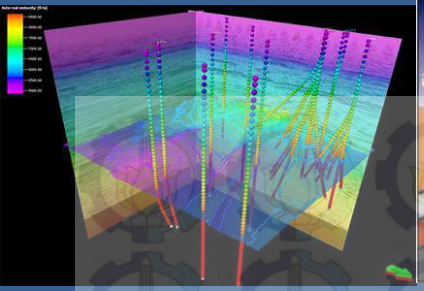
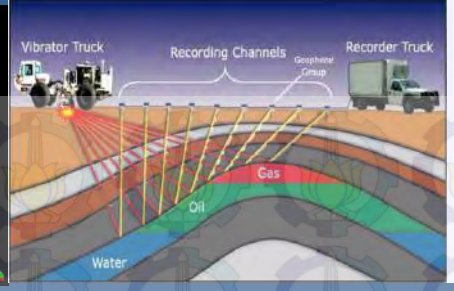
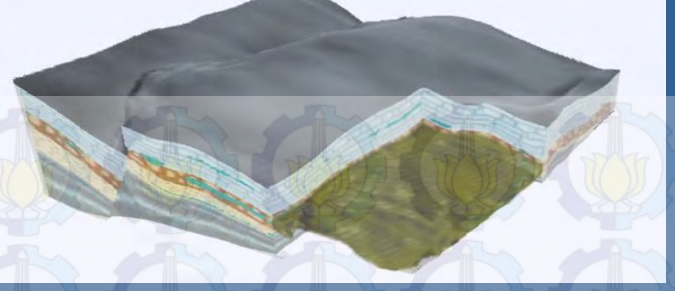





Ruang J108, 8 Januari 2015

ANALISIS AVO (*AMPLITUDE VERSUS OFFSET*), ATRIBUT SEISMIK DAN PROPERTI FISIKA BATUAN UNTUK IDENTIFIKASI GAS RESERVOIR KARBONAT *REEF BUILD UP*, LAPANGAN 'KATIMAN' CEKUNGAN JAWA BARAT BAGIAN UTARA

Oleh:

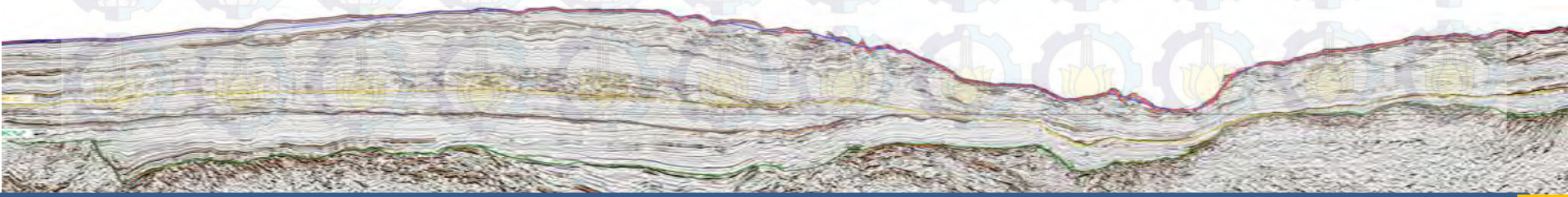
Pebrian Tunggal Prakosa

Dosen Pembimbing:

Prof. Dr. rer. nat. Bagus Jaya Santosa, S.U

Arek ITS cak! Cerdas, Amanah, Kreatif

PERTAMINA EP



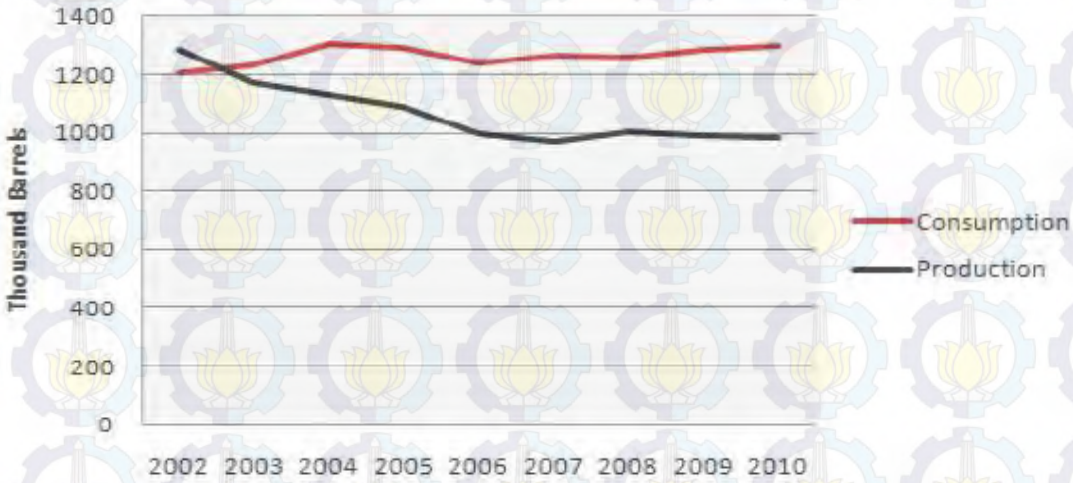
OUTLINE

- PENDAHULUAN
- GEOLOGI REGIONAL
- TINJAUAN PUSTAKA
- METODOLOGI
- HASIL DAN PEMBAHASAN
- KESIMPULAN

Latar Belakang

- Kebutuhan energi di Indonesia semakin meningkat

Produksi Hidrokarbon →

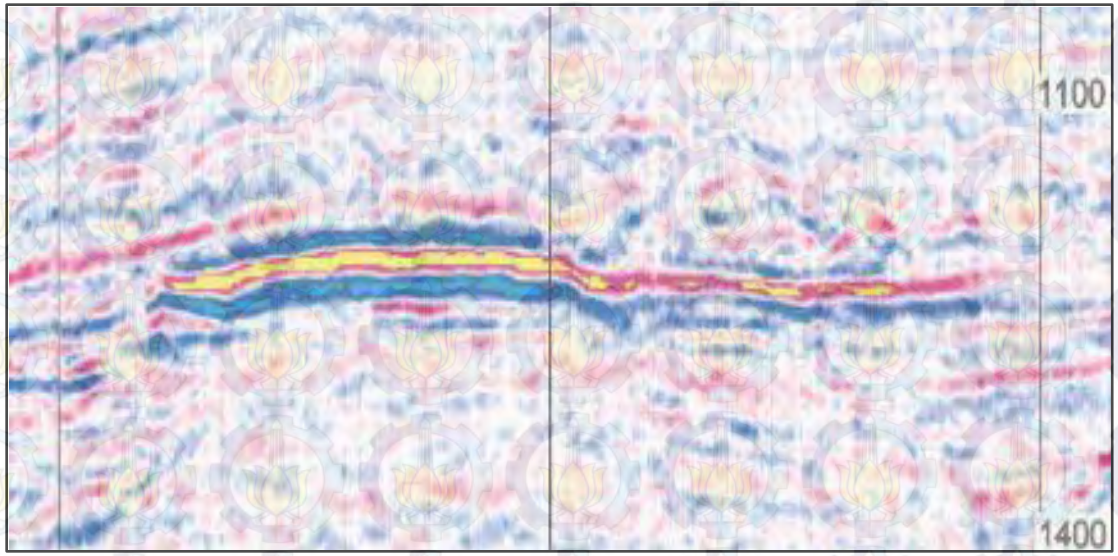


- Produksi hidrokarbon dari reservoir karbonat
- Perkembangan analisa AVO dan atribut seismik di reservoir Karbonat masih jarang.

Courtesy of International Energy Agency, 2007

Latar Belakang

1970 Anomali Bright spot menjadi indikator utama keberadaan hidrokarbon



Tidak semua anomali bright spot menunjukkan keberadaan hidrokarbon

1984 *Ostrander mengembangkan konsep untuk interpretasi anomali amplitudo yang dinamakan metode AVO.*

2003 sekarang *Dikembangkan analisa AVO pada reservoir karbonat clastic, dolomitic dan cavern reservoir.*

(www.seismicinterpreter.wordpress.com) (Priyono, 2000) (Dowton, 2003)

Tujuan

- Menentukan daerah prospek hidrokarbon menggunakan data sumur
- Mengetahui perbedaan respon AVO pada reservoar batuan karbonat yang berisi gas dan kering
- Mengetahui persebaran fluida gas reservoir karbonat Pada penampang seismik
- Mengetahui respon fluida terhadap properti fisika batuan

Batasan Masalah

- Daerah penelitian merupakan formasi Baturaja dan formasi Parigi cekungan Jawa Barat bagian Utara.
- Data seismik yang digunakan adalah data seismik *CDP gather*, dengan asumsi bahwa pengolahan data seismik sudah benar dan baik untuk dilakukan proses selanjutnya
- Data sumur yang digunakan adalah satu data sumur.
- Analisa fisika batuan hanya digunakan untuk melihat *trend* Pengaruh fluida gas.

OUTLINE

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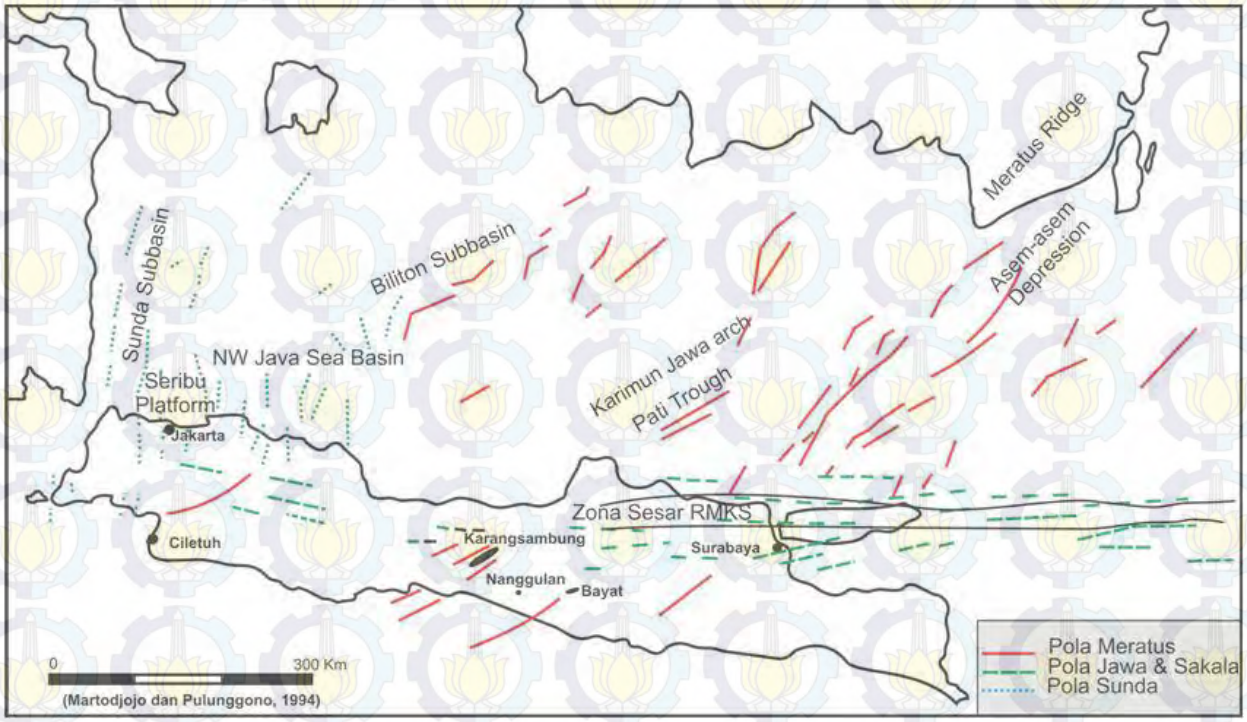
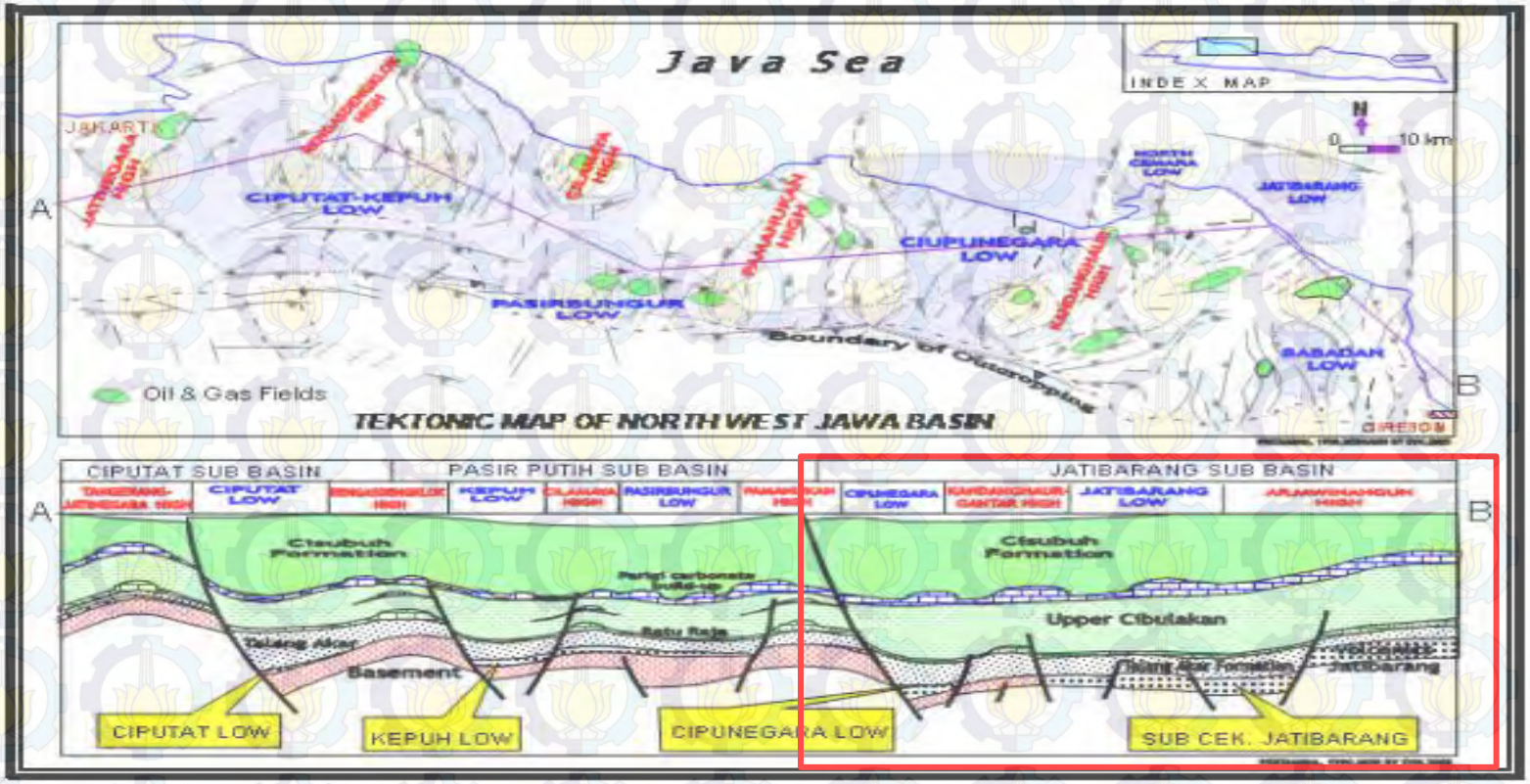
Tectonic setting Jawa Barat



