AEGC Australasian Exploration Geoscience Conference Brisbane 2021

New Age Dating of Evaporites in Canning Basin, WA, Australia. A Case Study based on samples from the Frome Rocks Salt Diapir.

Fionna McNee
Buru Energy
2/16 Ord Street,
West Perth, WA
fionnamcnee@buruenergy.com

John Gorter
John D. Gorter PL
PO Box 711
Claremont, WA
johngorter1@gmail.com

Frank Glass
Buru Energy
2/16 Ord Street,
West Perth, WA
frankglass@buruenergy.com

SUMMARY

The age of evaporitic units in the Kidson Sub-basin of the Canning Basin have been assigned to be of Late Ordovician to Early Silurian age through the dating of the sedimentary sequences within the Mallowa Salt.

The Frome Rocks 1 exploration well was drilled in 1959 on the Jurgurra Terrace on the southern margin of the Fitzroy Trough and encountered 600m of salt down to a total depth (TD) of the well at 1220mMD (1137mTVDSS). Based on seismic data, this salt sequence is interpreted to be part of a diapiric structure that resulted from the rapid deposition of Carboniferous/Permian sediments over a thick evaporitic sequence. It is generally accepted that the evaporite sequence encountered in the Frome Rocks 1 well was deposited contemporaneously with the Mallowa Salt in the nearby Kidson Sub-basin.

This paper presents an alternative model that suggests that an evaporitic salt sequence over the Jurgurra Terrace was deposited during the initial opening of the Fitzroy Trough during the Middle Devonian and prior to the deposition of the carbonate/claystone sequences of the Gogo and Pillara Formations.

The presence of several evaporitic deposits within the Mellinjerie Formation of Middle Devonian age encountered in wells surrounding the Fitzroy Trough supports this age interpretation, while global indications for a major sea level drop in the Early to Middle Devonian allow for the development and generation of evaporitic conditions in an isolated shallow marine basin that predates the opening of the Fitzroy Trough.

Ongoing work includes palynological and radiogenic dating of samples of the salt and overlying sediments from several recent mineral holes drilled on the Frome Rocks salt diapir.

The confirmation of evaporites of Middle Devonian age would significantly increase the hydrocarbon prospectivity of the Jurgurra Terrace structural province, with good quality reservoirs of Devonian age proven in this area.

Key words: Canning Basin, Kidson Sub-basin, Jurgurra Terrace, Salt, Middle Devonian Salt, Mallowa, Frome Rocks.

INTRODUCTION

The Mallowa Salt has been assigned to the Late Ordovician to Early Silurian based on the early land spores *Tetrahedraletes medinensis* found within mudstone interbeds in Gingerah Hill 1 (Foster and Williams, 1991). This evaporitic sequence is interpreted to have been deposited in a large intra-cratonic sag basin within the Kidson Sub-basin of the Canning Basin, WA (Figure 1). The lateral distribution of evaporitic sequences is almost exclusively within in the Kidson Sub-basin, with local restricted pockets of evaporites over the Barbwire Terrace and possibly the Jurgurra Terrace, Figure 1. (Haines, 2009).

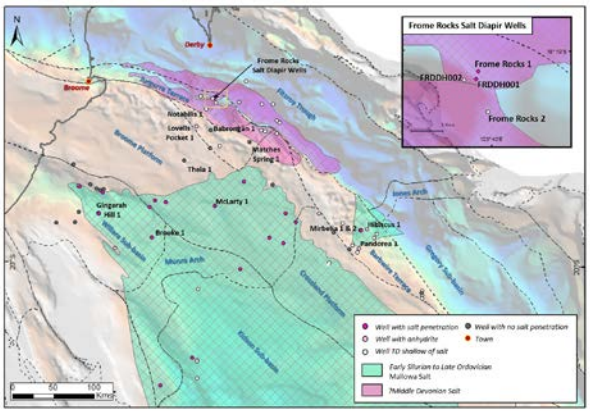


Figure 1. Canning Basin Location Map and Salt Distribution with key well penetration; Adapted from (Haines, 2009)

The salt sequence on the Barbwire Terrace is separated from the main body of the Mallowa Salt in the Kidson Sub-basin (Haines, 2009), Figure 1 & Figure 2. At Mirbelia 1 & 2, the salt sequence that has been intersected has been assumed to be the Mallowa Salt, as the thin chronostratigraphic marker of the Pegasus Dolomite Member from within the Sahara Formation (Upper Ordovician to Earliest Silurian) has been correlated stratigraphically above (Haines, 2010), Figure 3 & Figure 4. These wells highlight the transition on the Barbwire Terrace from the Upper Ordovician Mallowa Salt to the Upper Devonian Pillara/Nullara cycles, Figure 3. The Pandorea 1 and Hibiscus 1 wells further confirm the stratigraphy on the Barbwire Terrace from the Lower Devonian Tandalgoo Sandstone to the Upper Devonian Pillara/Nullara cycles, Figure 4. The Middle Devonian Mellinjerie Formation has strong indications of evaporites through the presence of anhydrites in all of the wells, Figure 4. This would be the time equivalent of the Lower-Middle Devonian early rift sequence in the Fitzroy Trough and the development of an initial shallow marine basin and deposition of another evaporitic salt sequence.

An additional isolated salt sequence has been identified on the Jurgurra Terrace and Fitzroy Trough, the Northern extent of which has been remobilised by salt diapirism as penetrated by the Frome Rocks 1 petroleum exploration well drilled in 1959 and most recently by the FRDDH001 mineral exploration core-hole drilled in 2020. None of the wells drilled on the Jurgurra Terrace have penetrated this isolated salt in-situ nor the pre-salt

sequence (Figure 5). Although there are no penetrations of the pre-salt section or age dating of this isolated salt sequence on the Jurgurra Terrace, it is generally accepted to be of the same age as the other salt sequences in the basin, i.e. Late Ordovician to Early Silurian.

Age dating of the salt from the 1959 Frome Rocks 1 well was indeterminate, however two specimens of fish plates *Holmsella sp.* taken from carbonate fragments within the salt, indicates an Upper Devonian to Lower Carboniferous age (Glenister, 1959). A single damaged fragment of a conodont bar is nearly identical to those common in the Upper Devonian in the northwestern Australia, which is compatible with the presence of *Holmsella sp.* (Glenister, 1959). With an age assumption of Late Ordovician to Early Silurian for the Jurgurra Terrace salt sequence, the fish plate and conodont were interpreted as being incorporated into the salt as part of a carbonate clast during remobilisation of the salt.

This paper suggests an alternative depositional model for the evaporites on the Jurgurra Terrace and supports a Middle Devonian age of deposition. This model assumes an additional evaporitic basin was established on the Jurgurra Terrace prior to the rifting of the Fitzroy Trough, with the development of a thick salt sequence contemporaneous with the deposition of the Mellinjerie Fm on the Barbwire Terrace. The seismic character of this unit has been evaluated and it is remarkably variable between the pre-salt sequence deposited in the Kidson Sub-basin and the pre-salt sequence deposited on the Jurgurra Terrace. This could be indicative of a different tectonic and stratigraphic environment on the Jurgurra Terrace in comparison to the Kidson Sub-basin, which would support the model of a salt of younger age having been deposited on the Jurgurra Terrace.

