithological break was observed by Dunster et al. (1989) from interbedded shales and siltstones to shales. Well-log curves, particularly at Beamesbrook#1, show a series of three dirtying-up trends within a retrogradational parasequence set interpreted as part of a TST. A maximum flooding surface (G3.3) occurs at 1660 m in Egilabria#1. Evidence for subsequent progradation is removed at Egilabria#1 by the overlying H1.0 unconformity. However, Beamesbrook#1 clearly shows a progradational trend within black shales above G3.3.

Both wells have high TOC and ditch-gas concentrations in TL7, particularly around maximum flooding surface G3.3 (6 to 7% TOC; **Fig. 15**). McConachie et al. (1996) believe TL7 was once a prolific petroleum source rock interval. Concentrations of base metals (Cu, Pb, Zn and Mn) are high at the top of TL7 when compared to the baseline curve of overlying sequences (**Fig. 15**; McConachie et al., 1996). In particular, Beamesbrook#1 has anomalously high zinc concentrations (up to 200 ppm) and sporadic pyrite nodules (Dunster et al., 1989). The zone of high TOC and base metals also coincides with a prominent low resistivity trend at Beamesbrook#1.

The low resistivity at Beamesbrook#1 is unusual, given this is a zone of high ditch-gas, which should produce low resistivity values, as shown at Egilabria#1. Possible causes of the low resistivity at Beamesbrook#1 are:

• Base metal enrichment due to the interaction of carbonaceous shales with metal-rich brines.

• Syndepositional precipitation of metals due to reduction by organic matter.

• The presence of graphite in organic-rich shales.

5.2. Wide Supersequence

Sequence WD1: A change in log trends at 1642 m in Egilabria#1 marks a regional unconformity at the base of the Wide Supersequence (**Fig. 13**). This includes an increase in density, resistivity, and sonic velocity, and a decrease in gamma values. The H1.0 unconformity is correlated to basin event boundary H (seismic surface WD1) at the base of the Century host (H4s) strata. The initial change in log trends is due to a 16 m thick micritic to finely crystalline, argillaceous limestone at Egilabria#1 (Dunster et al., 1993a), and a siltstone-dominated interval at Beamesbrook#1 (Dunster et al., 1989). Above the limestone, a sharp increase in gamma and decrease in density and sonic velocity coincide with a change in lithology to carbonaceous siltstones at Egilabria #1 and carbonaceous shales at Beamesbrook #1. The associated gamma-ray maxima at both wells are interpreted as a maximum flooding surface (H1.2). The Beamesbrook#1 shales have high TOC values at their base (7.0%), and possibly correlate to the Century host shales described by Andrews (in press). Subsequent log trends suggest an initial cleaning-up trend associated with a progradational parasequence. An upper transgression is interpreted based on the presence of finer grained lithologies in both wells. This upper transgression probably represents a minor fourth-order sequence within WD1.

Sequence WD2: Sequence boundary H2.0 is interpreted at 1572 m in Egilabria#1 at a change in log trends from the underlying transgressive limestones to aggradational very fine-grained silty sandstones. Above the silty sandstone package, an abrupt increase in gamma and decrease in sonic velocity and composite neutron-density values coincide with a marine flooding surface (H2.1) and a lithological change to black carbonaceous siltstones with high TOCs (7.0%). At Beamesbrook#1, the base of sequence WD2 contains a thick siltstone characterised by high resistivity values and a transgressive trend in the gamma and sonic curves. Beamesbrook#1 also shows the same marked increase in gamma and decrease in sonic velocity and resistivity at marine flooding surface H2.1 associated with a lithological change to shales with low TOCs (0.09%). Well-log trends through sequence WD2 are interpreted as indicating a TST that contains at least one locally correlative marine flooding surface.

Sequence WD3: Egilabria#1 shows a sudden decrease in gamma and increase in sonic velocity and resistivity at 1553 m, which are interpreted as sequence boundary H3.0. Changes in log trends are due to the presence of very fine-grained, slightly lithic-micaceous, quartz arenite interbedded with siltstones. Gamma values within the sandstones are relatively high, plotting around the siltstone base-line for Egilabria#1. Sequence WD3 is therefore correlated to the arkosic sandstones with high total gamma count readings observed by Krassay et al. (1997) in outcrop sections of the Widdallion Sandstone. At Beamesbrook#1, a similar change in log trends also occurs, more so in gamma and sonic values and less in resistivity and density. The absence of a sharp break in the resistivity and density logs is due to a lateral facies change to interbedded siltstones and shales at Beamesbrook#1. Log trends at Egilabria#1 show an initial broad aggradational trend as the sandstone content gradually decreases from 60% to 40%. A transgressive surface (H3.1) is interpreted at 1400 m where gamma values increase significantly and the sandstone content decreases to just 20%. Transgressive surface 3.1 is also apparent in gamma logs from Beamesbrook#1. Overall, sequence WD3 is interpreted as a broad LST that floods into a thin upper TST.

5.3. Doom Supersequence

Sequence WD4: The base of the Doom Supersequence is picked at 1341 m, where a marked increase in gamma-ray values occurs (**Fig. 13**). This increase in gamma could easily be mistaken as representing a maximum flooding surface from the underlying TST. However, other logs clearly show a blocky log trend with an abrupt break from the underlying transgressive trend. The blocky log trend is associated with an increase in sandstone content from 20% to 50%. High-gamma sandstones overlying H4.0 are significantly dirtier than underlying sandstones, with up to 50% lithics noted by Dunster et al. (1993a). The blocky log trend suddenly ends as the lithology changes to a thin (25 m thick) zone of interbedded siltstone, limestone, and sandstone. Above this condensed interval, a series of two cleaning-up trends associated with siltstones and minor shales occur. Gamma values subsequently increase at 1150 m as the siltstones become carbonaceous. The overall log trends of WD4 shows the following log responses typical of lowstand submarine fan systems described by Vail & Wornardt (1990; **Fig. 11**):

- The basal high- gamma sandstone displays a blocky character with sharp bases and tops typical of basin floor fans.
- A condensed carbonate interval overlies the basin floor fan and is followed by a progradational interval of interbedded siltstones and shales typical of levee channel and overbank deposits within slope fans.
- An upper transgressive interval possibly marks a period of fan abandonment at the end of the sequence.

At Beamesbrook#1, a siltstone lithology exists above sequence boundary H4.0 and is characterised by the same high-gamma and blocky sonic, resistivity, and composite neutron-density response as the lowstand basin fan sandstone at Egilabria#1 (**Fig. 14**). Beamesbrook#1 also shows the same set of progradational parasequences above surface 4.2 despite being associated with a shale-dominated lithology. Clearly, a lateral facies change occurs between Egilabria#1 and Beamesbrook#1 consistent with a change from proximal to distal fan environments. WD4 is the last preserved sequence beneath the SNB unconformity at Beamesbrook#1.

Sequence WD5: Sequence boundary H5.0 is interpreted in Egilabria#1 at 1100 m where a sharply based cleaning-up log trend commences, associated with siltstones and minor limestones. The basal siltstone package is interpreted as a new lowstand fan system rather than a continuation of lowstand deposition from WD4, as indicated by the sharply based nature of log trends. A retrograding trend commences at 1033 m (surface H5.1). The subsequent TST is characterised by decreasing siltstone and increasing limestone and shale lithologies. Maximum flooding surface H5.2 is interpreted at 990 m where a turn-around to progradational log trends occurs in association with a coarsening-up from shales to siltstones and dolomites.

Sequence WD6: Sequence boundary H6.0 is picked at 952 m based on a marked change in log trends associated with an interval of interbedded fine grained sandstones and siltstones. Dunster et al. (1993a) noted a distinct “salt and pepper” coloring within the sandstones, owing to the presence of lithics, coarse muscovite, and rare biotite, which they proposed marks a change in sediment provenance. A blocky trend in the gamma, composite neutron-density, and sonic logs characterises the basal sandstones, which are interpreted as turbidite deposits within a LST. Above the lowstand sandstones, gamma, composite neutron-density, and sonic logs show irregular, “spiky” log-trends, suggesting thin interbeds of contrasting lithologies. The resistivity log shows a broader retrogradational and progradational trend and is used to define the overlying systems tract. A transgressive surface (H6.2) is picked at the top of the last major sandstone bed at 891 m. A series of four retrograding parasequences within a TST is interpreted between 891 and 730 m. The TST is characterised by a fining-up from interbedded dolomite/siltstone and sandstone/siltstone to carbonate-dominated lithologies. A maximum flooding surface (H6.4) is interpreted at 730 m at the top of a thick cryptocrystalline dolomite and siltstone unit.

Sequence WD7: Sequence boundary H7.0 is picked at 713 m at the base of a thick sandstone package. Although the gamma and sonic trends do not vary significantly from the underlying HST, the resistivity and composite neutron-density curves show a marked change in trend consistent with a third-order sequence boundary. The basal sandstone is fine grained, and again characterised by a distinct speckled “salt and pepper” colouring, owing to the presence of up to 50% lithics. Lithic fragments include well-rounded glassy black grains, translucent green and turquoise grains, dark grey and black mudstone, and black limestone (Dunster et al., 1993a). As with underlying sequences WD6 and WD4, the presence of a dirty basal sandstone is interpreted as indicating turbidite deposition within a LST. The lowstand sandstone is also characterised by elevated lead concentrations (206 ppm, **Fig. 15**). Above the lowstand sandstone occurs an arenaceous limestone grading through quartz packstone/wackestone to fine-grained calcareous sandstone (Dunster et al., 1993a). These are interpreted as shelfal carbonates deposited within a TST. The remaining sequence is dominated by fine-medium-grained, sub-lithic (up to 20% lithics) quartzose sandstones, and interbedded siltstones. An irregular spiky log trend possibly indicates shelf tempesite deposits within a HST. Previous interpretations by Dunster et al. (1993a) placed the base of the SNB at H7.0.

However, our revised interpretations clearly show the base of the SNB belongs higher up at a major erosion surface present within all Comalco drill holes.

Sequence WD8: The final preserved sequence boundary of the Doom Supersequence (H8.0) is picked at 568 m, at the base of a fine-medium to coarse-grained quartzose sandstone. The sandstone is characterised by blocky log trends, indicative of coastal or fluvial deposits within a LST. A sharp transgressive surface (H8.1) occurs above the lowstand sands at 524 m. The subsequent TST contains at least one retrogradational parasequence within interbedded sandstones and siltstones.

5.4. Post-Isa Super Basin Sequences

South Nicholson Basin SN1: The base of the SNB is very distinct at Egilabria#1, marked by a sharply based blocky trend in gamma, composite neutron-density, and sonic logs, and a sharply based progradational trend in the resistivity log (**Fig. 13**). Only one sequence is picked within the SNB. This is characterised by a thick interval (497-400 m) of fine-medium and medium-coarse-grained quartz sandstones. The blocky log trend which characterises the SN1 sequence is interpreted as fluvial deposition within a LST. A thin siltstone interval between 360 and 359 m probably marks a period of fluvial overbank deposition. At Beamesbrook#1, a thin interval of interbedded, fine-very fine-grained quartz sandstone and shale between 580 and 570 m is interpreted as part of the SN1 sequence (**Fig. 14**). Evidence of additional SNB sequences is missing, owing to erosion prior to deposition of the Mesozoic Carpentaria Basin successions.

Phanerozoic: The base of the Mesozoic Carpentaria Basin is based on palaeontological reports from the drilling, as well as dramatic changes in all log trends at Beamesbrook#1 (Egilabria#1 log trends are obscured by well casing). Between the two wells, the Carpentaria Basin forms a 300-560 m thick cover dominated by siltstones. The only significance of the Carpentaria Basin to mineral exploration within the underlying Proterozoic host rocks is its potential limit on economic recovery, owing to its increasing thickness to the east.

5.5. Southern Outcrop-Eastern Comalco Cross-Section

Three NABRE field sections measured at Gorge Creek, about 20 km northwest of Century, cover the mapped stratigraphic interval from the approximate top of Widdallion Sandstone to the base of H4s. With the stratigraphic position of H4s known at Gorge Creek, it is possible to accurately correlate the Century host stratigraphic position onto wells from the eastern Comalco grid through comparison of gamma log trends (**Fig. 16**).

An extensive zone of no-outcrop occurs beneath the Gorge Creek section and probably represents recessive shales from the H4r member. The lowest outcropping unit at Gorge Creek is a dolomitic siltstone with a blocky, low-gamma trend. This low-gamma dolomitic siltstone is correlated to the low-gamma siltstone at Beamesbrook#1 based on the similarities in lithology and gamma-ray trends. Basin event boundary H1.0 and the H4s/H4r contact are, therefore, placed at the base of the dolomitic siltstone. The remainder of sequence WD1 is dominated by siltstones and sandy siltstones. Maximum flooding surface H1.2 and the fourth-order sequence boundary H1.3 are correlated from Gorge Creek to Egilabria#1 and Beamesbrook#1 (**Fig. 16**).

Siltstones and sandy siltstones with relatively low gamma values and an overall slightly retrogradational trend characterise sequence WD2. The gamma trend and lithologies of WD2 at Gorge Creek are very similar and, therefore, correlated to the basal WD2 siltstone package at Beamesbrook#1. The high-gamma shale/carbonaceous siltstone present at the top of WD2 at Egilabria#1 and Beamesbrook#1 is absent at Gorge Creek. Numerous siltstone clasts from WD2 are present at the base of the overlying WD3 Widdallion Sandstone sequence. Thus, the absence of the high-gamma shale unit is attributed to erosional truncation by WD3. Overall, H4s-equivalent strata thicken from 100 m at Egilabria, to 125 m at Beamesbrook and 160 m at Gorge Creek. This is one-third to one-half the maximum thickness of 300 m reported by Andrews (in press) at the Century ore body. The greatest change in thickness occurs within the TSTs of both WD1 and WD2 sequences.

Surface H3.0 marks the sequence boundary between H4s and Widdallion Sandstone. This is characterised by a pronounced increase in gamma values at Gorge Creek and a sharp decrease at Beamesbrook#1 and Egilabria#1.

The presence of relatively high-gamma sandstones is attributed to a high detrital mica and feldspar content (Krassay et al., 1997). A relative increase in gamma values occurs at the Gorge Creek H3.0 sequence boundary, owing to the absence of high-gamma shales from the upper TST of WD2. Within the WD3 sequence, gamma curves at all locations show a similar irregular, aggradational trend. At Egilabria#1 and Gorge Creek the WD3 sequence is initially quite sandy, while at Beamesbrook#1 correlative strata are interbedded siltstones and shales. A distinct transgressive surface (H3.1) is present in all three locations, above which gamma values increase relatively rapidly and lithologies tend to fine-up. The WD3 sequence thickens from 210 m at Egilabria#1, to 300 m at Beamesbrook#1, and 560 m at Gorge Creek. These thickness variations occur in both the LST and TST.

Sequence boundary H4.0 is picked at the base of a high-gamma sandstone at all localities. At Gorge Creek, the high-gamma counts are due to the presence of an arkosic sandstone with up to 30% detrital feldspar visible in outcrop specimens as slightly weathered and relict feldspar grains. Gamma values subsequently increase through a series of interbedded sandstones and siltstones, which are correlated to the progradational parasequences from the slope fan deposits interpreted at Egilabria#1 and Beamesbrook#1. The top of the Gorge Creek section is covered by rubble from the overlying SNB. However, Andrews (pers. comm) infers that a thin H6r succession is preserved. NABRE field work did not find any direct evidence for member H6r at Gorge Creek. Overlying sequences identified at Egilabria#1 are absent at Gorge Creek, owing to extensive erosional truncation by the SNB.

5.6. Comalco-WMC Cross-Section

Figure 17 shows the correlations of sequences from the Egilabria#1 type section to other Comalco holes and one WMC hole (WFDD#17) from the Walford Prospect. The TL7 sequence is present as an organic-rich siltstone-shale interval at Beamesbrook#1, Egilabria#1, and Desert Creek#1. Our interpretation differs from McConachie et al. (1996) who interpreted TL7 as a HST based on an apparent progradational trend in the resistivity curve (**Fig. 18**). However, resistivity curves are very sensitive to the presence of hydrocarbons (Rider, 1986). Thus, the apparent cleaning-up resistivity trend at Desert Creek#1 and Egilabria#1 indicates increasing TOC content as the siltstone-shales transgress into maximum flooding surface G3.3. Low resistivity values are only present at Beamesbrook#1 where they represent an important anomaly generated by either syndepositional sulphide precipitation, postdepositional mineralisation, or the presence of graphite (the latter considered unlikely, owing to the low levels of metamorphism in the northern Lawn Hill Platform).

Basin event horizon H1.0 is present in all wells as an abrupt drop in gamma values. The absence of TL7 at Argyle Creek#1 and both TL6 and TL7 at WFDD#17 indicates a regional erosional surface exists beneath H1.0. The H4s-equivalent strata vary considerably in thickness, from a maximum of 150 m at Desert Creek#1 to a minimum of 25 m at WFDD#17. Sequence WD1 is very similar in log character and thickness at Beamesbrook#1, Egilabria #1, and Desert Creek#1. Each well shows an initial transgression to maximum flooding surface H1.2, subsequent progradation of siltstones and shales within a HST, and an upper transgressive limestone package. Further west at Argyle Creek#1, WD1 is characterised by a blocky trend associated with siltstones from the HST. North of Argyle Creek#1 at WFDD#17, the HST coarsens to a thin package of fine grained quartz sandstones.

Sequence WD2 shows a westward thinning from 60 m thick at Beamesbrook#1 to 35 m thick at Desert Creek#1, and is absent at Argyle Creek#1 and WFDD#17. The trend that appears to occur in the H4s sequences is for units to thin northwards and possibly westwards by the TST pinching out, presumably through onlap.

Sequence WD3 is present in all wells, although Argyle Creek#1 only shows partial preservation of the sequence, owing to erosion by the SNB. In all cases, the lithologs and, to a lesser extent, the gamma logs show a broad transgressive trend within WD3. An apparent cleaning-up trend at WFDD#17 is attributed to a combination of a basal high-gamma sandstone and a loss of organics in the overlying silty shale package through the zone of regolith weathering. An apparent gamma-low in Desert Creek#1 at 350 m is due to the presence of well casing, and was incorrectly interpreted as a sequence boundary by McConachie et al. (1996; **Fig. 18**). Sequence WD4 shows a westward- and northward-thinning trend from a maximum of 300 m at Beamesbrook#1, to 100 m at Desert Creek#1, and 40 m thick at WFDD#17. Thinning of the sequence is attributed to onlap within the LST and

TST. In most holes, lithology is dominated by siltstones and silty shales. However, Beamesbrook#1 shows an anomalously high sandstone content, suggesting it was near a local source for the Widdallion Sandstone.

Sequence WD5 is only preserved at Egilabria#1 and Beamesbrook#1. Elsewhere at Desert Creek#1 and WFDD#17, only the basal lowstand sandstone is present, the remaining sequence eroded out either by the SNB or the base of Mesozoic unconformity.

The Comalco wells show evidence for extensive erosion beneath the SNB. From Egilabria#1 to Beamesbrook#1, at least 600 m of section is lost, with sequences WD5 to WD8 removed by erosion. Further west, the SNB erodes at least 750 m of strata at Desert Creek#1, and 1000 m at Argyle Creek#1. This evidence contradicts observations from the seismic data by McConachie & Dunster (1998) that the SNB becomes conformable with the ISB north of the Elizabeth Creek Fault zone. At Egilabria#1, the SNB is dominated by medium-grained fluvial sandstones. Only a thin remnant of the SNB is preserved at Beamesbrook#1. At Argyle Creek#1, the SNB is dominated by fine-grained coastal or fluvial sandstones at the base, and a thick shelfal (glauconitic) siltstone interval at the top.

5.7. Summary

Sequence stratigraphic interpretations from outcrop and well logs reveal important details regarding the accommodation history of the upper ISB. The TL7 sequence occurs at the top of the Lawn Supersequence. This is an organic-rich potential source-rock interval, with indications of base-metal concentrations significantly higher than background values, particularly around maximum flooding surface G3.3. Relatively high base-metal concentrations in TL7 may have formed by hydrocarbons reacting with metal-bearing brines during the Isan Orogeny, or resulted from syndepositional formation of sulphides produced during the oxidation of organic matter by sulphate.

Century orebody equivalent sequences WD1 and WD2 occur at the base of the Wide Supersequence. The base of WD1 is a regional unconformity with a maximum of 450 m of erosion between Desert Creek#1 and WFDD#17. The WD1 and WD2 sequences are characterised by TSTs which thin and pinch-out northwards and, possibly, westwards. As the TSTs pinch-out, the HSTs appear to coarsen and, possibly, shallow. The Widdallion Sandstone-equivalent WD3 sequence is characterised by a thick basal LST, then rapidly fines up into an overlying TST. Significant lateral facies variations occur within the LST; sandstones dominating WD3 south of the seismic grid, interbedded sandstones and siltstones present at Egilabria#1, and interbedded siltstones and shales occurring in all other wells. The tendency for the northern wells to be finer grained than southern outcrop sections is consistent with Andrews' (in press) interpretation of a southerly provenance for the Widdallion Sandstone. The WD3 sequence also tends to thin northwards and to the west. The dominance of rapidly thinning TSTs and LSTs within the Wide Supersequence suggests the presence of tectonically active basins characterised by high subsidence rates and accommodation-dominated sequences.

Submarine fan systems within LSTs dominate the upper Widdallion Sandstone and H6r-equivalent Doom Supersequences. The absence of rapidly thinning TSTs in WD4 and WD5 appears to mark an end to the underlying accommodation-dominated tectonically driven Wide Supersequences. A distinct high-gamma sandstone and siltstone at the base of WD4 may also indicate a change in sediment provenance for the Doom Supersequence. The final three Doom sequences (WD6-8) show evidence of rapid shallowing and cleaning-up from the basinal turbidite sandstones and shelfal carbonates of WD6 to the shelfal tempesite sandstones and siltstones of WD7, to the fluvial/coastal sandstones of WD8. The onset of these supply-dominated conditions probably relates to rapidly decreasing accommodation space and increasing sediment supply rates during the initial phases of the Isan Orogeny at about 1585 Ma. Initiation of the Isan Orogeny is also marked at WD6 by a change in provenance and a significant increase in lead concentrations for the lowstand sandstone, the latter possibly indicating fluid flow through sandstone aquifers during the Isan Orogeny.

Dunster et al. (1993a) interpreted the basal fluvial sandstones of the SNB at Egilabria#1 as a continuation of the final shallowing and coarsening-up trend of the Doom sequences. However, clear evidence exists in the wells for up to 1000 m of erosion beneath the SNB. Additional evidence from seismic data and SHRIMP zircon dates clearly indicates the fluvial sandstones of the SNB formed at least 80 to 100 m.y. after deposition of the ISB.

6. SEISMIC SEQUENCE STRATIGRAPHY

Interpretations of outcrop and well-log sections provide a high-resolution sequence stratigraphic subdivision of the ISB. However, well-log interpretations and correlations are 2-dimensional. Seismic reflection profiles provide important details on the continuity of stratal surfaces, geometry and stacking patterns of sequences, and the structural controls on basin evolution. To obtain an accurate understanding of the tectonostratigraphic history of the ISB, field sections and well logs must be integrated with seismic reflection profiles. Three wells, Argyle Creek#1, Desert Creek#1, and Egilabria#1, have published checkshot surveys (Dunster et al. 1993a,b,c), which are used to convert measured well depths to time. No checkshot survey data are published for Beamesbrook#1 and, therefore, sonic velocity curves are used here for depth-time conversions. Gamma and sonic logs with interpreted picks are plotted on seismic sections using these depth-time conversions (**Figs 19-22**). Potential errors in the placement of well-log picks onto the seismic are mainly from drill hole deviation. However, Egilabria#1 is the only well with significant deviation with the measured depth up to 58 m greater than the corrected true vertical depth. Synthetic seismograms are available for all four wells and have been used to verify the accuracy of picks onto the seismic sections, particularly at Egilabria#1.

The internal geometry of each well-log sequence is examined in detail on seismic sections. Seismic sequence geometry is highlighted using variable intensity colour plots with high vertical exaggeration. Post-depositional folding of sequences is removed in all accompanying figures of this section by flattening overlying sequence boundaries. A flattened and vertically exaggerated Wide Supersequence and Doom Supersequence type-section is tied into the gamma log from Egilabria#1 in **Figure 23**.

6.1. Lawn Supersequence

TL7 Sequence: The TL7 seismic sequence represents a northward-thinning wedge. TL7 is generally a semi-transparent seismic unit, consistent with its associated lithology of homogenous carbonaceous silty shales. TL7 is bounded above and below by high amplitude, continuous reflections. In many areas the upper boundary (WD1) is highly erosional. A moderate-amplitude, semicontinuous reflection is generally found within the sequence corresponding to the approximate location of maximum flooding surface G3.3. Low-amplitude, discontinuous, clinoformal reflections often downlap onto the maximum flooding surface within a thin HST. Sequence TL7 reaches a maximum thickness of 150 m at the southwestern end of line 89BN-07 (**Fig. 24**). Anomalousl high-amplitude reflections in the thickened section of TL7 possibly indicate base-metal mineralisation or a cemented interval. The sequence subsequently thins northwards to about 50 m. Thinning of the TL7 sequence is mainly through a combination of regional northward onlap and erosional truncation of folded strata. In western areas around Desert Creek#1, sequence TL7 again thins rapidly northwards from a maximum of 100 m to 0 m. At Argyle Creek#1, TL7 is absent, owing to increasing onlap and truncation to the west.