- **Pola Meratus (arah Timur laut - Barat daya)**
- **Pola Sunda (arah Utara – Selatan)**
- **Pola Jawa (arah Barat – Timur)**

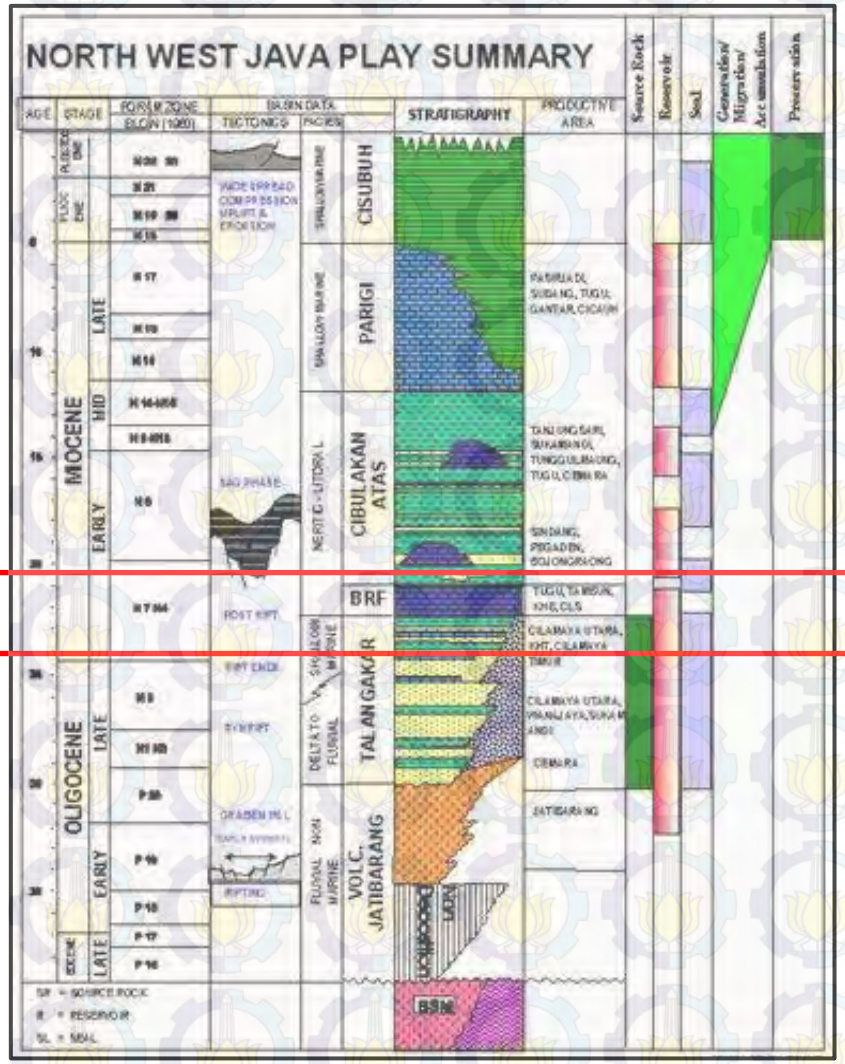
(Martodjojo dan Pulunggono, 1994)

Sub-cekungan di cekungan Jawa Barat bagian Utara



(Pertamina, 1996)

Stratigrafi Jawa Barat Bagian Utara



(Pertamina, 1996)

Formasi Baturaja

- Diendapkan pada fasies laut dangkal, pada fase *postrift*
- Terdiri dari batuan karbonat *reefal*

OUTLINE

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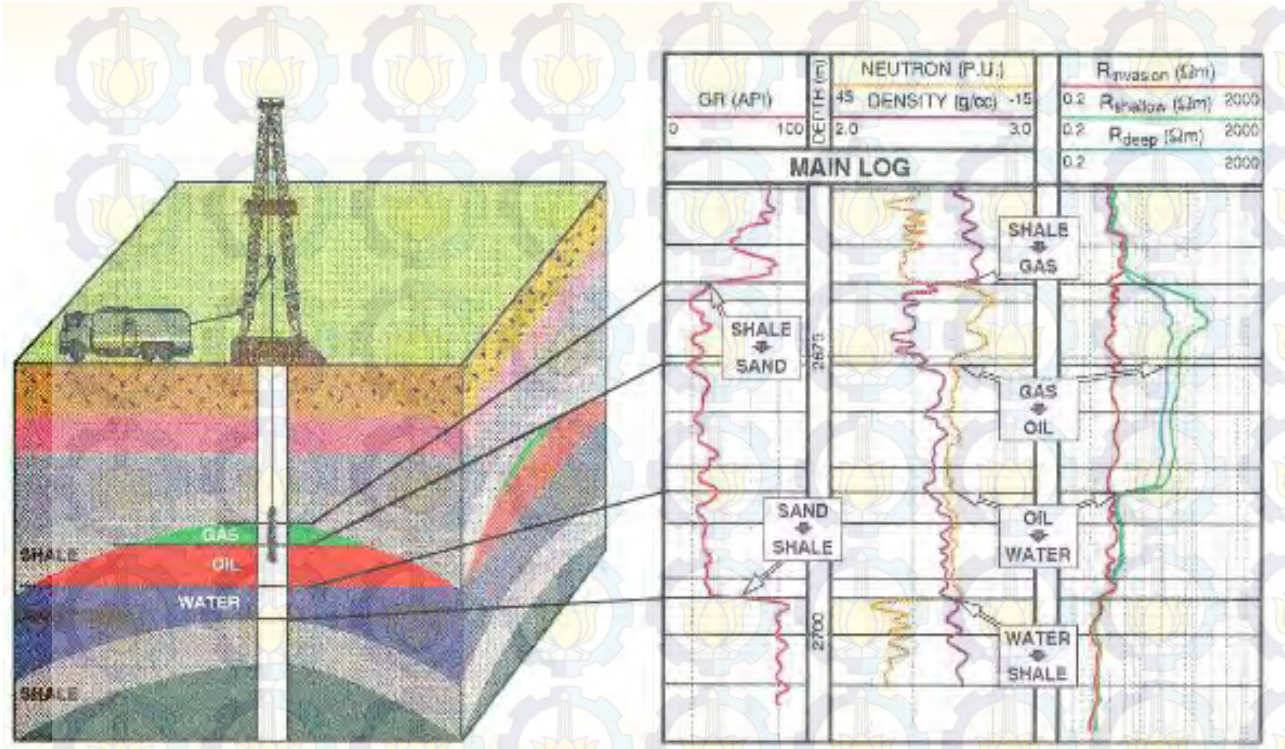
Analisa Well Log



Standart log

- Gamma Ray
- Caliper
- Resistivity (Induction / Laterolog)
- Density
- Neutron Porosity
- Akustik / Sonic

(Harsono, 1997)

PERTAMINA EP

Properti Fisika Batuan

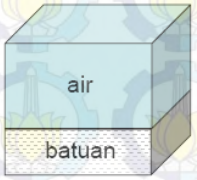
Porositas

Perbandingan antara volume pori batuan dengan volume totalnya

Saturasi Air

Nilai prosentasi pori batuan yang terisi air formasi

$$\frac{1}{Rt} = \left(\frac{V_{cl}\left(1-\frac{V_{cl}}{2}\right)}{\sqrt{R_{cl}}} + \frac{\phi_e}{\sqrt{R_w}} \right)^2 S_w^{\,2}$$

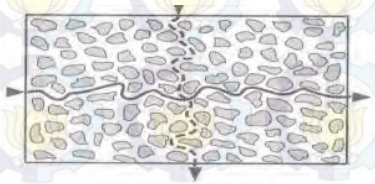


ϕ = 0 - 33%
Sw = 100%
Fluida = air

Permeabilitas

Kemampuan Batuan untuk melewatkan fluida

$$K = 8649 \frac{\emptyset^{4.4}}{Sw^2}$$



P-impedance

Kemampuan batuan untuk melewatkan gelombang seismik

$$ZP = \rho * Vp$$

(Asquith, 2001), (Raharjo, 2009), (Hendriansyah, 2005)

PERTAMINA EP

Properti Fisika Batuan

Poisson's Ratio

Konstanta elastis suatu batuan yang menggambarkan perbandingan dari perubahan bentuk yang diakibatkan pengaruh gelombang P dan S

$$\sigma = \frac{\gamma - 2}{2\gamma - 2} \qquad \text{dim}\,ana: \quad \gamma = \left(\frac{V_P}{V_S}\right)^2$$