The FRDDH001 and FRDDH002 mineral core holes were drilled by Resource Potentials in 2020 in the vicinity of the 1959 Frome Rocks 1 petroleum exploration well. Both holes targeted the Frome Rocks salt diapir and its flank and were continuously cored. The cores allowed further evaluation of the stratigraphy of the upper part of the Frome Rocks salt diapir, and this was compared with the stratigraphy of the wells through the Mallowa Salt in the Kidson Sub-basin. (Gingerah Hill 1 and Brooke 1).

Analysis of the composition of the salt at FRDDH001 was conducted through X-ray fluorescence (XRF) with a high-resolution continuous scanning machine by Minalyze Ltd with a helium purge to allow for detectability of light elements such as Sodium (Na). Analysis of the overlying strata was conducted with a handheld X-ray fluorescence (HHXRF).

The XRF data shows elemental variation with depth and potassium (K), Thorium (Th) and Uranium (U) can be used to generate a pseudo-Gamma-Ray (GR) log similar to a conventional GR log. Note that no conventional log data was acquired over the salt unit cored by FRDDH001. FRDDH002 reached TD shallow of the salt and also no conventional log data was acquired.

An age determination of the salt and the overlying strata was also attempted by palynology conducted by MG Palaeo, based on conventional shale clasts and also a new technique using the salt itself to identify palynomorphs. All the samples within the salt sequence were indeterminate, with very rare palynomorphs indicating a possible Devonian or younger age.

In an effort to determine the age on the salt and the over lying sequence, innovative methods developed by CSIRO have also been employed. These methods include using radiogenic dating on dolomite and fluid inclusions within the halite. This is an ongoing project with further results pending.

The hypothesis that the salt on the Jurgurra Terrace is an evaporitic sequence of Middle Devonian age leads to a previously unrecognised petroleum play beneath this salt sequence. The Tandalgoo Sandstone as encountered on the Barbwire Terrace pre-dates the deposition of the salt and demonstrates a significant supply of coarse clastics prior to the development of the evaporitic basin. This could allow for the presence of a regional reservoir seal pair prospective for hydrocarbons.

DEVONIAN EVAPORITE DEPOSITIONAL MODEL

The proposed model for the salt on the Jurgurra Terrace is that an evaporite sequence was deposited in the Middle Devonian during the opening of the Fitzroy Trough and prior to the deposition of the carbonate/claystone sequences of the Gogo and Pillara Formations. The presence of evaporitic deposits of Middle Devonian age encountered in wells surrounding the Fitzroy Trough (Mellinjerie Fm) supports a period of regional evaporitic conditions. The paleo temperature throughout the Lower to Middle Devonian indicates a global cool period associated with glaciation and a significant drop in sea level. Furthermore, tectonic plate reconstructions place the Canning Basin in an arid climatic zone during the Early to Middle Devonian (Joachimski et al, 2009). These conditions would allow for the proposed pre-rift basin over the Jurgurra Terrace to be isolated from the open marine environment and the development of favourable conditions for the deposition of thick evaporitic sequences.

The proposed depositional model for this alternative evaporite deposition during the initial rifting of the Fitzroy Trough during the Early to Middle Devonian period assumes that a large saline lake with intermittent marine connection developed over the area of the Jurgurra Terrace that was exposed to a period of evaporation and salt deposition during the Middle Devonian (Figure 6). An Early to Middle Devonian salt sequence within the Fitzroy Trough is shown in the stratigraphic column in Figure 3 and has not previously been postulated.

From the seismic data it appears that this pre-salt sequence is laterally discontinuous possibly due to rift shoulder geometries, gravity induced deposits and perhaps carbonate mounds. The sequence has strong lateral amplitude variability, visible angular unconformities and irregular appearance on seismic data.

The thickness of the salt is also likely to be variable and enhanced in places subject to the remobilisation of the salt, such as the Frome Rocks diapir. The post-salt sequence has been penetrated by several wells on the Jurgurra Terrace, including Babrongan 1, Notabilis 1, Frome Rocks 1, Frome Rocks 2, and FRDDH001, Figure 5. It consists of a thick syn-tectonic deposit of carbonates and clastics. The two wells on the crest on the diapir Frome Rocks 1 and FRDDH001; have encountered a condensed and truncated section as a result of the vertical movement of the salt.

DELINEATING THE SALT DIAPER

Several magnetotelluric (MT) surveys have been acquired in an effort to delineate the extent of the salt diapir. Note that there is no seismic data over the FRDDH001 and FRDDH002 drill hole locations. Further MT data was acquired in 2020, which helped to provide a 3D visualisation of the salt diapir, due to the large depths of investigation required to map the resistivity regime. There is a strong resistivity contrast between the salt diapir and the surrounding sediments, with an overhang on the northern side of the diapir identified from the MT model, Figure 7.

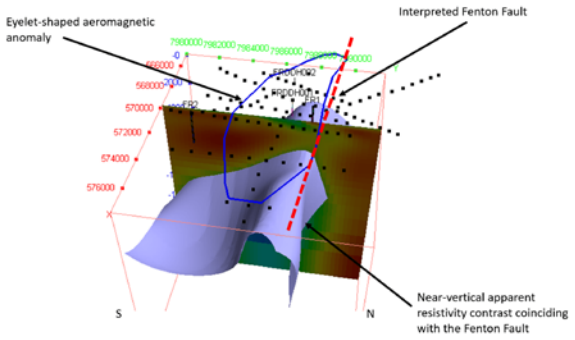


Figure 7. 3D MT Model showing the outline of the salt diapir from the resistivity contrast with an overhang on the northern side; figure attributed to Sharna Riley of Resource Potentials.

A regional airborne total magnetic intensity (TMI) survey (Feijth & Cevallos, 2015) recorded over the Frome Rocks area shows a magnetic anomaly at FRDDH002 (Figure 8). This high magnetic response is most likely from the presence of shallow volcanics in this drill hole. The edge of the salt diapir may be distinguished from the dolomitised unit on top of the salt diapir as it directly contrasts with the low magnetic response of the surrounding sediments indicating an eyelet shaped salt diapir (Figures 7 and 8).

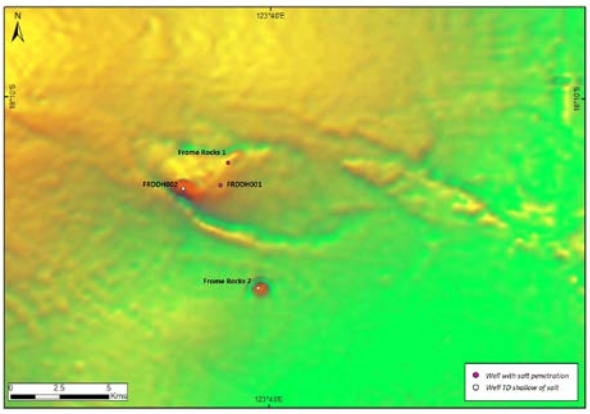


Figure 8. Magnetic Survey over the Frome Rocks Area

FRDDH001 CORE DESCRIPTION AND ELEMENTAL INTREPRETATION

No conventional log data were acquired in FRDDH001 except from a GR in the top-hole section. Evaluation of the continuous core and chip trays from FRDDH001 allows sub-division into five sections based on palynology, visual descriptions and interpretations of the core and XRF data.