6.2. Wide Supersequence

WD1 and WD2 Sequences: The WD1 and WD2 seismic sequences occur above a major basin event (surface H) throughout the Comalco grid. In many areas, the base of WD1 is a local unconformity that truncates gently folded TL7 strata (**Fig. 25**). WD1 and WD2 are mostly characterised by a distinct set of three high-amplitude, continuous, parallel seismic reflections. The highly reflective nature of sequences WD1 and WD2 is attributed to the associated dolomitic limestone lithologies documented in wells. In western areas, WD1 and WD2 represent a condensed, relatively planar unit. Occasionally, minor growth occurs within narrow grabens (**Fig. 26**). South of Egilabria#1 on line 89BN-07, WD1 and WD2 form a southward-thickening wedge (**Fig. 25**). Here, the sequences thin from 575 m to 115 m towards the northeastern end of the line. Thinning of WD1 and WD2 is mainly through onlapping of low-amplitude seismic reflections. Southerly prograding, high-amplitude clinoforms form thin HSTs within both sequences. The presence of thick TSTs and thin HSTs in WD1 and WD2 is consistent with well-log observations from Egilabria#1 and Beamesbrook#1. An important feature of the WD1 and WD2 sequences on line 89BN-07 is a 200 m thick zone of anomalous high-amplitude reflections (see **Fig. 35**). This high reflectivity zone occurs within a late-stage but pre-SNB fault system, and may represent cementation or mineralisation of carbonaceous shales and siltstones.

WD3 Sequence: The WD3 sequence represents a series of southward-thickening wedges throughout the Comalco grid. In many areas, WD3 shows syndepositional growth into wrench fault systems (**Fig. 27**). WD3 is generally characterised by moderate-amplitude, semi-continuous, parallel to slightly chaotic reflections. The WD3 sequence stands-out on seismic sections as northward-thinning wedges above the highly reflective WD1 and WD2 sequences (**Figs 26-29**). Internal geometry of WD3 is relatively complex. Several of the basal and upper reflections onlap towards the northern ends of lines, which gives WD3 a broadly transgressive appearance. However, up-dip WD3 reflections alternate from northerly onlapping to southerly prograding clinoforms (**Figs 26, 27**). Possible mechanisms for generating this alternating reflection geometry include:

• Debris flows generated during intermittent fault movements.

• Rapid reversal anomalies formed during tectonic activity.

• Progradation of deltas into the tilt blocks from a northerly source.

Another common feature of the WD3 sequence are incision surfaces, interpreted as representing submarine canyons and channel levee complexes (**Figs 28, 29**). The seismic geometry of WD3 is consistent with interpretations from Egilabria#1 and Beamesbrook#1 of a wedge containing a thick LST and a thin TST.

6.3. Doom Supersequence

WD4 Sequence: The WD4 sequence is characterised by a tabular ramp geometry of relatively uniform thickness. In all areas, the sequence begins with a distinct pair of high-amplitude positive and negative polarity, parallel reflections (**Figs 23, 26**). The negative polarity reflection stands out in eastern areas as an unusually thick black zone containing some light clinoformal reflections (**Fig. 23**). The reflective basal unit of the WD4 sequence ties with high-gamma sandstones and siltstones at Egilabria#1 and Beamesbrook#1. Above the basal unit, seismic reflections are less reflective, discontinuous to chaotic, and display shingled and channelled geometry (**Figs 23, 26**). Clinoforms with bidirectional downlap are often present. WD4 is interpreted as consisting of one extensive LST. The reflective basal unit is similar to the “basin floor fan” unit of the passive margin sequence model (**Fig. 11**). However, the subplanar nature of the basal reflections suggests a “basinfloor sheet”, possibly representing regional-scale debris flows. The overlying shingled/channelled unit is very similar to channel levee complexes found within lowstand slope fans in passive margins basins. The presence of regional-scale debris flows and channel levee complexes, in the absence of a recognised shelf break, suggests a continuation of the basin margin instability that characterised the underlying WD3 sequence. However, the tabular ramp geometry and lack of growth against faults in WD4 indicate that tectonic activity had ceased by WD4 time.

WD5 Sequence: WD5 is poorly preserved, particularly in western areas, owing to erosion by the SNB. Where present, the WD5 sequence is characterised by a series of parallel, continuous reflections. Geometry within WD5 and overlying sequences is best illustrated on Line 89BN-03 in the eastern Comalco grid (**Fig. 23**). The base of WD5 is generally conformable with the underlying channelled WD4 sequence. However, in some areas minor erosion (~20 m) is evident (**Fig. 30**). One northerly prograding clinoform reflection is present above the sequence boundary on the type section. This clinoform ties with the LST interpreted at Egilabria#1 (**Fig. 23**). A TST occurs above the LST, and is characterised by moderate to high-amplitude reflections which onlap to the north. The reflective nature of the TST is consistent with observations from Egilabria#1 of increasing carbonate content toward maximum flooding surface H5.2. An upper reflection is interpreted as representing a topset geometry within the HST observed at Egilabria#1. WD5 is distinguished from underlying sequences by its uniform, planar internal geometry. The planar nature of WD5 compared to the channelled WD3 and WD4 sequences suggests the basin margins were relatively stable.

WD6 Sequence: The WD6 sequence is mostly absent except on seismic sections located near Egilabria#1. On the type section, the WD6 sequence boundary is conformable with WD5 (**Fig. 23**). A series of moderate-amplitude, semicontinuous to continuous, southward-prograding clinoforms occur above the sequence boundary. This basal clinoform package ties with the interbedded sandstone/siltstone/carbonate interval interpreted as a LST at Egilabria#1. The overlying TST is characterised on seismic sections as a distinct high-amplitude reflection doublet. The highly reflective nature of the TST is consistent with the presence of thick carbonates at Egilabria#1.

A HST is clearly defined at the top of WD6 by a series of low to moderate-amplitude, semicontinuous, northward-prograding clinoforms. Geometry within WD6 is relatively uniform and suggests continued basin margin stability. The presence of well-defined clinoforms within both the LST and HST is interpreted as indicating a shoaling-up trend from the underlying WD5 sequence.

WD7 Sequence: WD7 shows a more irregular internal geometry than WD5 and WD6 (**Fig. 23**). The base of WD7 is characterised by a conformable sequence boundary. A semicontinuous, moderate amplitude reflection occurs above the sequence boundary. This lower reflection ties with the condensed carbonate interval from the WD7 TST at Egilabria#1. The negative polarity reflection beneath the TST is interpreted as the WD7 LST. A series of moderate-amplitude, relatively continuous, northerly prograding clinoforms downlaps onto the thin TST. These downlapping reflections are noticeably steeper than clinoforms from the underlying sequences, and give WD7 a more irregular appearance. A thick, well-developed HST in the TL7 sequence indicates continued shoaling-upwards into northerly prograding shelf deposits.

WD8 Sequence. WD8 is only partially preserved on the type section (**Fig. 23**). The base of WD8 is an unconformable sequence boundary with incised valleys eroding up to 30 m into WD7. Only the LST of WD8 is preserved beneath the SNB (**Fig. 23**). The LST is characterised by a continuous, moderate-amplitude seismic reflection which onlaps both north and south onto the incised sequence boundary. Seismic geometry of the WD8 LST is consistent with interpretations of a lowstand fluvial sandstone at Egilabria#1. The beginning of fluvial incision and deposition in WD8 suggests low accommodation space and possibly an end to deposition within the ISB.

6.4. Summary

Integrated seismic and well-log interpretations provide important information on the geometry of sedimentary sequences and tectonic history of the upper ISB. The TL7 sequence is the final depositional package from the Lawn Supersequence. TL7 consists of organic-rich shales deposited within a southward-thickening TST and a very thin HST. Organic-rich shales from TL7 are correlated to the H4r shales of the Lawn Hill Formation south of the seismic grid. Seismic data show no evidence for growth of the TL7 sequence across faults. However, the sequence is interpreted as representing a period of increasing basin accommodation.

The Wide Supersequence documents a period of wrench-fault activity and basin margin instability. The base of the Wide Supersequence, basin event surface H, erodes over the tops of positive flower structures. A series of southward-thickening wedges occurs above this unconformity. The first two sequences, WD1 and WD2, are dominated by thin, highly reflective, dolomitic and carbonaceous siltstones within northward-onlapping TST's and southward prograding HSTs. WD1 and WD2 are correlated with the H4s siltstone member, which hosts the Century ore body in the upper Lawn Hill Formation. In western areas, WD1 and WD2 show minor growth across wrench-fault systems within narrow grabens (**Fig. 31**). Southward-thickening wedges are only prominent in the southeastern seismic grid, where the TSTs increase in thickness toward the Elizabeth Creek Fault zone (**Fig. 31**). The presence of anomalous high-amplitude reflections in faulted segments of these wedges suggests local cementation or potential mineralisation of H4s-equivalent strata in the southeastern seismic grid. The WD3 seismic sequence is characterised by several southward-thickening wedges throughout the seismic grid. Sandstones and siltstones within the WD3 sequence are correlated to the Widdallion Sandstone member of the upper Lawn Hill Formation. North of the seismic grid, the WD1 and WD3 sequences correlate to an upper member of the Doomadgee Formation (Pfd3). WD3 wedges show frequent syndepositional growth across wrench-fault systems (**Fig. 31**). The WD3 sequence typically consists of a thick LST and thin TST. Southward-prograding debris flows/pro delta slopes and channel levee complexes are concentrated toward the northern margins of WD3 tilt blocks.

Ramp margin systems with tabular geometry dominate the WD4 to WD8 seismic sequences. The WD4 sequence is characterised by a thick LST. An extensive "basin floor sheet" debris flow associated with "high-gamma" sandstone occurs at the base of WD4. This basal sandstone is correlated to the upper part of the Widdallion Sandstone member in the Lawn Hill region. The remainder of WD4 is composed of extensively slumped and channelled siltstones. WD4 is interpreted as a transitional tectonic sequence with some basin margin instability still present, as indicated by extensive debris flows and channel levee complexes. Subsequent sequences show a progressive shoaling up from relatively planar, deep marine siltstones and carbonates of WD5 and WD6, to the northward-prograding shelfal sandstones of WD7 and the fluvial sandstones of WD8. The siltstones which dominate from WD4 through to WD6 are correlated with the H6r member of the uppermost Lawn Hill Fm. Sandstones in the WD7 and WD8 sequences have no known equivalents outside of the seismic grid. The fluvial WD8 seismic package represents the final preserved phase of deposition in the ISB. An end to deposition was probably driven by decreased accommodation space associated with the early phases of the Isan Orogeny.

A prominent angular unconformity is apparent beneath the SNB on most seismic lines. Erosion of the underlying Doom Supersequence is concentrated over folded and faulted anticlines. The Doom Supersequence is increasingly eroded toward the main SNB depocentre in the southwestern Comalco seismic grid (**Fig. 32**). Recent SHRIMP zircon dates (Page pers. comm) indicate that deposition of the South Nicholson correlative Roper Group commenced around 1500 Ma; some 85 m.y. after deposition of the McNamara Group. The combined evidence from seismic interpretations, geochronology, and outcrop relationship argues that the SNB is a separate basin entity from the underlying ISB. The two basin systems are separated by the 1585 to 1500 Ma Isan Orogeny.

7. STRUCTURAL EVOLUTION OF THE NORTHERN LAWN HILL PLATFORM

Previous structural interpretations by McConachie et al. (1993) of the Comalco seismic data proposed regional throughgoing structures of sinuous geometry. McConachie et al. (1993) interpreted a basal "rift" package. The throughgoing structures were considered normal faults of the rift system that were variously reactivated during a subsequent progressive foreland basin evolution. The NABRE re-interpretation of the data finds no evidence within the reflective package of a basal rift. Rather a sub-acoustic basement "rift package" is postulated which has been tested against observed geophysical data (Scott & Tarlowski, 1998). Our investigations in the northern Lawn Hill Platform area deconvolve the fault zones of McConachie et al. (1993) into four distinct periods of deformation (**Fig. 33**). Discerning basin and depositional geometry using the sequence stratigraphic approach through time has been the key to our refinement. Understanding depositional geometry is essential to develop an accurate structural interpretation. The four deformation events overprint the basement, which probably was dominated by E-W and N-S trends.

1. ~1730 Ma: Extensional geometry is mainly constrained through interpretations of geopotential data (Scott et al., 1998) that suggest steep NNE-NE-trending transverse structures that connect ESE-SE normal bounding faults (cf. Betts' (1997) work around the Fiery Creek Dome, which suggests NE normal faults and NW transfers). A polarity reversal of major bounding faults bisects the northern Lawn Hill Platform, with northward-deepening half grabens in the east and southward-deepening half grabens in the west (**Fig. 33**). In general, steep transverse structures are considered the better candidates for tapping deep fluids during any event. Along their length, points adjacent to normal faults (i.e. "corners") are considered to have higher potential for fluid flow. Where later organic-rich depocentres are localised above the steep transverse faults prospectivity is further increased. The polarity-switching transverse structure extends from the Murphy Inlier to the Century deposit. A similarly trending structure is interpreted to the east of a major magnetic low. The Elizabeth Creek Prospect area overlies this structure in a relationship which is similar to that which the Century ore body has to the 1730 Ma basement template. The 1730 Ma geometry appears to have largely overprinted the earlier basement fabric and is the system most commonly reactivated by subsequent events.

2. ~1640 Ma: Extensional geometry is constrained by the seismic interpretation. Two interconnected fault systems are interpreted:

- WNW-NW "transfer" faults associated with NE normal faults
- NNE offsets associated with ENE normal faults.

This linked system of variable fault orientation produces local depocentres within tilt blocks. The geometry of 1640 Ma structures is influenced by the underlying basement template. In the west, faults of River Supersequence age occur on the shoaling, hinge side of the underlying 1730 Ma event. Both ESE and NE normal faults are interpreted. The western 1640 Ma structures reflect the geometry of the earlier "Barramundi Event", which gives the Murphy Inlier its dominant E-W trend. Transverse structures in extensional systems are commonly better developed on the deepening side of half grabens. These ESE structures may be good indicators of a regional N-S extensional event operating on relatively homogeneous substrate. In the east, the 1730 Ma event has better developed transverse structures, producing deep heterogeneities. Thus, the subsequent 1640 Ma structures assume more NW and NE trends, with depocentres developed best against reactivated NE 1730 Ma structures. 1640 Ma structures appear less segmented and to have greater offset and stratigraphic growth in the east; however, this may be a bias introduced by the more widely spaced data. Regardless of orientation of bounding faults, growth of River Supersequence stratigraphy in local depocentres occurs into both “normal” and “transverse” faults.

3. ~1595 Ma: Structural geometry is constrained by the seismic interpretation. The primary trend suggests wrench motion on steep WNW strike slip faults. Both negative and positive flower structures occur. Growth of the Wide Supersequence is usually contained within wrench grabens (**Fig. 31**). The geometry of the 1595 Ma age fault system is significantly influenced by the underlying River structures. The steep WNW trends frequently root into 1640 Ma structures. The strike-slip system appears to “jog” consistently over offsets in the 1640 Ma system, so grabens and horsts tend to form here. Thus, complexity of 1595 Ma fault networks is increased over the NE 1730 Ma trends. Where they root into the NE and NNE transverse 1640 Ma structures, which are commonly coincident with the older 1730 Ma event NNE structures, there is a very high potential for tapping deep fluids. Conversely, the NE-trending splays frequently sole out into the River or, less frequently, the Loretta packages, and so are considered less likely to tap deep fluids. However, they may be appropriate conduits at the time of dilation for both organic-rich fluids and metal-rich brines stored temporarily in deeper sequences.

4. <1580 Ma: An ENE and WNW conjugate joint set dominates a distinct pulse of deformation occurring after the deposition of the Doom Supersequence (**Fig. 32**). The fault pattern suggests regional N-S compression, probably from the initial stages of the Isan Orogeny. Other joint orientations are interpreted, but are less pervasive. Deconvolving multiple sets is not possible, owing to deep erosion of the affected sequence by the SNB. Alternatively, only one deformation could account for the complexity revealed by the data as the density of joints is markedly increased over older structural systems. Variability of joint orientation may be due to reactivation. In some instances, joints appear to offset the entire ISB “mega-wedge” and clearly offset earlier fault systems. However, the majority of “late stage” fracturing appears to reactivate at least segments of earlier structures. Because pre-existing structures are variously aligned, the complexity of the fracture system in these locales is increased. These late-stage structures are thought to be the main conduits for the metalliferous brines that resulted in the Century ore body (Broadbent et al., 1996).

Figure 34 shows a simple example of the evolution of the fault zones as interpreted from seismic line 91BN-03. Only the largest scale late-stage (<1580 Ma) conjugate set is shown for clarity. The data reveal that the fault zone is pervasively jointed down to scales of seismic resolution and probably even smaller. Multiple variations of fault connectivity are possible when considering a prospect-sized system. Establishing which element of which deformation is present will be crucial to establishing fluid flow pathways. Unfortunately, only one seismic line images the Elizabeth Creek Prospect and so three-dimensional fault geometry is unconstrained. However, stratigraphic geometry in the seismic data demonstrates that structures of the 1640 Ma, 1595 Ma, and <1580 Ma events are all present in the prospect area (**Fig. 35**). Basement interpretations suggest that this fault system overlies a northeast 1730 Ma transverse structure. Thus, all the structural elements considered crucial to high prospectivity are present. Further, late-stage compressional deformation has unroofed the system, bringing the potential mineralised zone to depths that allow economic exploration.

From a structural viewpoint, prospectivity in suitable host rocks will increase with increasing connectivity to basement structures for two reasons:

- It increases the number of possible sources for brines to acquire metals from (e.g. from both the Eastern Creek Volcanics and Fiery Creek Volcanics).
- It increases the number of possible sources for metalliferous brines (e.g. increases the potential for deep acquifers to have been tapped which may already hold metalliferous brines from previous fluid flow events).
- The northeastern and southwestern areas of the northern Lawn Hill Platform area are considered more prospective than the western areas because:

- NE structures of 1730 Ma event are better developed on yhe bounding fault side of half grabens than on the "hinge".
- Geopotential modelling suggests that most Haslingden Group potential acquifers have been eroded in the west, but are preserved in the east.
- Geopotential modelling suggests that the Fiery Creek Volcanics may have been largely eroded in the northwest and the Eastern Creek Volcanics outcrop in the southeast, eliminating a possible metal source and the host rocks in these areas.
- Mafic rocks in the deep side of half graben will have reached appropriate depths ("metals window") for the leaching processes to have occurred, whereas on shoaling sides potential source rocks remain shallow.

8. POTENTIAL MINERAL PROSPECT IN THE WIDE SUPERSEQUENCE

Predicting and identifying potential mineral exploration targets that lie buried beneath up to 500 m of cover requires new exploration strategies. In the absence of direct geochemical indicators and outcropping gossans, many companies have used airborne EM and magnetics in an attempt to identify prospective horizons beneath shallow cover. Indeed, the Cannington deposit was discovered after identification of an airborne magnetic anomaly. However, relationships between sub-basin geometry, growth faults, and potential plumbing systems remain unclear using these techniques. In contrast, strategies employed in this study permit known prospective stratigraphic intervals to be identified, the shape of associated sub-basins realised, and stratigraphic architecture elucidated. However, in the absence of subsurface samples, geochemical indicators cannot be used to identify deposits. Organic-rich shales intersected in Egilabria#1 have Zn values of several hundred ppm and highly conductive sections of Beamesbrook#1 may be due to sulphide mineralisation. However, the available evidence is equivocal and clearly additional drill-core samples are required if the prospect is to be tested.

WMC discovered low-grade Zn-Pb-Cu-Ag mineralisation at Walford Creek in 1984. Rohrlach et al. (1998) document four stages of fluid flow and associated mineralisation hosted in black carbonaceous siltstones of the 1640 Ma Mt Les Siltstone (River Supersequence). Fluids associated with Stages I & II mineralisation promoted synsedimentary to early diagenetic sulphide precipitation at burial depths of less than 200 m. Stages III & IV mineralisation are interpreted to occur much later at 1-2 km burial depths. Although the exact timing of these fluid flow events is uncertain, the seismic interpretations presented here indicate that the burial depths would be consistent with fluid flow between 1595-1580 Ma. Century host strata are dated as 1595 Ma. Fluid flow associated with Stages III & IV mineralisation at the Walford Prospect may have been driven by compression associated with either the WD1 or WD4 surfaces (**Figs 3, 6**), or initial onset of the Isan Orogeny at 1580 Ma and closure of the ISB. Thus, mineral-bearing fluids were moving through strata in the northern Lawn Hill Platform after deposition of the Century-equivalent sediments discussed in this report. A lack of regional mineral paragenesis data and uncertainty regarding the stratigraphic location of the metals source or sources renders the formulation of predictive models for mineralisation difficult. The NABRE fluid flow proposal aims to address some of these data gaps and will ultimately lead to better mineral system prediction. However, with the currently available information it is possible to propose a deep burial play model. The play is imaged on seismic line 89BN-07 and is based on the series of evolutionary steps proposed by Broadbent et al. (1996) for the Century Mine (**Fig. 36**).

1. Deposition of ~590 m of H4s carbonaceous siltstones and organic-rich shale interbeds within a southward-thickening wedge, the Elizabeth Creek sub-basin, at 1595 Ma (**Fig. 36A**). The Elizabeth Creek sub-basin was probably generated by growth across a wrench fault system in the Elizabeth Creek Fault zone. The Elizabeth Creek sub-basin thins to only 90 m over a distance of 25 km and is of similar dimensions to the Century sub-basin (**Fig. 37**). Potential host organic-rich shale beds will also pinch-out as the sub-basin thins northwards. This thinning of host strata limits potential mineralisation to a zone extending ~20 km along the southwestern end of the H4s wedge (**Fig. 31**).

2. Deep burial of the Elizabeth Creek sub-basin beneath a cover of ~1500 m of the remaining Wide and Doom Supersequences between 1595-1585 Ma (**Fig. 36B**). This falls within the range of overburden cover of 800 to 3000 m proposed for the Century ore body (Broadbent et al., 1996).

3. Regional deformation of the ISB during the Isan Orogeny resulted in a network of late-stage faults and fractures (**Fig. 36C**). The late-stage faults provided potential conduits for metal-bearing brines. The brines may have originated in either igneous basement or from reservoir rocks hosting fluids that migrated in response to earlier tectonic events. According to Broadbent et al. (1996), the Century ore body formed through a complex series of stages in which sulphide-bearing fluids generated hydrocarbons within a source-reservoir and restricted fluid circulation to an overpressured zone. Subsequent reactions between hydrocarbon reductants and metal-bearing fluids precipitated high purity sphalerite at the gas/oil interface. Formation of the Century ore body was terminated when the overpressured system was breached by a network of minor fault systems and reactivation of the Termite Range Fault.

Palinspastic reconstruction of line 89BN-07 shows the development of "dome and basin" folding and a network of late-stage fault systems reactivated from earlier fault trends that sole into igneous basement (**Fig. 36C**). It is difficult to determine the precise timing of folding and faulting. However, truncation at the tops of two anticlines resulted in the partial erosion of the TL7 sequence prior to Wide Supersequence deposition. This truncation suggests an initial pulse of compression and folding prior to 1595 Ma. Subsequent folding is likely to have occurred during the early phases of the Isan Orogeny. Thus, it is likely that the anticlines formed structural traps to hydrocarbons generated in the H4s strata and any fluids transported through the late-stage fault systems. Several of the late-stage fault systems appear to terminate below the upper surface of the Doom Supersequence and were likely conduits for sulphate-bearing fluids. At least one late-stage fault offsets all strata and would have breached any overpressured reservoir developed in the smaller northeastern anticline. The Elizabeth Creek Fault zone immediately southwest of the seismic line is also likely to have been reactivated and to have breached the overpressured zone in the southwestern anticline. Both anticlines are characterised by high-amplitude reflections within Century-equivalent strata. The northeastern anticline is particularly reflective. However, this is currently buried beneath about 1450 m of overburden and is, thus, below economic recovery. The southwestern anticline is a broader feature in which several high-amplitude reflections continue from the more reflective northeastern structure. These high-amplitude reflections may represent mineralised intervals within depths of economic recovery (~350 m of Carpentaria Basin overburden; **Figs 38, 39**). A depth limit of ‹500 m for economic recovery restricts the area of prospectivity to a 7 km zone at the southwest end of seismic line 89BN-07. We have named the potentially prospective southwestern end of line 89BN-07 the Elizabeth Creek Prospect.

9. SUMMARY

The Elizabeth Creek Prospect is proposed as a potential site for a Century equivalent ore body for the following reasons:

- It contains stratigraphically equivalent rocks;
- The prospect has similar structural and architectural stratigraphic geometry;
- Well logs through carbonaceous shales immediately below the prospect interval show elevated base-metal concentrations;
- Seismic reflections in the prospect area are of higher amplitude than those of surrounding areas;
- Faults of all generations are present and probably interconnected;
- It is in an area where Century correlative stratigraphy shows significant thickening into a major fault system (the Elizabeth Creek Fault zone).
- Continued deformation during the Isan Orogeny has folded the succession, thus increasing the probability of fluid flow into a structural trap and bringing the prospect within depths of economic recovery.