Rigiditas

Kemampuan batuan untuk berubah bentuk atau bergeser *(slide over)* terhadap *stress*

$$\mu\rho = ZS^2$$

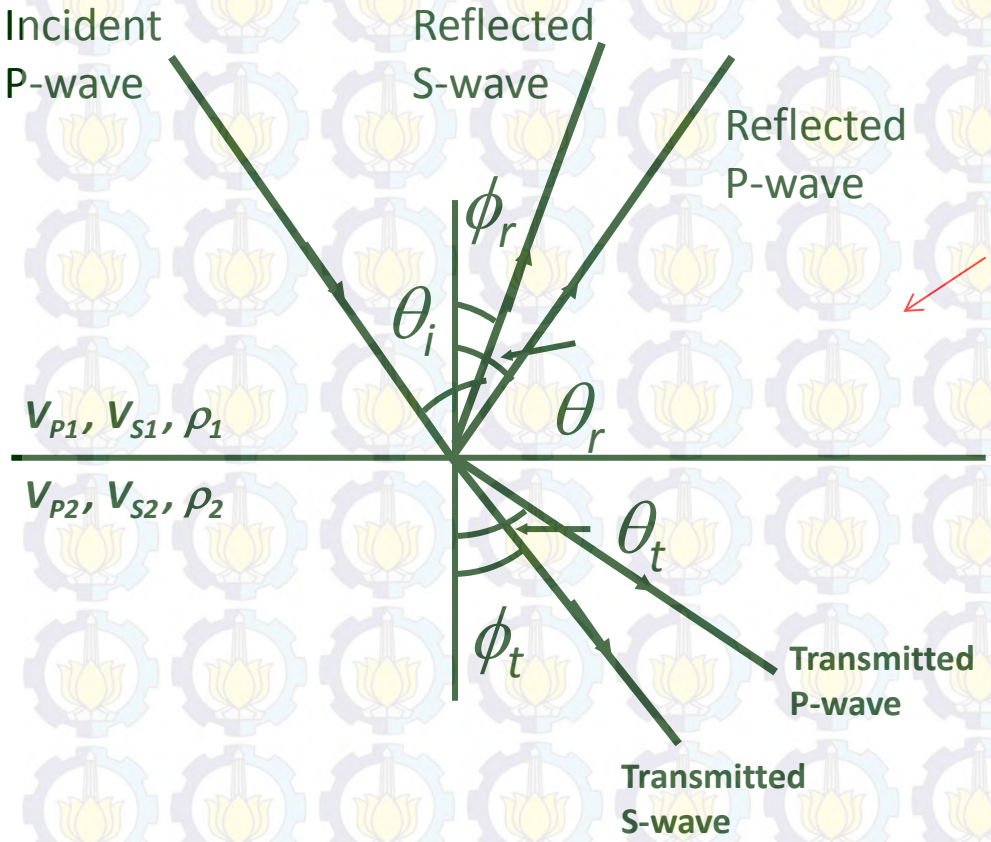
Inkompresibilitas

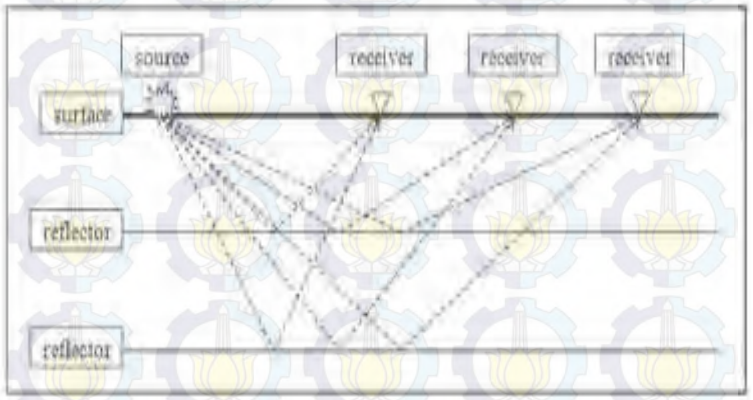
Parameter yang menunjukkan besarnya perubahan volume apabila dikenai *stress*

$$\lambda\rho = ZP^2 - 2ZS^2$$

(Asquith, 2001), (Raharjo, 2009), (Hendriansyah, 2005)

Seismik Refleksi





Jika θ> *0°*, gelombang *P yang datang* akan menghasilkan refleksi gelombang *P* and *S* Juga *transmisi gelombang P dan S.*

(Russell, 1996)

Persamaan Zoeppritz

Zoeppritz menurunkan amplitudo dari gelombang yang terefleksi dan tertransmisi menggunakan konservasi dari stress dan displacement sepanjang batas lapisan, yang memberikan empat persamaan dari empat variabel yang tidak diketahui.
Dengan menginversi matriks dari persamaan Zoeppritz memberikan amplitudo sebagai fungsi sudut (zoeppritz, 1919)

$$\begin{bmatrix} R_P \\ R_S \\ T_P \\ T_S \end{bmatrix} = \begin{bmatrix} -\sin\theta_1 & -\cos\phi_1 & \sin\theta_2 & \cos\phi_2 \\ \cos\theta_1 & -\sin\phi_1 & \cos\theta_2 & -\sin\phi_2 \\ \sin 2\theta_1 & \frac{V_{P1}}{V_{S1}}\cos 2\phi_1 & \frac{\rho_2 V_{S2}^2 V_{P1}}{\rho_1 V_{S1}^2 V_{P2}}\cos 2\phi_1 & \frac{\rho_2 V_{S2} V_{P1}}{\rho_1 V_{S1}^2}\cos 2\phi_2 \\ -\cos 2\phi_1 & \frac{V_{S1}}{V_{P1}}\sin 2\phi_1 & \frac{\rho_2 V_{P2}}{\rho_1 V_{P1}}\cos 2\phi_2 & -\frac{\rho_2 V_{S2}}{\rho_1 V_{P1}}\sin 2\phi_2 \end{bmatrix}^{-1} \begin{bmatrix} \sin\theta_1 \\ \cos\theta_1 \\ \sin 2\theta_1 \\ \cos 2\phi_1 \end{bmatrix}$$

Dimana : Rp : Amplitudo gelombang P refleksi
Rs : Amplitudo gelombang S refleksi
Tp : Amplitudo gelombang P transmisi
Ts : Amplitudo gelombang S transmisi

(Zoeppritz, 1919)

Persamaan Aki Richard

$$R(\theta) = R_{po} + G\sin^2\theta + C\tan^2\theta\sin^2\theta$$

$$R_{po} = \frac{1}{2}\left[\frac{\Delta Vp}{Vp} + \frac{\Delta\rho}{\rho}\right] \qquad G = \frac{1}{2}\frac{\Delta Vp}{Vp} - 4\left[\frac{\Delta Vs}{Vs}\right]^2\frac{\Delta Vs}{Vs} - 2\left[\frac{\Delta Vs}{Vs}\right]^2\frac{\Delta\rho}{\rho} \qquad C = \frac{1}{2}\frac{\Delta Vp}{Vp}$$

Persamaan Shuey

$$R(\theta) = \frac{1}{2}\left(\frac{\Delta v_P}{v_P} + \frac{\Delta\rho}{\rho}\right) + \left(\frac{1}{2}\frac{\Delta v_P}{v_P} - 4\frac{v_S^2}{v_p^2}\frac{\Delta v_S}{v_S} - 2\frac{v_S^2}{v_p^2}\frac{\Delta v_P}{v_P}\right)\sin^2\theta + \frac{1}{2}\frac{\Delta v_P}{v_P}(\tan^2\theta - \sin^2\theta)$$

$$R(\theta) = R_p + \left(R_p A_0 + \frac{\Delta\sigma}{(1-\sigma)^2}\sin^2\theta + \frac{1}{2}\frac{\Delta\alpha}{\alpha}\left(\tan^2\theta - \sin^2\theta\right)\right)$$

Untuk sudut kecil **$\sin^2\Theta = \tan^2\Theta$,** sehingga

$$R(\theta) = A + B\sin^2\theta$$

(Aki & Richard, 1980), (Shuey, 1985)

AVO

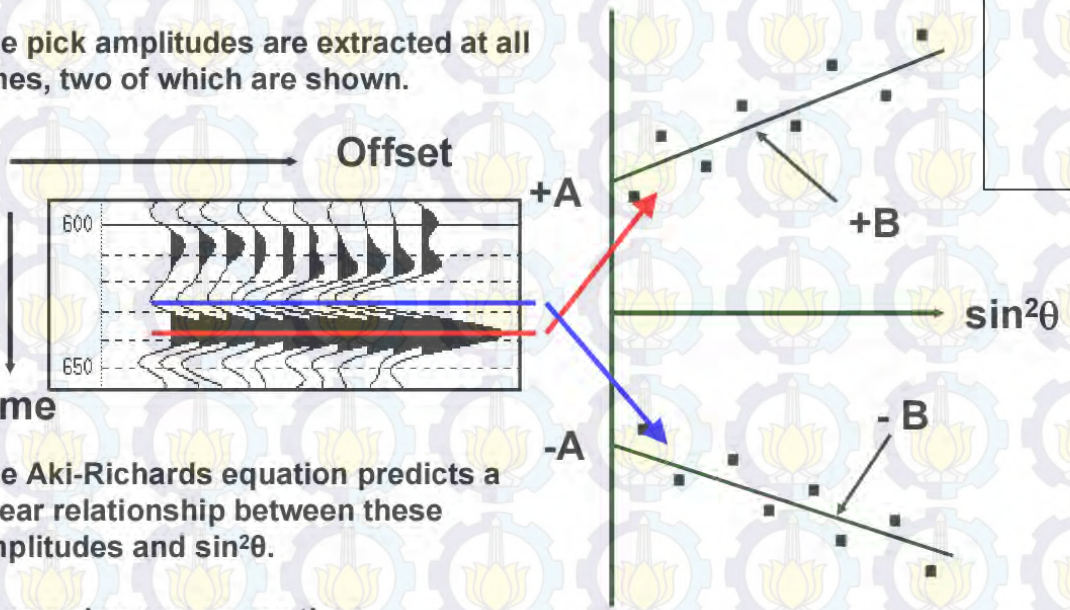
$$R(\theta) = A + B\sin^2\theta \qquad (1)$$

dimana:

$$A = \frac{1}{2}\left[\frac{\Delta V_p}{V_p} + \frac{\Delta \rho}{\rho}\right] \qquad (2)$$

$$B = \frac{1}{2}\frac{\Delta V_p}{V_p} - 4\left[\frac{V_s}{V_p}\right]^2 \frac{\Delta V_s}{V_s} - 2\left[\frac{V_s}{V_p}\right]^2 \frac{\Delta \rho}{\rho} \qquad (3)$$

The pick amplitudes are extracted at all times, two of which are shown.



The Aki-Richards equation predicts a linear relationship between these amplitudes and $\sin^2\theta$.

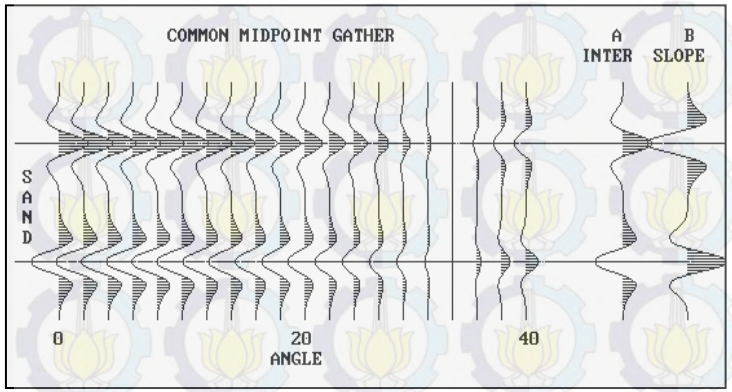
Regression curves are then calculated, to give A and B values for each time sample.