Section One :From TD at 1200mMD (-1117mTVDSS) to the Top Salt at 620mMD (-537mTVDSS). XRF data was acquired over this section by Minalyze but there are no firm palynology age dates for this section.

This section consists of a claystone breccia in a halite matrix. The claystone breccia ranges in size up to 10cm, angular to sub-angular clasts, occasionally sub-rounded, suggesting some movement, but insufficient to completely round the fragments. The breccia varies in colour from green, grey green to orange green with layers of similar colouration in 2-6 m thick intervals, suggesting original layering that has been maintained despite remobilisation of the halite.

The Minalzye XRF data shows a high amount of silica (SiO2) is present and may be due to the abundant silicate rich clasts present within the salt. Magnesium (Mg) is also present and likely from dolomite clasts. (Figure 9).

There are halite crystals within the silt breccia clasts (Figure 10a), which indicates that the silt and salt was syn- depositional, with alternating layers that may represent intermittent refreshing through access to an open marine environment.

Subsequent mobilisation of the halite resulted in the brecciation of the siltstone layers and admixture of the halite to form the matrix. This mechanism of brecciation fragmented the rock into a similar size range. If the halite had simply dissolved or vacated the deposits rather than moving en-masse, the size of the fragments would be more variable.

Section Two: From the Top Salt at 620mMD (-537mTVDSS) to a local unconformity 468mMD (-385mTVDSS). There are no firm age dates from palynology for this section. This section is a claystone breccia without a halite matrix, (Figure 10b). As the breccia has similar features to the underlying breccia with a halite matrix, it suggests that although halite was originally present, the halite was subsequently removed most likely through dissolution.

The timing of halite removal is unknown, but likely occurred after mobilisation of the halite as otherwise the brecciation would not have occurred. The HHXRF data confirms this, there is a decreasing Chlorine (Cl) trend from within the salt to the top of the local unconformity where there is no Cl present (Figure 9). Cl is a direct indicator of evaporites, along with the high S which is related to the presence of anhydrite and gypsum (sulphates) (Figure 9). The HHXRF data confirms the interpretation from the core that the deposition was within the evaporitic basin, therefore any age dates over this section can be directly linked to the age of the salt.

Section Three: From a local unconformity at 468mMD (-385mTVDSS) to 352mMD (-269mTVDSS) interpreted to be the basal part of the Anderson Unconformity.

This section of the core consists of steeply dipping red and grey calcareous claystone in approximately 50m thick beds, with 50m thick interbeds of dark grey claystone rich brecciated zones, which as seen in Section Two has had halite removed. The top of this section returns to steeply dipping red and grey calcareous claystone beds around 50m thick. The HHXRF data indicates that this section has been predominately dolomitised from the high presence of Mg (Figure 9). There is still

significant S which as with Section Two is related to the presence of anhydrite and gypsum.

As with Section Two, the interbeds of brecciation would be related to halite removal at some time after salt mobilisation. The steeply dipping bedding within the grey/red calcareous claystone layers suggests that this was mobilised with the halite (Figure 10c). These claystone layers would have been deposited in an arid environment, with very little influx of coarse-grained sediments. It is recording an intermittent mudflat deposit as part of a regressive sea level, to a predominately halite sequence with syn-deposition of claystone as part of a transgressive sea level back to an intermittent mudflat. This section would have been related to the deposition within the evaporitic basin.

Section Two and Three at FRDDH001 have been correlated to the Dolomite Breccia cap rock at Frome Rocks 1 1959. Based on the evidence observed from the continuous core at FRDDH001 this has been re-interpreted to have been deposited as part of the evaporitic basin and not a separate carbonate unit mobilised with the salt, therefore any age dates over both Section Two and Three are directly linked to the age of the salt, Figure 11.

Section Four: From the basal Anderson unconformity 352mMD (-269mTVDSS) to 178mMD (-95mTVDSS) interpreted to be the Meda Unconformity.

This section represents the Serpukhovian (Early Carboniferous) sequence of the dated *G. maculosa* zone interpreted Anderson Formation, the base of which has been identified as unconformable to the underlying strata. The last palynology identification within this zone is at 343mMD (-260mTVDSS), all other deeper palynology samples returning indeterminate.

This section in the core consists of grey fluvio-marine sandstones interbedded with siltstones, the sands possess wave ripples while some of the siltstones are bioturbated, this indicates a likely deposition in a shallow marine to deltaic environment influenced by wave and tidal currents. The deposition of this section is not related to the deposition of the underlying evaporites, as there is an obvious unconformity and change in depositional environment between the sections in the core. This is clearly identified from the HHXRF by an increase in K and a decrease in S, and a change in the Chem-Lithology, which does support a shallow marine to deltaic influenced depositional environment (Figure 9).

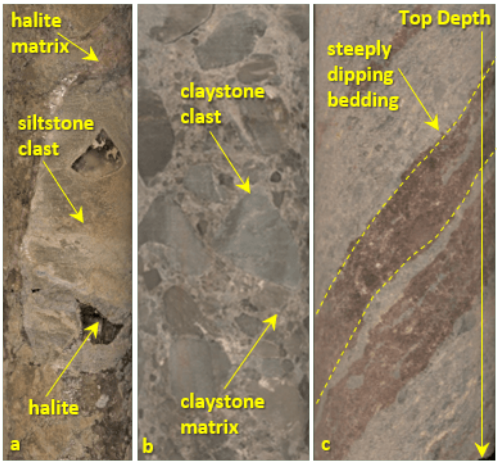


Figure 10. FRDDH001 a) Halite crystals within the silt breccia clast 943m; b) Claystone breccia without a halite matrix 485m; c) Steeply dipping bedding 455m

Section Five: Observations and data has been collected from the chip trays and can be summarised from the Meda Unconformity at 178mMD (-95mTVDSS) to the Fitzroy Unconformity at 133mMD (-50mTVDSS). This section represents the Bashkirian to Serpukhovian (Early to Middle Carboniferous) sequence of dated *S.ybertii*, interpreted Reeves Formation, bounded at its top and base by unconformities.

Note very rare *S.ybertii* zone was noted in samples from 538mMD (-455mTVDSS) and 573mMD (-490mTVDSS), however this is within a brecciated section of the core and most likely re-worked.

Above the Fitzroy Unconformity at 133mMD (-50mTVDSS) the Wallal Sandstone has been interpreted from the conventional Gamma-Ray (GR) log and chip tray observations, with a fine clean sandstone identified, no palynology samples were attempted.

DETERMINING THE AGE OF THE EVAPORITES ON THE JURGURRA TERRACE

Various methods have been used to collect all observations and indications to support the hypothesis that the salt encountered within the salt diapir in Frome Rocks area is different to the Ordovician Mallowa Salt intersected in the Kidson Sub-basin and on the Barbwire Terrace. Combining innovative dating techniques with the palynology, depositional modelling and interpretations from the core may directly lead to unlocking new conventional petroleum prospects on the Jurgurra Terrace.

