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WELL AND OUTCROP CORRELATION IN THE EASTERN PART OF AKIMEUGAH BASIN, PAPUA: MESOZOIC PLAY POTENTIAL

KORELASI DATA SUMUR DAN DATA SINGKAPAN BATUAN DI CEKUNGAN AKIMEUGAH BAGIAN TIMUR, PAPUA: POTENSI *PLAY* MESOZOIKUM

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ABSTRAK

Batuan sedimen Mesozoikum adalah target utama eksplorasi hidrokarbon di bagian timur Cekungan Akimeugah, Papua. Akan tetapi, hanya sedikit informasi yang tersedia tentang paleogeografi dan penyebaran bawah permukaan unit batuan ini. Studi ini menganalisa unit batuan Mesozoikum yang tersingkap di daerah Wamena dan sekitarnya serta data sumuran di bagian timur Cekungan Akimeugah. Korelasi singkapan dan data sumuran dilakukan untuk menginterpretasi paleogeografi batuan Mesozoikum. Studi ini juga menggunakan data seismik 2D dan passive seismic tomography untuk menentukan distribusi bawah permukaan batuan Mesozoikum dan potensi hidrokarbonnya. Unit batuan Mesozoikum di bagian timur Cekungan Akimeugah dibagi menjadi empat formasi berdasarkan karakteristik litologinya. Berturut-turut dari tua ke muda adalah Formasi Kopai, Woniwogi, Piniya dan Ekmai. Lingkungan pengendapan batuan Mesozoikum di bagian selatan area studi adalah lingkungan shore/tidal dan lingkungan shelf dan basin floor di bagian utara. Tiga potensi play Mesozoikum di daerah studi dibagi menjadi 1) Central Range Mountains thrust-fold belt play, 2) Akimeugah low land thrust-fold belt play dan 3) Tanah Merah pinch-out play. Hasil studi yang disajikan di tulisan ini diharapkan dapat menjadi petunjuk untuk ekplorasi hidrokarbon lebih lanjut di daerah studi.

Kata Kunci: *cekungan akimeugah, play mesozoikum, kopai, woniwogi, piniya, ekmai.*

ABSTRACT

Mesozoic sediments are the main objective for hydrocarbon exploration in the eastern part of Akimeugah Basin, Papua. However, little information is currently available on paleogeography and subsurface distribution of the Mesozoic rock unit. This study analyzed Mesozoic rock unit from outcrops at Wamena and surrounding area to wells data in the eastern part of Akimeugah Basin, Papua. Outcrop and well correlation was made to interpret paleogeography of Mesozoic unit. This study was using existing 2D seismic and passive seismic tomography data to determine the distribution of Mesozoic rock unit in the subsurface and its hydrocarbon potential. The Mesozoic rock unit in the eastern part of Akimeugah Basin is divided into four formations based on their lithological characteristic. Respectively from old to young, Kopai, Woniwogi, Piniya and Ekmai Formation. The depositional environment of Mesozoic rock unit in the southern part of the study area is shore/tidal to shelf and basin floor in the northern part. Three Mesozoic potential plays in the studied area are divided into 1) Central Range Mountains thrust-fold belt

play, 2) Akimeugah low land thrust-fold belt play and 3) Tanah Merah pinch-out play. The results presented in this paper are expected to be a guide for further hydrocarbon exploration in the study area.

Keywords: akimeugah basin, mesozoic play, kopai, woniwogi, piniya, ekmai.

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I. INTRODUCTION

The Mesozoic unit in Papua has long attracted explorationist to determine its hydrocarbon potential. These rocks are believed to produce hydrocarbons in NW shelf of Australia and Papua New Guinea. Abadi field and Bintuni bay fields are the only two area which discovers hydrocarbon at Mesozoic reservoir in Indonesia by far.

There have been many previous workers who studied Mesozoic rock outcrops scattered throughout Banda Arc islands from Timor to Banggai, southeast and east arms Sulawesi and at Papua. The outcrop of the Mesozoic unit in Central Range Papua Mountains spread out relatively west-east strike, exposed in Timika - Tembaga Pura section, Wamena - Tolikara section and Mulia - Enarotali - Waghete section. Study of lithological characteristics and depositional environment of the Mesozoic unit in Papua have been done by (Pigram & Panggabean (1983)), Sukanta et al. (1995), Parris (1994, 1996), Kusnama (2008), Davies (2012) & Harahap (2012).

Regional potential hydrocarbon plays in Akimeugah Basin have been provided by Nayoan et al. (1991) and Satyana (2017). The active petroleum system has been proven present in the Mesozoic section which some oil was identified in Cross Catalina-1 and Kau-2 wells (Argakoesoemah 2017).

However, little information is currently available on paleogeography and subsurface distribution of the Mesozoic rock unit in the eastern part of Akimeugah Basin. The purpose of this paper is to determine hydrocarbon potential of the Mesozoic unit in Akimeugah Basin by doing well to outcrop correlation, paleogeography analysis, and 2D seismic interpretation. The results presented in this paper are expected to be a guide for further hydrocarbon exploration in the study area.

II. METHODOLOGY

This research was conducted with mapping of rock outcrops at Wamena and surroundings area (Figure 1) along with measured section on selected sections; rock type, unit thickness, heading and distribution of units, and lateral and vertical changes. Furthermore, separated Mesozoic rocks measured sections were combined in composite stratigraphic log of Wamena and surrounding area based on their lithological characteristic and fossils age. Formation thickness was determined by GPS waypoints combine with regional dip measurements.

Well data used for this study are Noordwest-1, Sande-1, Cross Catalina-1, Kumbai Satu-1, Kuruwai-1 and Digul-1 (Figure 1). Well analysis comprises lithological interpretation using log, cutting and core report, and electrofacies analysis, integrated with outcrop analogy to interpret unit boundary and depositional environment. Lithological unit age used biostratigraphy report of each well. All of the interpreted depositional environment from each stratigraphic intervals of wells and outcrop data were used to produce a series of Mesozoic rock formation palaeogeographic maps.

Seismic lines used for this study are Lines TPW-1, TPW-15, NK-211 and section L-L' of passive seismic tomography (PST) Boka area (Figure 1). Seismic analysis comprises dividing seismic stratigraphy based on reflection termination and strong amplitude classification guided by stratigraphic analog from well and outcrop correlation. Faults interpretation was conducted where obvious offsets can be identified.

