

Comparison of Stratigraphic Characteristic (Lithology and Thickness) of Eldon Range Group / Tiger Groups in Tasmania with the Equivalent Sediments of Munda Group (Officer Basin) In Central Australia Basins

References with underlines have been written at reference section.

Add Officer Basin's reference to the list.

Introduction:

The Tiger Range Group in Tasmania has been defined as Late Ordovician to Early Devonian (Burrett and Martin, 1989). The outcrop of the Tiger Range Group lies conformably above the Gordon Group on western side of the Florentine Valley south of Tasmania. These sediments have been defined as Silurian – Devonian (Banks, 1989, Stacy **2008**, Alan Chester, **2001**) shallow marine, quartz – sandstone and mudstone sequences. The correlate of the Tiger Range Group in the Zeehan area is known as Eldon Group (Baillie, 1989) which, lies disconformably above Gordon Group.

The closest Proterozoic basins comparable with the Tiger Range Group / Eldon Group in the Central Australia Basins is Officer Basin. Officer Basin encompasses sediments from Pre-Cambrian to Paleozoic and includes Munda Group as the shallowest sediment age Early – Middle Ordovician to Silurian and Mimili Formation age Early – Late Devonian. Officer Basin covers an area of > 350,000 km² of Western Australia and South Australia (Morton & Drexel, 1997, Brewer et al., 1987; Benbow, 1982; Gatehouse et al., 1986; Fig. 1). The lithostratigraphy of the Officer Basin is relatively poorly known due to poor outcrops and complex stratigraphy with at least 33 mappable stratigraphic units.

Tiger Range Group:

Tiger Range Group is identified as Early Silurian – Early Devonian overlying Florentine Valley, Ordovician sediments in south-central Tasmania and comprises siliciclastic shallow marine quartz-sandstone and mudstone sequences (Burrett and Martin, 1989). A change from Sandstone to Orthoquartzite represents a change to originally more permeable and porous rocks which allowed ready access to siliceous solution. Tiger Group is conformable with the Gordon Group and comprises 1150 m of sediments with stratigraphic column of Arndell

Sandstone on top of the Gordon Group followed by Gell Quartzite, Richea Siltstone, Currawong Quartzite and McLeod Formations.

Arndell Sandstone:

Arndell Sandstone is identified as top of the Gordon Group or the base of Eldon Group in early Silurian in Westfield area (p225 Fig, 12, Burrett and Martin, 1989). Arndall Sandstone is mostly sandstone and siltstone and overlies Gordon Group conformably.

Gell Quartzite:

Gell Quartzite overlies Arndell Sandstone with 130 m thickness, **which becomes increasingly sandy in early Silurian** consisting dominantly of siliceous orthoquartzite (Banks, and Baillie, 1989) and contains oscillation ripple marks (Baillie, 1979; Clarke, 1981; Burrett and Martin, 1989) flaser-bedding and reactivation surfaces. These features indicates **very shallow water environment**.

Richea Siltstone:

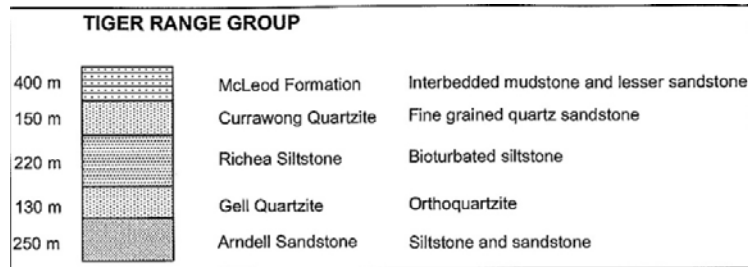
Richea Siltstone overlies Gell quartzite with 220 m bioturbated fossiliferous siltstone contains Late Llandovery fauna and Wenlock fossils (Banks, and Baillie, 1989; Baillie, 1979-from website updated 2008) siltstone **deposited in deeper, low energy environments than Gell Quartzite** (Clarke, 1981; Burrett and Martin, 1989).

Currawong Quartzite:

Currawong Quartzite with about 150 m thickness dominantly fine grained quartz sandstone, minor siltstone and mudstone had overlain Richea Siltstone. These sediments **were probably deposited in similar environments with Gell Quartzite** (Clarke, 1981; Burrett and Martin, 1989; Baillie, 1979).