Palynology

Three shale clasts were identified within the salt in the core recovered from the 1959 Frome Rocks 1 well (Figure 12). With the initial palynology dating having been conducted in 1959, it was hoped that it might be possible to identify a biozone with more modern techniques.

Although several different processing methods were attempted, none were successful in recovering any palynomorphs. In the absence of palynomorphs, the slides were scanned for vascular plant material, but there was none found other than extensive minerals and some inertinite fragments. It

was concluded that there was no in-situ organic material present and all samples were barren.

Figure 12. Additional palynology samples from Frome Rocks 1

Samples from FRDDH001 below 343.3mMD, returned indeterminate results despite using two different sampling methods.

A dark very rare woody material was identified within samples immediately above the salt and the top of the salt (Figure 13) which could be of Devonian age or younger if in place, as this type of material is not present in older strata.

Other samples of note were from 725mMD (-642mTVDSS) and 774mMD (-692mTVDSS) as these contained a very rare black tracheid material, which provides evidence of vascular plants, which would give an age of Devonian or younger if in place.

The samples above 343.3mMD that did yield palynomorphs indicated an older stratigraphy of Carboniferous age compared with the younger Jurassic sediments dated at Frome Rocks 1.

Based on a combination of these observations, interpretations and age established by palynology, a Devonian Salt Model over the Frome Rocks salt diapir and surrounding strata has been postulated (Figure 11).

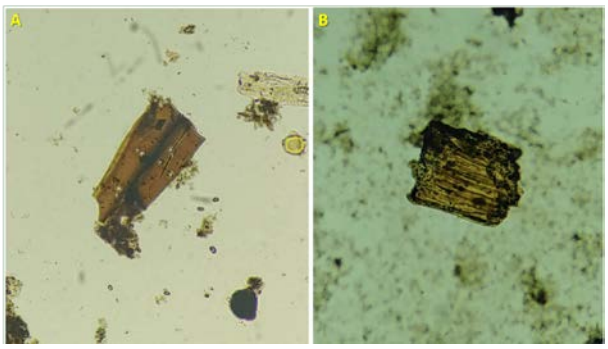


Figure 13. FRDDH001 Dark very rare woody material possible Devonian or younger a) 605.4mMD b) 538.6mMD

Innovative Dating Mechanisms

CSIRO has combined innovative methods and techniques to attempt to date the evaporite sequence encountered in the FRDDH001 drill hole. Salt is a challenging material to work with as it is easily remobilised, minerals may recrystallise, and salt can re-precipitate at laboratory conditions and potentially affect the measured properties. CSIRO have proposed to test a series of analytical methods to investigate evaporites and carbonates in samples of the core from the FRDDH001 drill hole. This work includes the examination of fluid inclusion and radiogenic dating of the salt and associated material to a provide minimum age and is ongoing.

CONCLUSIONS

The availability of the two continuously cored FRDDH001 and FRDDH002 drill holes allowed for an extensive search for the absolute dating of the Frome Rock salt diapir. The cored post salt section from FRDDH001 with the brecciated claystone and dolomites (Section Two and Three) appears to be deposited contemporaneous with the salt, and hence any age indication from these sections would be applicable to the age dating of the underlying salt. Although none of the age dating attempts so far have been conclusive, there are several indications that the evaporitic sequence in this core is of Devonian age (dark very rare woody material at the top salt and the very rare black tracheid material within the salt). Ongoing age dating work by CSIRO was not available at time of writing but might yield additional support.

There have also been no indications of any samples aged older than Devonian, which might have been expected if the evaporite and associated salts were contemporaneously deposited as the Mallowa Salt in the Ordovician.

Without any conclusive evidence for an absolute age, the hypothesis that the salt on the Jurgurra Terrace and the Frome Rocks diapir could be of Middle Devonian age remains viable. The core from FRDDH001 gives a unique insight in the stratigraphic development of the evaporites on the Jurgurra Terrace but did not provide any age measurements to disprove this hypothesis.

The regional tectonic and depositional model allows for a local marine basin to have developed as part of the initial opening of

the Fitzroy Trough during the Early to Middle Devonian, which could have become isolated by a global sea level drop in Middle Devonian. The resulting evaporites and salt deposits would cover an unknown, pre-salt stratigraphic sequence deposited contemporaneously with the Mellinjerie Fm on the Barbwire Terrace. This stratigraphy has not been penetrated in any of the wells, and as such is not yet a recognised part of the stratigraphy of the Canning Basin. It is postulated that this sequence could contain some of the coarse clastics of the Early Devonian Tandalgoo Sandstone, which would result in a petroleum play with a regional reservoir seal pair that is entirely independent of the subsequent Carboniferous and Triassic tectonic phases.

The age dating project of the salt on the Jurgurra Terrace has been part of the ongoing exploration efforts by the Buru Energy-Origin Energy Joint Venture to unlock the petroleum potential of the Canning Basin. These efforts include the planned acquisition of new 2D seismic data in 2021 and the potential testing of the sub-salt play in the succeeding years.

ACKNOWLEDGMENTS

The authors would like to thank Buru Energy and Origin Energy for allowing publication of this study; Chemostrat, CSIRO, MG Palaeo, Minalyze, Resource Potentials, Rey Resources, Strat Trap Pty, and contributions from Buru geoscientists. We also acknowledge the Nyikina Mangala community, traditional owners of the land where the wells over the salt diapir are located.

REFERENCES

Feijth. J, Cevallos. C, 2015, Fixed wing FALCON airbourne gravity gradiometer survey: Canning Basin, Western Australia, Intrepretation Summary Report – Southern Caiing Basin, Ref 2442.

Foster, CB, and Williams, GE, 1991, Late Ordovician – Early Silurian age for the Mallowa Salt of the Carribuddy Group, Canning Basin, Western Australia, based on occurrences of *Tetrahedraletes medinensis* Strother & Traverse 1979: Australian Journal of Earth Sciences, v. 38, p. 223–228.

Glenister. B, 1959, Conodonts and Fish Plates from Frome Rocks 1, Report No 28, part of Appendix A in Frome Rocks 1 Well Completion Report, p 21-22.

Haines, PW, 2009, The Carribuddy Group and Worral Fomration, Canning Basin, Western Australia: Stratigraphy, Sedimentology, and Petoleum Poetntial, Geological Survey of Western Australia, Report, Ref 9821/2525/W721, p 105, 60.

Haines, PW, 2010, The Carribuddy Group and Worral Fomration, Canning Basin,WA: Reassessment of stratigraphy and petroleum potential. The APPEA Journal, Janurary 2010 50th Anniversary Issue. DOI: 10.1071/AJ09026. p 425-444.

Joachimski, M. Breisig, S. Buggisch, W. Talent, J. Mawsom, R. Gereke, M. Morrow, J. Day, J. Weddige, K. 2009, Devonian climate and reef evolution: Insights from oxygen isotopes in apatite, Elsevier, Earth and Planetary Science Letter 284, 599-609.