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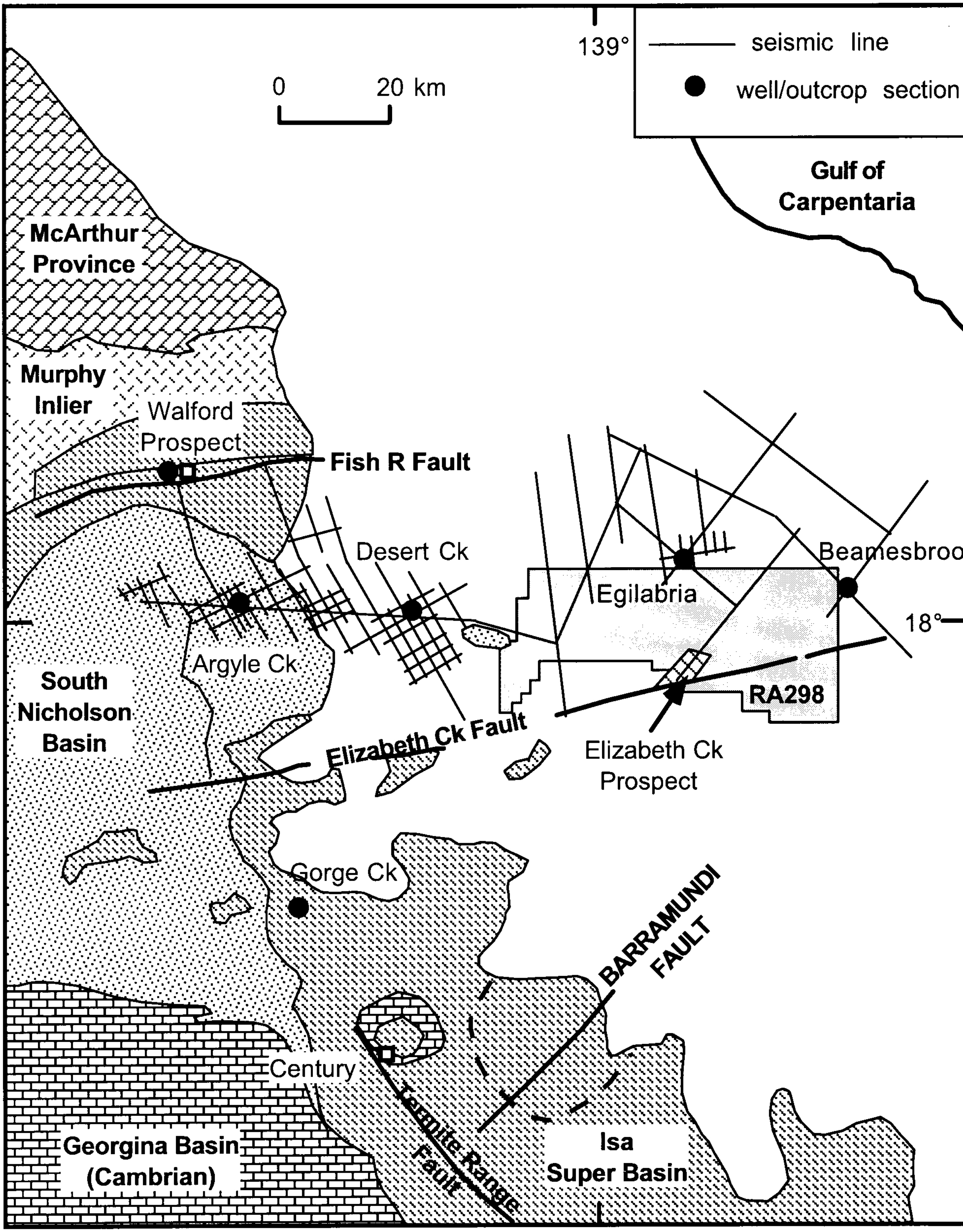


Figure 1. Regional geology of the northern Lawn Hill Platform (from McConachie et al, 1993). Also shown are the locations for seismic lines, drillholes, mineral prospects, and RA298.

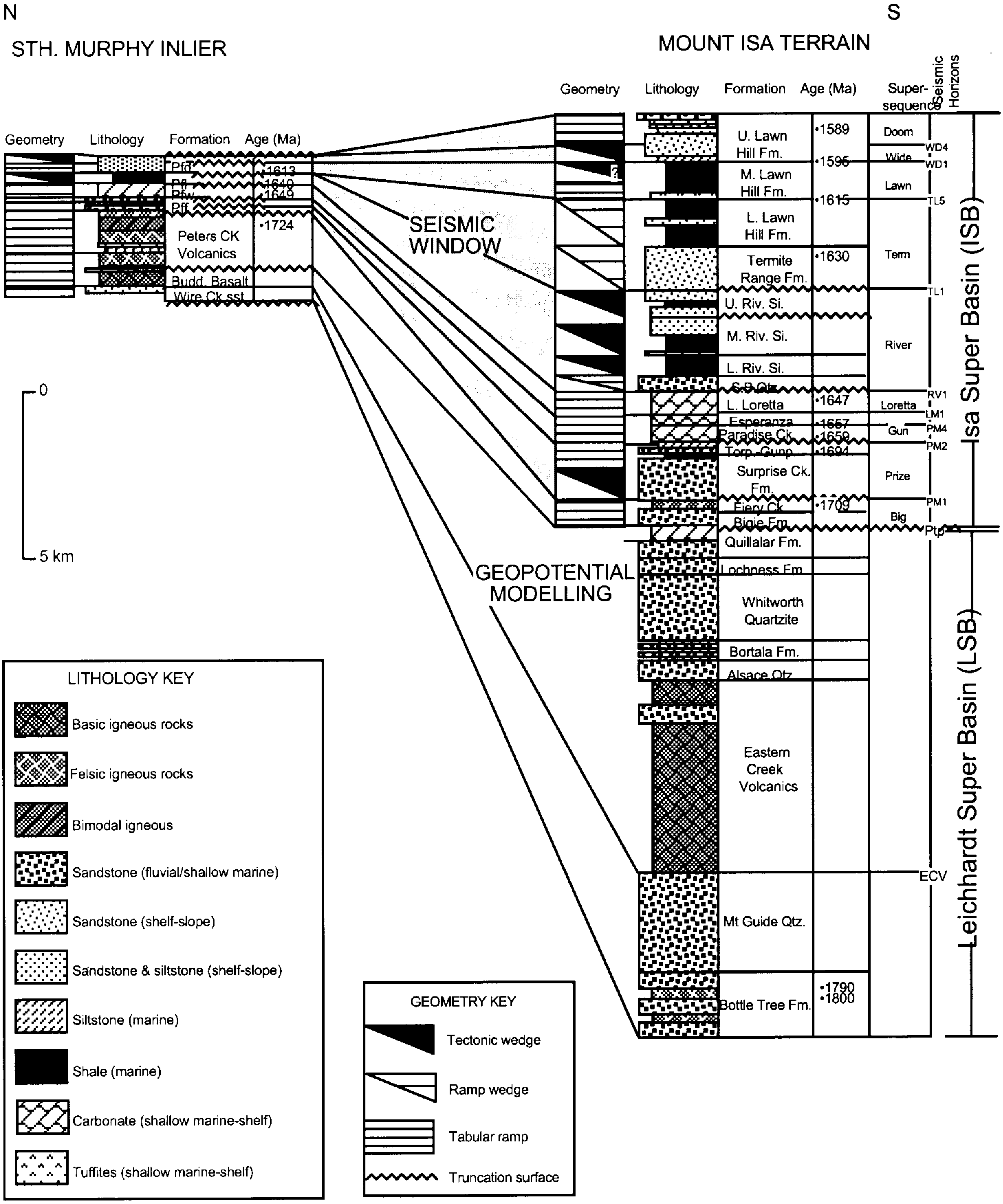


Figure 2. Correlation of the Leichhardt Super Basin and Isa Super Basin from the Mount Isa Terrain to the southern Murphy Inlier. Supersequences from the Isa Super Basin thin significantly from south to north. The Comalco seismic grid provides detailed information on the basin geometries associated with this thinning.

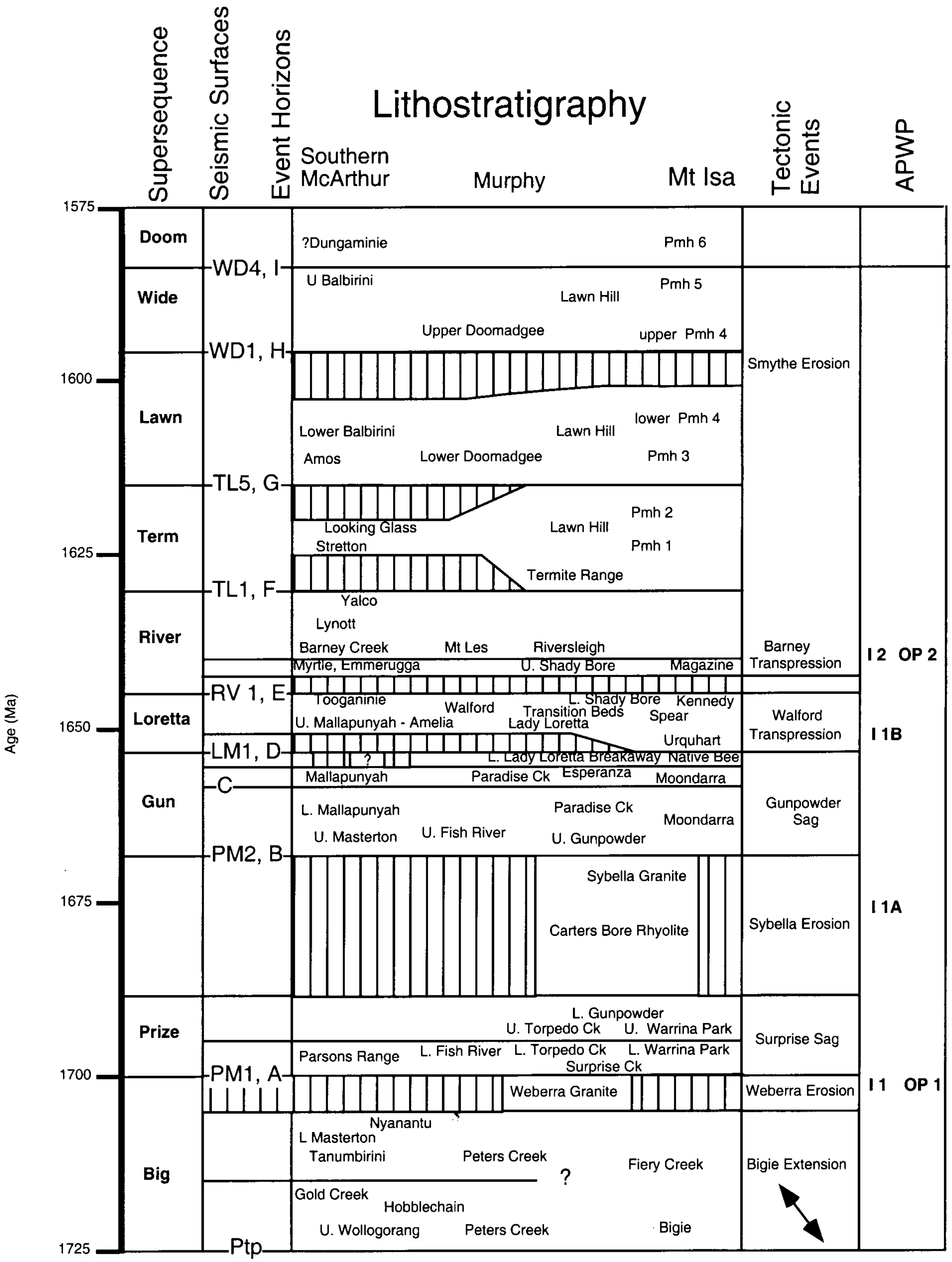


Figure 3. Basin event chart showing the breakdown of the Isa Super Basin into nine supersequences. The Century Zinc deposit occurs within the Wide Supersequence.

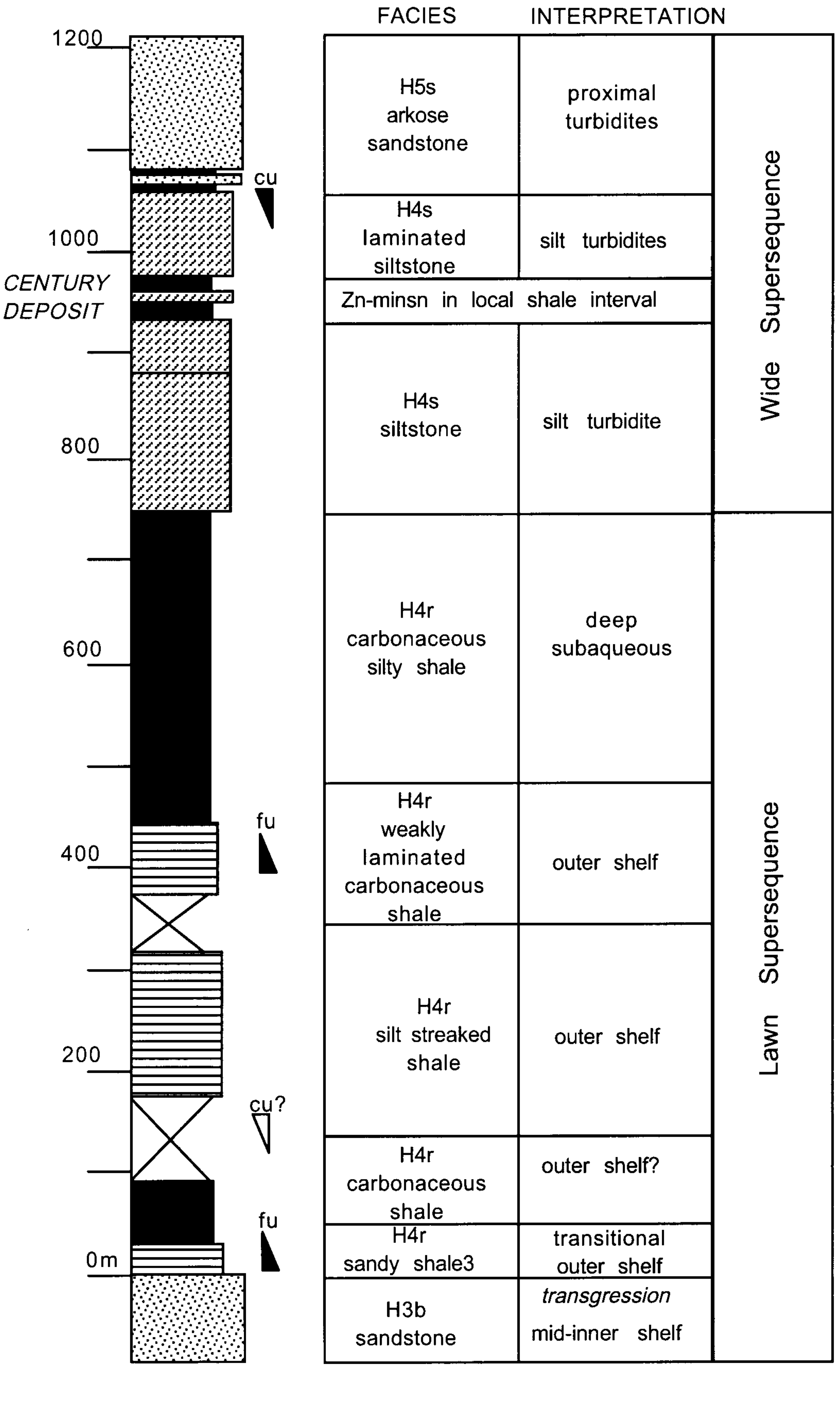


Figure 4. Composite drillcore section of the upper Lawn Hill Formation, members H4r, H4s, and H5s (from Andrews, in press). The Century Zinc deposit occurs within a thin shale interval of member H4s.

Figure 5. Regional geometries of the upper Lawn Hill Formation, members H4r, H4s, and H5s (from Andrews, in press). The Century Zinc deposit is associated with a local thickening of the H4s member around the Termite Range Fault zone.

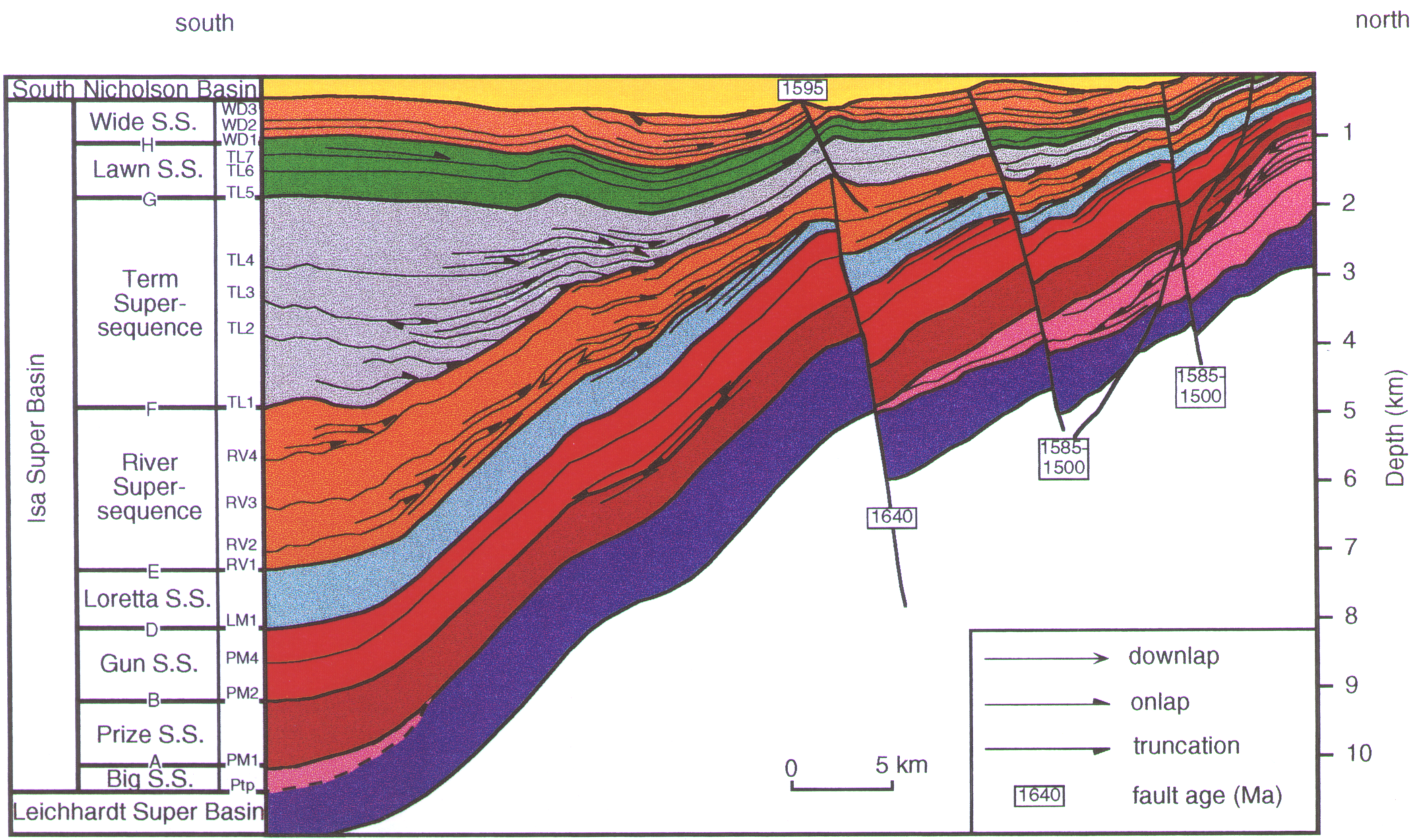


Figure 6 **Seismic geometries of supersequences from the Isa Super Basin on the northwestern Lawn Hill Platform. The Big, Gun, Loretta, and Lawn Supersequences thin mainly by erosional truncation, while the Prize, River, Term, and Wide Supersequences onlap to the north. Note the relatively conformable relationship between the Leichhardt Super Basin and Isa Super Basin.**

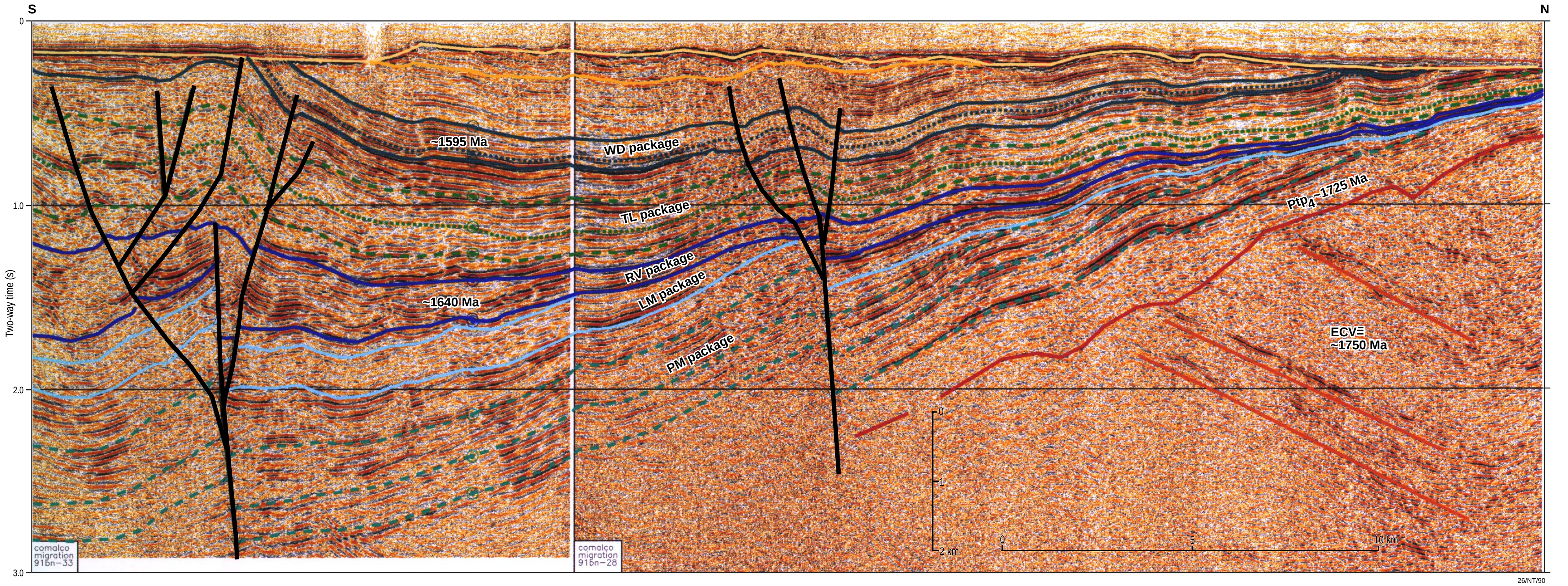


Figure 7. Seismic geometries of supersequences from the Isa Super Basin on the northeastern Lawn Hill Platform. Here, the Prize, Gun, and Loretta Supersequences are absent on the southern Murphy Inlier due to erosional truncation. Note the marked angular unconformity between the northward dipping Leichhardt Super Basin and the southward dipping Isa Super Basin.

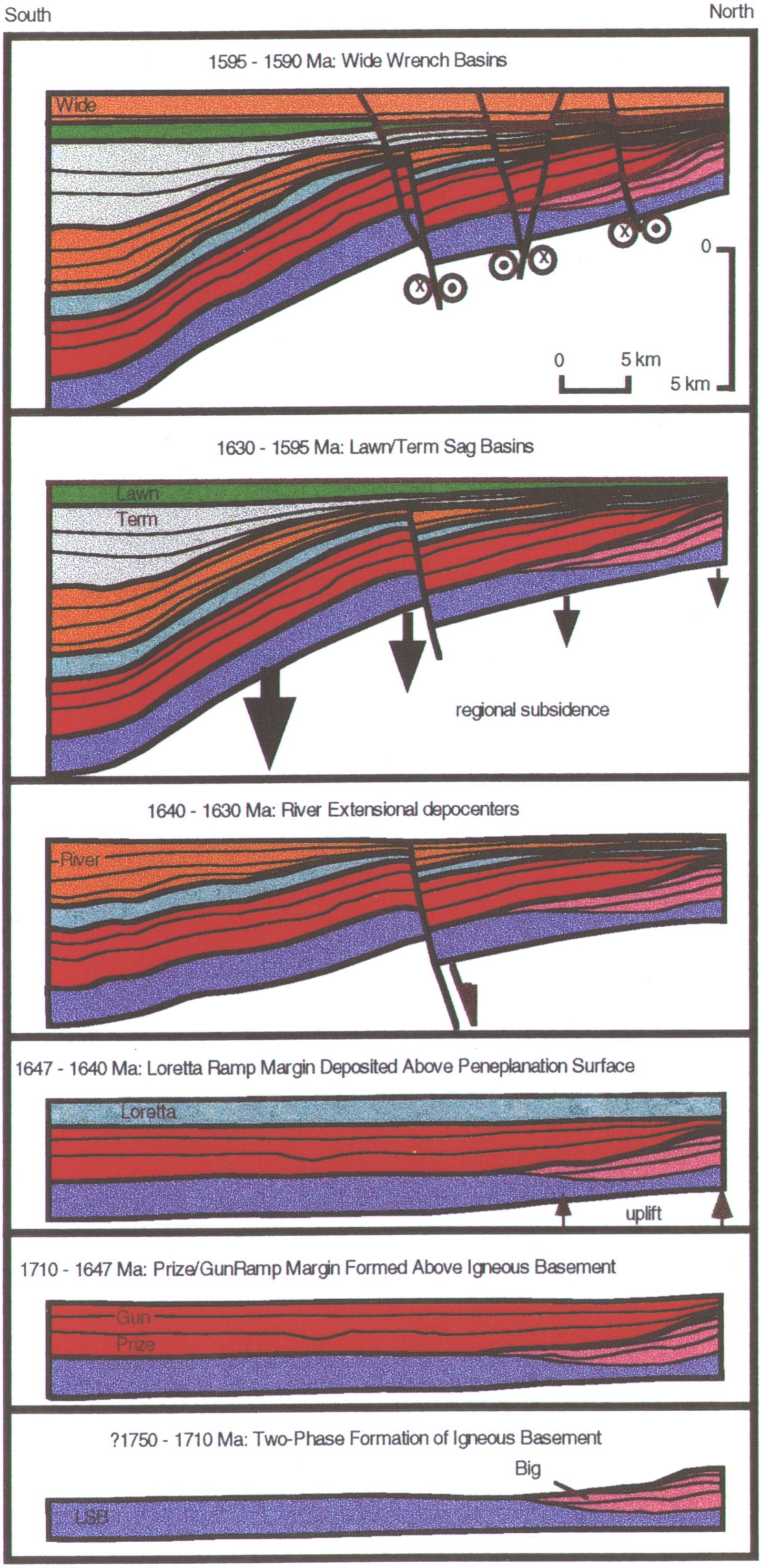


Figure 8. Reconstruction of basin phase events and supersequence development in the Isa Super Basin, northwestern Lawn Hill Platform (non-decompacted).