(Goodway, 2001)

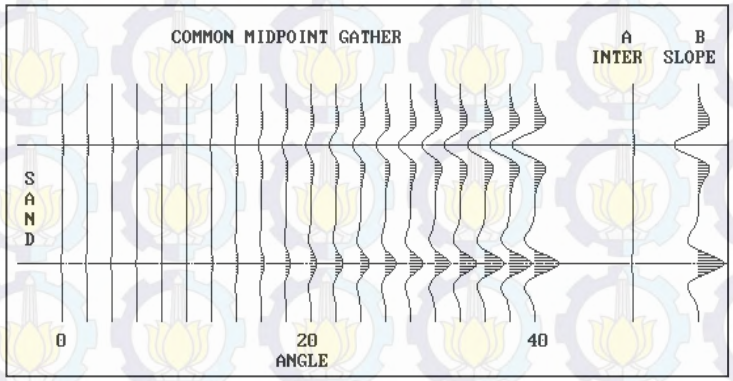
PERTAMINA EP

Contoh fenomena AVO

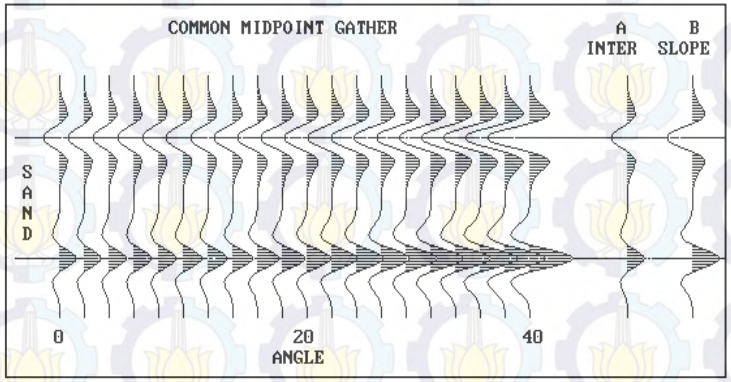
AVO Kelas I



AVO Kelas II



AVO Kelas III



(Rutherford dkkl, 1989)

Atribut Seismik

Atribut seismik merupakan transformasi matematis dari data trace seismik, yang digunakan sebagai alat bantu dalam interpretasi data seismik

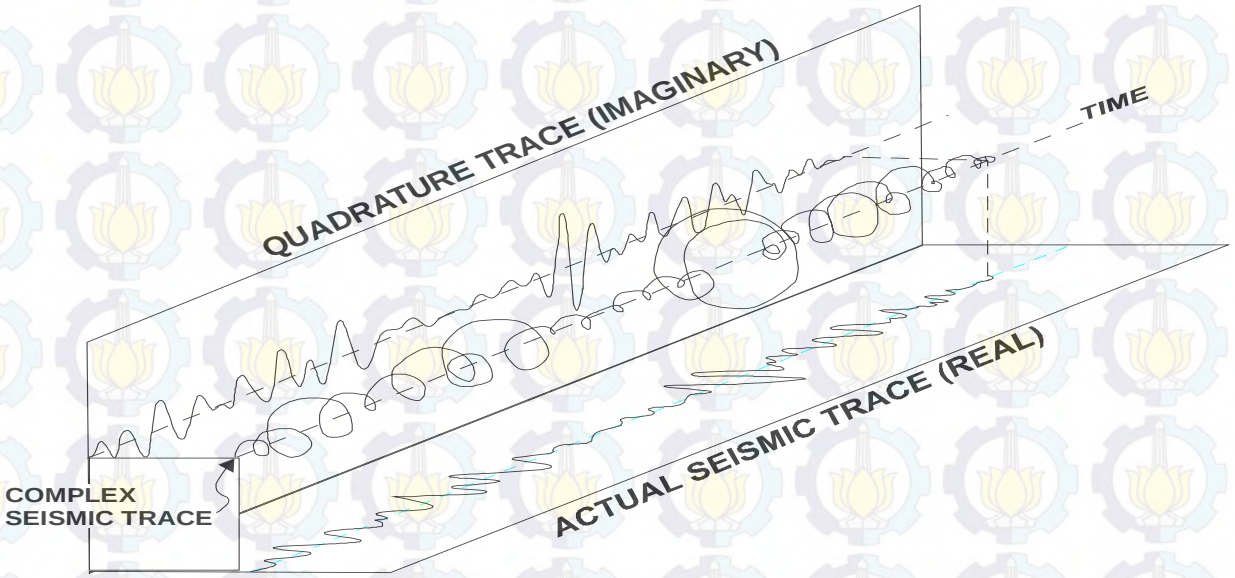


Diagram trace seismik real dan imajiner

Atribut Seismik

Instantaneous Frequency:

$$\omega(t) = d\theta(t)\,/dt$$

Instantaneous phase:

$$\theta = tan^{-1}\left[\frac{f(t)}{h(t)}\right]$$

Dimana,

F(t) = Trace seismik real
h(t) = Trace seismik imajiner

Envelope

$$At = (f(t)^2 + h(t)^2)^{1/2}$$

Sweetness:

$$sweetness = \frac{[Amp.envelope]}{\sqrt{Inst.Frequency}}$$

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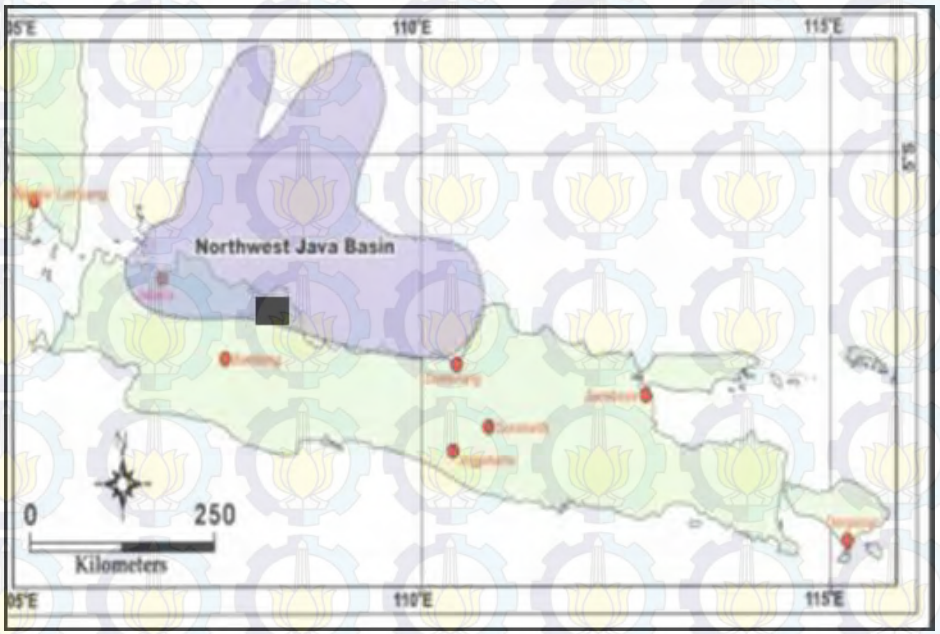
Lokasi Penelitian

Peta cekungan Jawa Barat bagian Utara



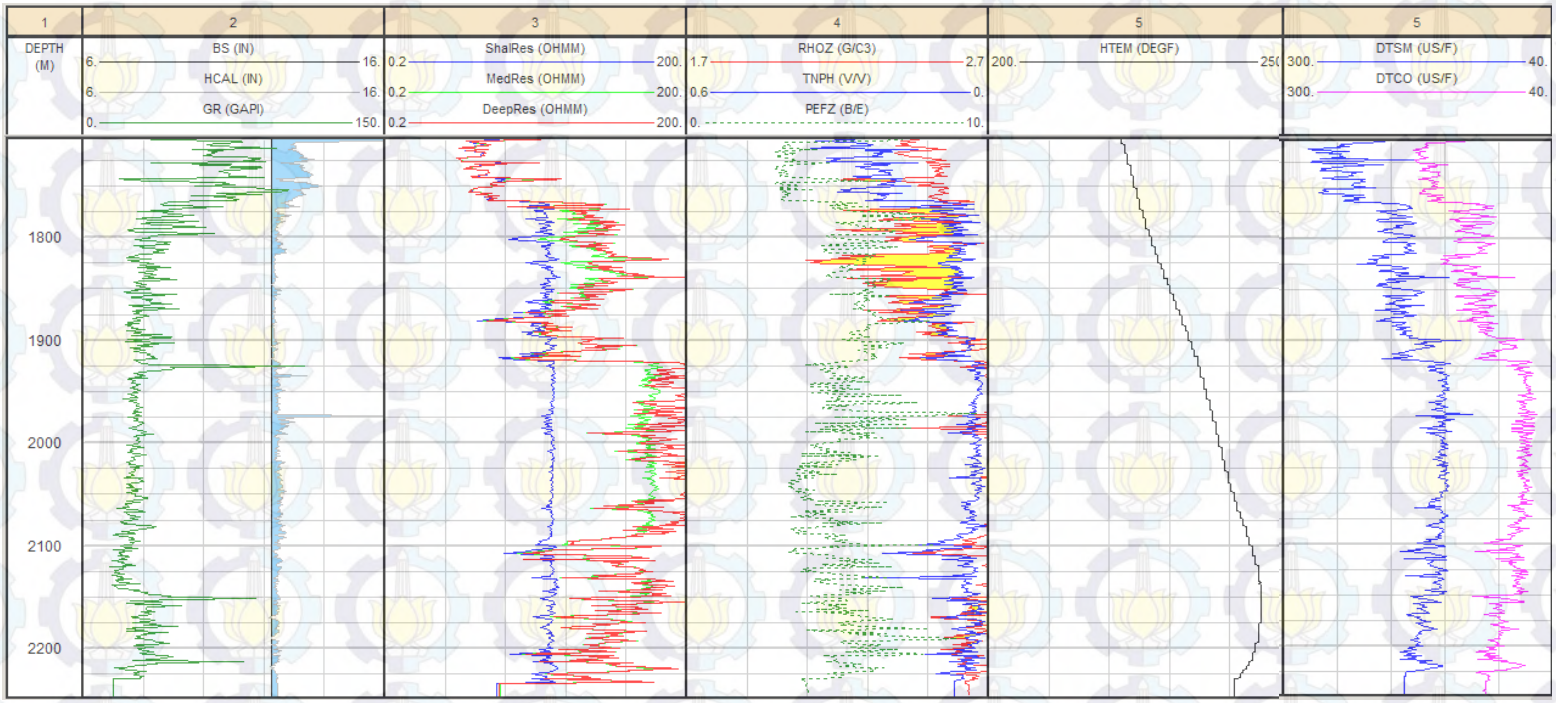
- Data Seismik
  - *Data seismik CDP Gather inline : 4286-4288 , xline : 10577-11657*
- Data Sumur
  - *Sumur Tole_1, Data sumur Vertikal*
- Pengolahan data
  - *Interactive Petrophysics 3.5*
  - *Hampson Russell 9*

PERTAMINA EP

Data Sumur

Data Sumur **Tole_1**

Kedalaman 1760 m – 2200 m

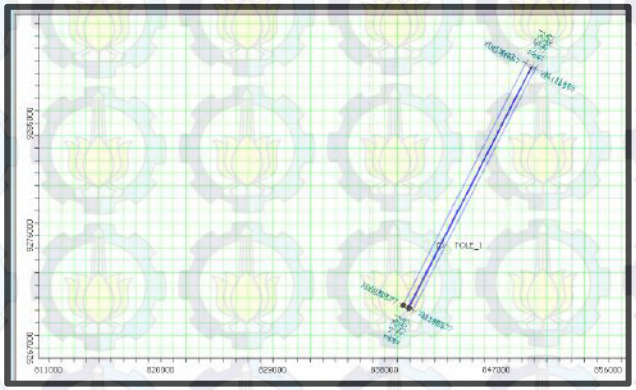


Caliper	Gamma Ray	RHOZ	TPHI	Deep Resistivity	Shallow Resistivity	Medium Reisitivity	Vp	Vs	SP	Temp
ada	ada	ada	ada	ada	ada	ada	ada	ada	ada	ada

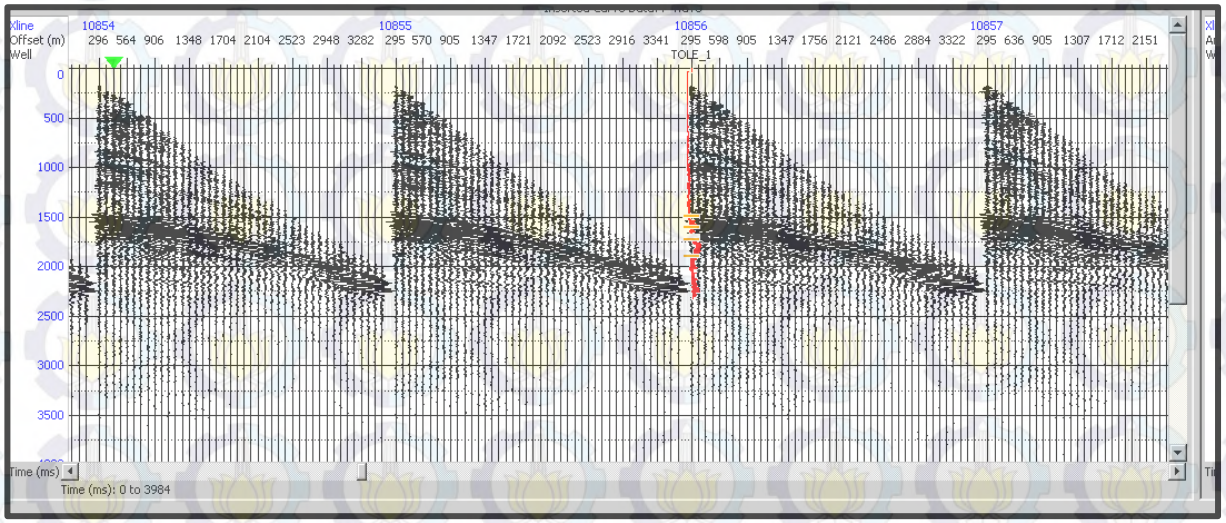
Data seismik

- Data 3D Gather
- NMO
- Bandpass Filter
- Trim Static
- INVEST
- Mute
- Super Gather
- Trim Static
- Angle Gather