III. RESULTS AND DISCUSSIONS

A. Stratigraphy

Mesozoic rocks at Wamena and surrounding area outcropping well at new cut road resulted by intensive road infrastructure built around Papua area. Four geological road sections have been done at this research, namely: Wolo, Tolikara, Tiom and Mbua Sections. Mesozoic rocks outcropping at these sections divided and named into their lithological unit based on lithological characteristic similarity

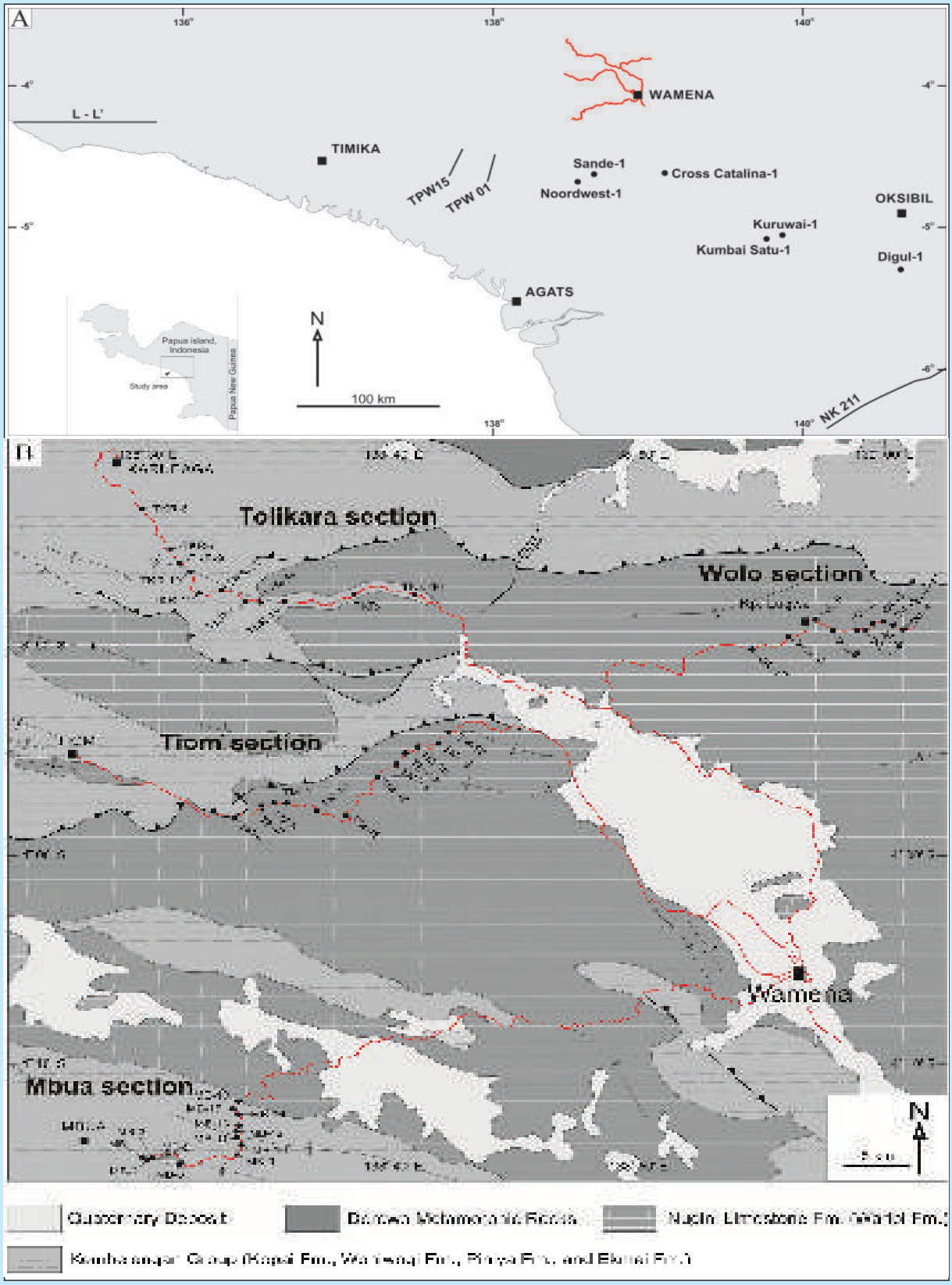

Figure 1.
A. Map of the study area, red lines are geological transect of Wamena and surrounding area, black lines are seismic sections and black dots are wells position., B. Zoom in of geological transect map, showing Mbua, Tiom, Tolikara and Wolo sections. Black dots are outcrop position. Geological map adapted from Sukanta et al. (1995) and Parris (1996).

to those of the previous workers description. Stratigraphy of Mesozoic rocks unit at Wamena and surrounding areas are as follow (from old to young):

Kopai Formation

Kopai Formation is characterized by carbonaceous shale, greyish black, bit hard, fissile, with sandstone intercalation, dark grey, very fine to fine grain, bit hard, medium to well sorted, limestone concretion and contain ammonite fossil (Figure 2 and 3). Sedimentary structures are parallel lamination and hummocky cross-stratification. Kusnama (2008) stated that Kopai Formation contained ammonite, belemnite, gastropod, bivalve, and crinoid, which indicate the age of the Middle to Late Jurassic. Palynology fossil found at Kopai Formation were *Classopollis monostriatus* (Zhang 1984) and *Classopollis simplex* (Danze-Corsin and