McLeod Formation:

McLeod Formation, age Lower Devonian consists of 400 m poorly fossiliferous fine-grained sandstone and shale (Banks and Baillie, 1989 - from poorly from website updated on 2008; Baillie, 1979) with interbedded mudstone and minor sandstone in the uppermost formation in Tiger Group (Clarke, 1981; Burrett and Martin, 1989).



Eldon Group:

Eldon Group comprised Early Silurian – Early Devonian sedimentary rocks overlying the Upper Benjamin Limestone Member of Gordon Group in Zeehan area in the West of Tasmania [Terrane \(a section of the Earth's crust that is defined by clear fault boundaries, with stratigraphic and structural properties that distinguish it from adjacent rocks\)](#). Eldon Group is defined as shallow- marine interbedded quartz sandstone and mudstone with subordinate limestone (Banks, 1962; Clarke in Gee et al., 1969; Baillie, 1979; Burrett and Martin, 1989).

The maximum thickness of about 2.3 km (Baillie & Corbett, 1985; Calver et al., 1987) of Eldon Group has been documented in the Strahan – Queenstown Little Eldon area. Gill & Bank (1950) identified Eldon Group as ~1760 m thick in Zeehan area, where section was defined as Crotty Quartzite at the base overlaid by Amber Slate, Keel Quartzite, Florence Quartzite and finally Bell Shale at the top. Devonian rocks with over 1 km thickness and six distinguish lithological units, were found at Lower Gordon River (Gee at al., 1969).

At Point Hibbs area, Talent & Banks, (1967) found limestone and sandstone of Lower Devonian formation in Spero Bay Group.

Crotty Quartzite:

Crotty Formation previously known as Crotty Quartzite (Banks and Baillie, 1989 -from website updated on 2008) is the basal formation of the Eldon Group overly unconformably

above Gordon Group with a thickness of 490 m. The formation consists of fine to coarse grained quartz sandstone, conglomerate and mudstone.

Amber Formation:

Amber Formation previously known as Amber Slate is 240 m interbedded mudstone and siltstone with minor sandstone, occasional layers of limestone and fine-grained sandstone present (Banks and Baillie, 1989 -from website updated on 2008).

Keel Quartzite:

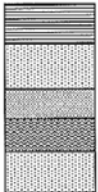
Keel Quartzite consists of 120 m cross-bedded and ripple-marked fine grained quartz sandstone . The Astral Creek Siltstone previously known as Hill Shale is a formation of thin bedded grey and green-grey siltstone and fine quartzite in the Duck Creek Syncline (Banks and Baillie, 1989 - from poorly from website updated on 2008), mudstone occurring in the top 60 m of Keel Quartzite (Blissett, 1962) overlain by Florence Quartzite. Astral Creek Siltstone was originally mapped by Taylor (1954) as Hill Shale between Keel and Florence Formations, but later defined in the Zeehan area as Austral Creek Formation (Gill and Banks 1950).

Florence Quartzite:

Florence Quartzite comprises 490 m of fine to very fine-grained quartz sandstone, with minor interbedded siltstone and mudstone and is bioturbated. Fix this description

Bell Shale:

Bell Shale comprises of about 420 m that comprises an upper; dominantly mudstone with marine macrofossils; and a lower: thin bedded, very fine-grained quartz sandstone, siltstone and mudstone; with marine macrofossils (Banks and Baillie, 1989 - from poorly from website updated on 2008). Rare horizons of impure limestone have been identified in Bell Shale (Burrett and Martin, 1989).

ELDON GROUP			
420 m		Bell Shale	Sandstone and mudstone
490 m		Florence Quartzite	Fine to very fine quartz sandstone
120 m		Keel Quartzite	Fine grained quartz sandstone
240 m		Amber Slate	Interbedded mudstone, siltstone and fine-grained sandstone
490 m		Crotty Quartzite	Quartz sandstone, conglomerate and mudstone

Environmental Deposition

(I should change writing in this part, copied from Alan Chester's)

The deposition of clastic material over the Ordovician carbonates indicates that the commencement of a significant uplift in the source area occurred combined with regression of the sea. The sequence of the sandstone to later mudstone / siltstone sequences is consistent with a reduction in uplift with time, and consequent lowering in the rate of erosion.

Significant for hydrocarbon exploration, these sediments mark a burial phase of possible source rocks and the sequence also contains possible sandstone reservoir rocks and suitable fine grained mudstones as seals.

(From book, Page 232)

In General evidences show that in all western Tasmania Terrane Siluro - Devonian rocks were deposited under shallow marine conditions through barrier bar systems, which are to

some extent deeper than tidal-flat environment which Bell shale and Mc Leod Formation were deposited.