Base Map

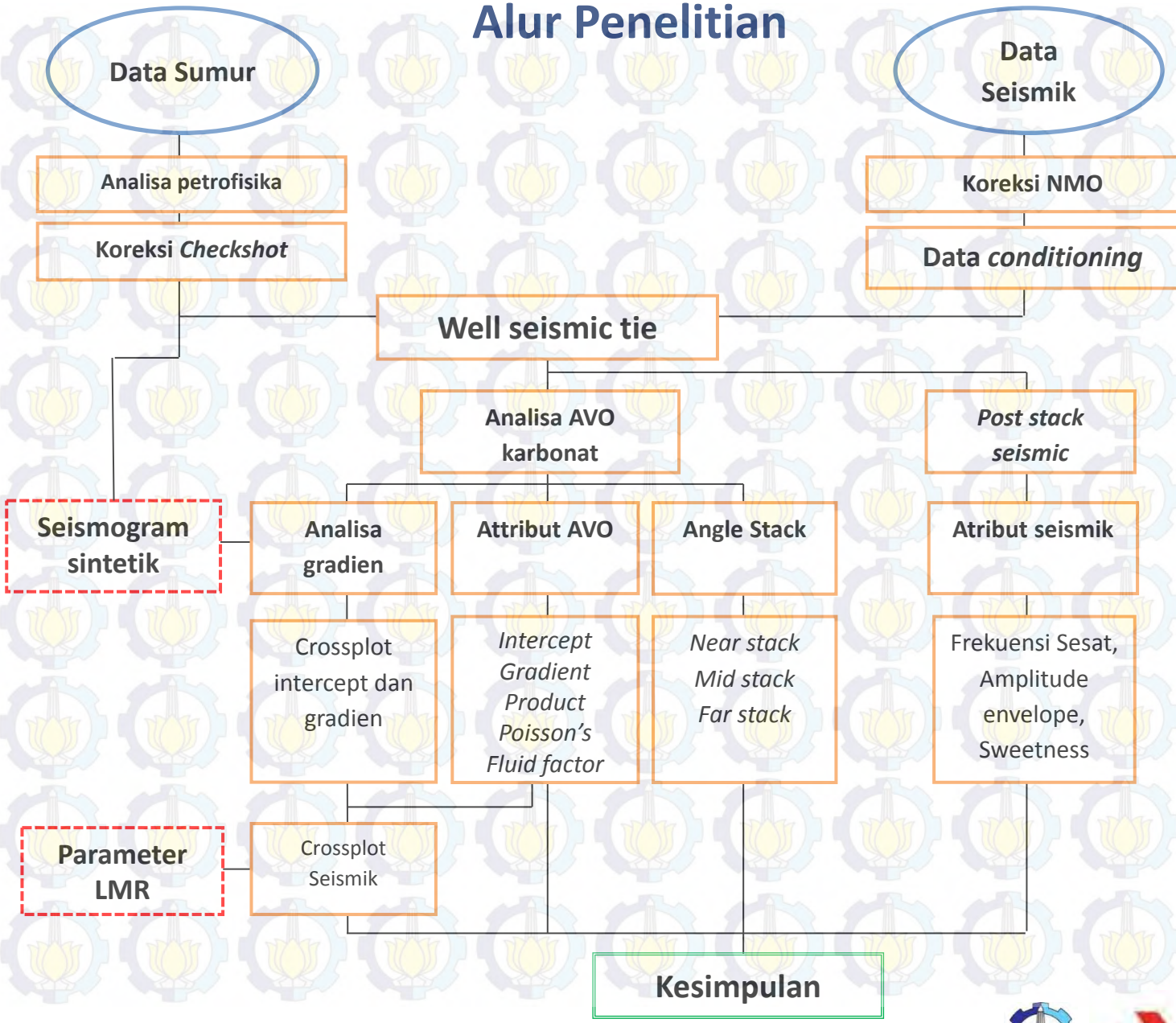


Data Gather



PERTAMINA EP

Alur Penelitian



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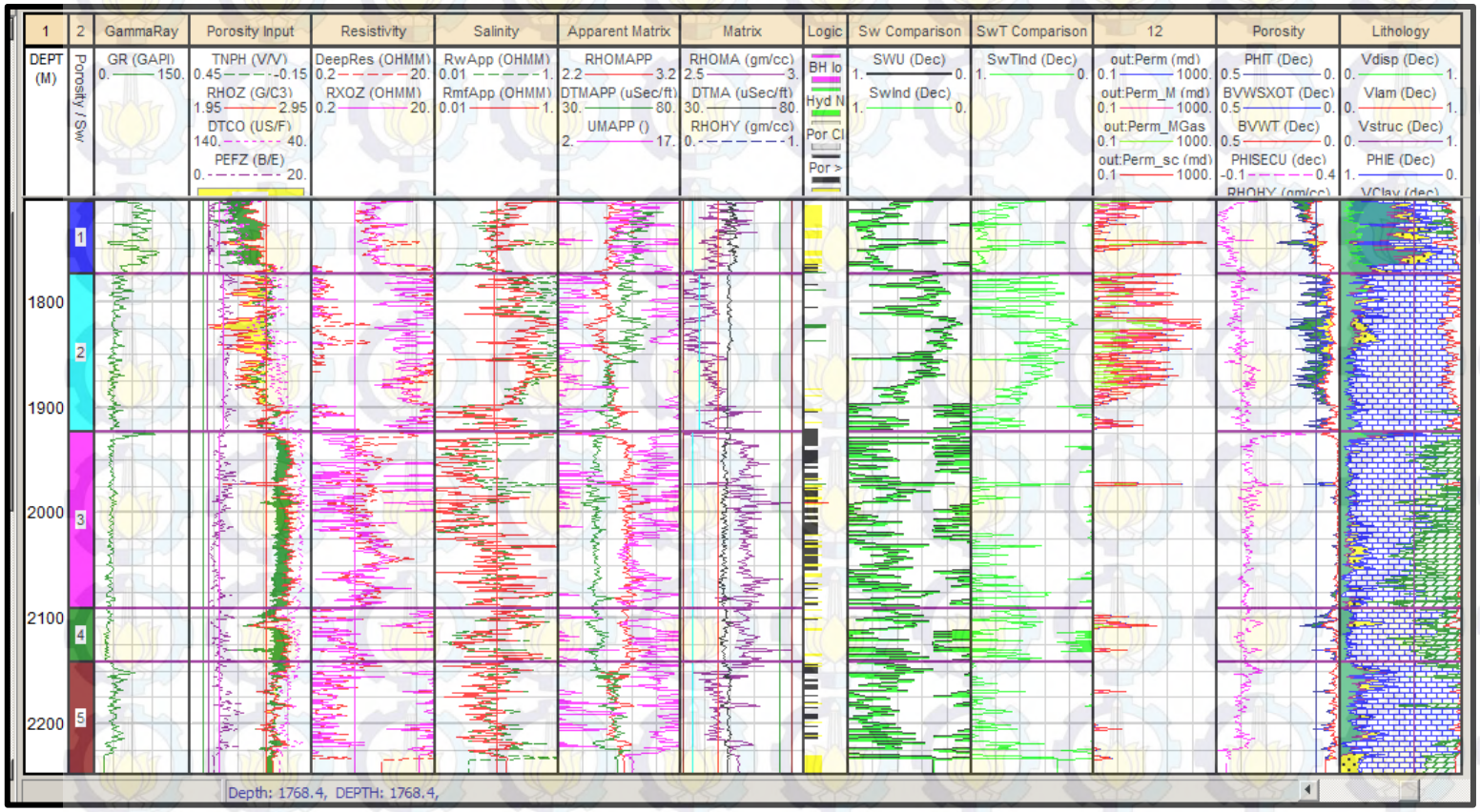
Analisa Data Sumur