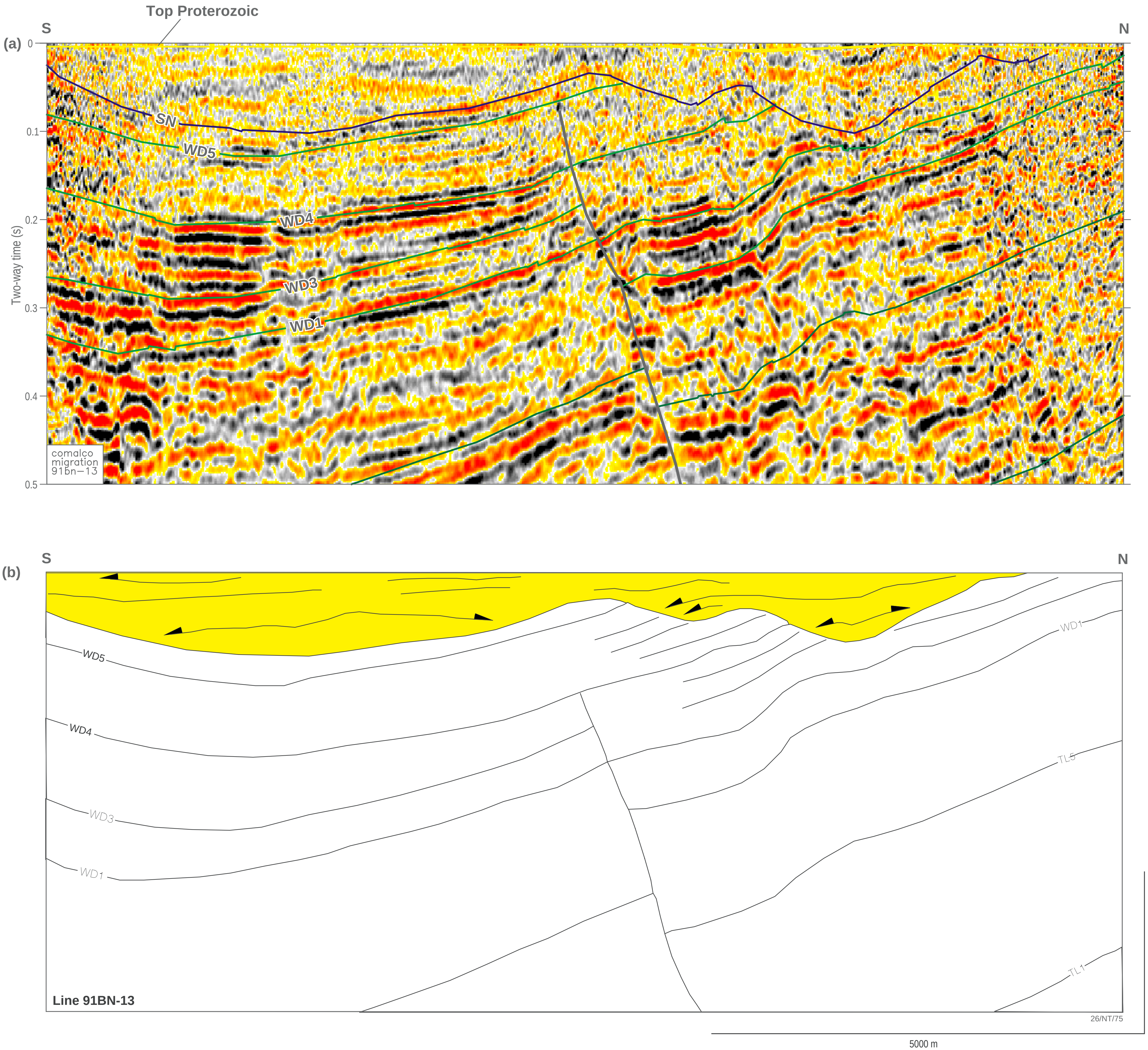


Figure 9. Seismic geometry of the South Nicholson Basin on the northwestern Lawn Hill Platform; a) variable intensity seismic section, b) schematic cross-section highlighting the internal geometry of the South Nicholson Basin. The base of the South Nicholson is highly erosional, removing most of the Doom Supersequence.

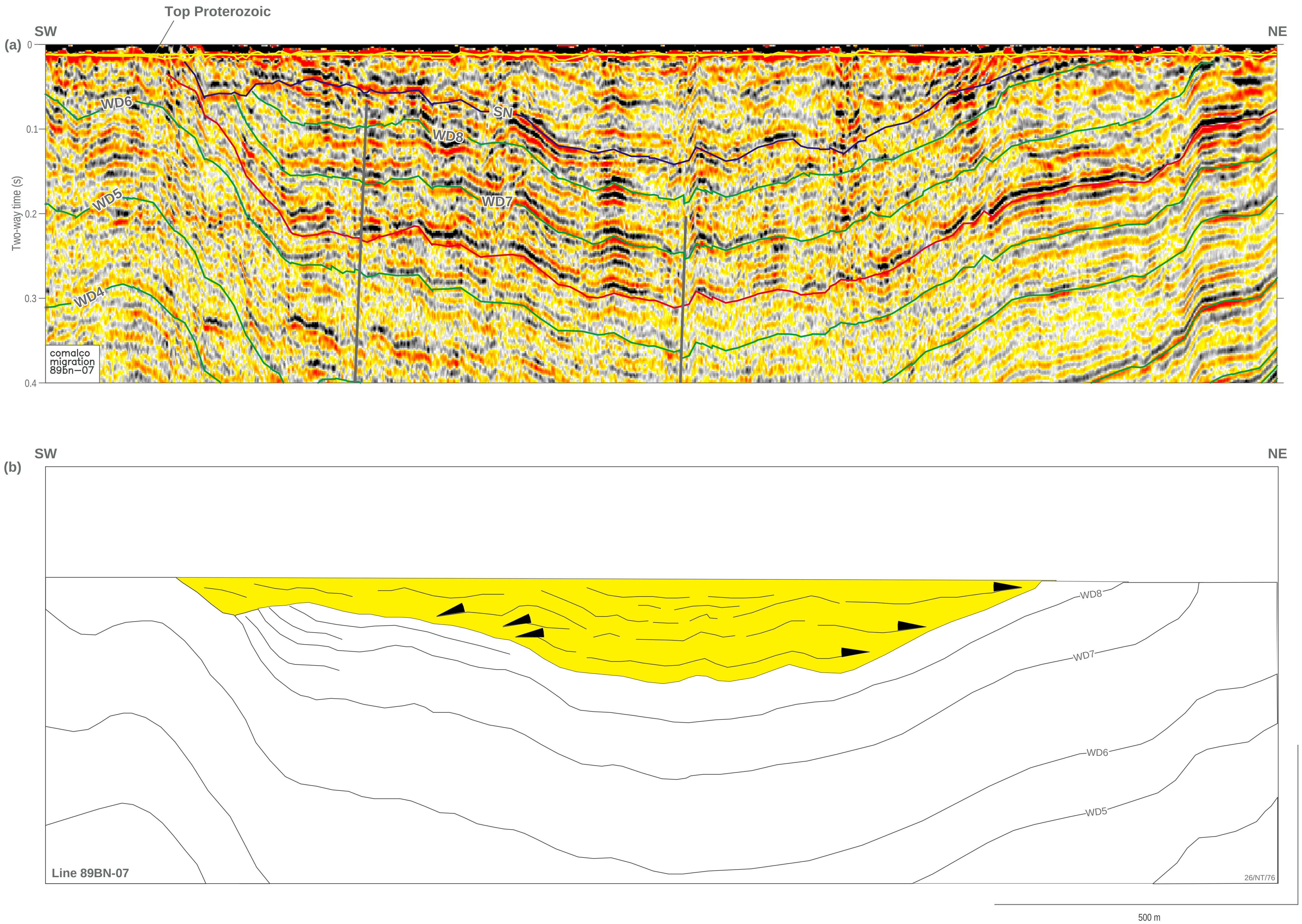


Figure 10. Seismic geometry of the South Nicholson Basin on the northeastern Lawn Hill Platform; a) variable intensity seismic section, b) schematic cross-section highlighting the internal geometry of the South Nicholson Basin. Here, the South Nicholson Basin has formed within a syncline from the Isa Super Basin. Seismic reflections within the South Nicholson clearly onlap against the edges of the syncline.

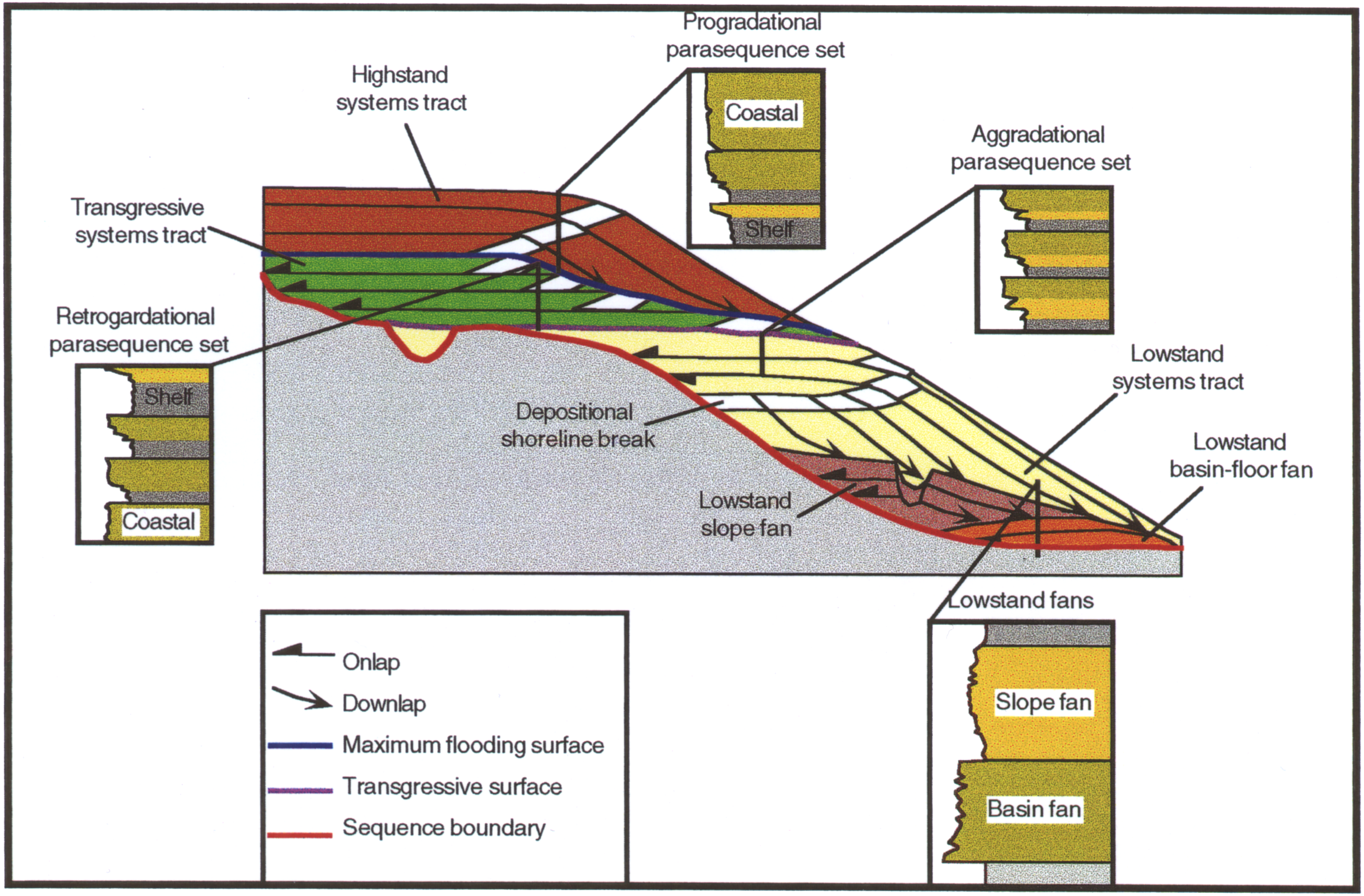


Figure 11 Sequence stratigraphic model and systems tract nomenclature developed for passive (shelf break) continental margins. Also shown are the typical gamma log responses through each systems tract (from Emery and Myers, 1996; Van Wagoner et al., 1990).

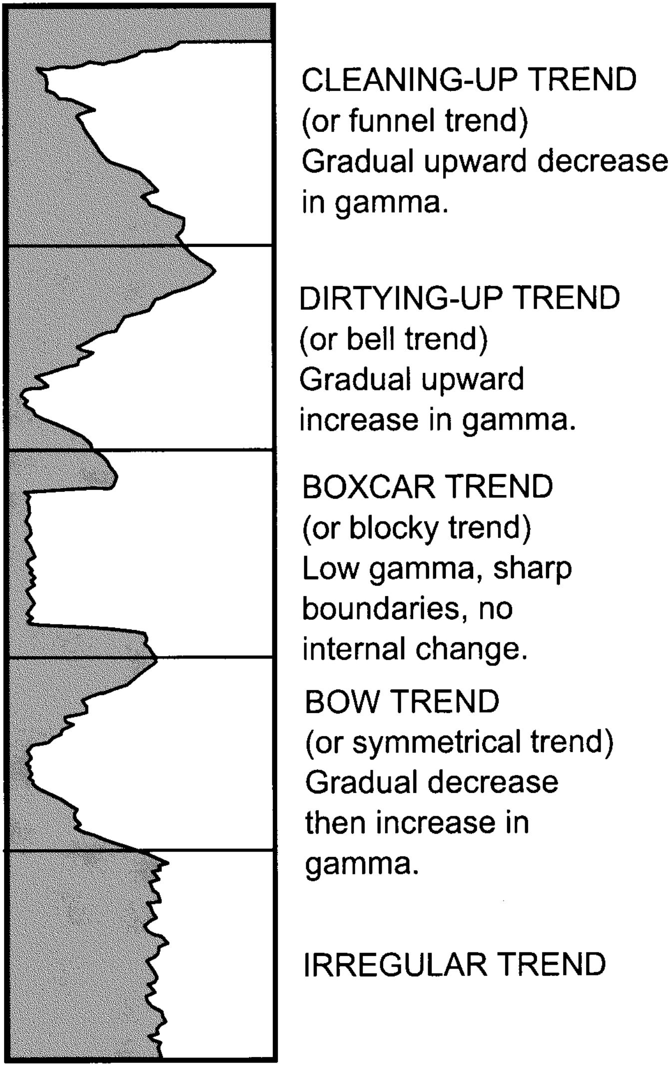


Figure 12. Five main gamma log trends used to determine palaeo-environments and parasequences (from Emery and Myers, 1996).

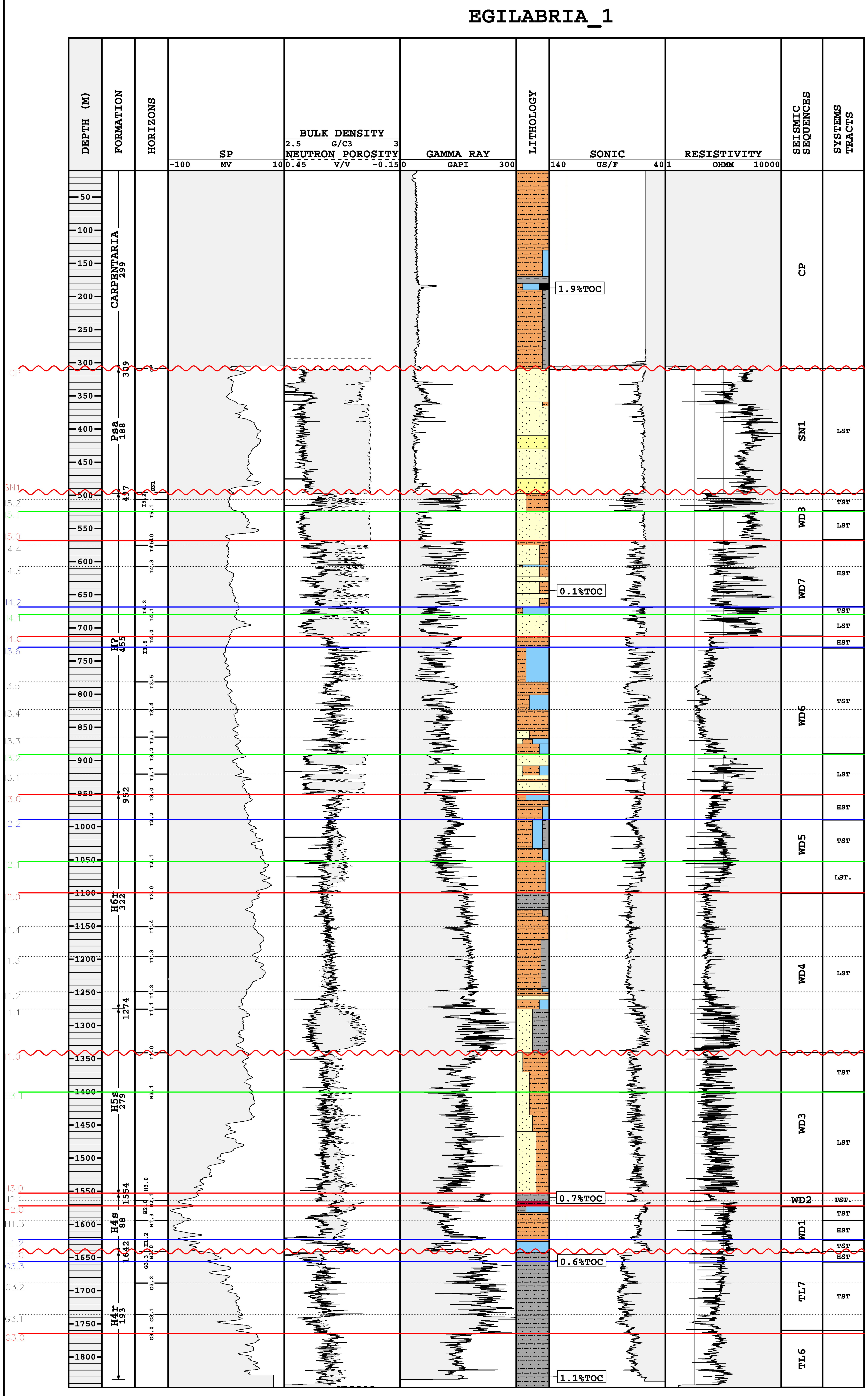
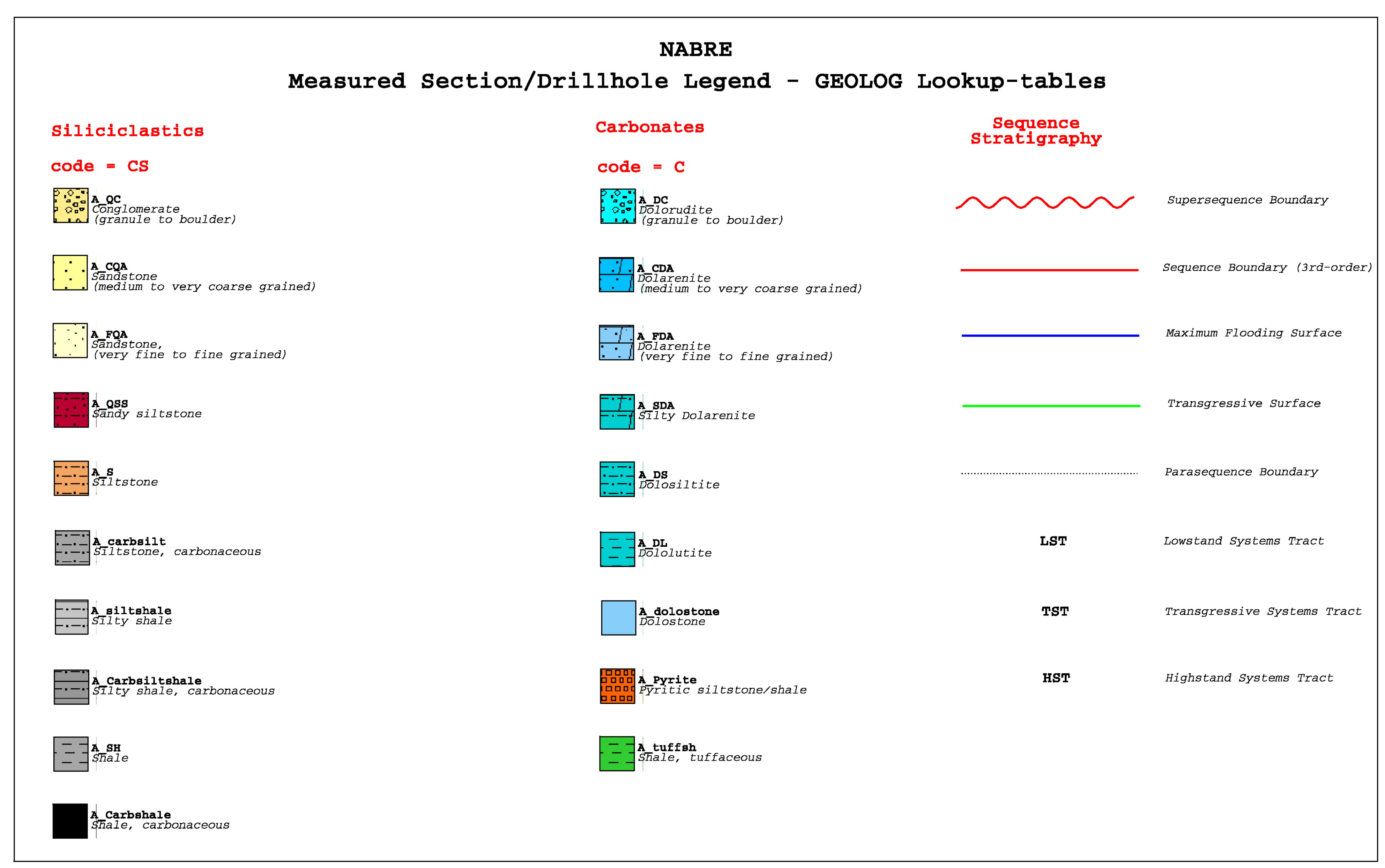


Figure 13: Well log sequence stratigraphy for Egilabria#1. Century-equivalent H4s strata occur in the WD1 and WD2 seismic sequences. Egilabria#1 is the only Comalco well to penetrate the complete Wide and Doom Supersequences of the Isa Super Basin.



