CHAPTER 4

RESULT

4.1 Long Term INPEFA

A hierarchy of the change is commonly observable in the spectral trend attribution curve (INPEFA-GR CURVE), indicating a hierarchy of vertical lithofacies trend and change. The analysis and interpretation of spectral trend curve is done in several iterative steps with increasing detail. In the first step of this correlation is dividing the sequence of long term INPEFA-GR curve which are generated form the total study interval (total depth of well). This study use the interval of the Formation 2 for the comparison between the previous sequence divided by the litho-stratigraphy and the sequence divided by climate stratigraphy which is used in this study. The long term INPEFA curve, typically, shows relate little detail; only the major turning point and trend are obvious.

The systematic changes in litho-facies by climatic variation can be represented by Stratigraphic Packages (StratPacs). StratPacs are bounded by adjacent negative bounding surfaces of the same hierarchical rank. The StratPacs name is named by the after lower NBS: e.g., StratPacs M1000 is bounded at the bottom by NBS M1000 and at the top by NBS M2000. The letter M in StratPacs name comes from the word "Marker". The positive bounding surfaces are named after the StratPacs within which they occur; they are labeled with an additional letter P.

The result from the experiment in this study, climate stratigraphy of Formation 1 and Formation 2, platform B, Arthit project; can be distinguished to 8 major stratigraphic packages base on the long term INPEFA-GR curve (Figure 4.1). These major stratigraphic packages have been identified and correlated in the study well labeled M1000 to M8000 from bottom to top. Figures 4.1, the climate stratigraphic packages interpretation of well 6 cover most of the stratigraphic interval analysis in this study. The figure clearly shows the major break and trend.

The base of this interval study is M1000, marked by the first prominent negative point and represents the first negative bounding surface (NBS) which coincides with the top of FM0. Negative bounding surface M 1000 shows strongly anti-clockwise of trend, that means StratPacs M1000 consist of a stacking of predominant sand prone unit. In addition, Figure 4.1 can be seen the colored GR logs (colored in 15 classes by log value, red representing low value and blue representing high value). The base of StratPacs M1000 mostly shows red color. Blue-green color is less, on the top of StratPacs 1000. That means, StratPacs M1000 is more sand supply.

The basal boundaries of StratPacs M2000, M3000 and M4000, are marked by the distinctive negative turning point or negative bounding surface. The positive bounding surface (PBS) of StratPacs M2000P are marked by the distinctive clockwise trend of long term INPEFA-GR curve, represent shaly value or fine-grained deposit. The positive bounding surface M3000P can be recognized in the middle of StratPacs M3000, at the obvious positives turning point, show increasing change in fine-grained sediment deposited heralding the overall progradational development of the M4000 (lower part) StratPacs. The positive bounding surface of StratPacs M4000P is sharp, occurs in the middle of it. This PBS marks the base of the very characteristic positive trend of sand-starved, shale rich interval, representing a more or less complete cessation of sand entering the depositional system.



Figure 4.1 Major stratigraphic packages base on the long term INPEFA-GR curve of well 6.

The StratPacs M5000, the over all trend of long term INPEFA-GR curves shows the strongly positive trend. However, the basal boundary can be marked by the obvious anti-clockwise trend of the step of sand supply, and a little changing slope of long term INPEFA-GR which represent changing in net accumulation rate. The slope changing in this StratPacs not presents clearly in all of the study wells, but generally presents. However, if it not shows slope changing, it still has the obvious anticlockwise trend of the step of sand supply and can be marked the negative bounding surface.

The basal boundary of StratPacs M6000 is marked by the distinctive negative bounding surface and changing slope in the long term INPEFA-GR curve which is compared to the lower StratPacs. This characteristic represents the changing in the net accumulation rate (the gentle slope corresponds with the low net accumulation rate, the steep slope corresponds with the high net accumulation rate). Changes in accumulation rate cause by lithofacies change; coarser sediments will accumulate faster than fine-grained sediment deposit, the slope change from steep to gentle slope. In this case, StratPacs M6000 is higher net accumulation rate (steep slope) than StratPacs M5000; that means, StratPacs M6000 relative to coarse grained sedimentary supply more than the lower StratPacs.