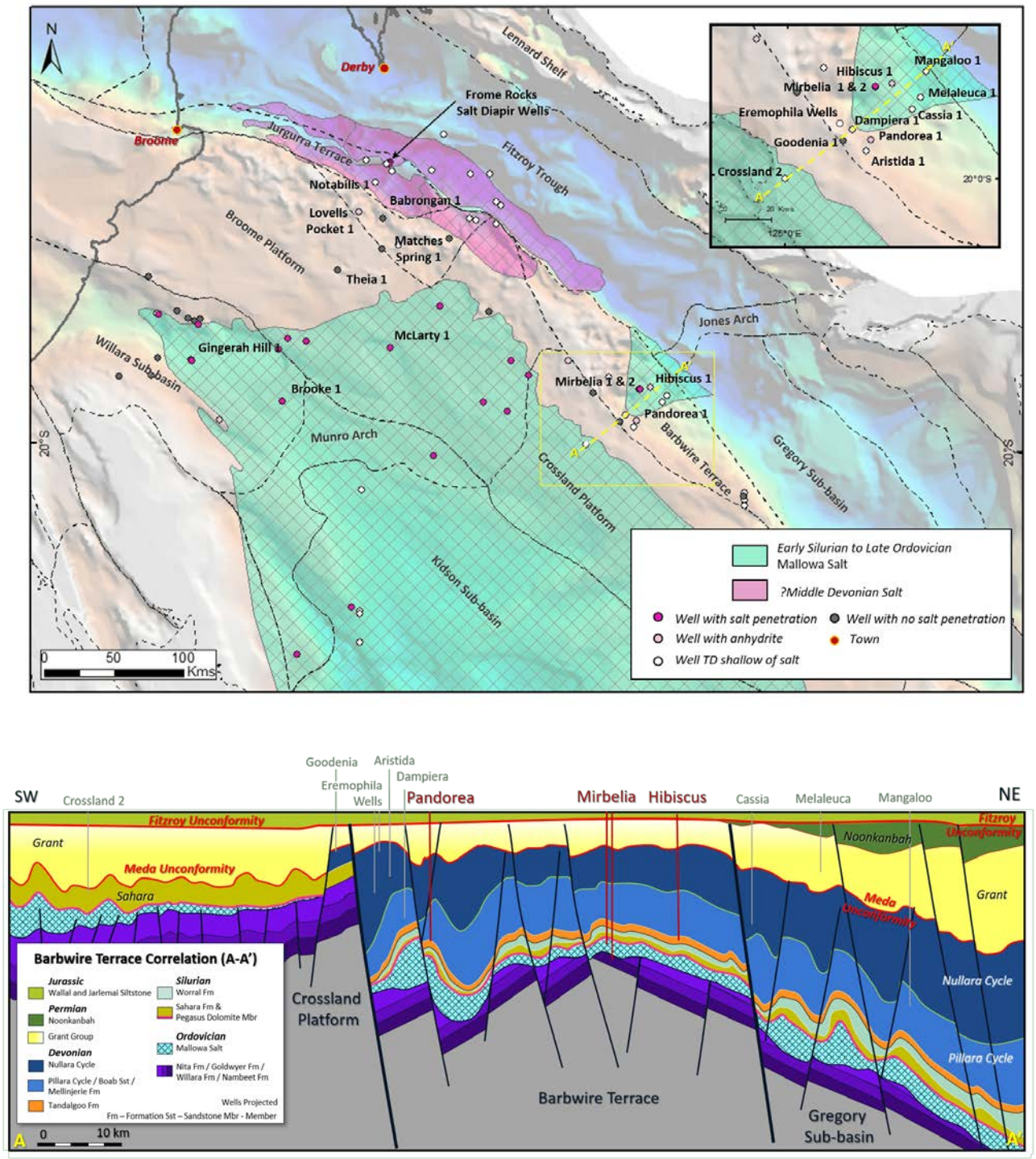


Figure 2. Barbwire Terrace Correlation A-A': Correlation across Crossland Platform along Barbwire Terrace to Gregory Sub-basin highlighting the separated Mallowa Salt sequence

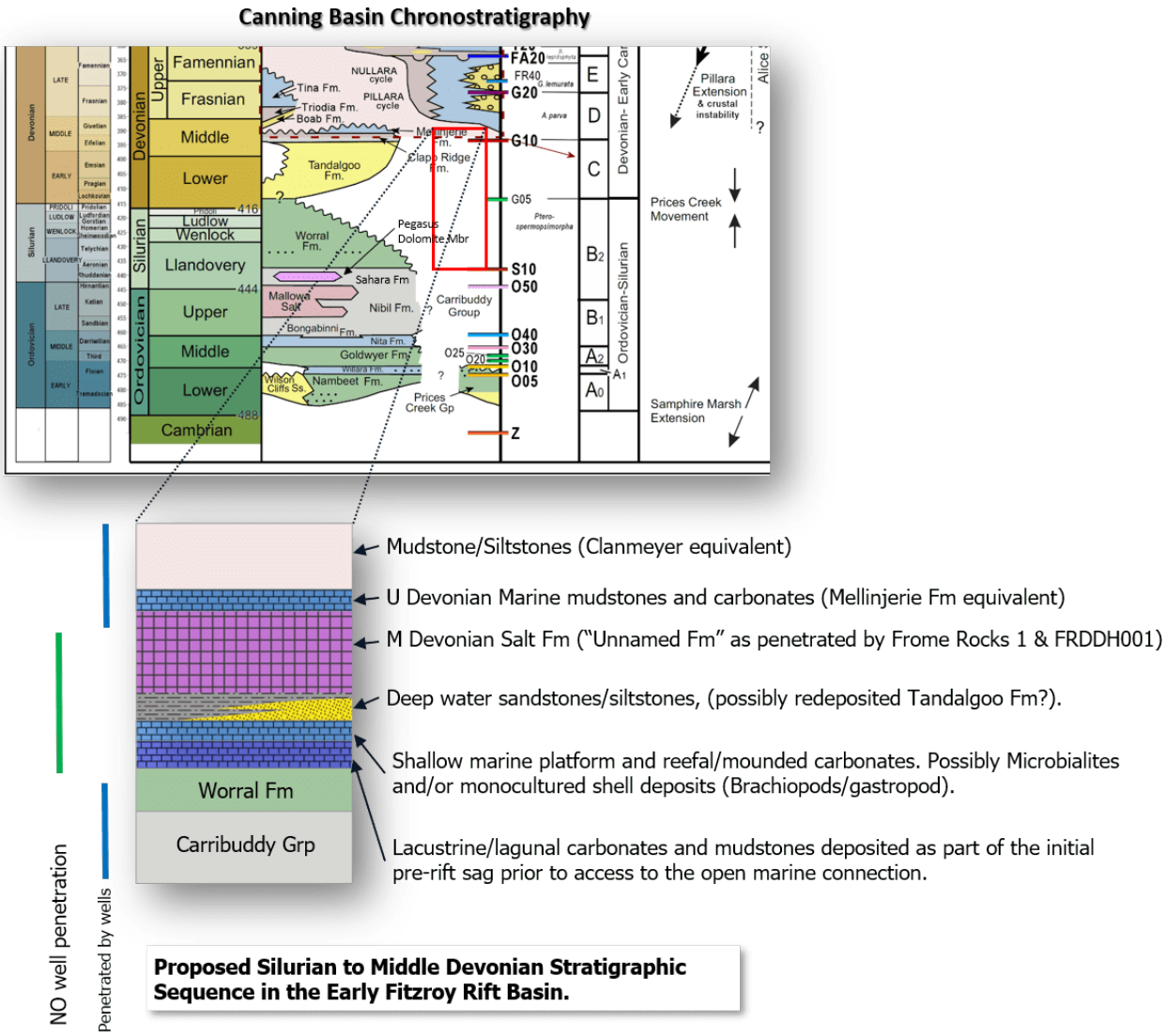


Figure 3. Canning Basin Stratigraphic Column and Proposed Stratigraphic Column with a Devonian Salt