Officer Basin:

The Officer Basin covers an area of > 350,000 km² of Central Australia from Yilgarn block in Western Australia to Gawler Craton in South Australia (Fig. 1). It is an arcuate depression ~ 500 km long and up to 10,000 m thick (Morton & Drexel, 1997) gently folded Neoproterozoic and Palaeozoic sediments.

The lithostratigraphy of the basin is relatively poorly known compared to other South Australian basins. This is due to poor stratigraphic control and multitude of sedimentary units with similar depositional environments of different age with at least 26 mappable formations and many members. Outcrops are poor and of limited stratigraphic intervals due to low dips and subdued topography.

The Officer Basin represents a structural history of mid Neoproterozoic to Late Devonian (~820–360 Ma). The early Palaeozoic sediments are largely non-marine. The basal Cambrian Marla Group comprises the Aeolian to marine Relief Sandstone intercalated with the marine Ouldburra Formation. The overlying Observatory Hill Formation records a variety of Palaeoenvironments from fluvial to alkaline playa lake. The upper Marla Group comprises shallow marine to fluvial sandstones (Arcoellinna and Trainor Hill Sandstones) separated by the shallow marine Apamurra Formation. Kulyong Formation (volcanics and sands), from late Cambrian is poorly known.

The marginal marine Mount Chandler Sandstone (Early to Middle Ordovician), Indulkana Shale (Mid to Late Ordovician) and Blue Hills Sandstone of the Munda Group (Late Ordovician, Silurian to Middle Devonian) are the shallowest sediments of the Officer Basin. The youngest unit in the basin is the Devonian non-marine Mimili Formation, restricted to the central Munyarai Trough (Fig 2; Morton & Drexel, 1997).

Ordovician to Devonian (~500 – 360 Ma) deposition comprise a thick wedge, thickening to the north against the Musgrave Block, and terminated by the Alice Spring Orogeny which occurred ~360 Ma.

Munda Group:

Munda Sequence was defined by Krieg (1973) for the predominantly Ordovician sequence of formation. Morton & Drexel (1997) redefined it as Munda Group containing three Formations age Late Ordovician to Early Silurian. Overlain defined Formation is Mimili Group of Late Devonian (Morton & Drexel, 1997). The system track recorded on the sequence of formations shows a major transgression from LST (Low stand System Tract) in Mount Chandler Sandstone to TST (Transgression System Tract) in Indulkana Shale which was formed during maximum transgression. Later on during HST (High stand System Tract) Blue Hills Sandstone was formed. Moussavi-Harami and Gravestock, (1995) have suggested that maximum thickness of Munda Group is >3000 m in the Marla area therefore, 1500-2000 m of Munda Group has been removed by erosion. The lower contact of Munda Group is unconformable probably due to Delamerian Orogeny. The upper unconformable contact is attributed to Rodingan Event (Morton & Drexel, 1997).

Mount Chandler Sandstone:

Mount Chandler Sandstone with age of Late Ordovician, 457- 450 Ma is widely distributed over the Officer Basin. The thickness varies from 160 m in manya to 472 m in Karlaya and up to 609 m in outcrop in Cartu Hill area (benbow, 1982), while type section has been identified 40-512 m in Karlaya (Morton & Drexel, 1997). Reference sections are defined as 33-245 m in Byilkaora and 1189 -1355 m in Munyarai (Morton & Drexel, 1997).

The lower part of the Mount Chandler Sandstone formation comprises quartz sandstone to friable, well sorted, well rounded, fine grained white sandstone. The upper part is brownish orange to slightly reddish vaguely feldspatic sandstone. Minor layers of rounded to subangular polished with quartz pebbles occur. The basal contact is unconformable with Kulyong Formation of Early – Mid Cambrian. The upper contact is either conformable with the Indulkana Shale or unconformable with Permian sediments of Arckaringa Basin.

Byilkaoora Formation is defined as basal member of Mount Chandler Sandstone (Benbow, 1982). The unit is 15-20 m thick in outcrop and too thin to recognize in the subsurface therefore has been defined as part of the Mount Chandler Sandstone (Morton & Drexel, 1997). Byilkaoora Formation is characterised by conglomerate with well-rounded clasts of gray feldspathic sandstone, with light blue fine gray quartz, veined quartz and shale. A sandy facies is also present, comprising white kaolinitic, very fine grained sandstone with minor siltstone and claystone. The lower contact is sharp and unconformable but upper contact is gradational (Morton & Drexel, 1997).