Negative bounding surface M7000 is a distinct anti-clockwise change of trend, corresponding with a marked increase in the sand supply. Negative bounding surface M7000 is a stronger anti-clockwise turning-point, and the overall trend of the INPEFA_GR curves always swings to strongly negative. The M7000 NBS event is equivalent to the top of unit 2C.

Negative bounding surface M8000 is not present in all of well. Where present, it is marked by a distinct negative turning point, corresponding with more increasing in the sand supply than the lower StratPacs which the overall trend of its INPEFA_GR curves also show the negative trend. The M8000 NBS event is approximately equivalent to the top of unit 2D.

The regional correlations of the long term INPEFA_GR curves of all wells in this study (totally 18 wells) are shown in the Figures 4.2, 4.3 and 4.4.



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Figure 4.2 Major stratigraphic packages and correlation well to well base on the long term INPEFA-GR curve (Wells 11, 14, 10, 17, 6 and 7).





Figure 4.3 Major stratigraphic packages and correlation well to well base on the long term INPEFA-GR curve (Wells 13, 16, 12, 3, 18 and 2).

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4.2 Short Term INPEFA

Short Term INPEFA is used for more details required, made for sub-sections. The short term INPEFA curves usually show enhanced character and can be made detail interpretation as far as possible. Climate stratigraphy of Formation 1 and Formation 2 can be distinguished to 21 minor stratigraphic packages base on the short term INPEFA-GR curve (Figure 4.5 and Table 4.1).

Short Term INPEFA curve of StratPacs M1000 are created between the NBS M1000 and M2000. This curve is relative to the long term INPEFA curve, but enhance in the detail. The overall trend of this curve shows the abrupt change in negative trend. In this StratPacs have not been divide in the short term INPEFA curve because in this study have only 3 wells drilled in to the basal of StratPacs M1000 and generated the short term INPEFA curve. It is not clearly seen the negative or positive turning point to recognize additional higher-order negative or positive bounding surfaces (Figure 4.6).

Short Term INPEFA curve of StratPacs M2000 are C-shaped in the INPEFA GR curves. The basal boundaries of these C-shaped StratPacs correspond with the bases of relatively coarse-grained units, i.e. influxes of the relatively coarse material. The abrupt change in the positive trend of the C-shaped corresponds with the increasing in GR-value, where the supply of the relatively coarse-grained has been "switched off" and relatively fine-grained material deposited. Then, the C-shaped units in the INPEFA-GR curves consist of alternating fluxes of relatively coarse and relatively fine-grained material deposited (Figures 4.6, 4.7, 4.8, 4.9). StratPacs M2000 has been subdivided into two higher-order units in the short-term INPEFA-GR curve, M2100 and M2200. Higher-order negative bounding surface and StratPacs are

identified between the low-order boundaries, NBS M2000 and NBS M3000, so that, the basal boundary of StratPacs M2100 and M2000 in lower-order is equal. The higher-order positive bounding can be recognized in StratPacs M2100P and M2200P, show increasing in shaly or fine grained deposit. This PBS can be only recognized in the study wells that the short-term INPEFA-GR curve covers in StratPacs M2000, not all of the study wells.



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Figure 4.5 Major stratigraphic packages of well 6 enhance with short term

INPEFA-GR curve which can be distinguished to 21 minor stratigraphic packages.

STRACT-PAC	NBS	PBS	PREVIOUS TOP
M8000	M8100		
° b	M7300 M7200		TOP-2D
M7000	M7100	.07	TOP-2C
6	M6400		31
60	M6300	M6200P M6000P	3
	M6200		
222	A a a	M6100P	TOP-2B
M6000	M6100		
308	M5400		TOP-2A
C	M5300		A
H	M5200		6
M5000	M5100		
	M4500		
	M4400		TOP-FM1
	M4200	M4300P	
	1014300	M4000P	
	M4200		
M4000	M4100		
anein	ເດລິກເ	M3100P2	CIA N
andur		M3000P	OOTH
		M3100P1	
M3000	M3100	ng Mai l	Iniversit
		M2200P	
I rig	M2200	M2000P	rve
	112200	M2100P	
M2000	M2100		
		M1000P	
M1000	M1100		TOP-FM0

Table 4.1 Climate Stratigraphic scheme of Top Formation 0 - Top Unit 2D.