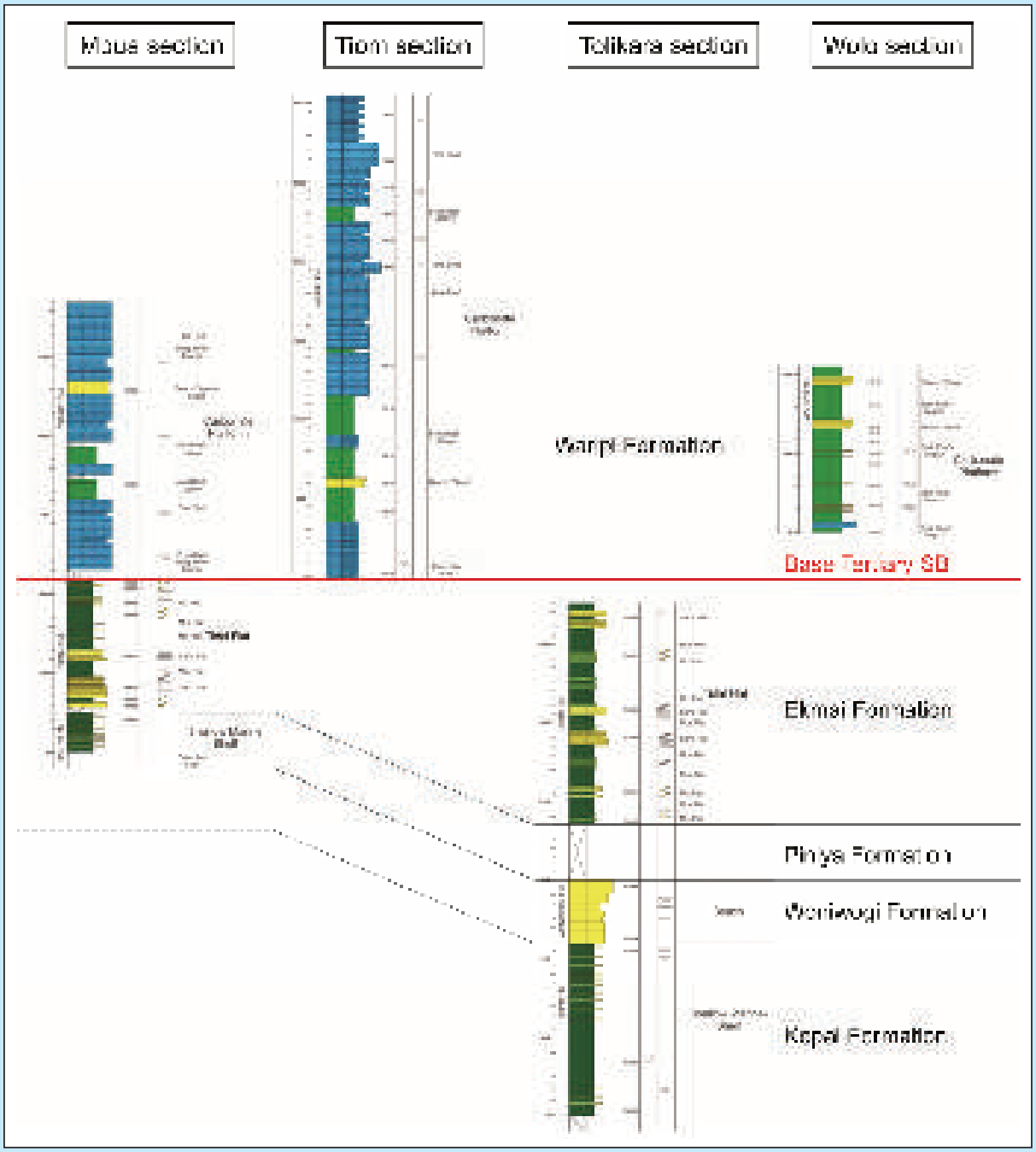

Figure 2
Composite log of four sections, showing stratigraphic position of Mesozoic rocks outcropping at Wamena and surrounding area. See figure 1B for section location.

Figure 3
Outcrop of Kopai Formation at TKR-1, showing: A, B and C. Carbonaceous shale with sandstone intercalation and limestone concretion., D. Fine grain sandstone hummocky cross-stratification., E and F. Ammonite fossils found at Kopai Formation. See figure 1B for outcrop position.

Figure 4
Outcrop of Woniwogi Formation at TKR-14, well sorted, white, medium to coarse grain sandstone. See figure 1B for outcrop position.

Laveine 1963) Reiser and Williams 1969, suggests Jurassic age (Raine et al. 2011). Based on hummocky cross-stratification structure at this unit, it was interpreted that Kopai Formation found at this area was deposited in storm influenced lower shoreface deposit. Kusnama (2008), Harahap (2012) and Davies (2012) all agree that this unit was deposited at shallow marine environment. This unit can be found at Tolikara sections with 1100 m thick.

Rocks unit older than Kopai Formation is not exposed at Wamena area. According to Kusnama (2008), Harahap (2012) and Davies (2012) unit is older than Kopai Formation was Tipuma Formation, with age of Triassic – Early Jurassic.

Woniwogi Formation

Woniwogi Formation is characterized by sandstone, white, medium to coarse grain, well sorted and open fabric (Figure 2 and 4). The sedimentary structures are parallel lamination and cross-bedding. This formation contains ammonite which aged Jurassic to Middle Cretaceous (Kusnama, 2008). Based on the lithological characteristic and sedimentary structure, this unit is interpreted to

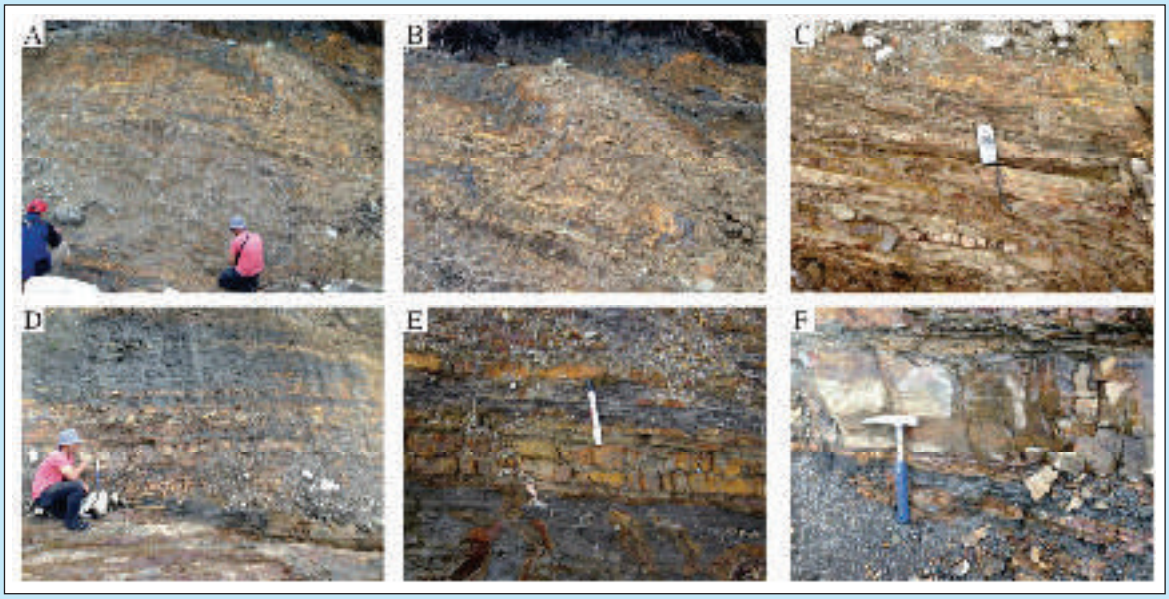

Figure 5
Outcrop of Piniya Formation at MB-3, showing interbedded of shale with siltstone, with intercalation of very fine to fine grain sandstone. A, B, C & D. Shale dominant with siltstone and very fine to fine grain sandstone intercalation., B. Slump structure at Piniya Formation., E & F. Interbedded of siltstone and shale. See figure 1B for outcrop position.