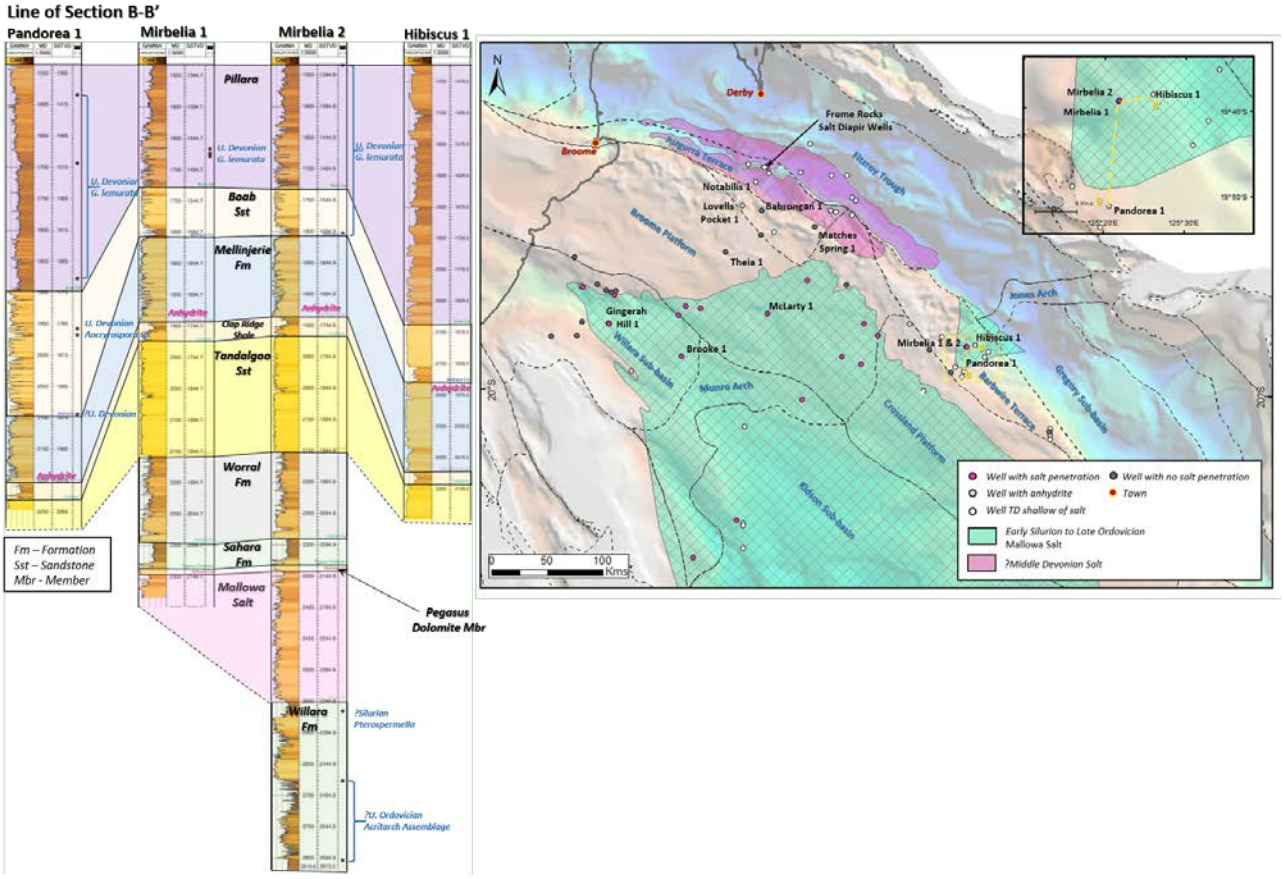
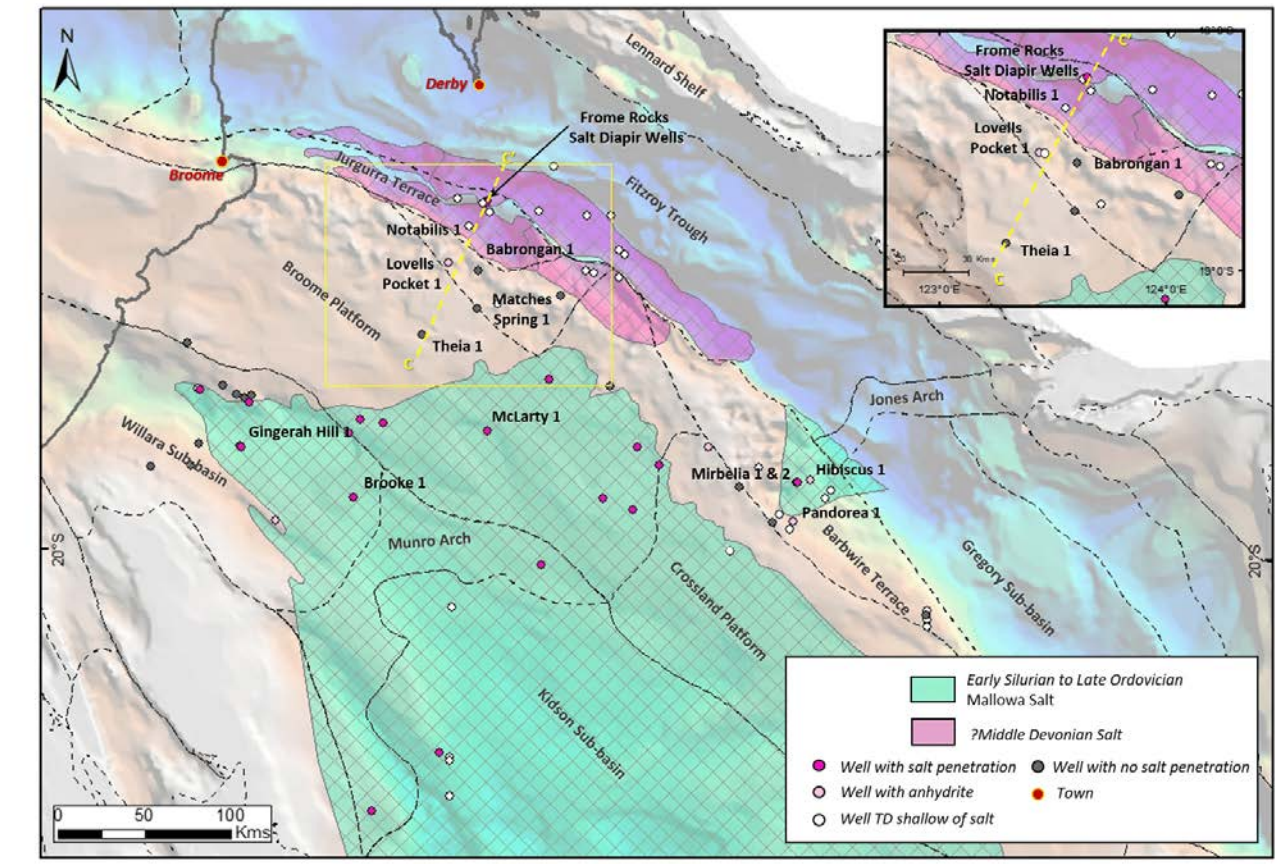