Figure 4.6 Short term INPEFA-GR curve and higher order StratPacs correlation of wells 11, 10, 14, 17 and 6 (StratPacs M1000-M4000).



Figure 4.7 Short term INPEFA-GR curve and higher order StratPacs correlation of wells 2, 7, 12, 3 and 18 (StratPacs M1000-M4000).

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Figure 4.8 Short term INPEFA-GR curve and higher order StratPacs correlation of wells 1, 9, 5 and 4 (StratPacs M1000-M4000).



Figure 4.9 Short term INPEFA-GR curve and higher order StratPacs correlation of wells 13, 16, 15 and 8 (StratPacs M1000-M4000).

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Short Term INPEFA curve of StratPacs M3000 are C-shaped curves. The positive bounding surface M3100P1 and M3100P2 can be recognized at the obvious positives turning point which is under and above long term positive bounding surfaces M3000P, show increasing change in fine-grained sediment deposit.

StratPacs M4000 is the thickest StratPacs. The Short Term INPEFA curve of this StratPacs has been subdivided into five higher-order negative bounding surfaces, M4100, M4200, M4300, M4400 and M4500, show relative coarse-grained material. The negative bounding surfaces of these StratPacs alternate with the positive bounding surface, M4000P and M4200P, respectively (Table 4.1). That means, this interval has the alternation between the relative coarse-grained and fine-grained material in each step.

The Short Term INPEFA curve of StratPacs M5000 resembles its long term INPEFA curve, but detail is enhanced. The overall of this short term INPEFA is the positive trend, relative to fine-grained material. However, the higher-order units in this interval can be divided by the distinct negative bounding surface of sand or coarse-grained material supply. The higher-order units have been divided to four units, M5100, M5200 M5300 and M5400 (Figures 4.10, 4.11, 4.12 and 4.13).

StratPacs M6000 shows C-shaped in the short term INPEFA-GR curves. This StratPacs has been subdivided to four higher-order units, M6100, M6200, M6300 and M6400, from bottom to top. The negative bounding surfaces M6100 and M6200 is the basal of stacking of sand supply, alternate with the positive bounding surfaces, M6100P, M6000P and M6200P which marks sand-starved and shale or coal rich interval. After M6000P which is the main flooding surface which relates to the transgression period, the short term INPEFA curve shows strongly positive trend



Figure 4.10 Short term INPEFA-GR curve and higher order StratPacs correlation of wells 11, 10, 14, 17 and 6 (StratPacs M5000-M7000).



Figure 4.11 Short term INPEFA-GR curve and higher order StratPacs correlation of wells 2, 7, 12, 3 and 18 (StratPacs M5000-M7000).



Figure 4.12 Short term INPEFA-GR curve and higher order StratPacs correlation of wells 1, 9, 5 and 4 (StratPacs M5000-M7000).



Figure 4.13 Short term INPEFA-GR curve and higher order StratPacs correlation of wells 13, 16, 15 and 8 (StratPacs M5000-M7000).

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which relates to fine-grained sediment. Nevertheless, the negative bounding surfaces M6300 and M6400 can be identify by the distinct negative turning point of the small stack of sand supply (Figures 4.10, 4.11, 4.12 and 4.13).

The Short Term INPEFA curve of StratPacs M7000 shows strongly several abrupt changes of negative turning points. This StratPacs has been subdivided to three higher-order units, M7100, M7200 and M7300, from bottom to top. This short term INPEFA-GR curves shows C-shape character, but vary from well to well (Figures 4.10, 4.11, 4.12 and 4.13). However, the pattern of change and trend, are still similar and correlatable, showing the synchrony of the vertical lithofacies changes and, the synchrony of fluxes of relatively coarse-and relatively fine-grained material or the INPEFA correlation offer a framework for analyzing lateral facies variation.

The over all trend of short term INPEFA-GR curve of StratPacs M8000 is strong positive trend correspond with the thick sand bed that overlies on the negative bounding surface M8100 (NBS M8100 equal to NBS M8000). This StratPacs have been seen only the base of StratPacs, not full StratPacs, which is most of the thick sand bed.

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