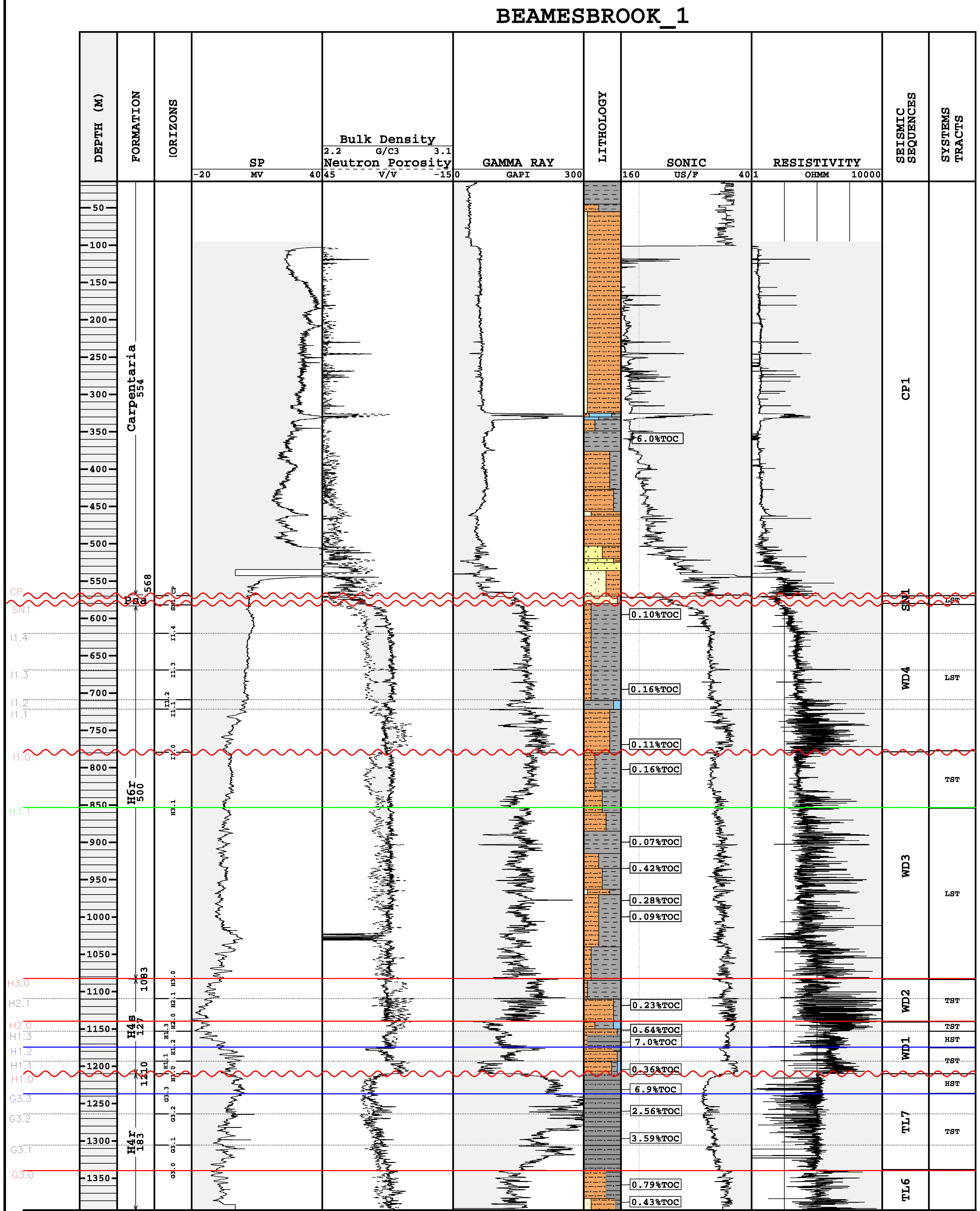
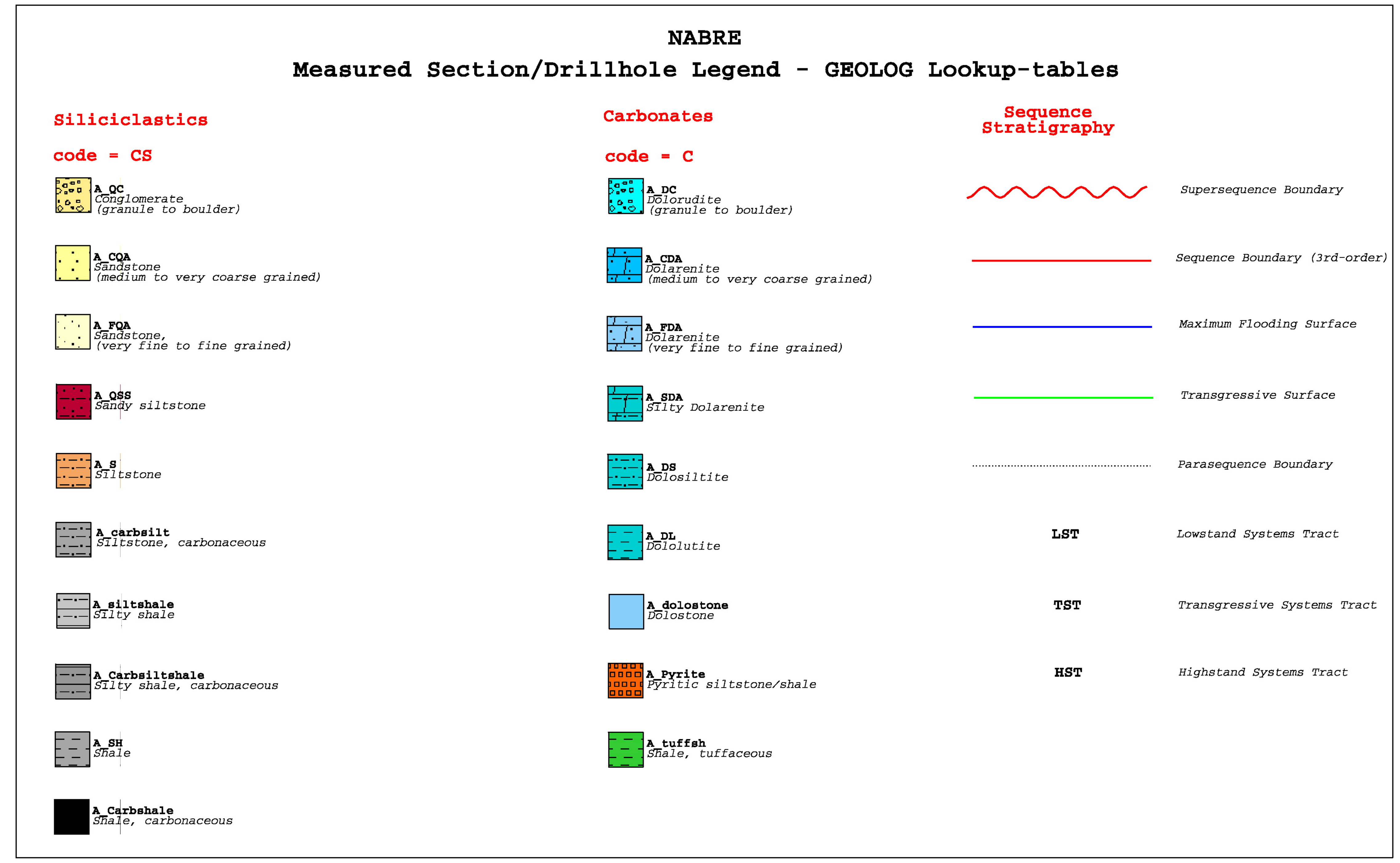


Figure 14. Well log sequence stratigraphy for Beamesbrook#1. Century-equivalent H4s strata occur in the WD1 and WD2 seismic sequences. Most of the Doom Supersequence is removed here by erosion beneath the South Nicholson Basin. An important feature of Beamesbrook#1 is the conductive organic-rich siltyshales beneath the WD1 sequence..



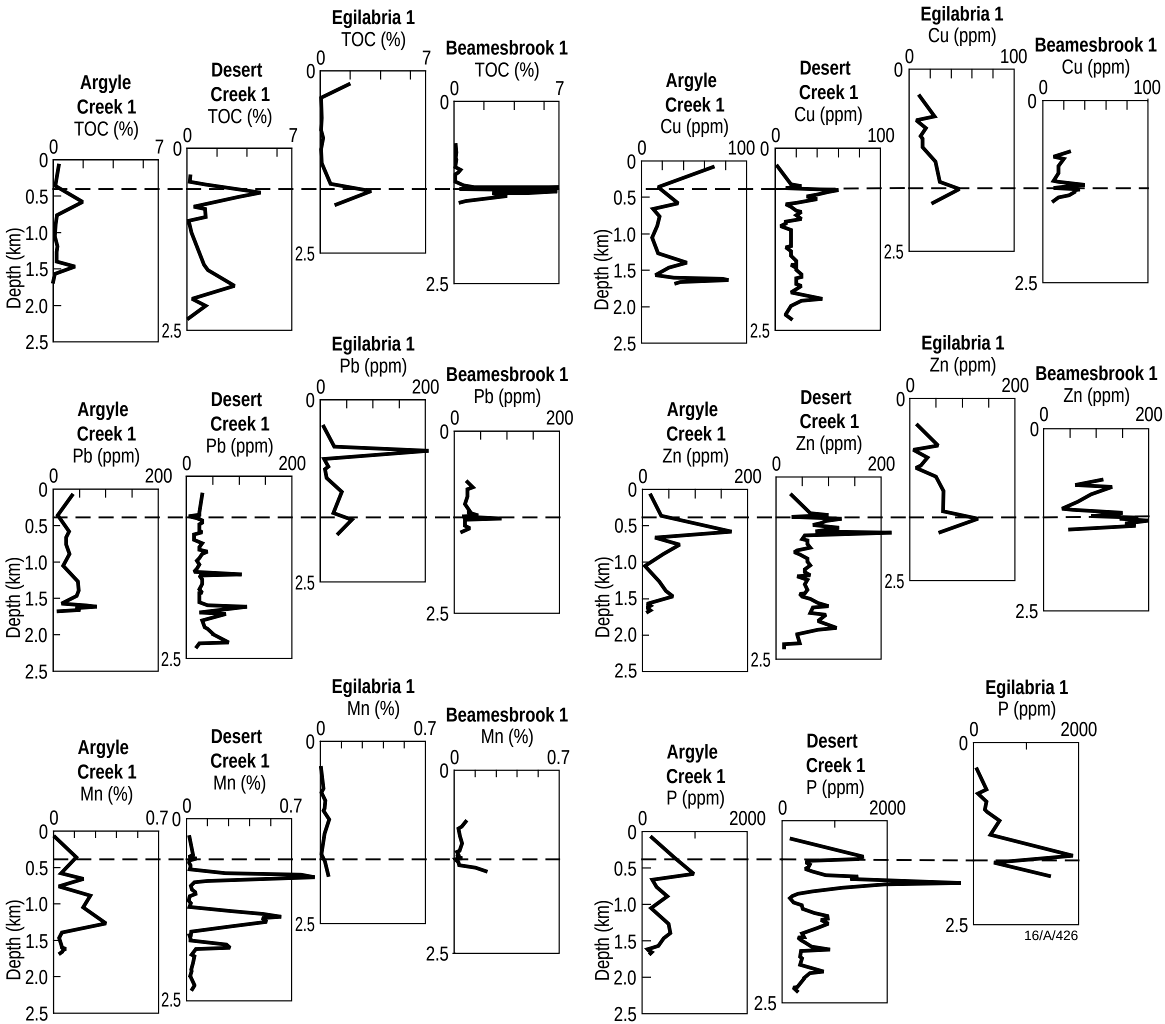


Figure 15 Profiles for TOC and base metals in the four Comalco wells (from McConachie and Dunster, 1996). Dashed line indicates the base of the Wide Supersequence. Note the elevated base metal values, particularly zinc, associated with the organic rich TL7 sequence below the Wide Supersequence.

Figure 16: Well log/outcrop cross-section for the Wide Supersequence. Gamma ray and litholog trends have been collected by NABRE from outcrop sections at Gorge Creek. Century-equivalent H4s strata are located on the Comalco grid by correlating sequence stratigraphic surfaces from outcrop sections to the Comalco wells.

Figure 17. Well log correlations of Comalco and WMC drill holes on the northern Lawn Hill Platform. Century-equivalent H4s strata occur within the WD1 and WD2 sequences at the base of the Wide Supersequence. The Wide Supersequence thins significantly towards the Murphy Inlier (Argyle Ck#1 and WFDD#17) in the northwestern seismic grid. The cross-section also clearly shows a major erosional unconformity beneath the South Nicholson Basin.

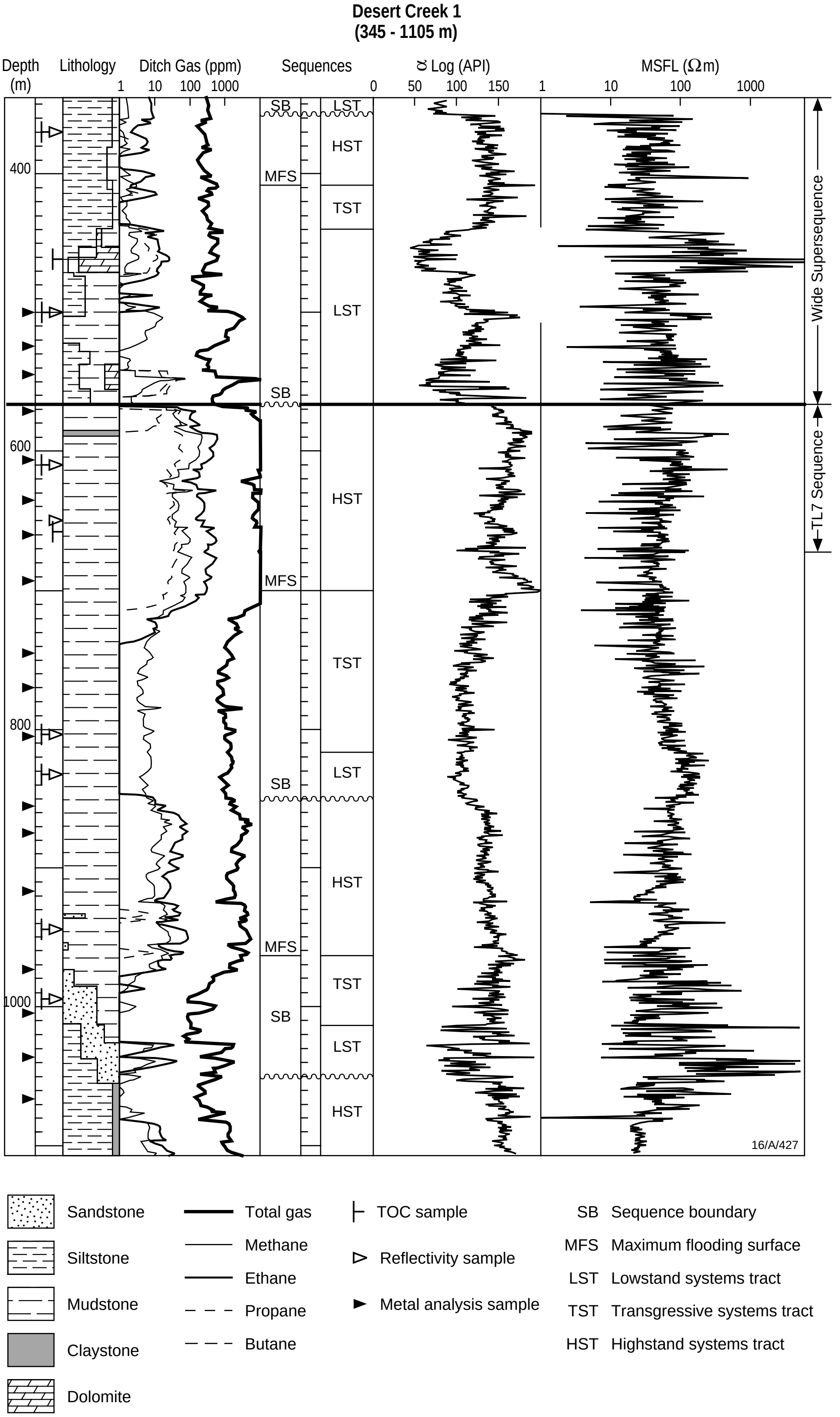


Figure 18 Sequence stratigraphic interpretation of Desert Ck#1 by McConachie and Dunster (1996). The organic-rich TL7 sequence produces a high resistivity response which has been interpreted by these authors as indicating a highstand systems tract. However, the gamma log clearly shows a retrogradational trend coinciding with increasing resistivity values; a trend typical of organic rich transgressive systems tracts.

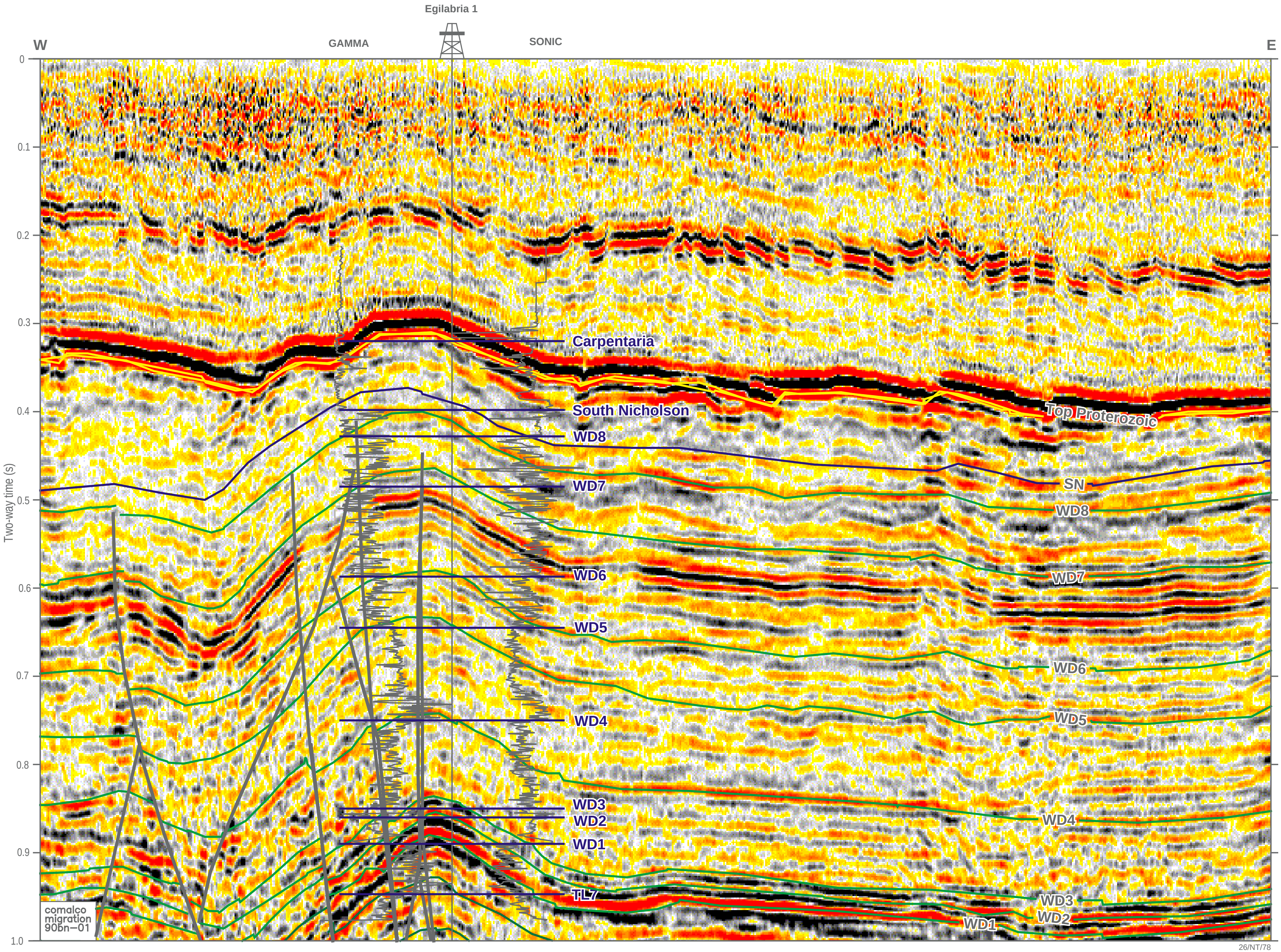


Figure 19. Sequence stratigraphic surfaces picked on gamma and sonic logs from Egilabria#1 tied to seismic line 90BN-01.

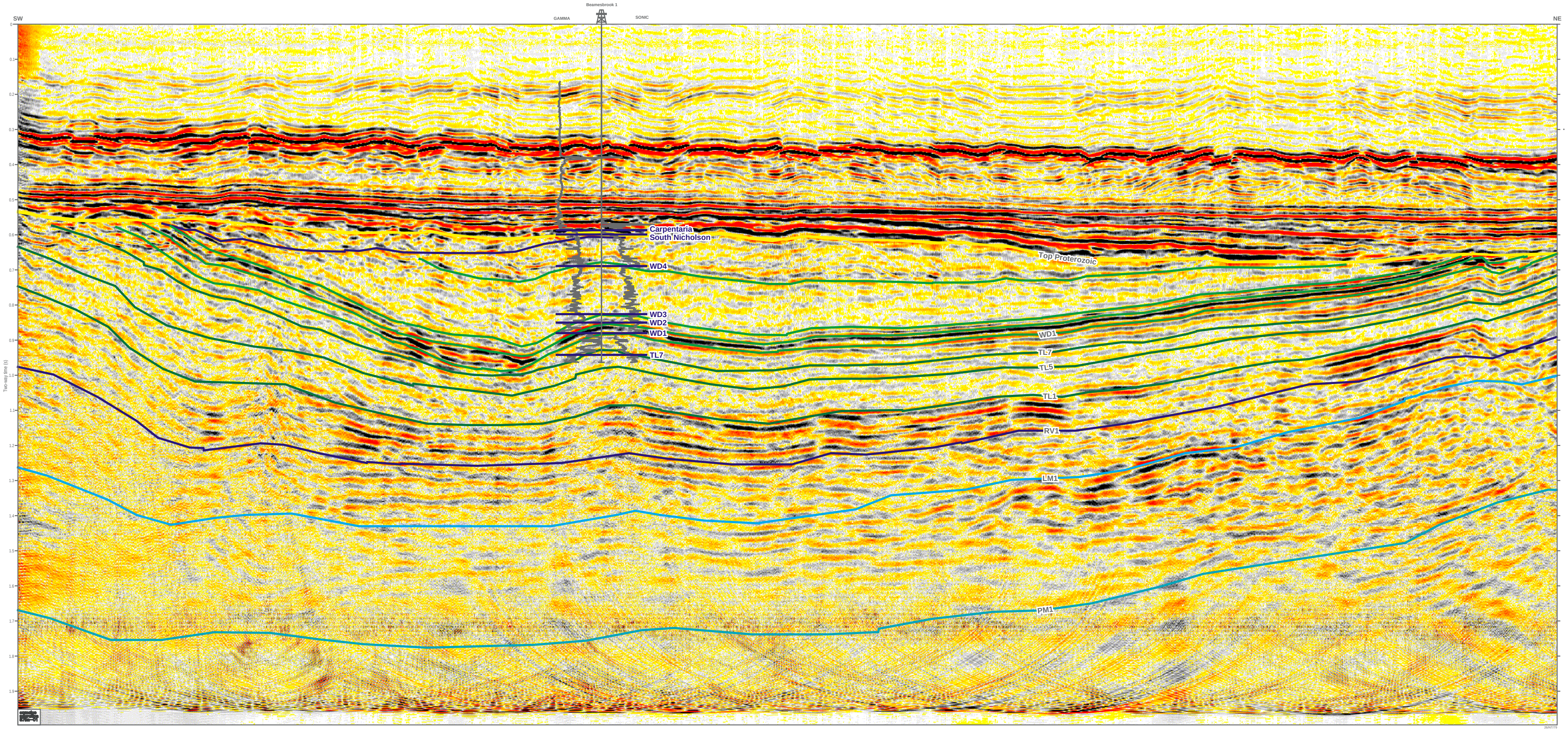


Figure 20. Sequence stratigraphic surfaces picked on gamma and sonic logs from Beamesbrook #1 tied to seismic line 87BN-01.

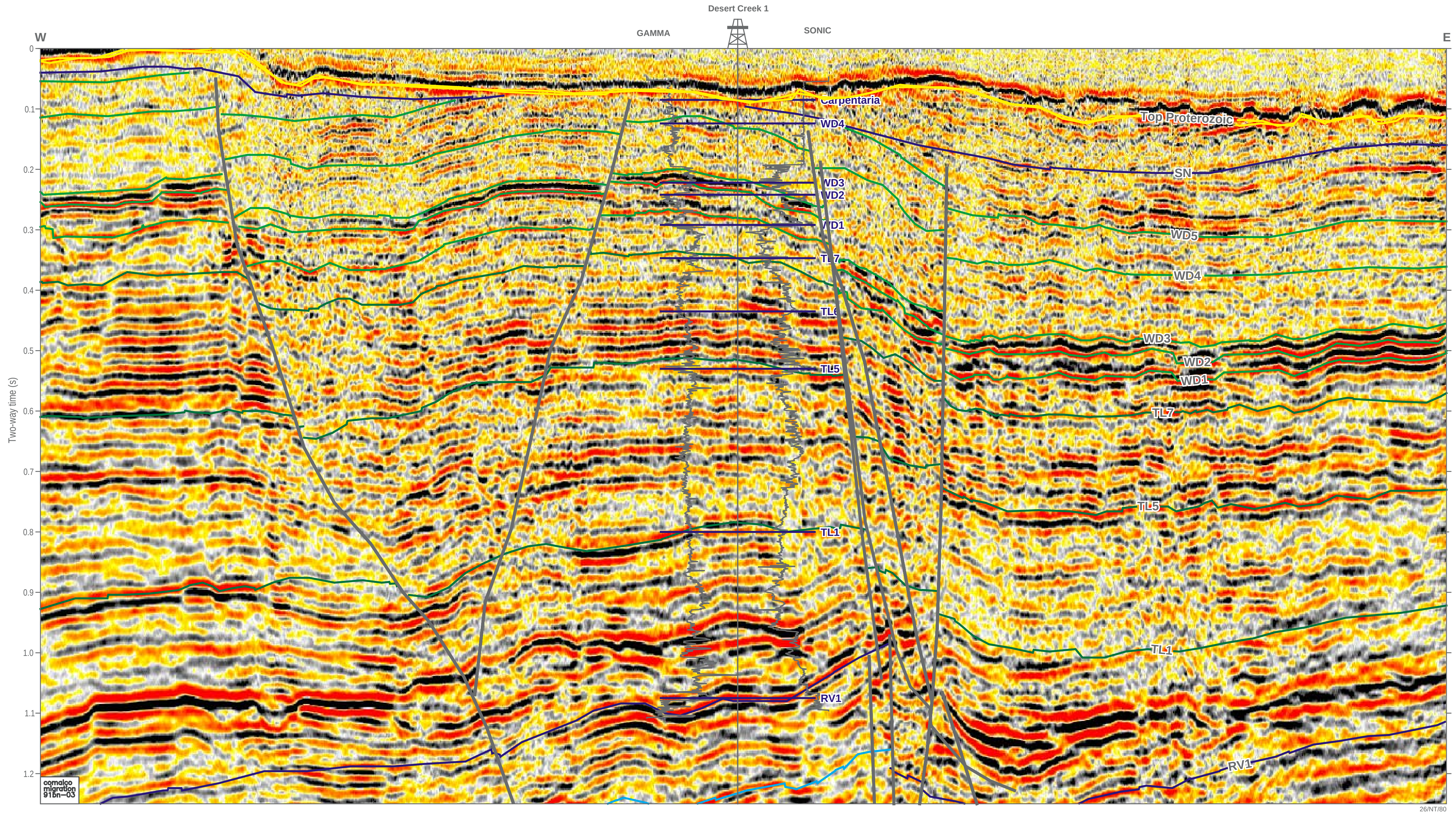


Figure 21. Sequence stratigraphic surfaces picked on gamma and sonic logs from Desert Creek#1 tied to seismic line 91BN-03.