Kedalaman 1705 m – 2248 m



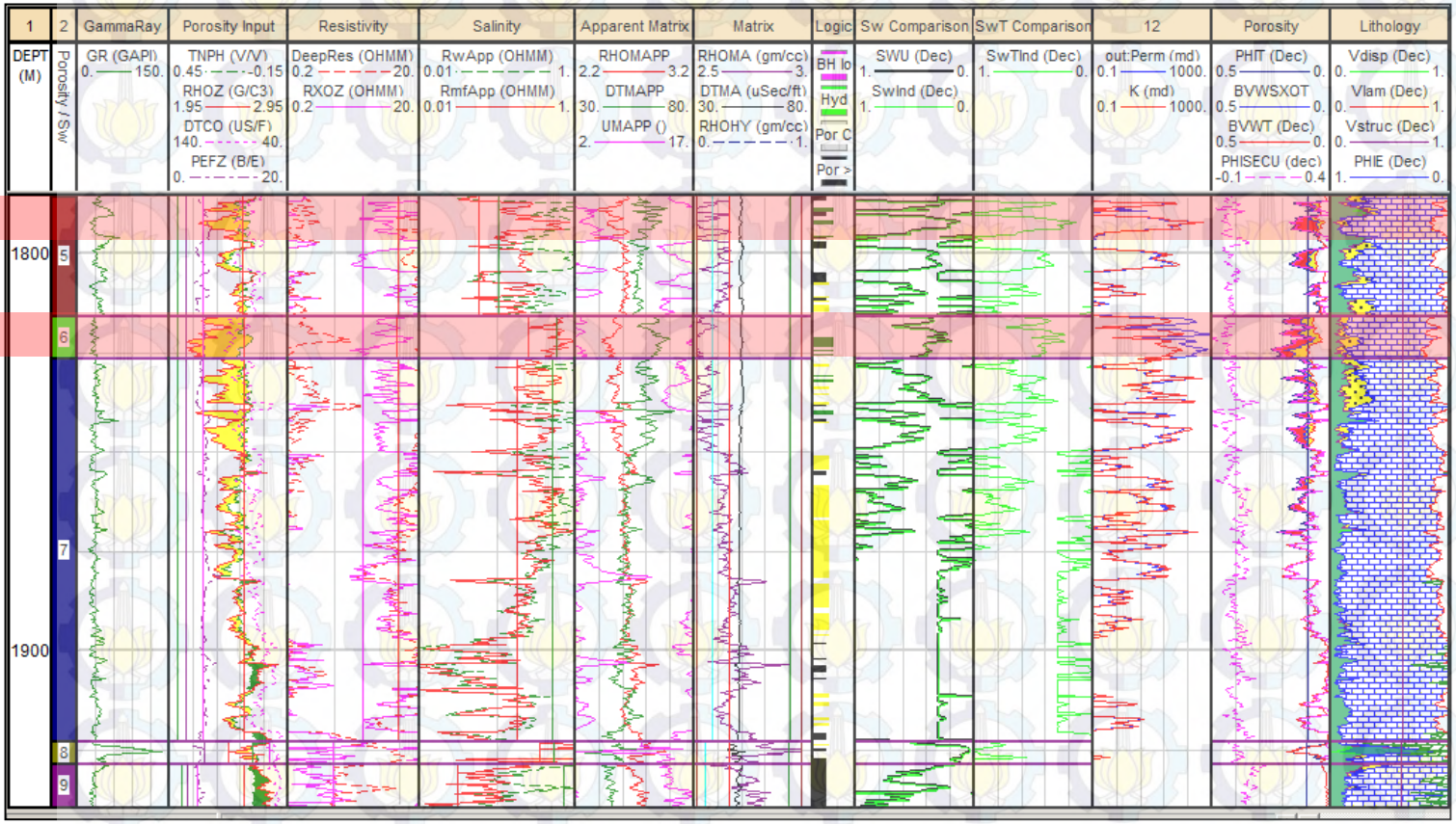
Formasi Cibulakan atas

Formasi Baturaja

PERTAMINA EP

Analisa Data Sumur

Kedalaman 1784 m – 1940 m



DST 2

DST 1

Zona Prospek Gas

PERTAMINA EP

Contoh Perhitungan parameter fisika batuan

Kedalaman zona reservoir

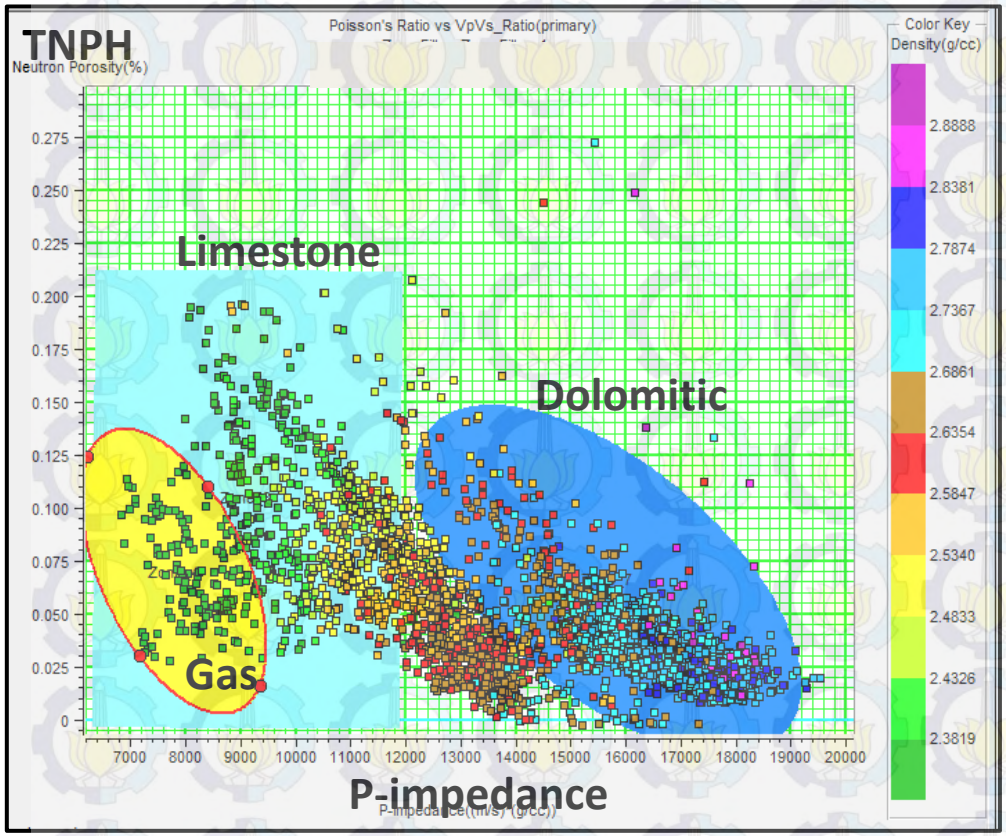
depth	CAL	GR	RHOZ	TNPH	LLD	LLS	RXO	V_clay	PHI_T	PHI_E	SW	SH	K	PR	ZP	ZS	LR	MR
m	in	API	g/cc	v/v	ohmm	ohmm	ohmm	%	%	%	%	%	mD	unit	ft/s*g/cc	ft/s*g/cc	Gpa/cc	Gpa/cc
1790.7	12.3881	39.5812	2.3998	0.0899	13.0479	10.6431	5.4896	0.185	0.1177	0.0945	0.3063	0.6937	2.8343	0.2709	29216.4	16377.9	29.46	24.92
1790.852	12.4212	31.0676	2.3828	0.1115	9.3921	8.2113	4.6746	0.115	0.1431	0.1286	0.2773	0.7227	13.4164	0.2608	28538.37	16233.4	26.7	24.48
1791.005	12.4322	27.0152	2.3849	0.125	9.2183	8.1113	4.565	0.082	0.1489	0.1386	0.263	0.737	20.7668	0.2853	28904.24	15841.93	30.99	23.32
1791.157	12.4102	26.9235	2.4002	0.121	12.6582	10.6542	5.2695	0.081	0.1403	0.1301	0.2388	0.7612	19.0441	0.2546	29755.86	17073.86	28.09	27.08
1791.31	12.4102	27.6401	2.3907	0.0931	20.4191	15.7041	6.6773	0.087	0.1378	0.1268	0.1923	0.8077	26.2885	0.2534	29993.6	17238.17	28.36	27.61
1791.462	12.3881	27.8769	2.3646	0.0824	24.5879	16.6639	7.0006	0.089	0.1382	0.127	0.1749	0.8251	31.9502	0.2525	29651.09	17061.01	27.6	27.04
1791.614	12.4102	26.7843	2.3275	0.0619	32.0857	18.2402	7.4883	0.091	0.1422	0.1321	0.1478	0.8522	53.3306	0.2465	28586.03	16579.88	24.84	25.54
1791.767	12.3991	28.1436	2.294	0.047	42.4482	21.9066	8.2703	0.101	0.1428	0.1313	0.1288	0.8712	68.393	0.2415	27622.54	16125.77	22.57	24.16
1791.919	12.3881	29.3278	2.2751	0.0422	52.8025	28.1327	9.1549	0.069	0.1275	0.1147	0.1311	0.8689	36.3826	0.2435	26979.46	15710.82	21.76	22.93
1792.072	12.4102	25.4583	2.2396	0.0416	61.7642	37.0174	10.006	0.023	0.1539	0.1452	0.0973	0.9027	185.9126	0.2538	26528.35	15237.47	22.24	21.57
1792.224	12.3881	19.8163	2.2121	0.0416	65.9499	45.1625	9.841	0.019	0.1715	0.1686	0.0822	0.9178	503.5465	0.2626	25825.91	14652.77	22.07	19.95
1792.376	12.3881	19.3426	2.1927	0.0423	53.9226	41.952	9.634	0.045	0.1715	0.169	0.0908	0.9092	417.3697	0.2634	25831.69	14639.11	22.17	19.91
1792.529	12.3881	22.5015	2.1965	0.0409	42.6892	34.4439	9.1403	0.101	0.1581	0.1524	0.1124	0.8876	172.7532	0.2737	26502.65	14793.26	24.59	20.33
1792.681	12.3991	29.3891	2.2147	0.0472	37.0995	30.0856	9.0813	0.107	0.132	0.1192	0.1506	0.8494	32.6174	0.2801	26997.8	14920.88	26.35	20.68
1792.834	12.3881	30.0996	2.2444	0.0493	33.5338	26.7772	8.8425	0.105	0.1345	0.121	0.1558	0.8442	32.5602	0.2579	27950.22	15963.77	25.23	23.68
1792.986	12.3881	29.8468	2.2816	0.056	33.3362	25.0748	8.8604	0.091	0.1526	0.1394	0.1364	0.8636	79.0901	0.2598	28558.95	16269.6	26.59	24.59
1793.138	12.3881	28.1702	2.3096	0.0531	33.346	24.033	8.7127	0.070	0.148	0.1365	0.1398	0.8602	68.6285	0.2583	28822.95	16453.94	26.88	25.15
1793.291	12.4102	25.5647	2.3196	0.0529	36.8601	25.9532	8.7128	0.075	0.1441	0.1353	0.135	0.865	70.7838	0.2468	28450	16494.9	24.64	25.28
1793.443	12.4102	26.1875	2.3062	0.0506	32.9725	24.2916	8.341	0.050	0.1496	0.1402	0.1377	0.8623	79.6666	0.2419	28107.36	16399.22	23.43	24.98
1793.596	12.4212	23.1083	2.2962	0.0598	25.6697	19.3486	7.7609	0.054	0.16	0.1537	0.1435	0.8565	109.8523	0.2713	27903.28	15632.16	26.93	22.7
1793.748	12.4322	23.582	2.2986	0.0709	17.8142	13.885	7.0632	0.033	0.1636	0.1568	0.1688	0.8312	86.8011	0.2739	27777.34	15499.97	27.04	22.32
1793.9	12.4322	21.091	2.32	0.0954	10.9786	8.9769	5.3226	0.054	0.1646	0.1604	0.2114	0.7886	61.0609	0.291	28552.54	15502.54	31.08	22.33
1794.053	12.4102	23.6965	2.3583	0.1165	8.3462	7.0214	4.5196	0.084	0.1562	0.1493	0.2586	0.7414	29.829	0.3052	29867.02	15815.17	36.4	23.24
1794.205	12.4322	27.2493	2.4258	0.1185	8.773	7.3168	4.6664	0.094	0.131	0.1204	0.3086	0.6914	8.123	0.3126	31768.28	16588.68	42.63	25.57
1794.358	12.4102	28.4948	2.4787	0.1027	11.9101	9.5932	5.5238	0.088	0.1037	0.0918	0.3427	0.6573	2.0007	0.3083	33145.1	17449.18	45.49	28.29