be deposited at shelf area. The thickness of this formation is not less than 400 m at Tolikara sections.

Piniya Formation

Piniya Formation is characterized by interbedded of shale and siltstone, with intercalation of very fine to fine sandstone, contain glauconite and pyrite (Figure 2 and 5). Foraminifera found at this unit by Pigram and Panggabean (1983) aged this unit to Late Jurassic. Palynology fossil found at Piniya Formation was *Classopollis itunensis* Pocock 1962, give aged of Cretaceous (Raine et al. 2011). Based on the occurrence of slump sedimentary structure, it was interpreted that the depositional environment of this unit was at slope to basin floor area. This unit can be found at Mbua section with not less than 250 m thick.

Ekmai Formation

Ekmai Formation consists of sandstone, siltstone, and claystone (Figure 2 and 6). This formation at Wamena and surrounding area are able to be divided into three facies:

1. Fine to medium grain sandstone facies (Figure 6A): dominated by fine to medium grain sandstone, well bedded, abundant belemnite fossil. Sedimentary structures are herringbone cross-stratification and flaser bedding which indicate deposition at tidal environment. Based on domination of sandstone and sedimentary structure, this facies is interpreted as tidal sand flat (intertidal environment).
2. Claystone and siltstone facies (Figure 6B): characterized by interbedded of claystone, siltstone, and very fine grain sandstone. Based on its mixed lithology, this facies is interpreted as tidal mix flat (intertidal environment).
3. Claystone facies (Figure 6C): dominated by claystone, carbonaceous, with lenticular bedding. Based on domination of claystone, this facies is interpreted as tidal mud flat (intertidal environment).

Thickness of Ekmai Formation at Wamena and surrounding areas are between 800−1500 m. Pigram and Panggabean (1983) give Cretaceous age for this unit. Palynology fossil found at Ekmai Formation are *Nothofagidites senectus* (Dettmann & Playford 1968) and *Crybelosporites striatus* (Cookson & Dettmann 1958) Dettmann 1963, indicate the age of Late Cretaceous (Helby et al. 1987; Raine et al. 2011).

Tertiary Nugini Limestone Formation

Nugini Limestone Formation consist of well-bedded limestone intercalation with quartz sandstone,

carbonaceous claystone, siltstone, and shale. This unit is interpreted to be deposited at carbonate platform system. This unit overlays with angular unconformity Ekmai Formation. The contact between Ekmai Formation and the younger unit can be found at Mbua sections (Figure 6H and I). This event marks the K−T boundary (Cretaceous − Tertiary boundary) which is also called Base Tertiary Sequence Boundary (SB). According to Pigram and Panggabean (1983), the oldest age of this unit is Paleocene.

B. Well and outcrop correlation

At the Central Range, from Noordwest-1 to Digul-1, the sediment of Carboniferous − Permian − Triassic was absent. At that time, this area was non depositional area. It was different with Timika area which deposited Permian Aiduna Formation and Triassic Tipuma Formation (Kusnama 2008; Parris, 1994). The deposition began at Middle − Late Jurassic times, leading to deposition of shelfal marine of Kopai Formation truncated above Modio Formation. The start of deposition of Mesozoic sediment at this area (Figure 7) was marked by the Near Base Jurassic unconformity/Near Base Jurassic Sequence Boundary (SB) (Barber et al. 2003). None of the Mesozoic units occurred at Kumbai-1 well, suggesting that area around this well was long-standing paleo high since deposition of Modio Formation, after Devonian.

As a result of the southwest to northeast diachronous Late Jurassic breakup (Callovian to Oxfordian, Barber et al. 2003), local depocentres