Figure 4. Line of Section B-B': Well Correlation along Barbwire Terrace highlighting Upper Ordovician to Upper Devonian Stratigraphy and evaporites within Mellinjerie Formation



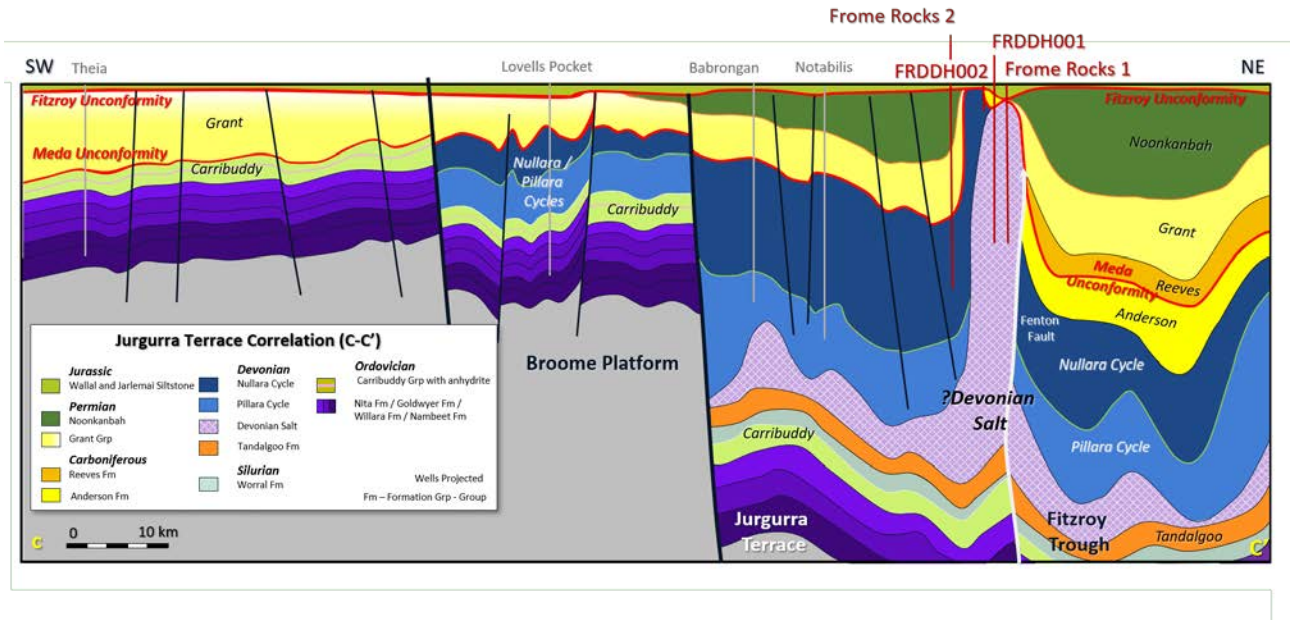


Figure 5. Line of Section C-C': Correlation from Broome Platform to Jurgurra Terrace with no well penetrations of in-situ salt or pre-salt sequence and anhydrite within Carribuddy Fm on Broome Platform