PERTAMINA EP

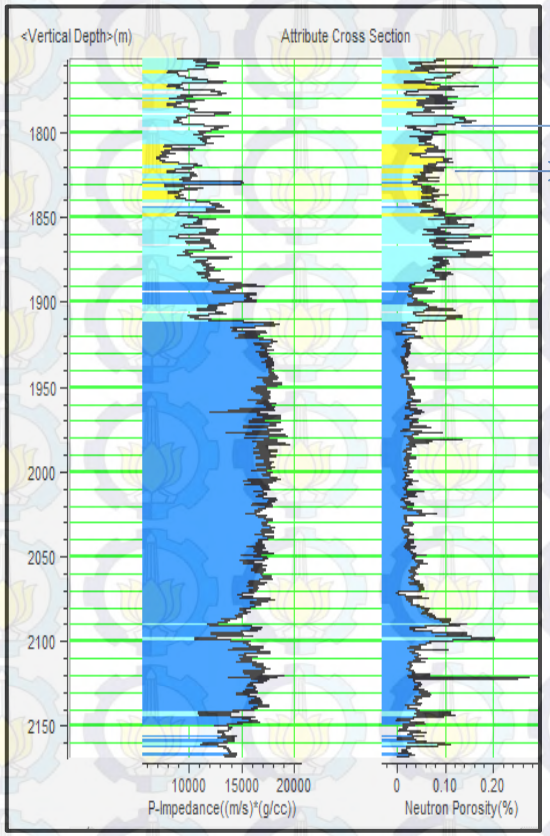
Analisa Fisika Batuan

P-impedance vs Porositas neutron

Crossplot



Cross section

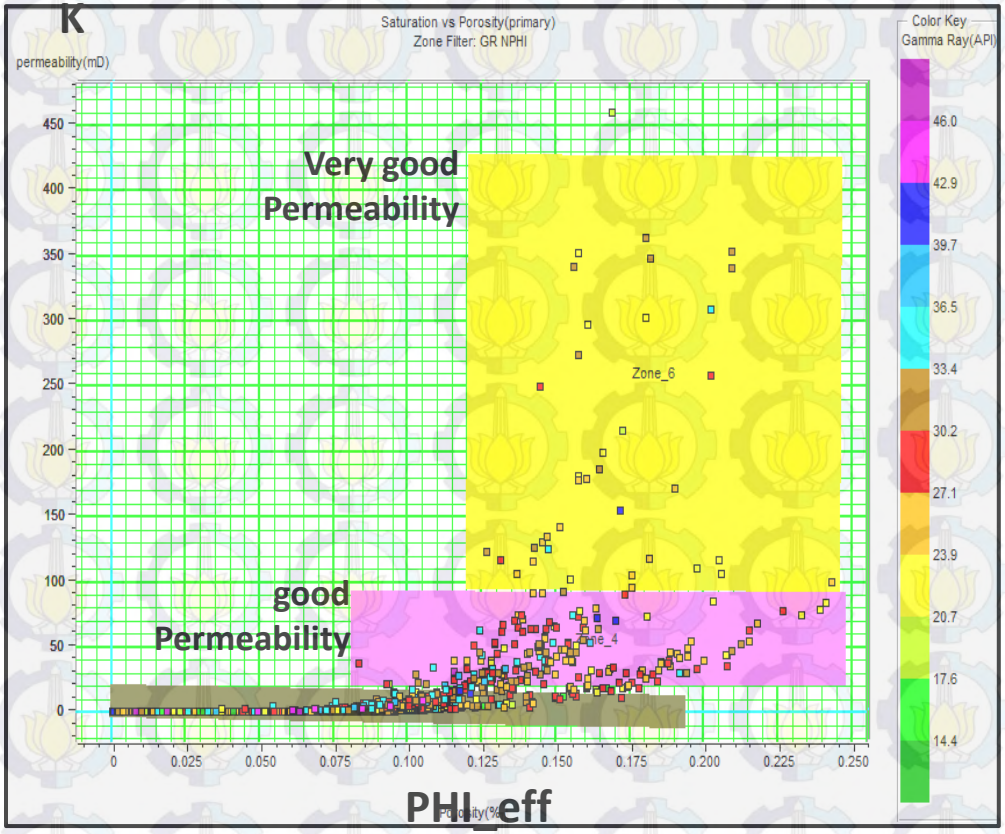


PERTAMINA EP

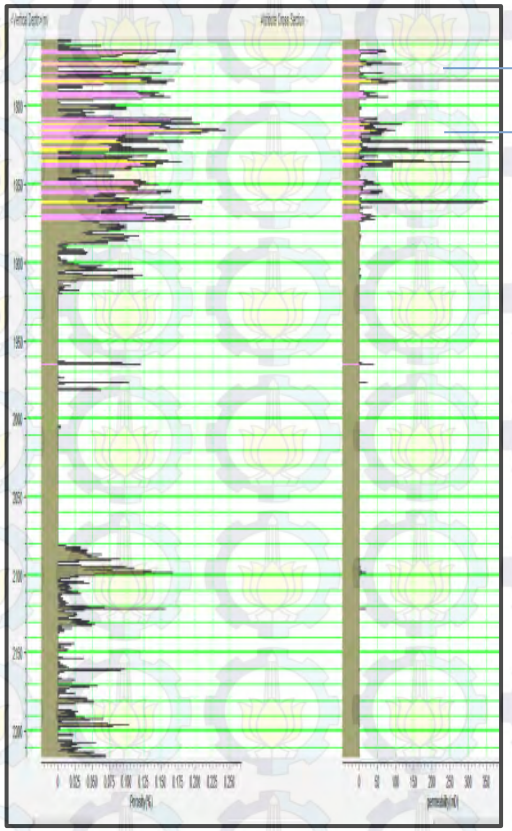
Analisa Fisika Batuan

Permeabilitas vs Porositas efektif

Crossplot



Cross section

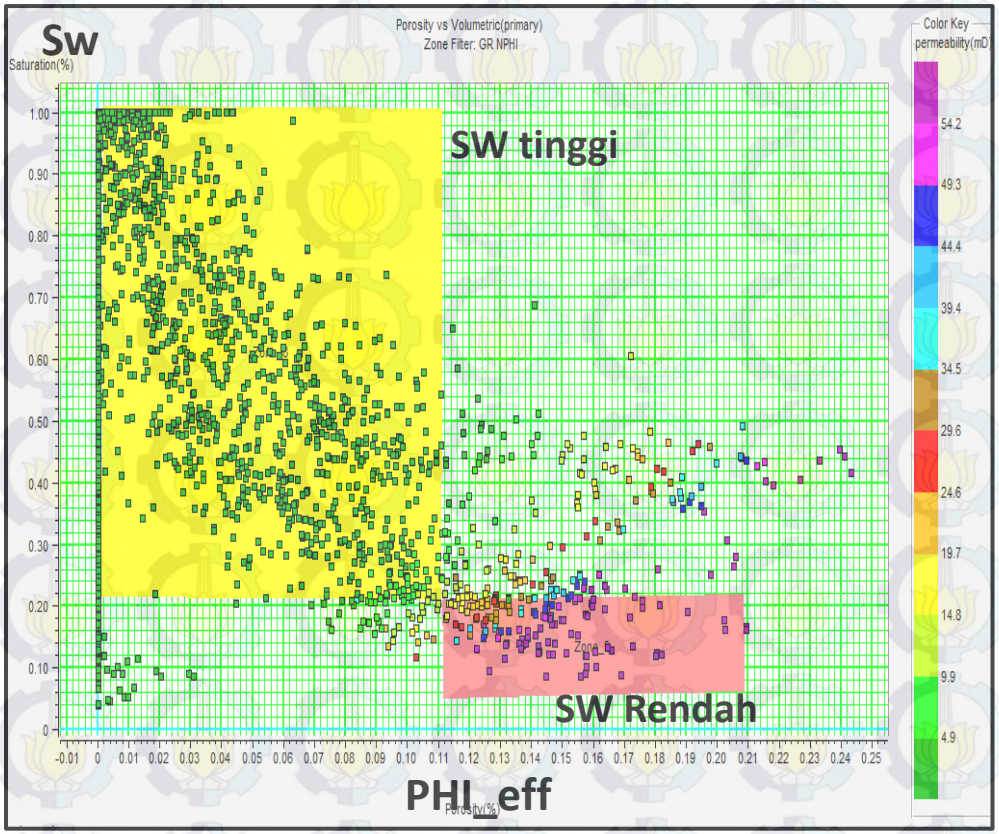


PERTAMINA EP

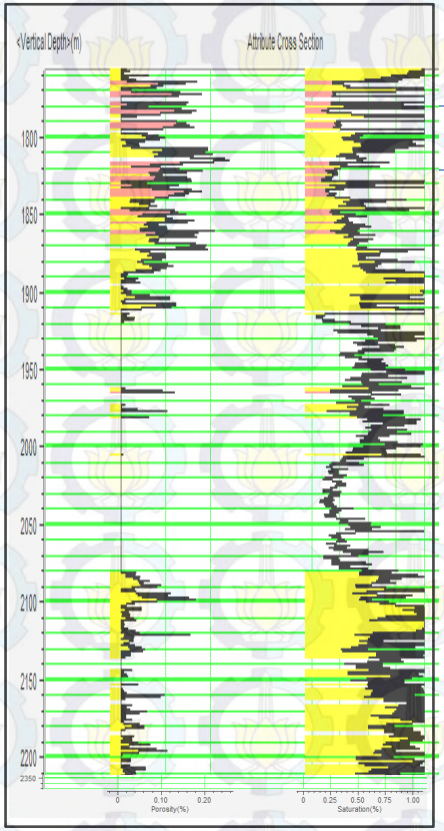
Analisa Fisika Batuan

Saturasi air vs Porositas efektif

Crossplot



Cross section



DST_1

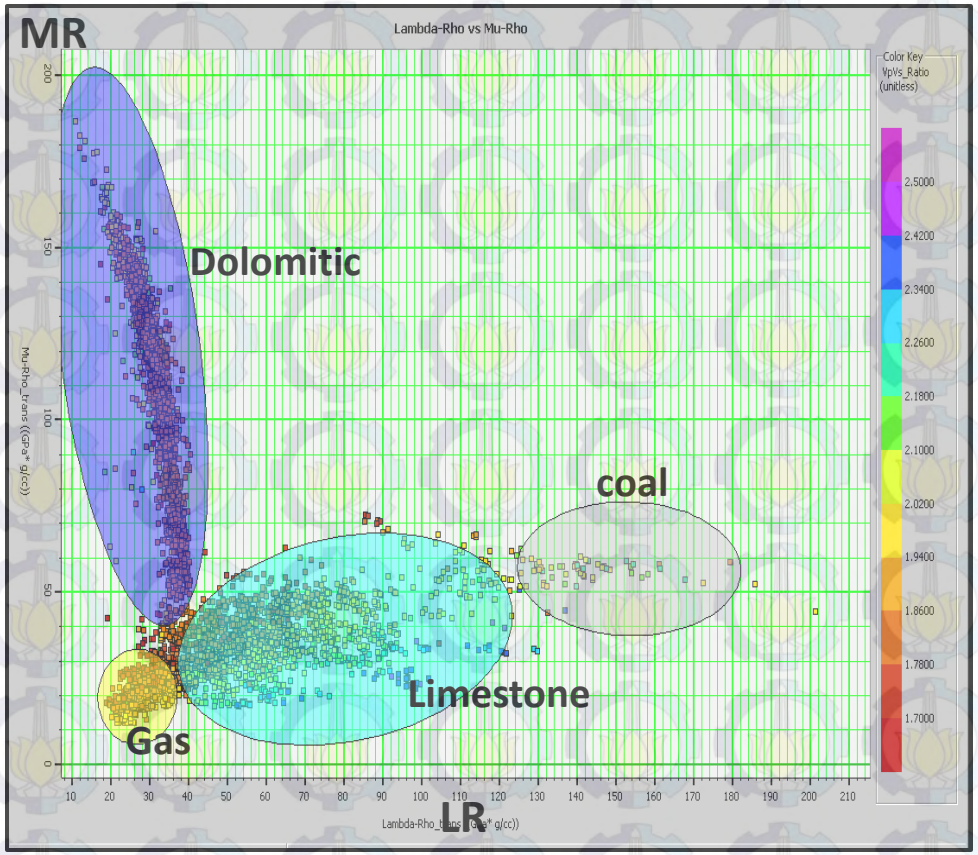
DST_2

PERTAMINA EP

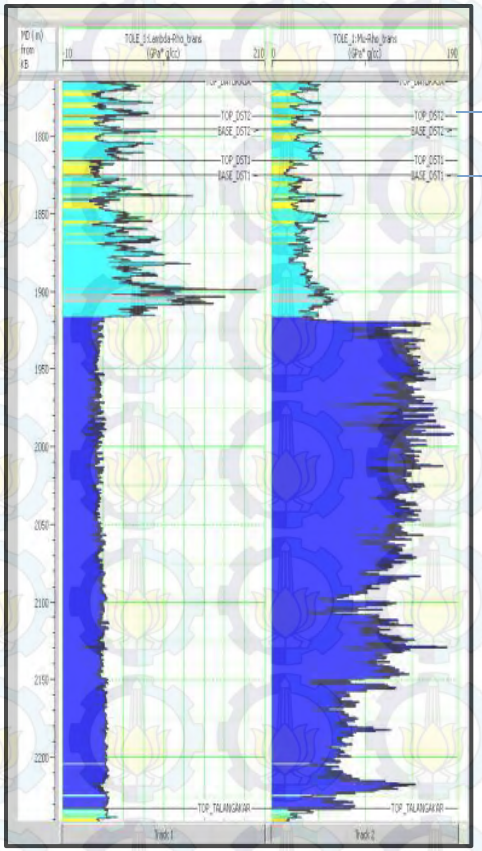
Analisa Fisika Batuan

Mu-Rho vs Lambda-Rho

Crossplot



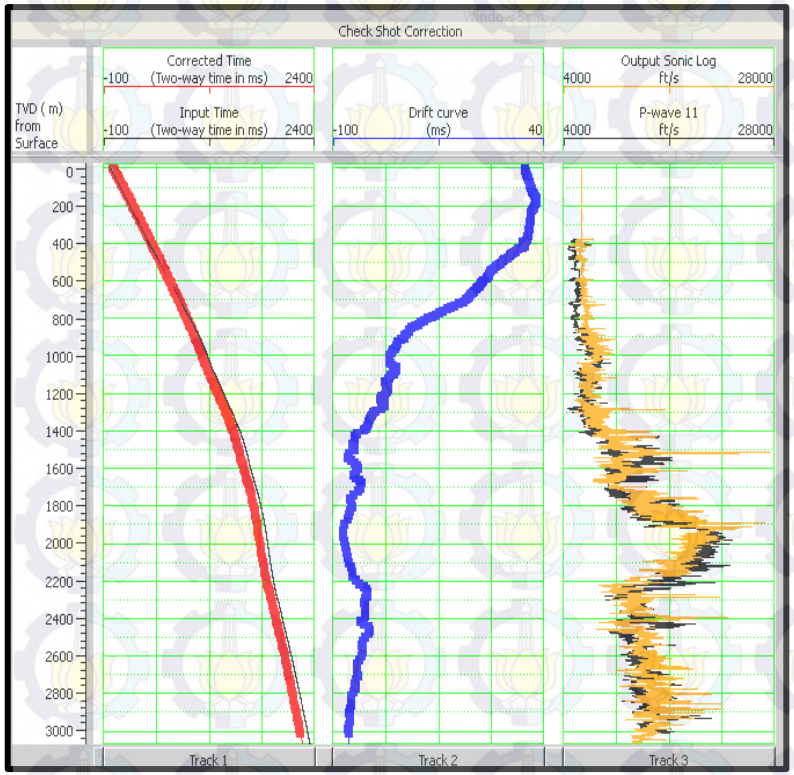
Cross section

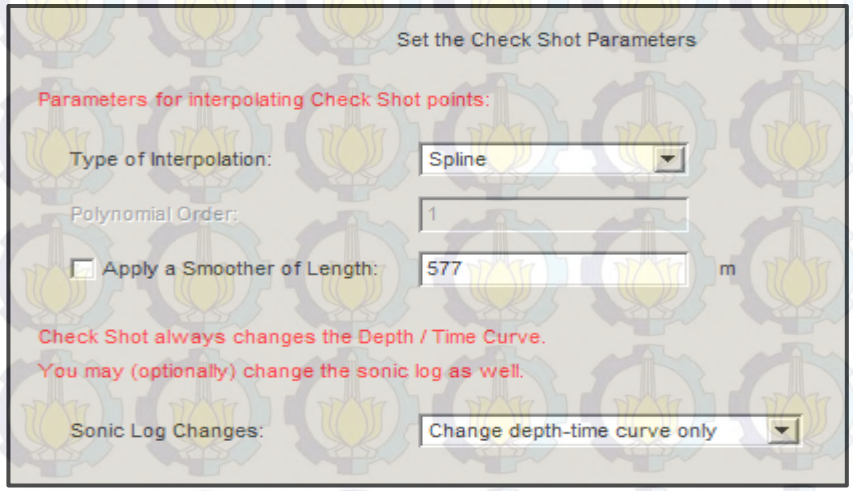


PERTAMINA EP

Koreksi Checkshot

Digunakan untuk mengoreksi kurva kedalaman pada data log sonik.