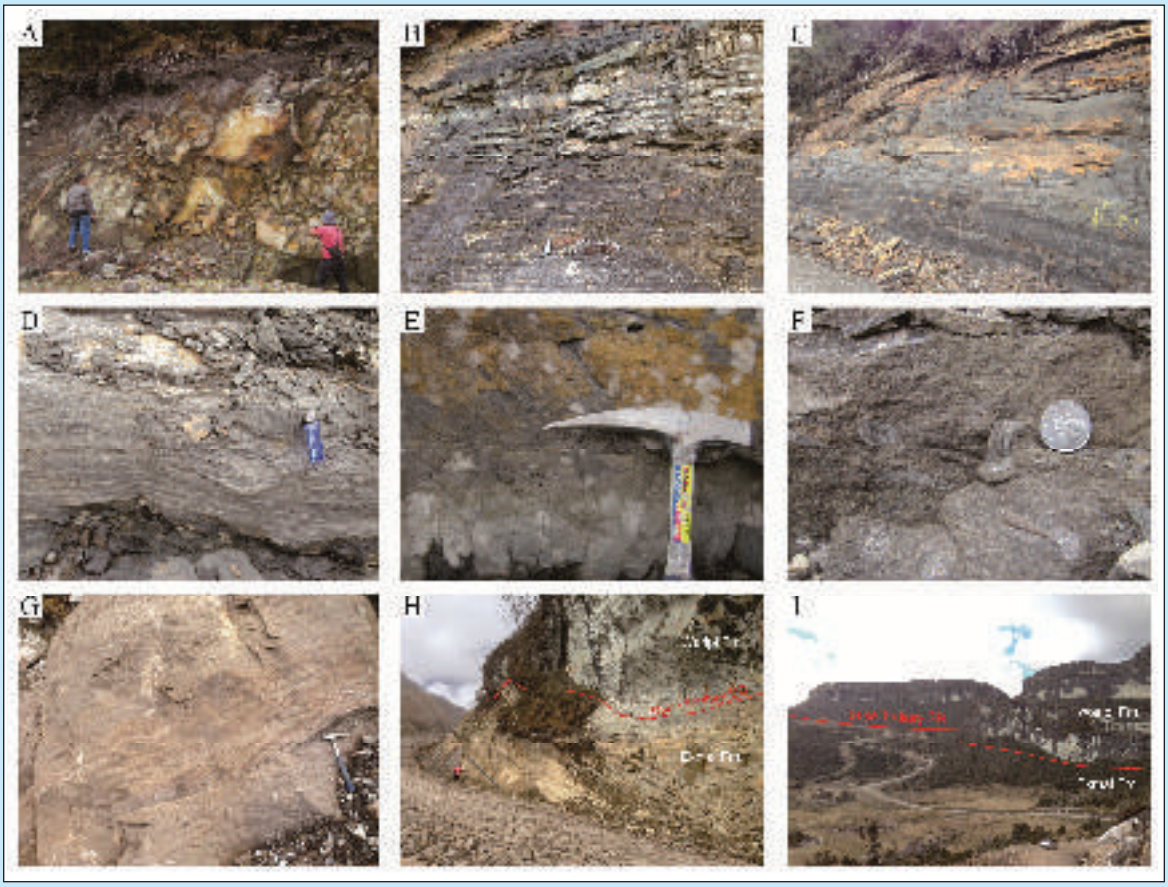

Figure 6
Outcrop of Ekmai Formation, showing: A. Fine to medium grain sandstone dominated, interpreted as tidal sand flat deposit (MB-2)., B. Interbedded of claystone, siltstone and very fine grain sandstone, interpreted as tidal mix flat deposit (MB-15)., C and D. Claystone dominated, carbonaceous, with lenticular bedding, interpreted as tidal mud flat (C:MB-11; D:MB-10)., E. Flaser bedding at Ekmai Formation (MB-10)., F. Belemnite bed at Ekmai Formation (MB-12)., G. Herringbone cross-stratification at sandstone of Ekmai Formation (MB-13)., H & I. Angular unconformity of Ekmai Formation and Waripi Formation (Nugini Limestone Formation). Note different beds strike at H between Ekmai Formation (below Base Tertiary SB) and Waripi Formation (above Base Tertiary SB). H:MB-16. I:Photograph taken from MB-13 with view to the north direction. See figure 1B for outcrop position.

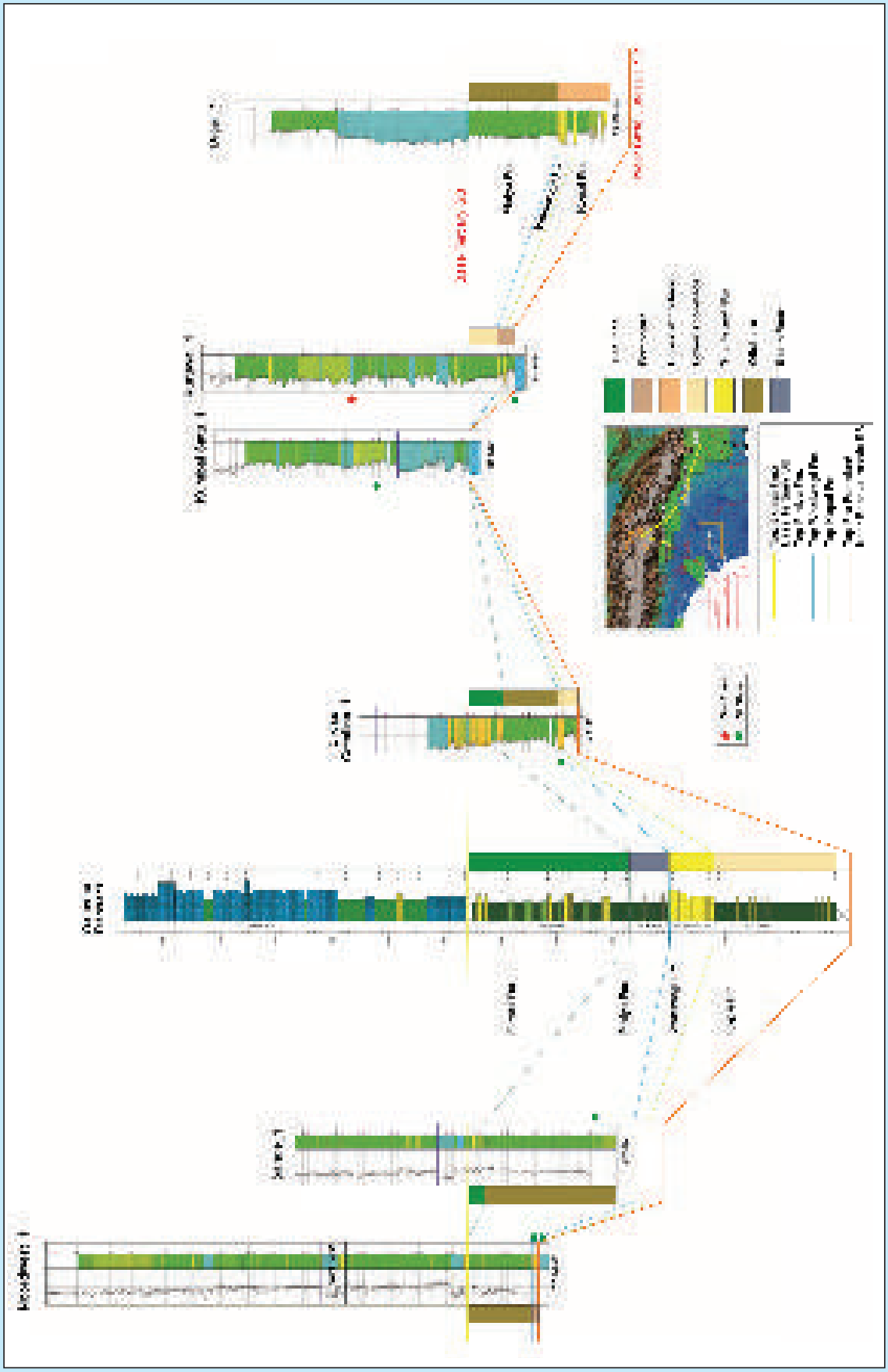

Figure 7
Correlation of Wamena and surrounding area field geology data with wells data of south of Wamena. Note thickness difference at every formation between outcrop and each well, indicating paleogeography position of each geological data.

such as Wamena area were formed, deposited Jurassic to Middle Cretaceous Woniwogi Formation. The southern area (Noordwest-1 to Digul-1) was deposited at shore environment and northern area (Wamena) was at shelf environment. It was then concluded that landward position was at the south and basinward position was at the north.