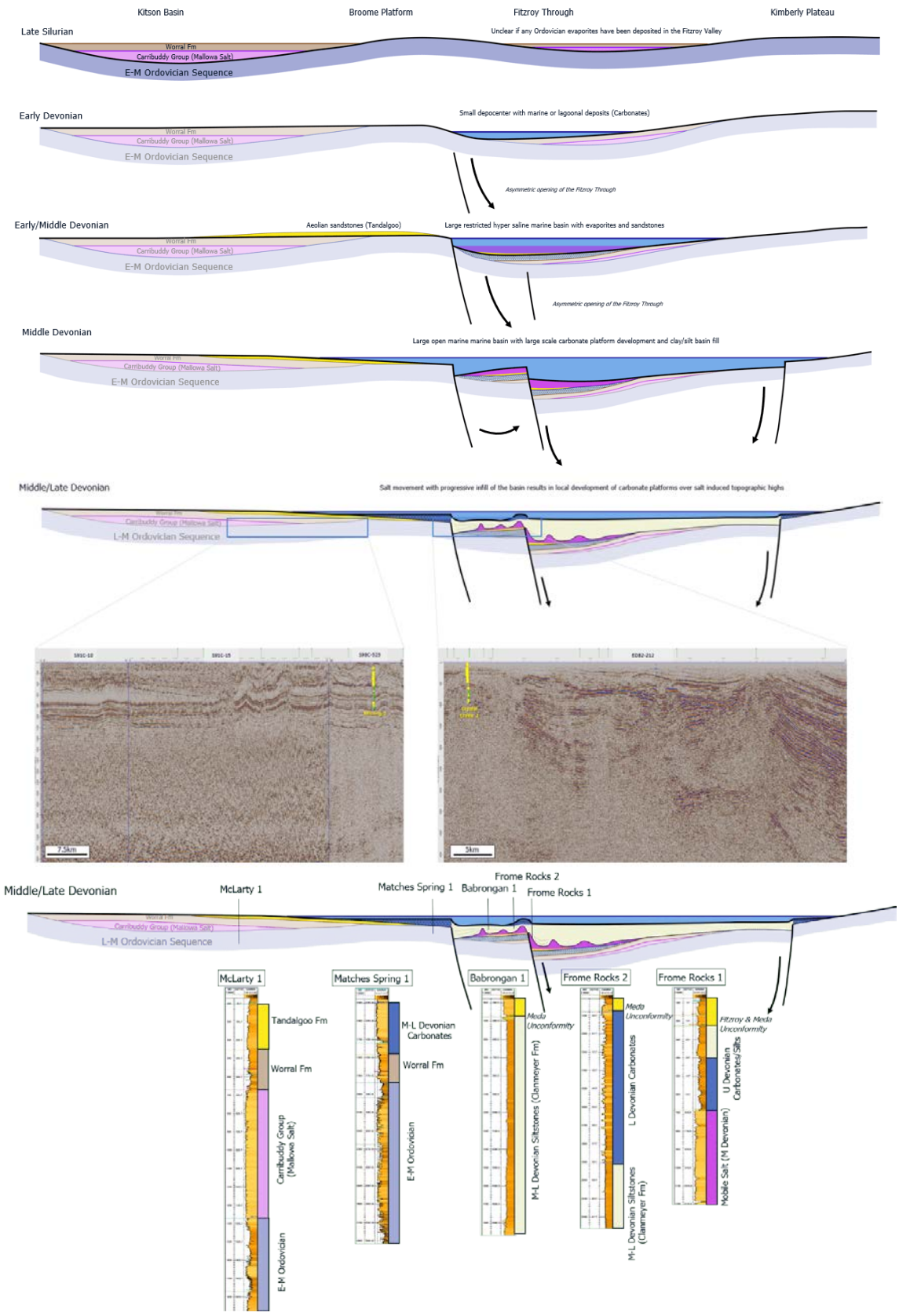


Figure 6. Alternative Devonian Evaporite Depositional Model

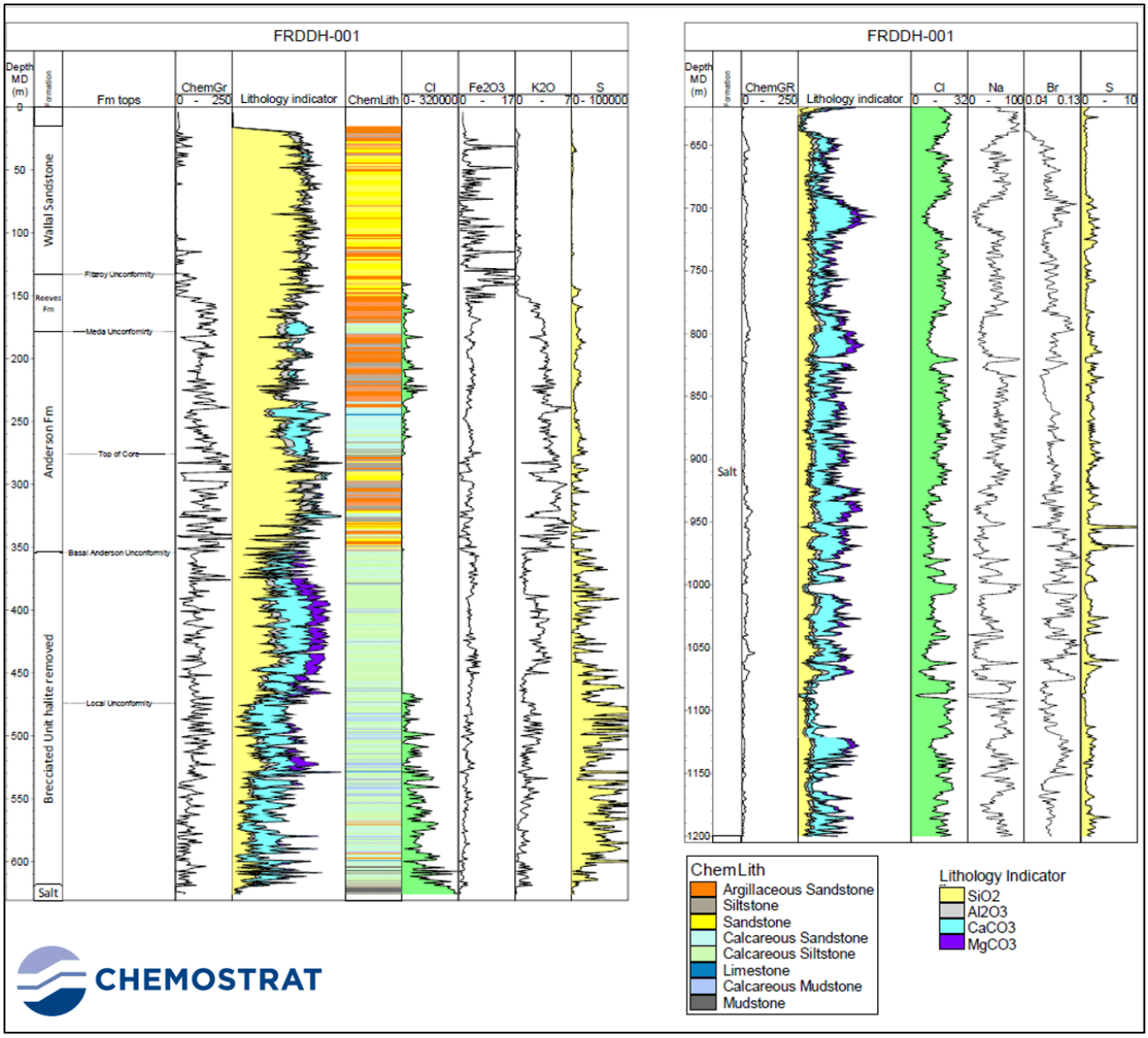


Figure 9. FRDDH001 XRF Data

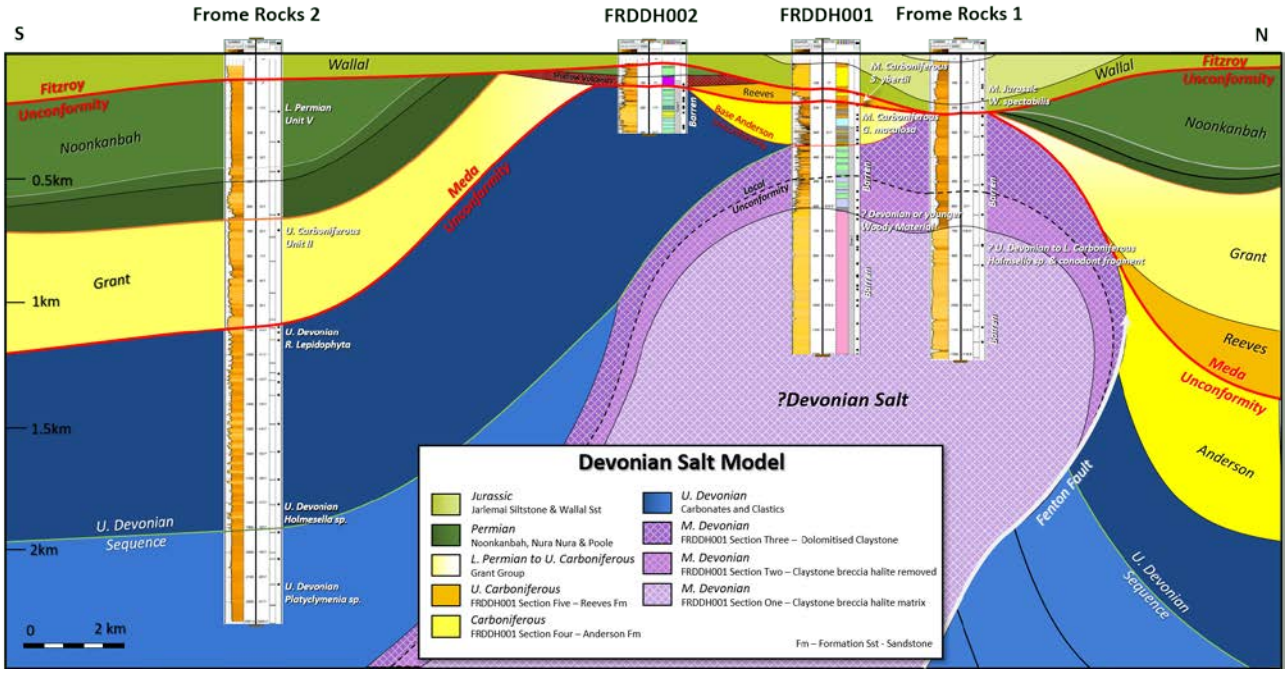


Figure 11. Devonian Salt Model over Frome Rocks Salt Diapir