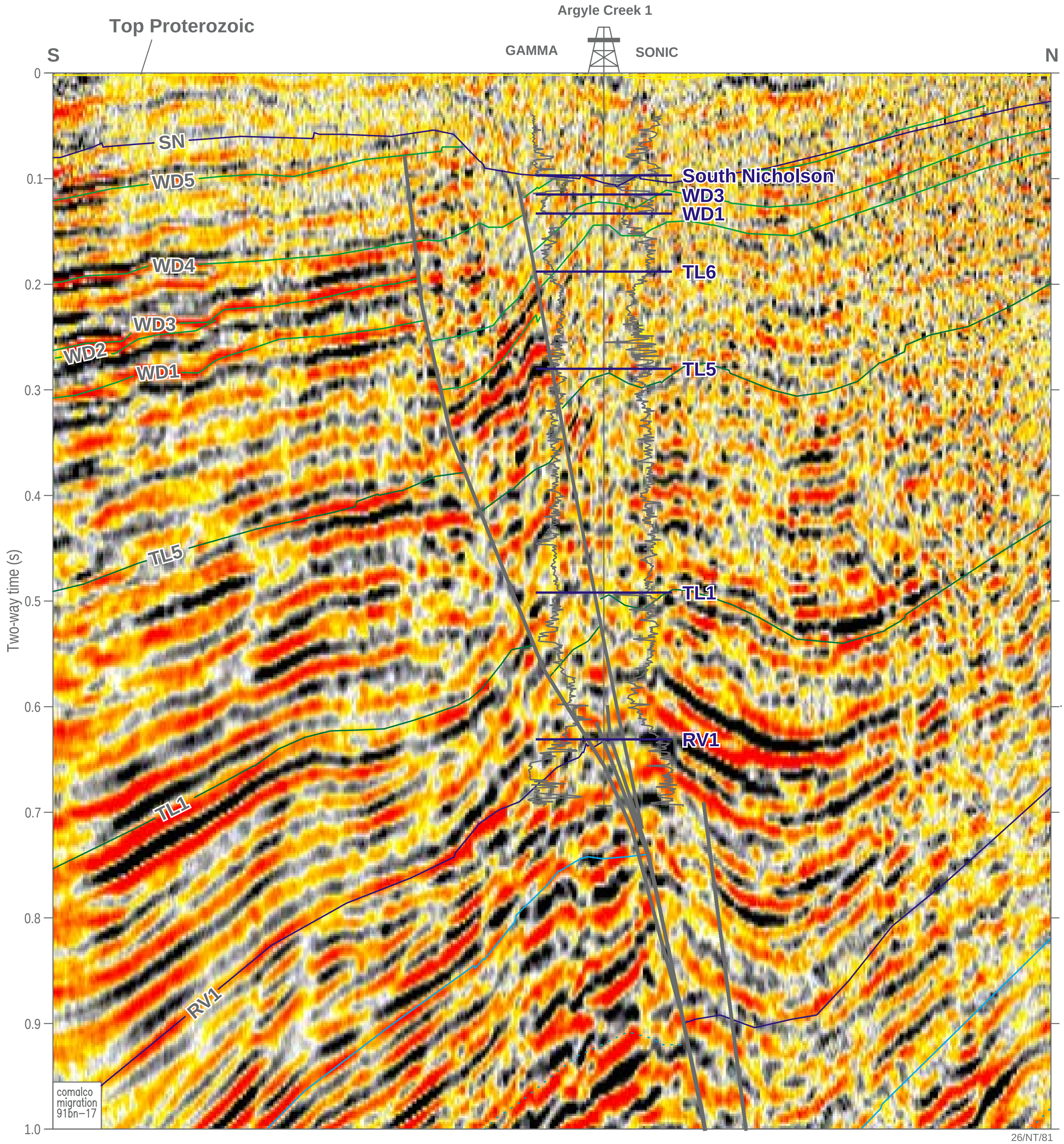


Figure 22. Sequence stratigraphic surfaces picked on gamma and sonic logs from Argyle Creek#1 tied to seismic line 91BN-17.

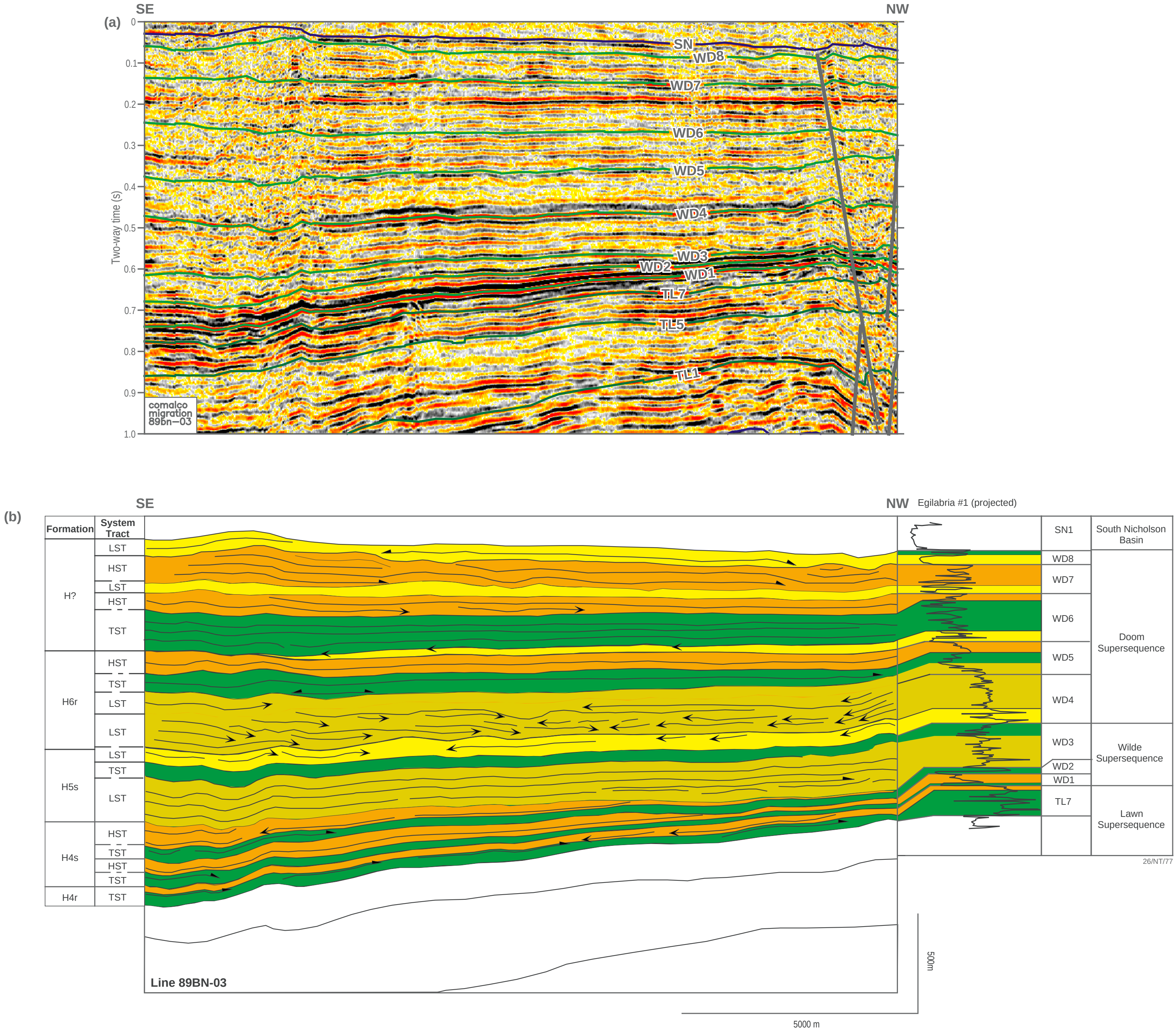


Figure 23. Seismic sequence stratigraphy of the Wide and Doom Supersequences at Egilabria#1; a) variable intensity seismic section, b) schematic cross-section highlighting the internal geometries and systems tracts. The Wide Supersequence is dominated by tectonic wedge geometries which onlap to the northwest. The Doom Supersequence is characterised by tabular ramp geometries and northwesterly prograding clinoforms.

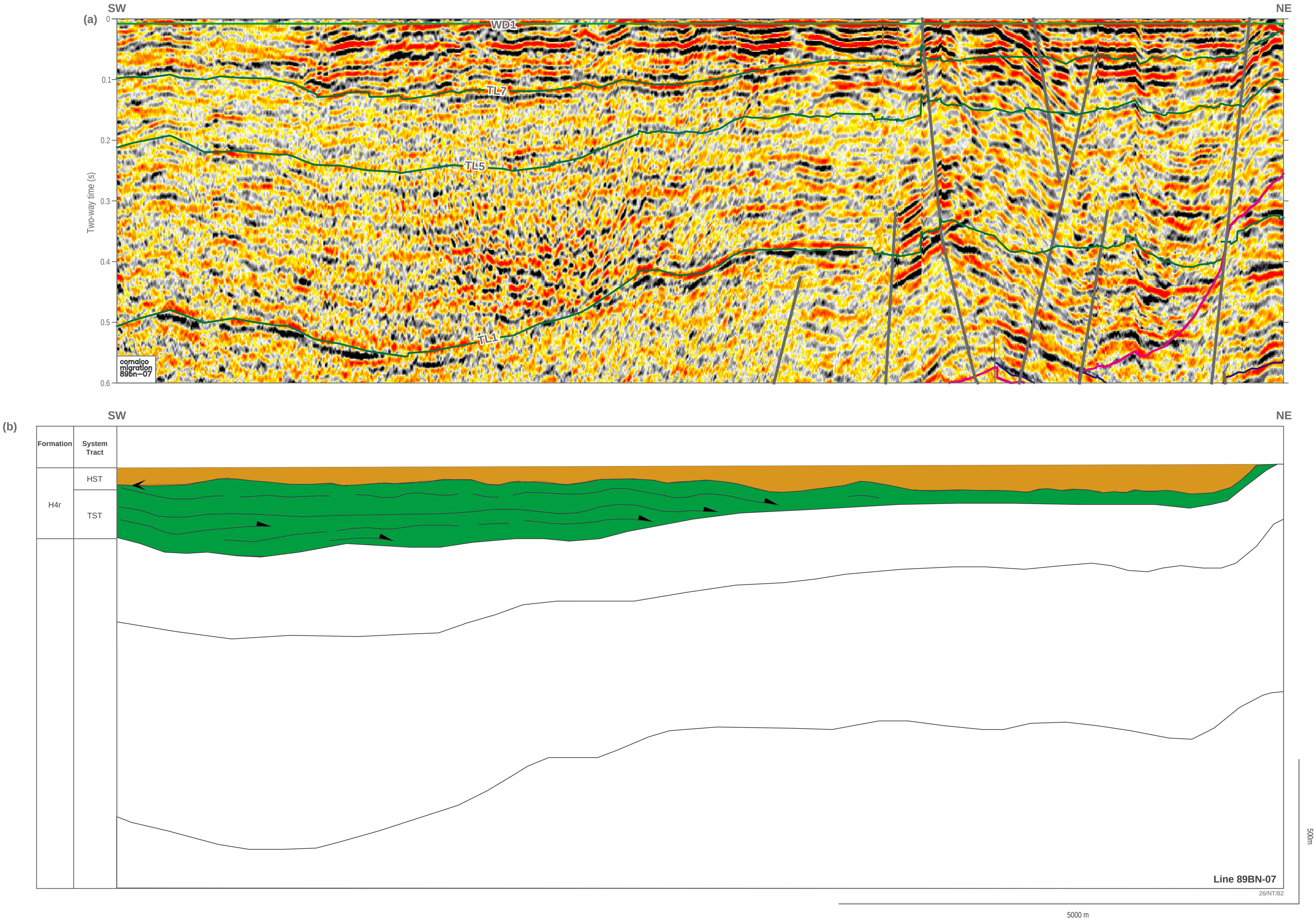


Figure 24. Seismic sequence stratigraphy of the TL7 sequence near Egilabria#1; a) variable intensity seismic section, b) schematic cross-section highlighting the internal geometries and systems tracts. Sequence TL7 is characterised by a northeasterly onlapping transgressive systems tract, and a thin highstand systems tract which has been truncated by the overlying Wide Supersequence.

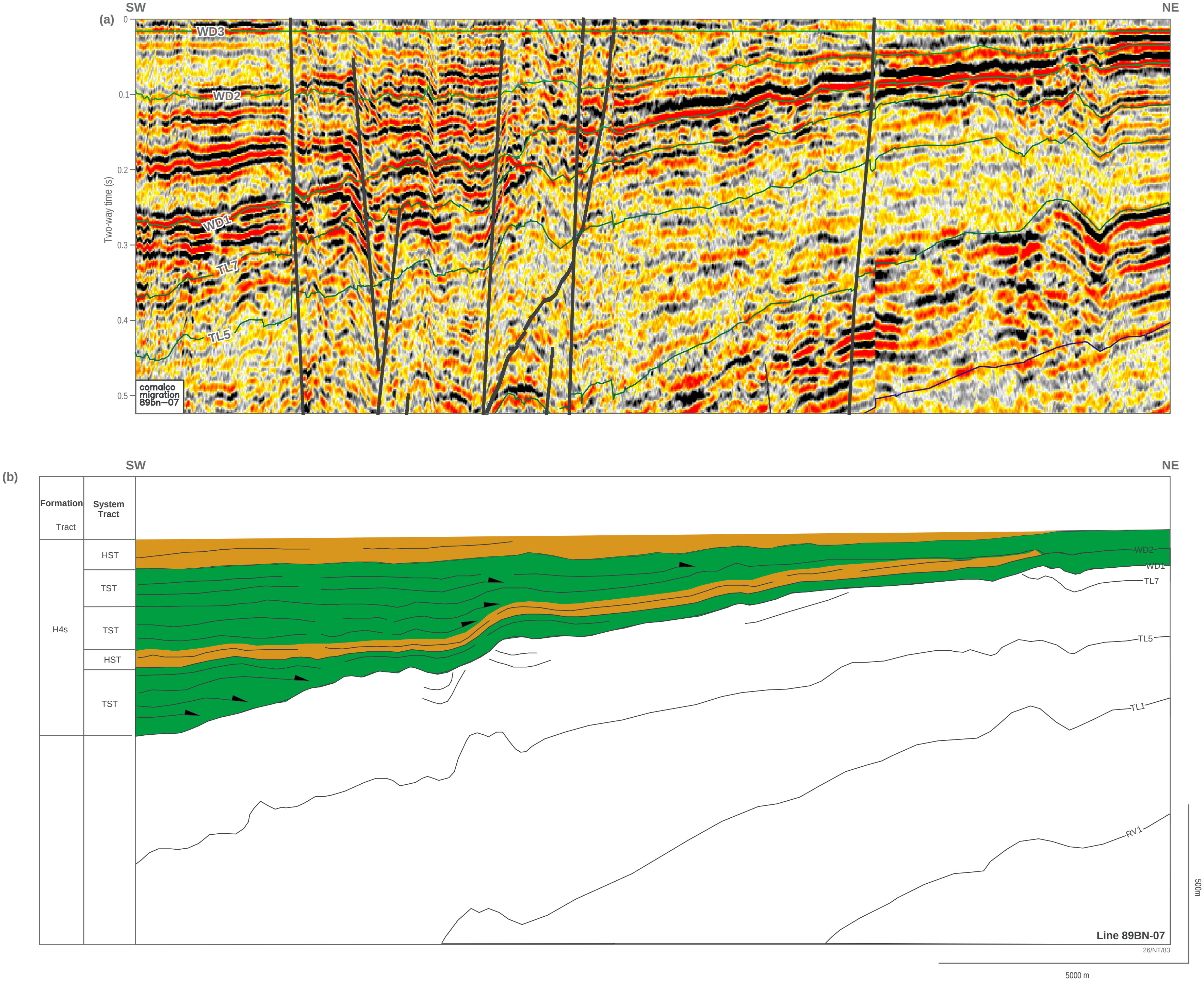


Figure 25. Seismic sequence stratigraphy of the WD1 and WD2 sequences near Egilabria#1; a) variable intensity seismic section, b) schematic cross-section highlighting the internal geometries and systems tracts. The Century-equivalent WD1 and WD2 sequences are characterised by tectonic wedges which locally thicken to the southwest into the Elizabeth Creek fault zone (located off the southern end of seismic section). Thickening of the wedge occurs in transgressive seismic units which probably correlate to the Century-host shales from member H4s.

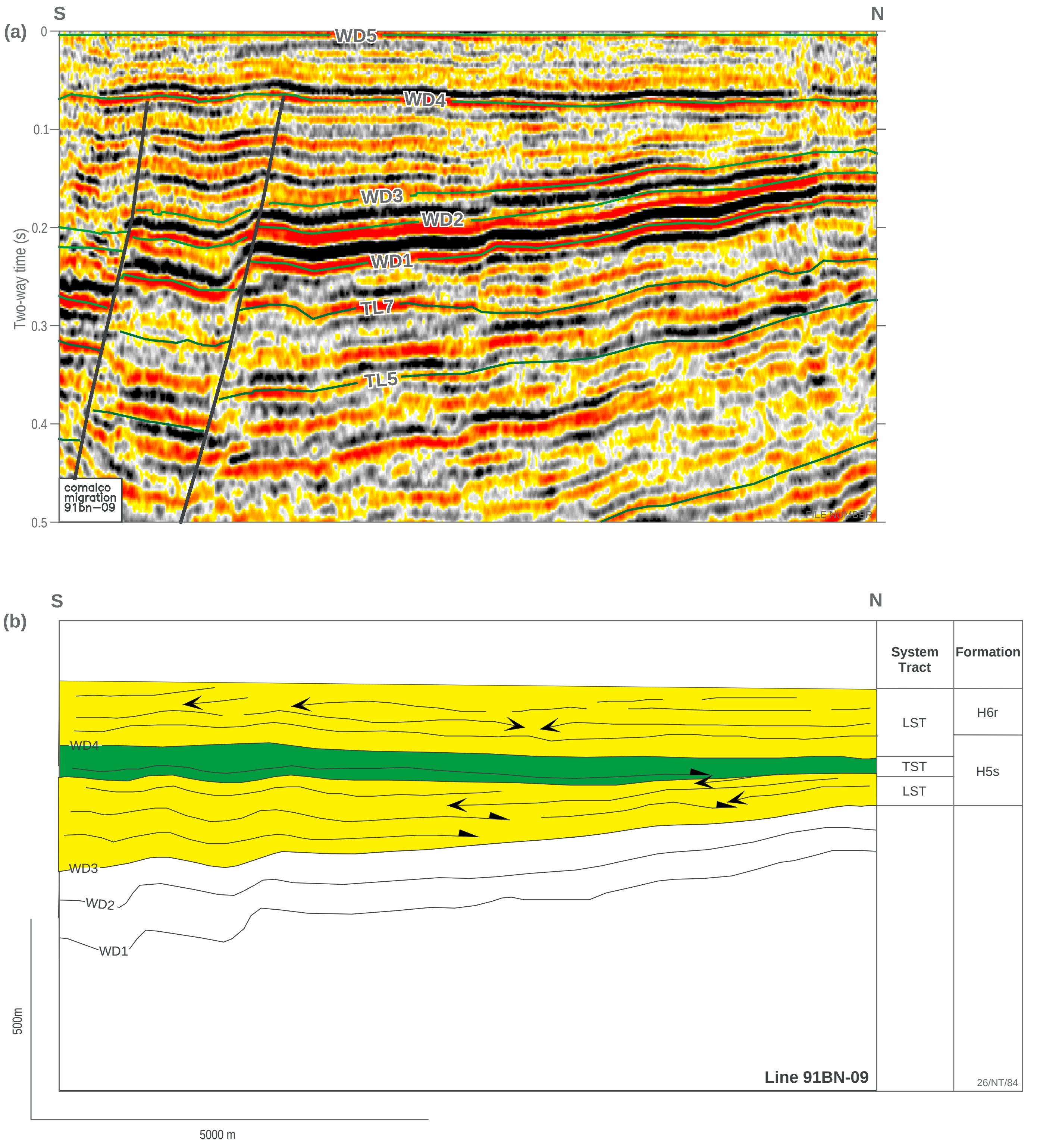


Figure 26. Seismic sequence stratigraphy of the WD3 and WD4 sequences near Desert Ck#1; a) variable intensity seismic section, b) schematic cross-section highlighting the internal geometries and systems tracts. Sequence WD3 shows a tectonic wedge geometry associated with a southward thickening lowstand systems tract. The WD4 sequence, in contrast, is characterised by a tabular ramp geometry associated with a lowstand systems tract.

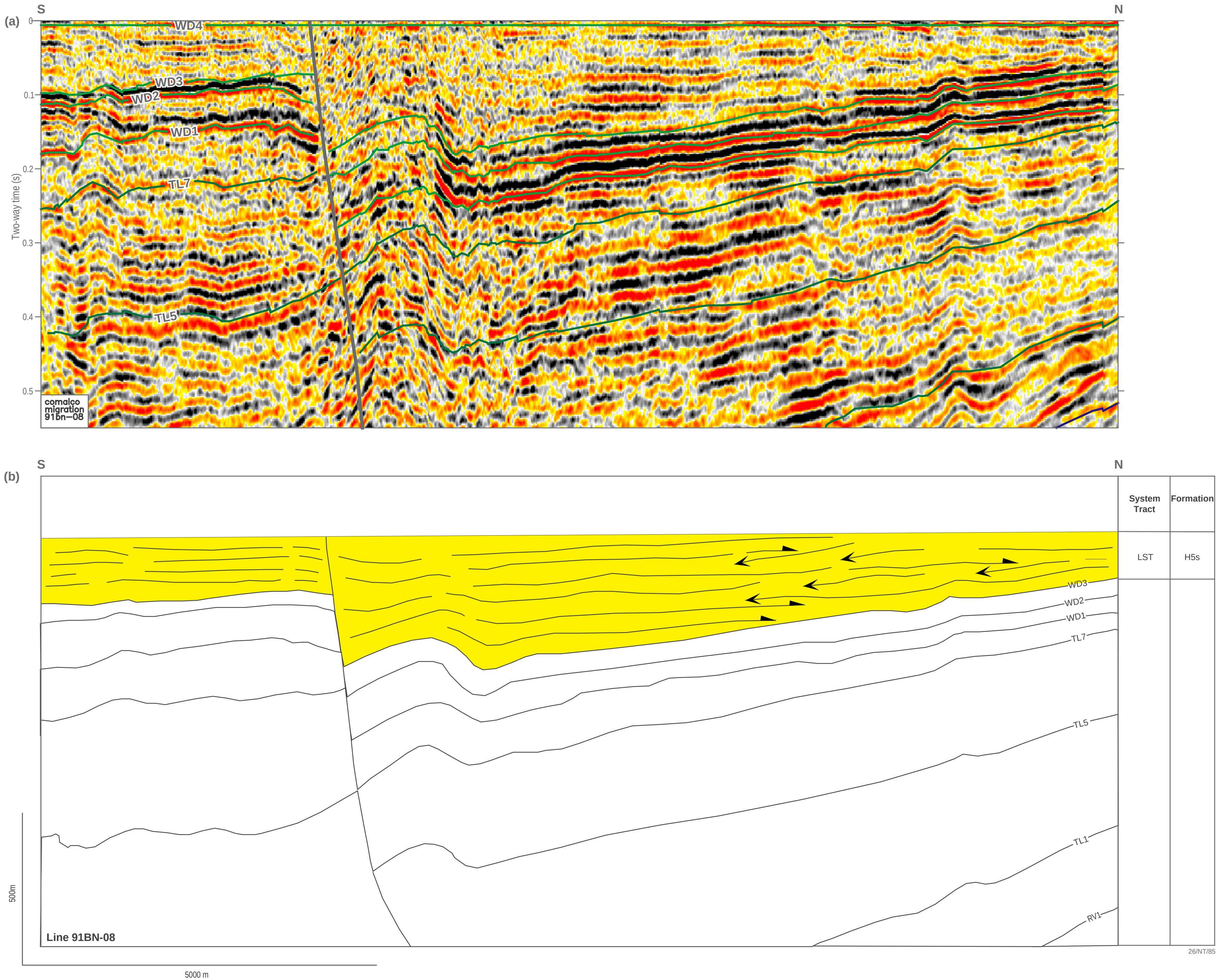


Figure 27. Seismic sequence stratigraphy of the WD3 sequence near Desert Ck#1; a) variable intensity seismic section, b) schematic cross-section highlighting the internal geometries and systems tracts. Here, the WD3 sequence thickens across a wrench fault system. Evidence for syndepositional fault activity is shown by the divergence of reflections into the fault system. An important feature of the WD3 sequence is the alternation of reflection geometries from northerly onlapping to southerly prograding. This reflection alternation is due either to intermittent tectonic activity triggering debris flows on the tilt blocks, or the presence of southerly prograding prodelta slopes.

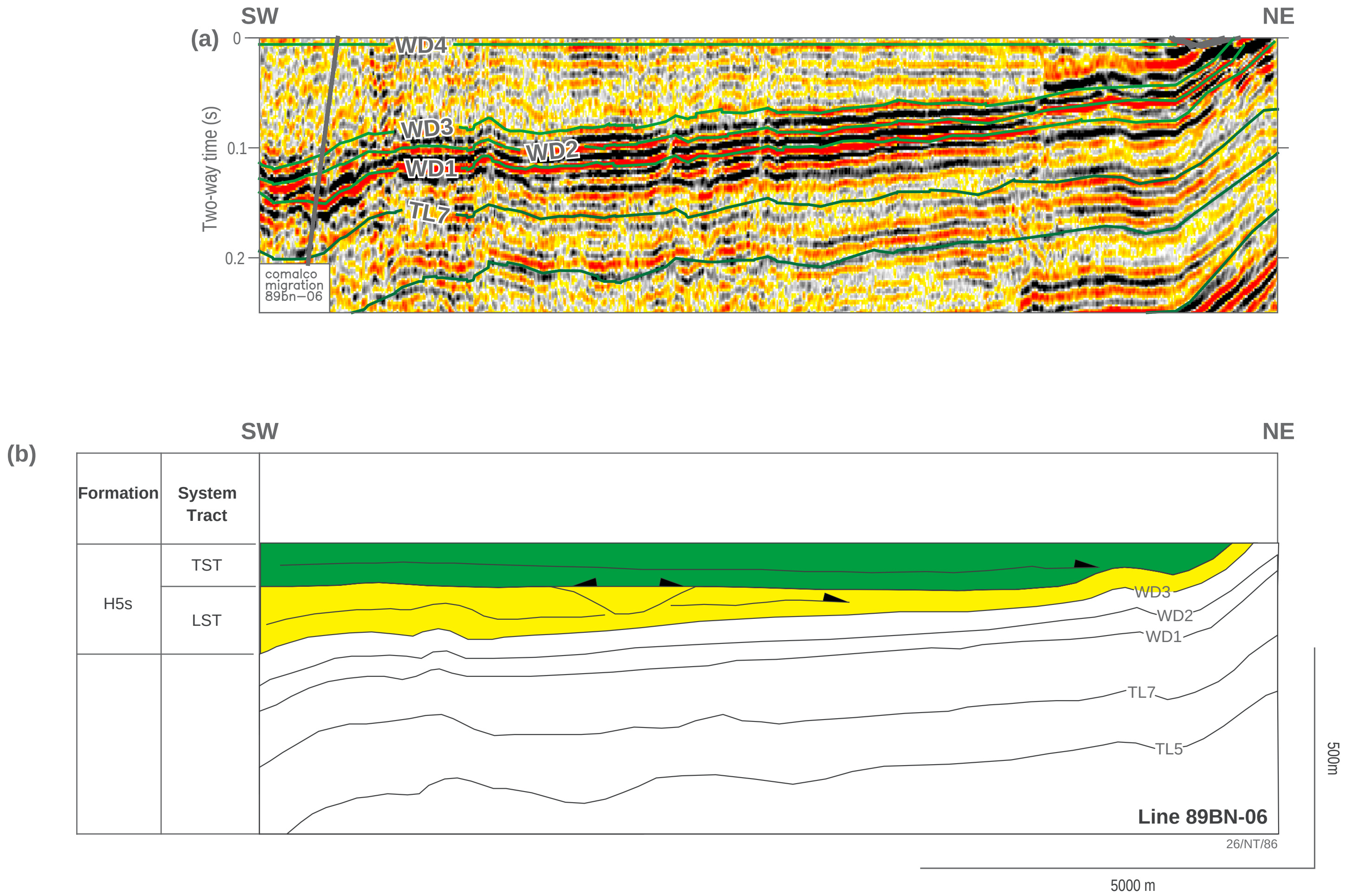


Figure 28. Seismic sequence stratigraphy of the WD3 sequence at Egilabria#1; a) variable intensity seismic section, b) schematic cross-section highlighting the internal geometries and systems tracts. The WD3 sequence thins to the northeast due to onlap within lowstand and transgressive systems tracts An important feature shown on this section is a small incision surface within the lowstand systems tract interpreted as part of a channel levee complex.