Subsequently, basinal deepening and transgression event resulted in deposition of thick marine Piniya Shale Formation. Later on, regressive event resulted in deposition of tidal Ekmai Formation deposit, marked the shallowing-upward succession until end of Cretaceous.

Above it, at Paleocene, deposited widespread carbonate-shelf platform of Nugini Limestone Formation. K–T boundary event on the seismic marker was called Base Tertiary SB (Figure 7) (Barber et al. 2003).

C. Mesozoic Paleogeography Interpretation

1. Kopai Formation

Based on well analysis, depositional environment of Kopai Formation at Kuruwai-1 was at foreshore, Digul-1 was at upper shoreface, Cross Catalina-1 was at lower shoreface which was similar to this formation cropping out at Wamena area (Figure 7 and 8).

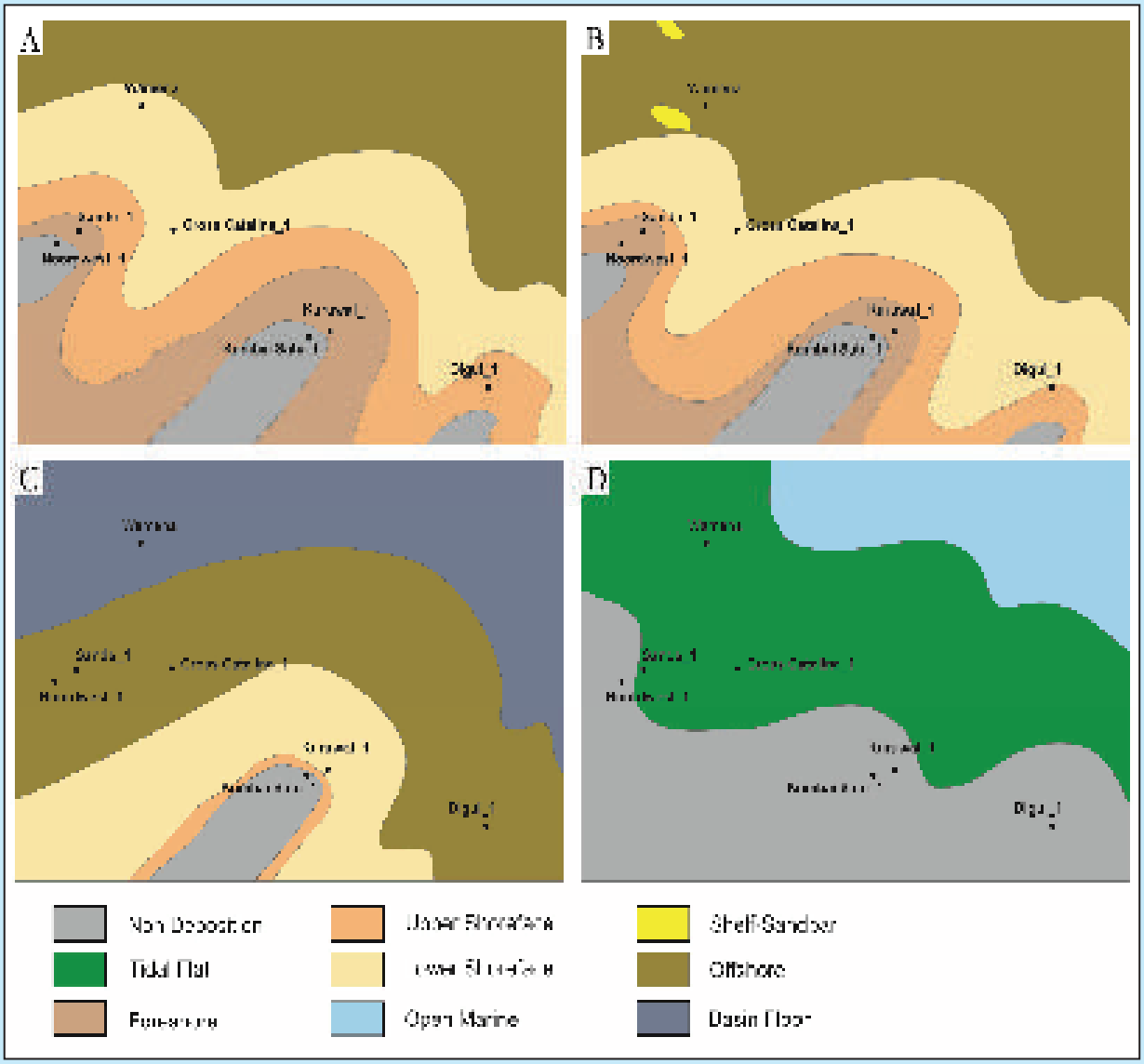

Figure 8
A. Paleogeography interpretation at deposition of Kopai Formation.,
B. Paleogeography interpretation at deposition of Woniwogi Formation.,
C. Paleogeography interpretation at deposition of Piniya Formation.,
D. Paleogeography interpretation at deposition of Ekmai Formation.

Kusnama (2008) at Tembaga Pura section (southeast of Wamena) found that thickness of this formation was 300 m. In addition, Harahap (2012) through his east-west well correlation from Timika area to Bintuni area, stated that average thickness of this formation is 300 m. Thickness of this formation at Wamena area outcrop is 1100 m. It is interpreted that Wamena area at the time of Kopai Formation deposition was a depocenter.

The Kopai Formation was absent in Noordwest-1 and Kumbai Satu-1 wells (Figure 7 and 8). The absence of this unit at those wells probably because those wells (located south of Wamena) are situated landward (non deposition area) at Middle to Late Jurassic. The presence of thin Kopai Formation at Cross Catalina-1 (156 m), Kuruwai-1 (67 m) and Digul-1 (305 m) confirm the conception of paleogeography distribution of this unit as to more landward position at the south. Sande-1 well only penetrated until Piniya Formation, therefore, paleogeography interpretation for Kopai and Woniwogi Formation at this well as foreshore deposit was interpolation based on its position relatively to Noordwest-1 and Cross Catalina-1.