Indulkana Shale:

Packham and Webby (1969, in Morton & Drexel, 1997) introduced the Indulkana Shale at outcrop on the northern side of Indulkana Range. Subsurface reference sections are defined as 282 – 293 m in Lairu with a possibility of 1180 – 1189 m in Munyarai. Lithology of Indulkana Shales comprises of maroon and green shale with thin, flaggy sandstone beds consisting clay pellets near the base and top. The formation contains limestone lenses and scatter micaceous silty sandstone. Distribution is irregular due to removal by erosion. The thickness is identified up to 60 m in outcrop in the Indulkana Range and is about 9 m in Munyarai and varies from 1 to 11 m in Lairu. The contact is conformable with upper and lower sediments. Stratigraphic and radiometric data confirm **Late Ordovician** (450 – 445 Ma) for Indulkana Range (Morton & Drexel, 1997).

Blue Hills Sandstone:

Blue Hills Sandstone was introduced by Krieg (1973). This unit includes overlying Cartu Beds (Stainton et. al., 1988) and Mintabin Beds (Packham and Webby, 1969 (unpublished); Krieg, 1973).

The type section was chosen in outcrop southwest of Mount Johns. Subsurface reference sections are proposed as 65 – 282 m in Lairu and 1018 – 1180 m in Munyarai. The lithology of lower parts is composed of fine to medium – grained quartz sandstone, containing various thin conglomerate beds. Covering soft kaolinitic sandstone and well sorted porous sandstone formation is feldspathic and micaceous in the Mintablie area. The formation is very irregular in Munyarai Trough where not removed by erosion. Blue Hills Sandstone conformably overlies Indulkana Shale and has a conformable contact with overlain Mimili Formation. The

Thickness is 162 m in Munyarai and varies from 1 to 187 m in Lairu. Krieg (1973) suggests over 1900 m in outcrop to the east. Based on stratigraphic data Blue Hills Sandstone represents **Late Ordovician to Early Silurian** (Morton & Drexel, 1997).

Mid – Late Silurian is missing, Early – Mid Devonian is missing too. A big regression? Hiatus.

Mimili Formation:

The youngest sandstone unit in the Officer Basin is introduced as Mimili Formation. Although a vertebrate fish fauna indicates an **Early to Middle Devonian** age for Mimili Formation. The upper and lower parts of the sequence are barren and thus age spanned is wider than indicated by fossils. Additionally based on palynology, Mimili Formation is mostly regarded as **Late Devonian** (375 – 360 Ma).

According to seismic data Mimili formation is restricted to Munyarai Trough area with a thickness of over 1018 m. The type section represents three units (Tucker, 1994). The lowest unit composed of fine to medium- grained micaceous and infrequently calcareous arkosic sandstone. The middle unit consists of interbedded greenish gray micaceous, calcareous mudstone with minor siltstone and fine to medium – grained sandstone. The top unit contains muddy brown arkosic sandstone (Morton & Drexel, 1997). The lower contact with the Blue Hills sandstone is unconformable. The top unit is eroded and upper contact is unconformable. The overlain formation is not known, but is suggested to be Permian or younger.

Fig. 1: Petroleum Geology of South Australia, Volume 3 Officer Basin, SA Mines and Energy Resources, 1st Edition, Edited by J.G.G.Morton and J.F.Drexel, April 1997

Fig 2: Summary of current stratigraphic history (after Tucker and McKerrow 1995).

Reference

Type section= a group made up of individuals or items that have strongly marked and readily defined similarities

Reference section= a source of information, e.g. a dictionary or an encyclopedia

Terrane = (a section of the Earth's crust that is defined by clear fault boundaries, with stratigraphic and structural properties that distinguish it from adjacent rocks)

Encountered = to confront somebody with hostility or aggression, a meeting with somebody or something, usually unexpected and brief.

Overlies = this covers some things else

Overlain = this is covered by some thing

Overlying the layer 1 is layer 2

Unconformably

disconformable

Use this in comparison part

The Officer Basin has undoubtedly sourced oil as evidenced from the oil shows recorded, some of which have been proven from biomarkers to have derived from Neoproterozoic source (P.4Petroleum Geo of south aust Edited by jGG Mort and Drexel, green cover)

Lack of Limestone in Officer Bassin, (Sand, Shale, siliciclastics).

Use these references. For any of in “..... “ use in text

Formations

[illegible]