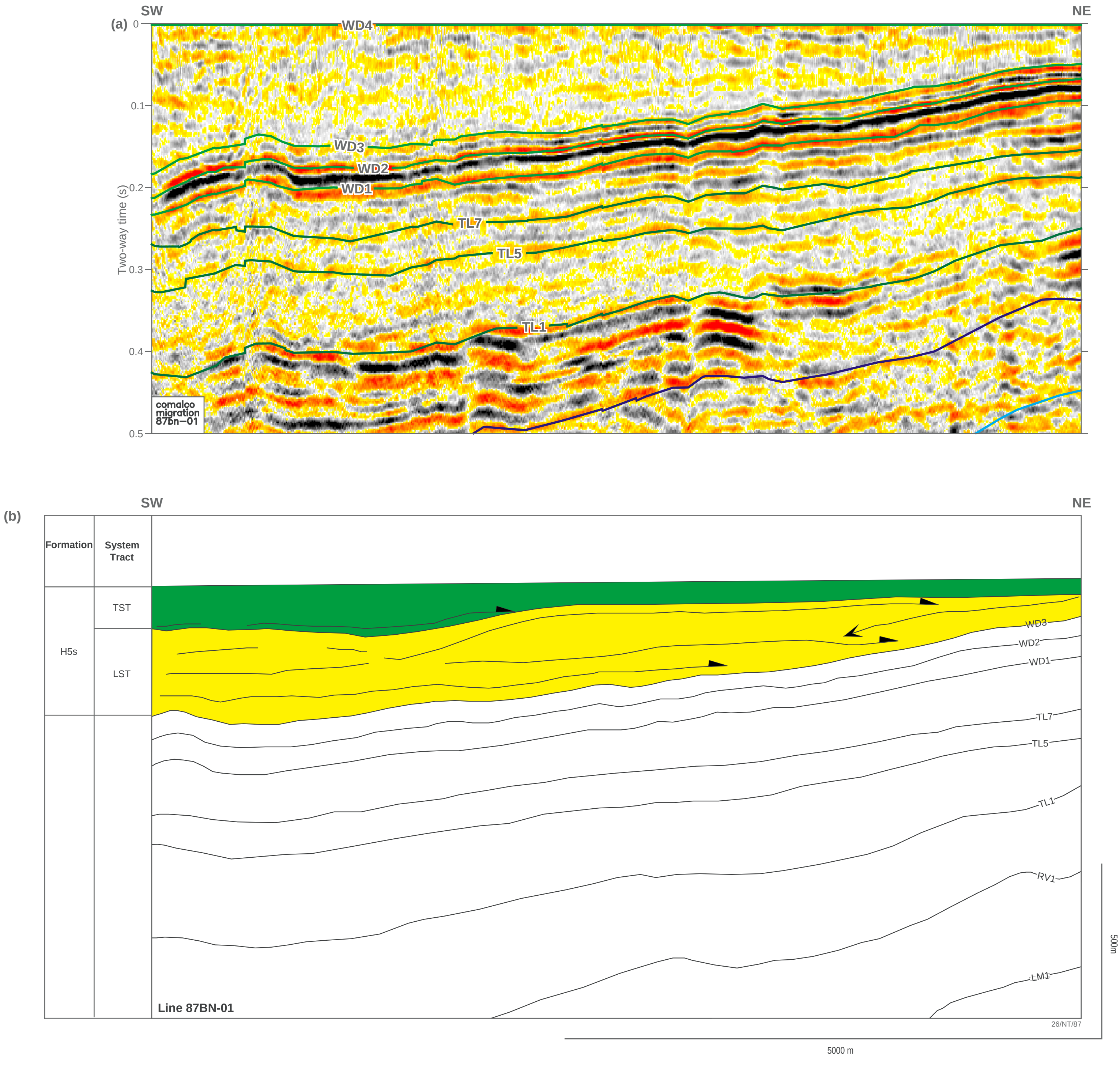


Figure 29. Seismic sequence stratigraphy of the WD3 sequence at Beamesbrook#1; a) variable intensity seismic section, b) schematic cross-section highlighting the internal geometries and systems tracts. This section highlights the alternating onlap and downlap reflections, as well as the presence of channel levee complexes within the WD3 tectonic wedge.

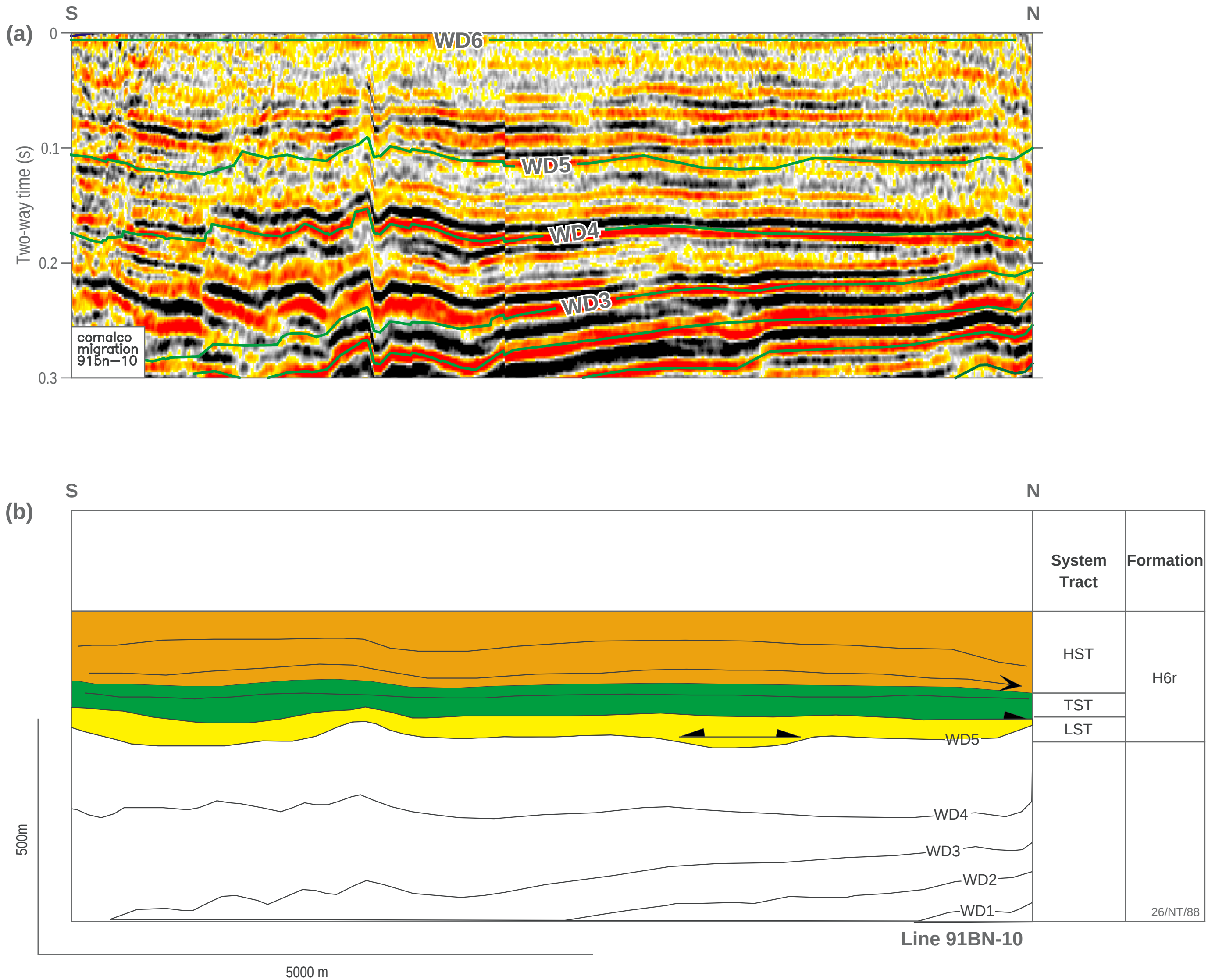


Figure 30. Seismic sequence stratigraphy of the WD5 sequence near Desert Ck#1; a) variable intensity seismic section, b) schematic cross-section highlighting the internal geometries and systems tracts. This section highlights the tabular ramp geometry which characterises the Doom Supersequence.

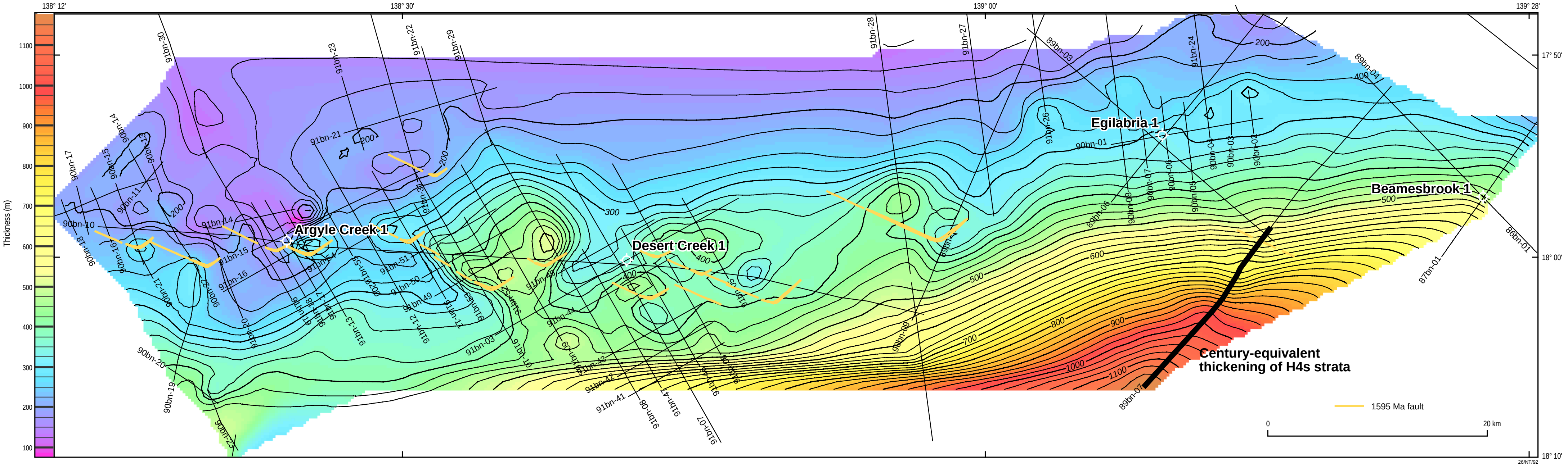


Figure 31 Wide Supersequence isopach map (converted from isochrons using an average interval velocity of 4500 m/s). Local growth of the Wide Supersequence occurs in many areas across 1595 Ma age growth faults. A broader regional thickening occurs to the southeast into the Elizabeth Creek Fault Zone at the end of line 89BN-07. This southeastern area is the only location where Century-equivalent strata are of sufficient thickness for the host carbonaceous shales.

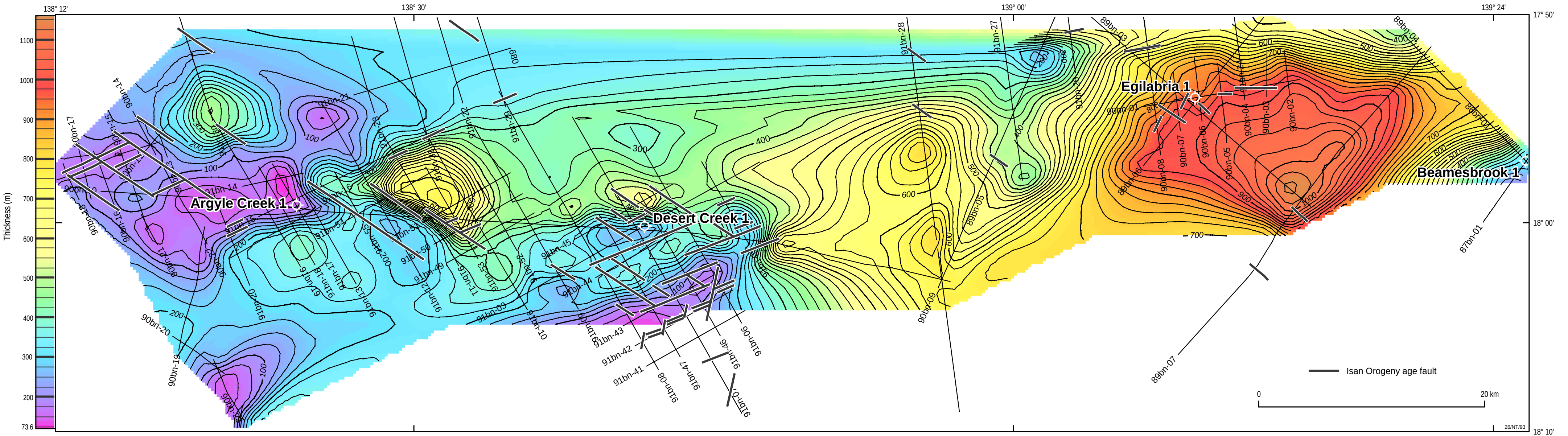


Figure 32 Doom Supersequence isopach map (converted from isochrons using an average interval velocity of 4500 m/s). Although planar tabular geometries dominate Doom sequences, the isopachs show irregular thickness trends due to post depositional folding and erosion during the Isan Orogeny. The Doom Supersequence is only well preserved to the east around the Egilabria#1 well. Major erosion of strata occurs outside of this zone, particularly in the west beneath outcropping South Nicholson Basin strata. Isolated preserved thickness of the Doom Supersequence are still present in the west on the hanging walls of late stage wrench fault systems.

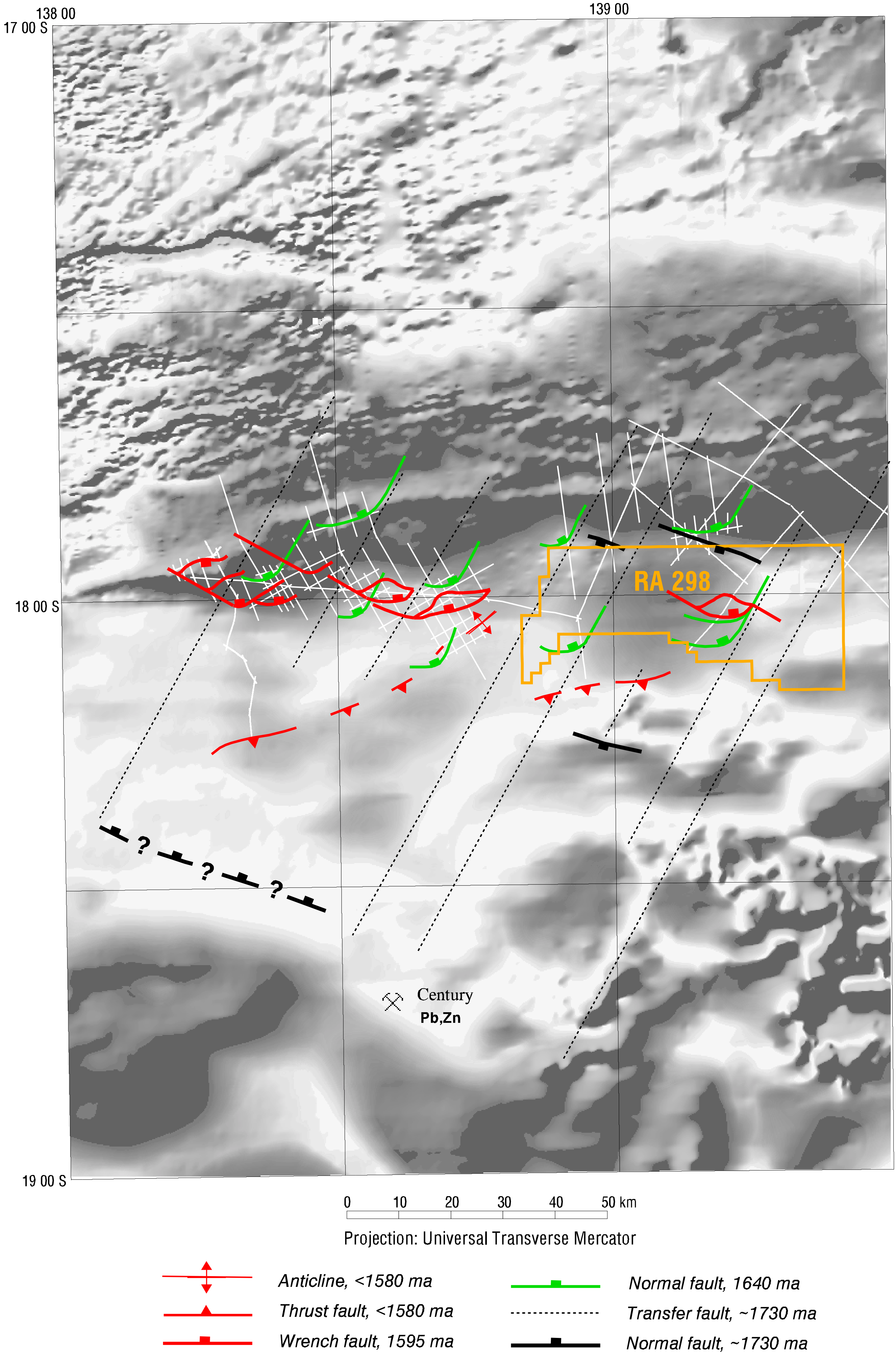
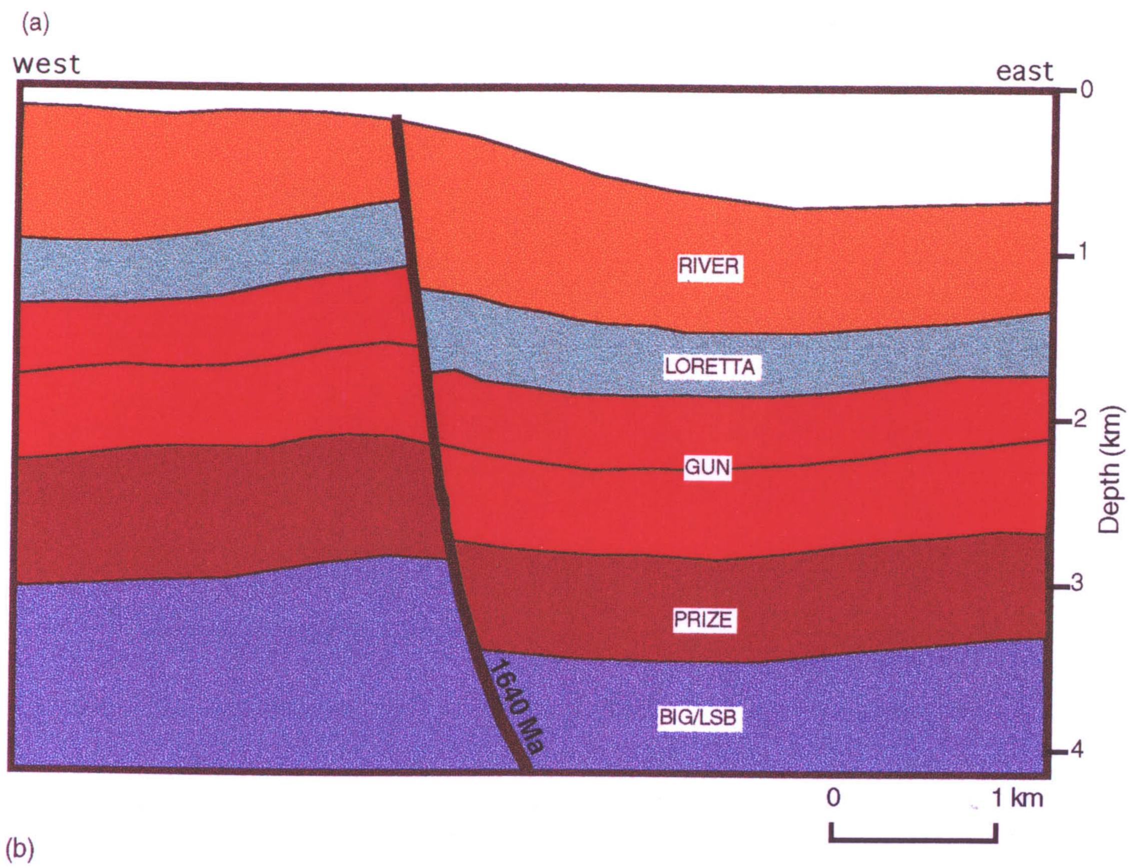
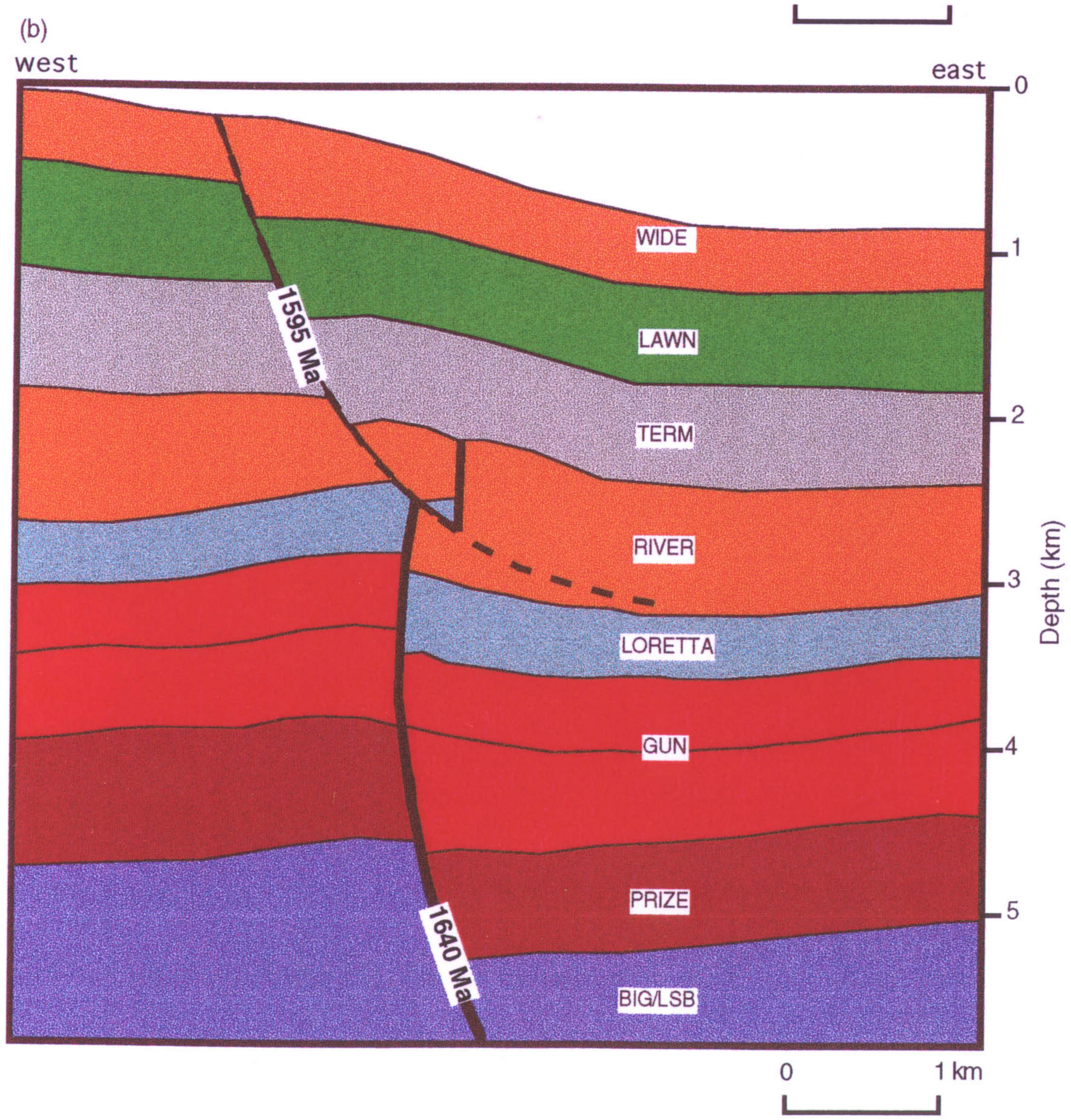


Figure 33. Regional magnetics and simplified fault map. Fault trends are picked on structural interpretations from seismic and geophysical data (from Scott and Tarlowski, in press). Note the location of Century and Restricted Area 298 along northeast-southwest trending traverse faults (ie potential fluid flow conduits) occurs adjacent to a magnetic low postulated to represent deeply buried mafics (a potential metal source).