2. Woniwogi Formation

At the Wamena outcrop, Woniwogi Formation thickness is not less than 400 m. Woniwogi Formation occurred at Noordwest-1, Cross Catalina-1, Kuruwai-1, and Digul-1, with thickness respectively 128 m, 56 m, 83 m, and 135 m. It was also interpreted that deposition was from south to north area.

This interpretation is supported by well analyses. There is different depositional environment interpretation which indicating lateral changes from landward to basinward direction. The results are foreshore environment at Noordwest-1 and Kuruwai-1, upper shoreface at Digul-1 and lower shoreface at Cross Catalina-1 well. Meanwhile, Woniwogi Formation outcrop at Wamena area is interpreted as sandbar deposit at shelf area. Kumbai Satu-1 well during Woniwogi Formation deposition time was at non deposition area (Figure 7 and 8).

3. Piniya Formation

At Cretaceous, deposition of Piniya Formation was widespread (Figure 7 and 8). This event is interpreted as regional transgressive event. This unit is only absent at Kumbai Satu-1 well. This interpretation is supported by the depositional environment analysis of Piniya Formation at Noordwest-1, Sande-1, Cross Catalina-1, and Digul-1 which indicated offshore environment. At Kuruwai-1 well, Piniya Formation was deposited at lower shoreface environment, whereas at Wamena area it was deposited at basin floor. On the contrary, at Kumbai Satu-1 well this formation was deposited at non deposition area. Thickness of Piniya Formation at each well are Noordwest-1 (607 m), Sande-1 (930 m), Cross Catalina-1 (484 m), Kuruwai-1 (261 m), and Digul-1 (800 m).

4. Ekmai Formation

Ekmai Formation only occurred at Sande-1 and Cross Catalina-1 (with thickness 153 m and 318 m) showed indication that this unit was only distributed locally/limitedly. Ekmai Formation at Wamena area outcrop, Sande-1, and Cross Catalina-1 is interpreted to be deposited at tidal flat environment, which give impression of regressive event resulting in shoreline shifting to the north (Figure 7 and 8). This regressive event at Late Cretaceous caused non deposition at Noordwest-1, Kumbai Satu-1, Kuruwai-1, and Digul-1 wells.

D. Mesozoic Play Potential

Seismic stratigraphy reconstruction at lines TPW-1, TPW-15 and NK-211 used three strong amplitude seismic markers that are Near Base Jurassic SB, Base Tertiary SB and Oligo−Miocene SB (Barber et al., 2003). Four seismic stratigraphy units identified at those lines, from old to young, are Pre-Jurassic Sediment Sequence, Kembelengan Group Sequence (Mesozoic rocks unit), Nugini Limestone Sequence and Mid Tertiary − Quartenary Sediment Sequence (Figure 9). The available seismic data consists of multi-vintage 2D lines mostly acquired before the 1990s which are poor to fair in quality.

The base boundary of Pre-Jurassic Sediment Sequence, its boundary with Proterozoic basement, cannot be identified at seismic profile. The top boundary of this sequence is Near Base Jurassic SB marker. Kembelengan Group Sequence confined at its bottom by Near Base Jurassic SB marker and its top by Base Tertiary SB. Nugini Limestone Sequence confined at its bottom by Base Tertiary SB and at its top by Oligo−Miocene SB. The top sequence at the study area is Mid Tertiary − Quaternary Sediment Sequence.

Structure pick of lines TPW-1 and TPW-15 yield that potential trap at this area are thrust-fold belt type (Nayoan et al. 1991; Satyana 2017). We interpreted that potential Mesozoic source rocks at

this area are Kopai Formation (TOC 1,5%, Digul-1) and Piniya Formation (TOC 1,22−1,24%, Sande-1; 0,04−6,64%, Noordwest-1). Potential Mesozoic reservoirs are Woniwogi Formation (Porosity 8%, Cross Catalina-1; 5,1−21,7%, Kuruwai-1, 5−16%, Digul-1) and Ekmai Formation (Porosity 19,6−25,4%, Sande-1). On the other hand, seal rocks are shales of Piniya Formation and limestone of Nugini Formation. This Mesozoic petroleum system is believed to be equivalent with Westralian petroleum system which is characterized by marine Jurassic source rocks, with reservoirs up to Early Tertiary, e.g. all ZOC and northern Australian fields and all PNG fold belt fields. Oil and gas show occurred in the studied well (Figure 7), indicating source rocks maturity at the surrounding area.

Lines TPW-1 and TPW-15 located at high altitude Central Range Mountains. Much lower altitude Mesozoic thrust-fold belt play potential present at this paper is at Boka area, west of Timika, bordering with Arafura sea at the south. Passive seismic tomography section L-L', Boka area (Badan Geologi 2016) shows fold belts which similar to those appearing in the Central Range Mountains. These fold belts present at this area, named Akimeugah low land fold belt (Figure 9). This low