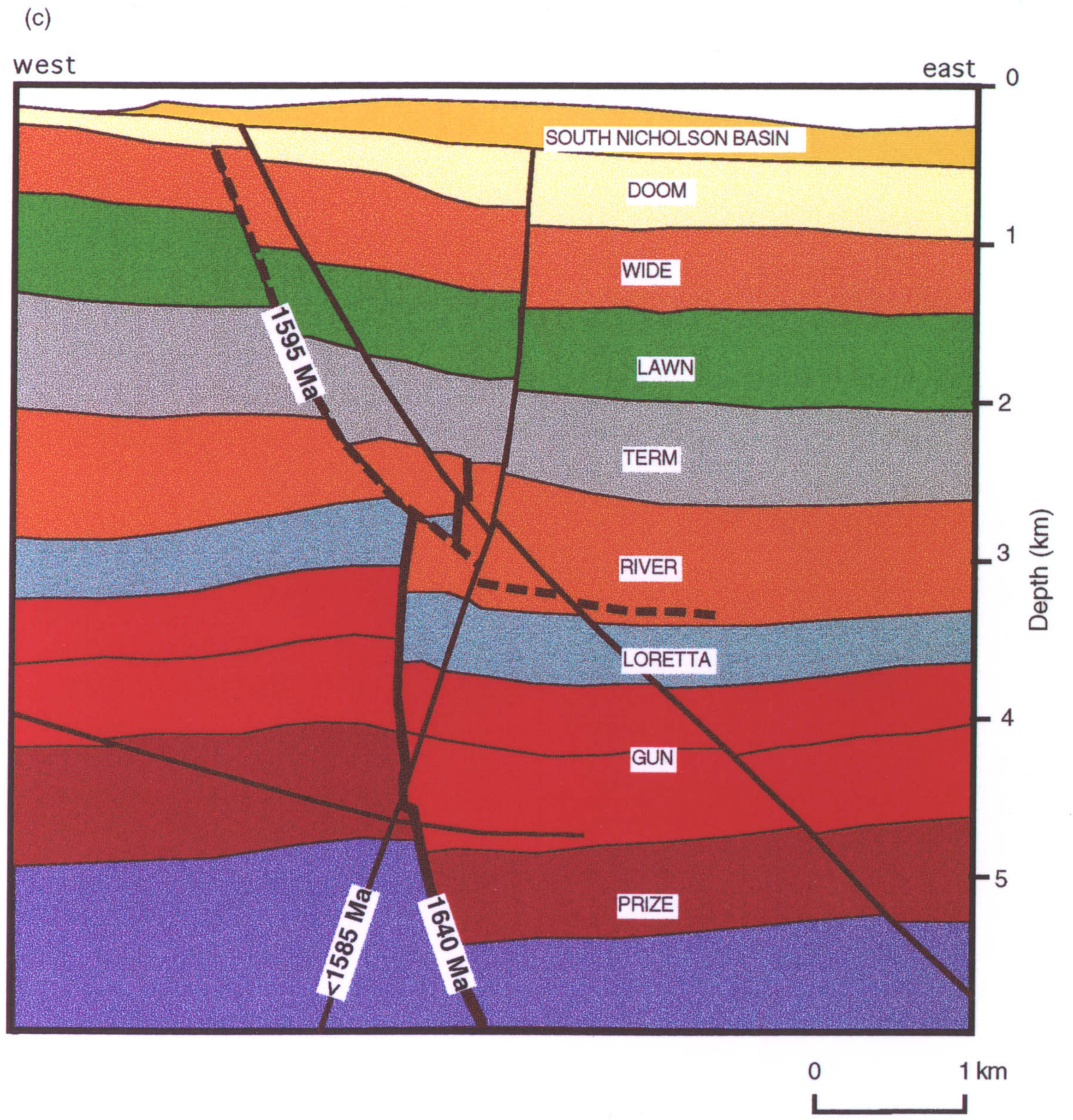


Figure 34. Model for evolution of fault systems in the Isa Super Basin based on interpretations from seismic line 91BN-03: a) Growth fault activity associated with the River Supersequence at 1640 Ma; b) Wrench faults reactivated above the River system during deposition of the Wide Supersequence at 1595 Ma; c) Late stage wrench fault activity during the Isan Orogeny between ~1585 - 1500 Ma.

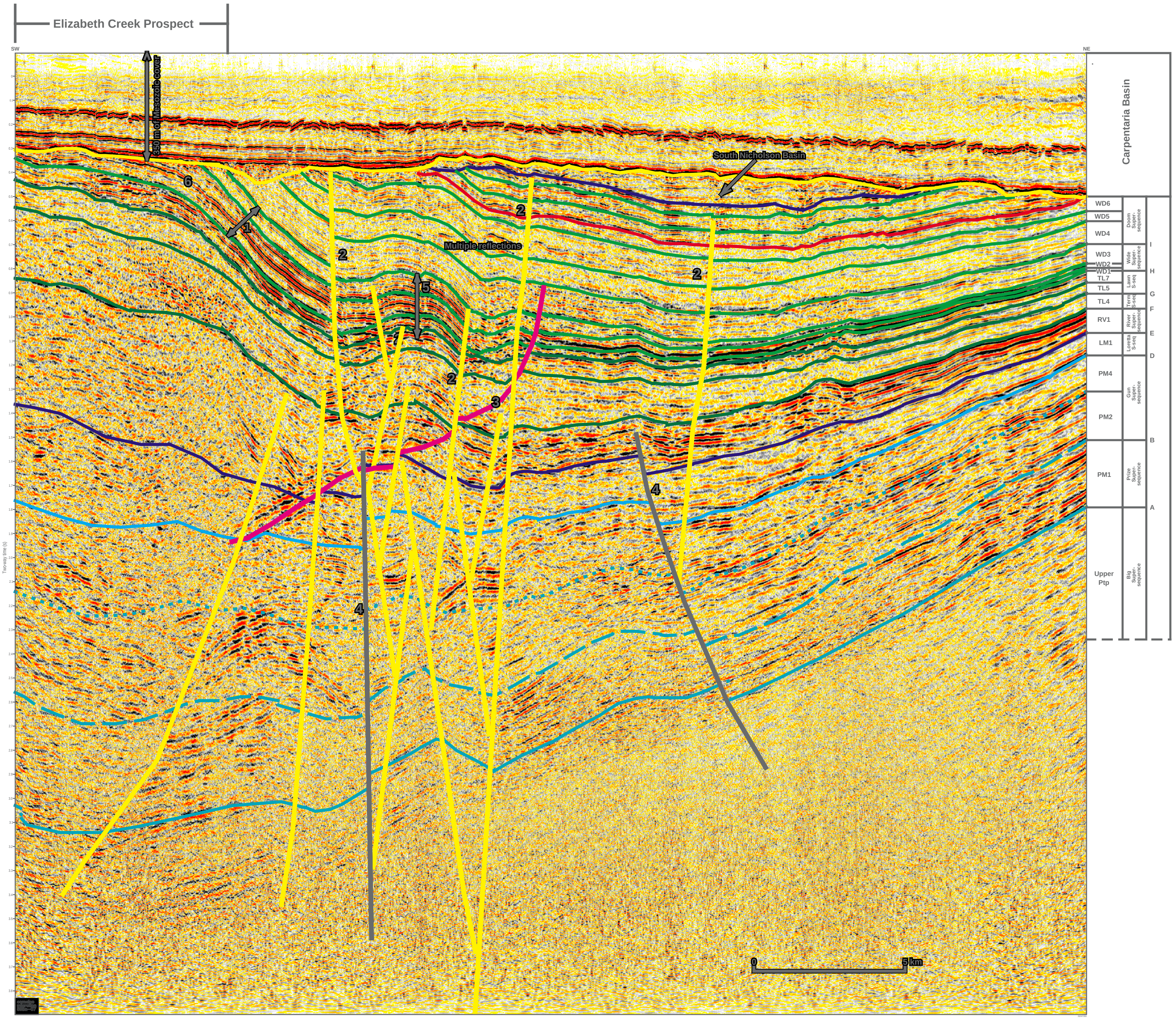


Figure 35. Seismic line through the Elizabeth Ck Prospect. This line clearly shows the thickening of strata required to form the shales which host the Century deposit (1). Also shown are late stage faults generated during the Isan Orogeny (2) which reactivated over older 1595 Ma (3) and 1640 Ma (4) fault systems. Possible indications of mineralisation in Century equivalent strata (seismic sequences WD1 and WD2) are the anomalously high amplitude seismic reflections within a heavily faulted zone (5). Although this fault zone is too deep for economic mineralisation (1450 m), several "boomers" continue to shallow subsurface depths (350 m; 6). The Elizabeth Creek fault zone immediately southwest of the seismic line is also a likely area for fluid flow and mineralisation in the thickened Century equivalent strata (7).

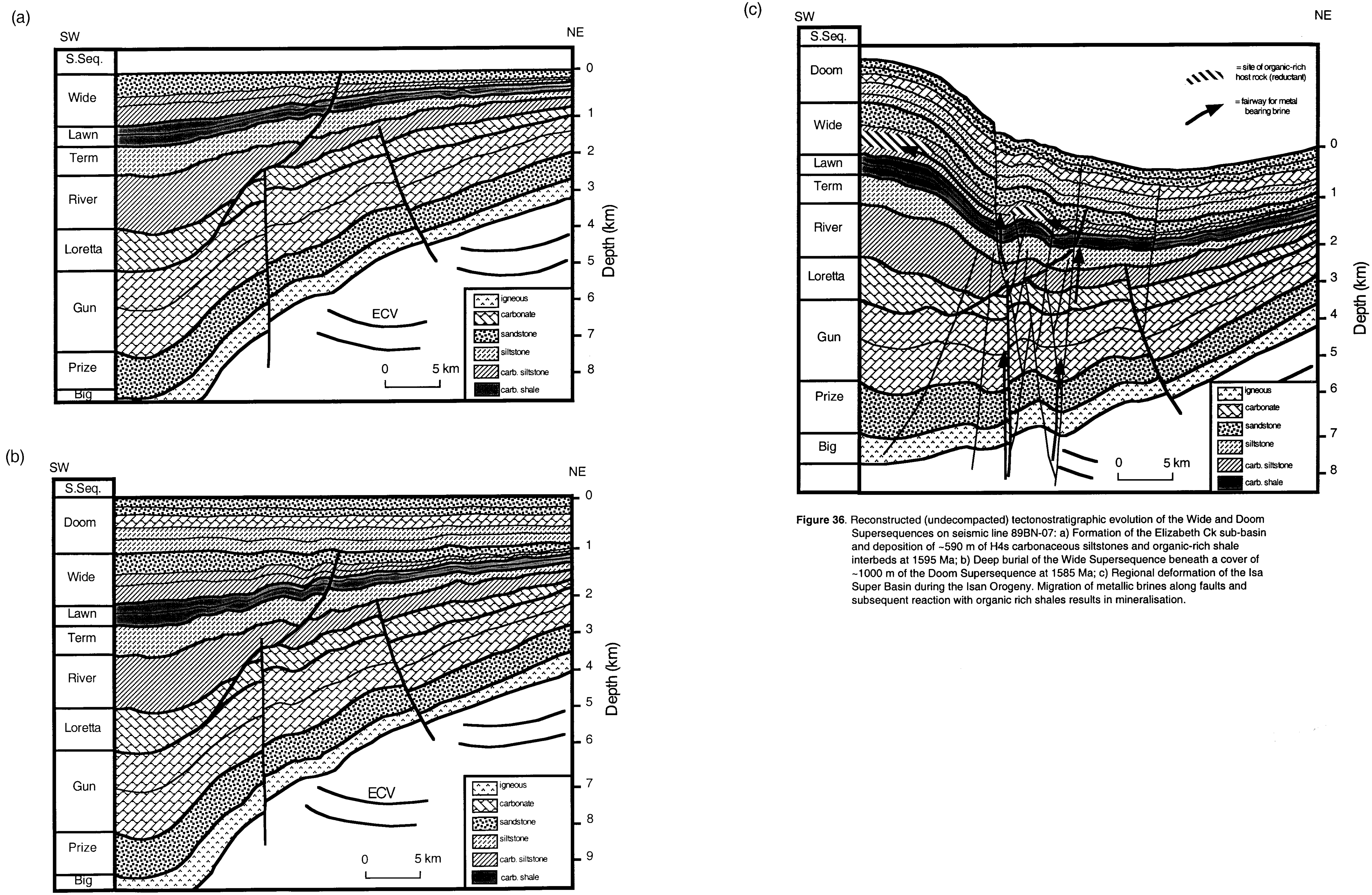


Figure 36. Reconstructed (undecompacted) tectonostratigraphic evolution of the Wide and Doom Supersequences on seismic line 89BN-07: a) Formation of the Elizabeth Ck sub-basin and deposition of ~590 m of H4s carbonaceous siltstones and organic-rich shale interbeds at 1595 Ma; b) Deep burial of the Wide Supersequence beneath a cover of ~1000 m of the Doom Supersequence at 1585 Ma; c) Regional deformation of the Isa Super Basin during the Isan Orogeny. Migration of metallic brines along faults and subsequent reaction with organic rich shales results in mineralisation.

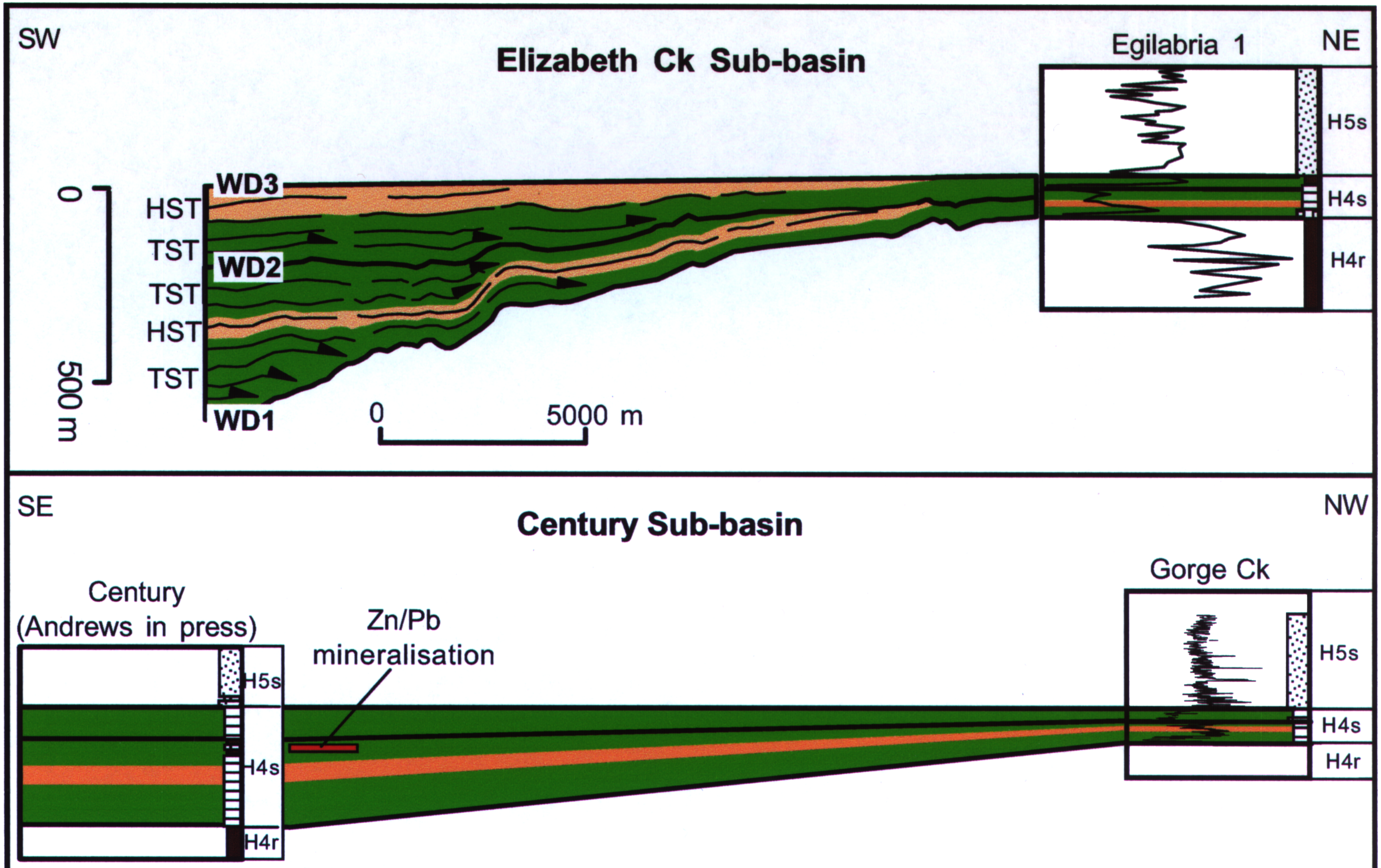


Figure 37 Comparison of the basin geometry and sediment architecture between the Elizabeth Creek sub-basin and the Century sub-basin.

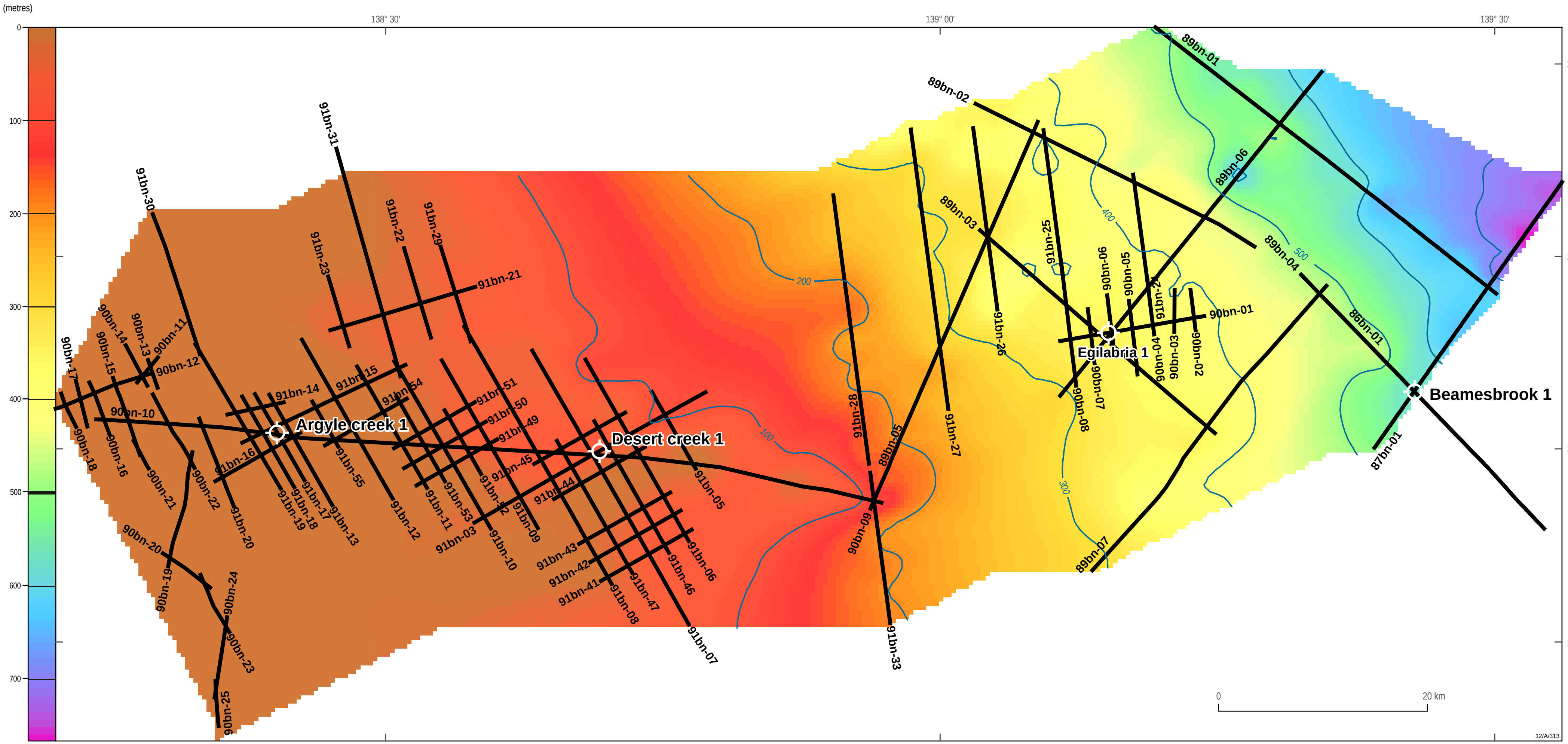


Figure 38: Depth to base of Mesozoic Carpentaria Basin in metres below mean sea level using an average velocity of 2500 m/s.
The Carpentaria Basin forms an eastward thickening cover above Proterozoic strata. At the Elizabeth Creek Prospect zone, the Carpentaria forms a 300-350 m thick cover.

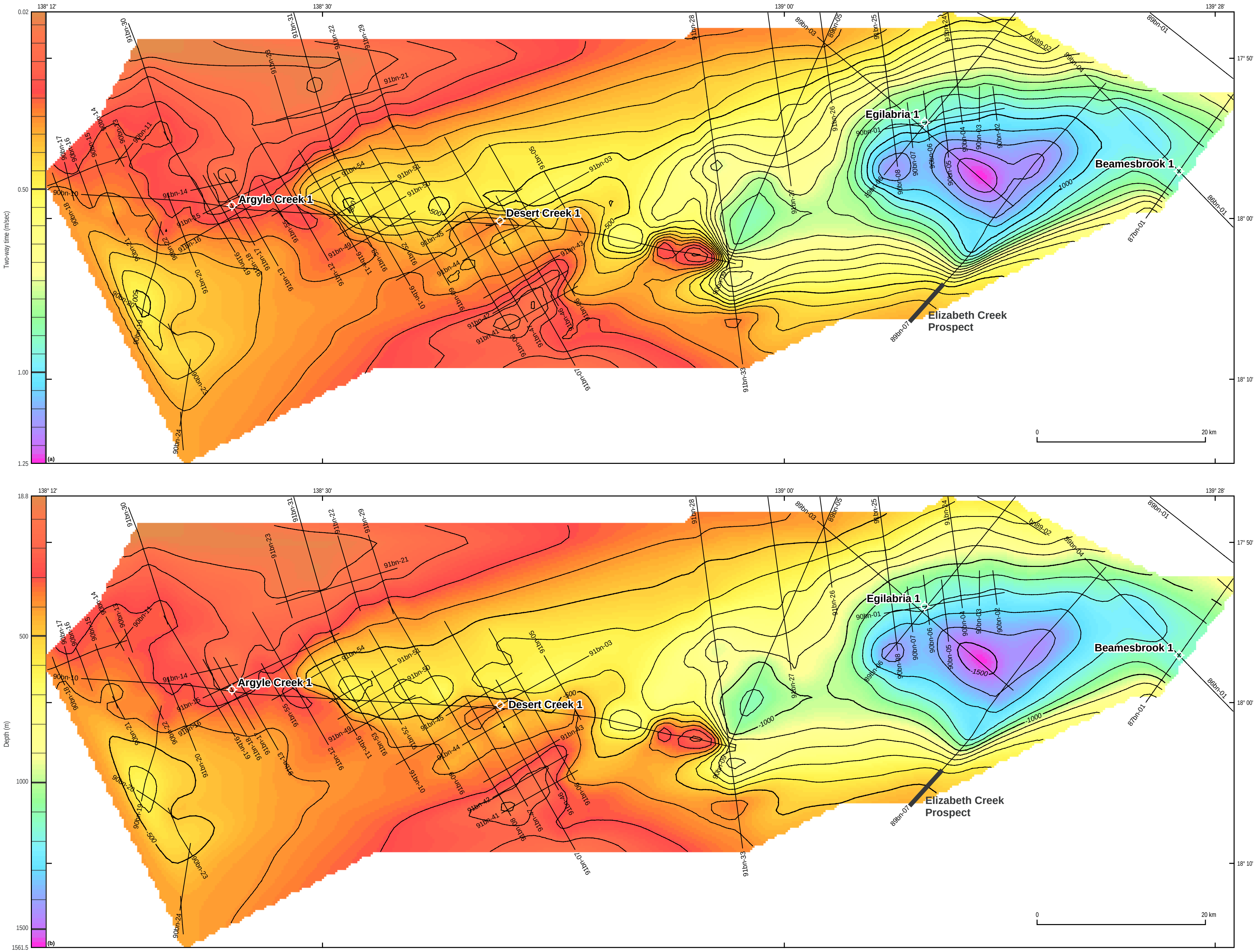


Figure 39 Structure maps for base of the Wide Supersequence: a) map contours in 2-way travel time; b) map contours in metres below mean sea level using an average velocity for the overlying Carpentaria Basin of 2500 m/s. The structure maps show that the thickened Century-equivalent strata of the Wide Supersequence only reach economic depth of recovery (<500 m) at the southwestern end of line 89BN-07. Depth conversions for the time structure contours are accurate in most areas where the base of the Wide Supersequence is within 600 m of the low velocity Carpentaria Basin (Beamesbrook#1, Desert Creek#1 and Argyle Creek#1). In the area around Egilbria#1, converted depths are ~400 m too shallow due to a thick cover of higher velocity (4500 m/s) Proterozoic strata.