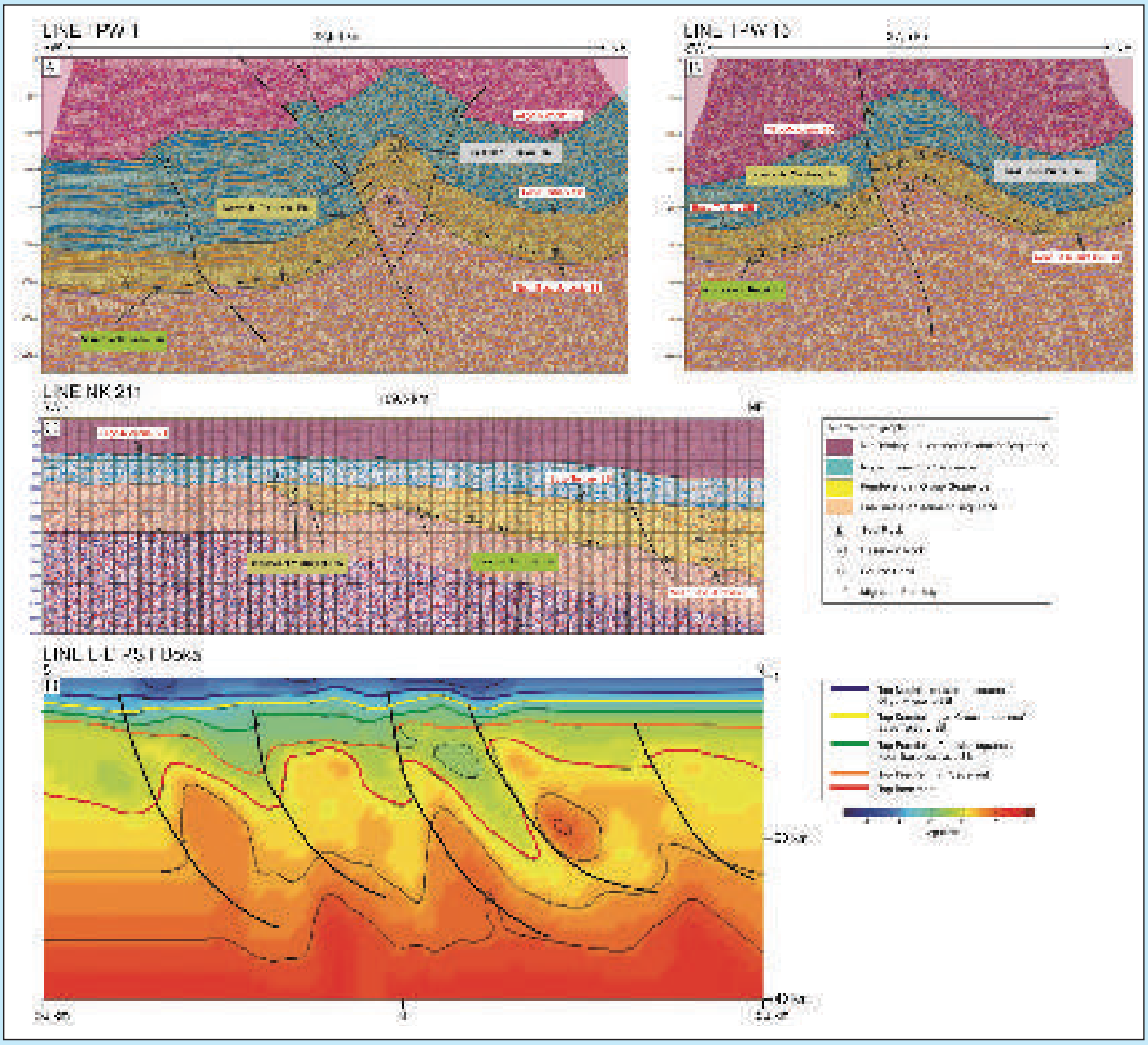

Figure 9.
Mesozoic plays in eastern part of Akimeugah Basin. A & B. Interpretation of Lines TPW 1 and TPW 15 showing Central Range Mountain fold belt play., C. Interpretation of Line NK 211 showing Tanah Merah pinch-out play., D. Interpretation of Line L-L' showing Akimeugah low land fold belt play. Seismic lines provided courtesy of Pusdatin, KESDM. See figure 1A for line seismic position.

land fold belt is interpreted as continues part of the flower structure of the mountain fold belt. Based on the structure map of northern low land (Sukanta et al., 1995) it shows that this fold belt is extending quite far east-west direction. It is interpreted that this low land fold belt still continues to the west probably until Boka-1 well area and to the east until south of Digul-1 well.

Seismic stratigraphy from PST section of Boka is divided based on their Vp value into Basement (Vp > 6,2), Pre-Permian Sediment Sequence (Vp = 5,7−6,2), Permian − Triassic Sequence (Aiduna - Tipuma Formation) (Vp = 5,0−5,7), Kembelengan Group Sequence (Vp = 4,5−5,0), Nugini Limestone Sequence (Vp = 4,0−4,5) and Mid Tertiary − Quartenary Sediment Sequence (Vp < 4,0) (Badan Geologi, 2016). It is also interpreted that Mesozoic petroleum system/Westralian petroleum system also present at this area (Figure 9).

Seismic stratigraphy interpretation of line NK-211 is showing potential of stratigraphic pinch-out trap at this area (Figure 9). Potential source rock, reservoir and seal rock at this area are similar to those in Lines TPW-1 and TPW-5, except for Ekmai Formation which is most probably not to occur at this area based on stratigraphic reconstruction with Digul-1 and Kuruwai-1 wells. The stratigraphic play of this area is named as Tanah Merah pinch-out play. Based on seismic interpretation on onshore seismic lines at Tanah Merah area to Merauke area, it is interpreted that the Tanah Merah pinch-out play is distributed in relatively half circle. This is related to the distribution of Pre-Permian Sequence as non deposition area at Carboniferous to Triassic, which resulted in truncation of Mesozoic rock to Pre-Permian rock.

All the three potential play are located in remote and heavy terrain area with very limited infrastructures. Central Range Mountains fold belt play is located at dense vegetation and rough mountainous terrain. Akimeugah low land fold belt play and Tanah Merah pinch-out play are located at thick swamp area. However, referring to Mesozoic plays of Bintuni area (11 discoveries, 19 TCF) and Abadi field (1 discovery, 14 TCF) (Satyana, 2013), this area is attractive for further exploration. This paper recommends the study area to become hydrocarbon working area which supports the exploration campaign by the government of Indonesia.

IV. CONCLUSIONS

Four rock unit formation is building the Mesozoic rocks of the study area:

1. Middle − Late Jurassic, interbedded of claystone and sandstone of Kopai Formation deposited at foreshore, upper shoreface, and lower shoreface environment.
2. Late Jurassic − Early Cretaceous, sandstone and claystone intercalation of Woniwogi Formation deposited at foreshore, upper shoreface, lower shoreface and shelf sandbar environment.
3. Early Cretaceous − Late Cretaceous, shale of Piniya Formation deposited at shelf and basin floor environment.
4. Late Cretaceous, interbedded of sandstone and claystone of Ekmai Formation deposited at tidal flat environment.

Paleogeography reconstruction of the study area shows that from Middle Jurassic to Late Cretaceous, sediments in Wamena area (north) were deposited in more basinward position compared to the sediments in Central Mountains area (south) which were deposited in more landward position.

Mesozoic play potential at the study area is divided into:

1. Central Range Mountains thrust-fold belt play present at Seismic Lines TPW-1 and TPW-5.
2. Akimeugah low land thrust-fold belt play present at section L-L' of Passive Seismic Tomography Boka area
3. Tanah Merah pinch-out play present at Seismic Line NK-211.

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