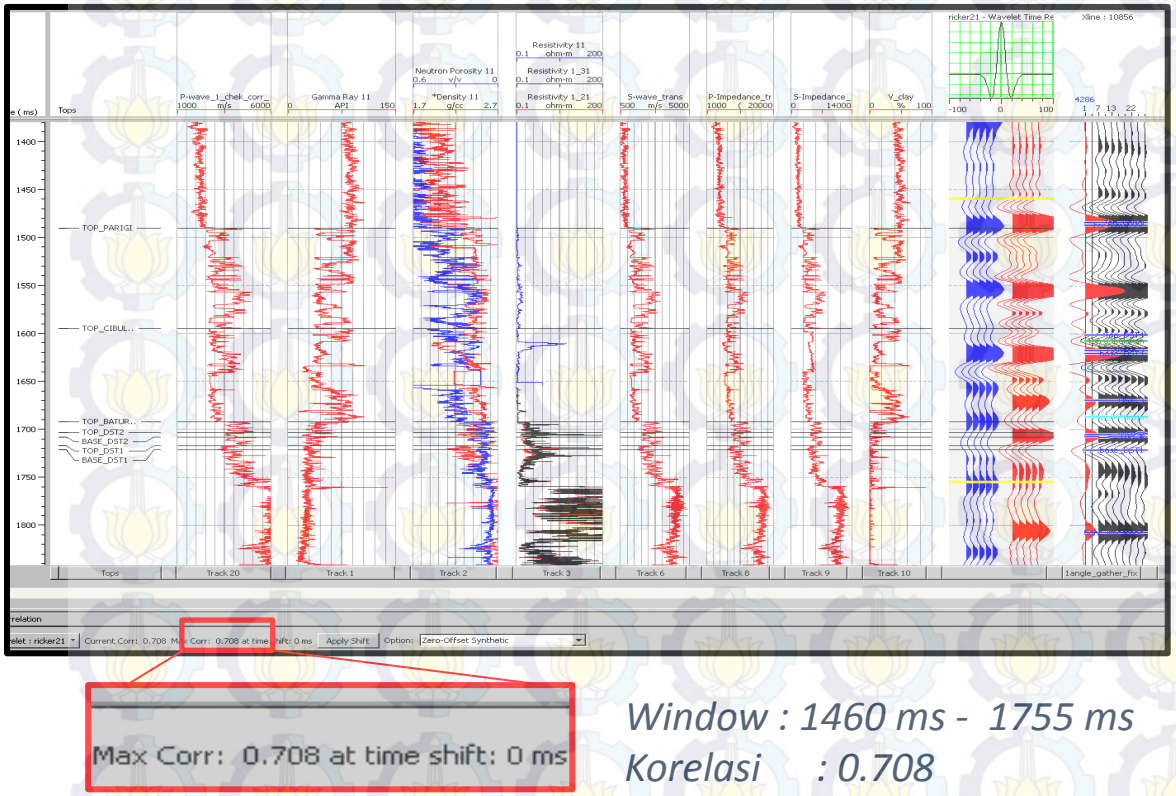




Well Seismic Tie

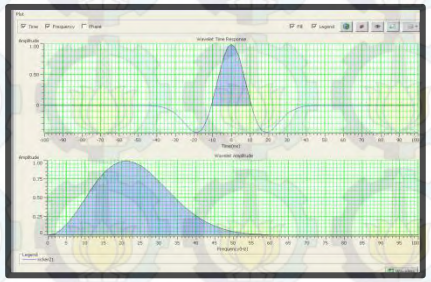
Well seismic Tie merupakan proses pengikatan data seismik dengan data sumur..

Korelasi

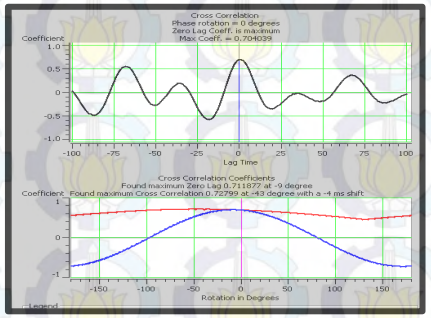


Window : 1460 ms - 1755 ms
Korelasi : 0.708

Wavelet



Ricker
Frequency 21
Zero phase



Cross Correlation

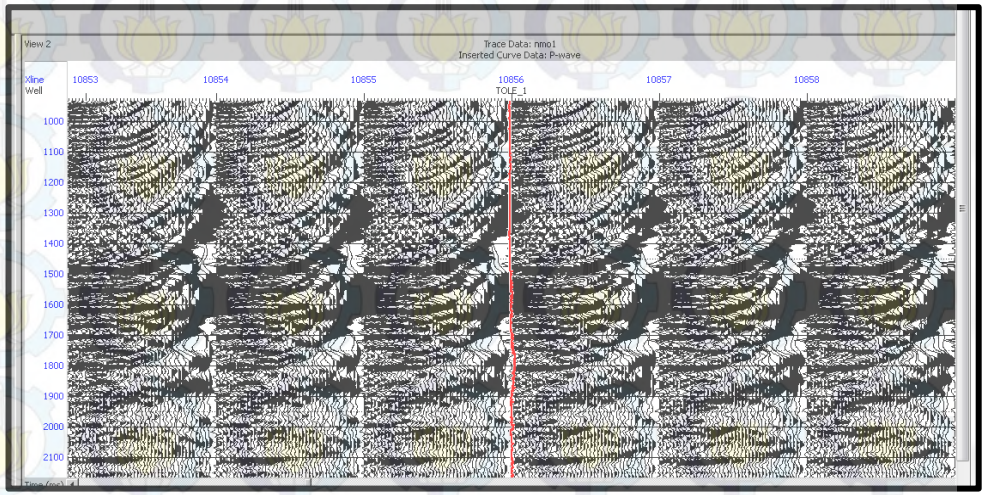
Conditioning data seismik

- Data 3D Gather
- NMO
- Bandpass Filter
- Trim Static
- INVEST
- Mute
- Super Gather
- Trim Static
- Angle Gather

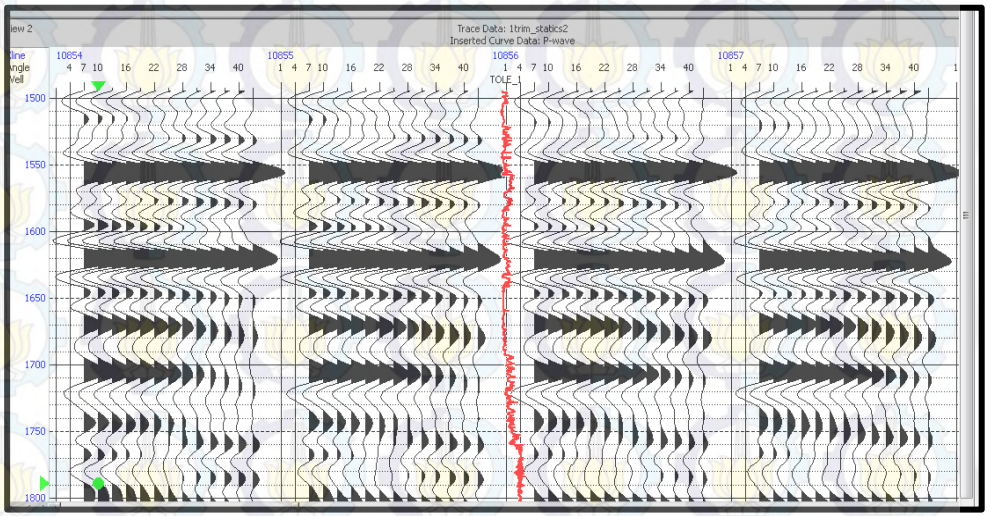
Koreksi NMO

$$t_x = \sqrt{t_0^2 + \frac{x^2}{V_s^2}},$$

Persamaan Dix



Angle Gather
(sudut 0 - 42)

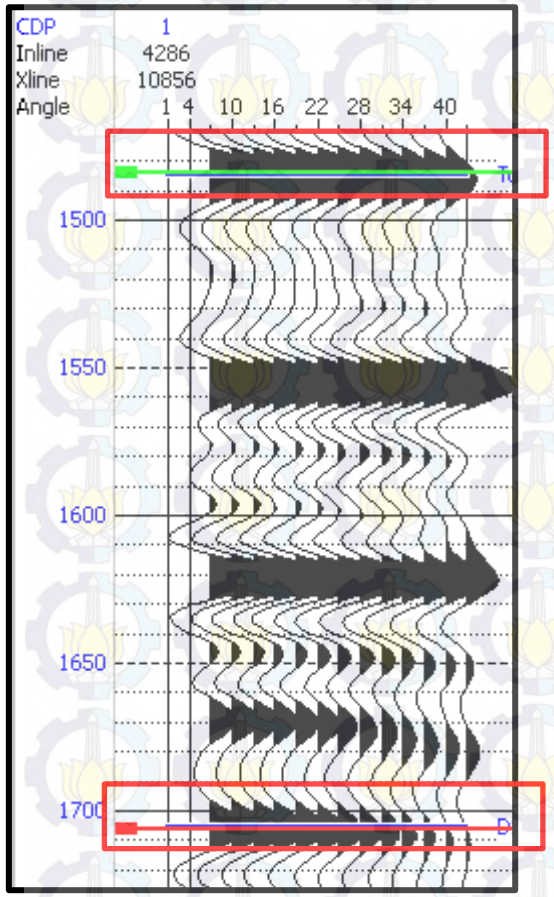


PERTAMINA EP

ANALISA GRADIEN AVO

Seismik

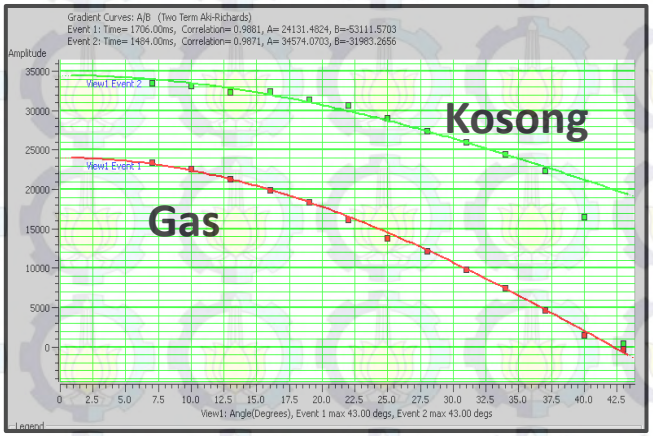
Seismik gather



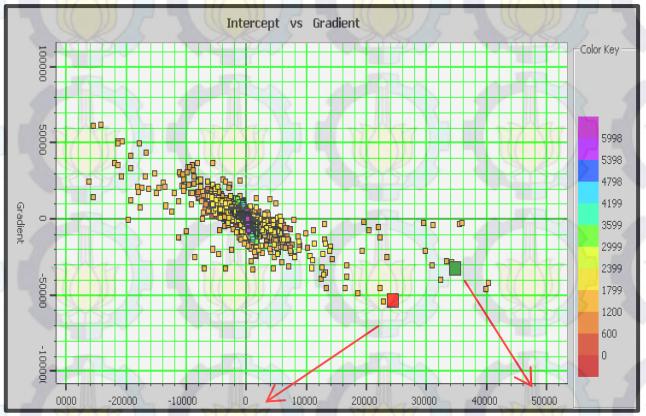
Parigi

DST 2, Baturaja

Amplitudo vs sudut



A vs B



Gas

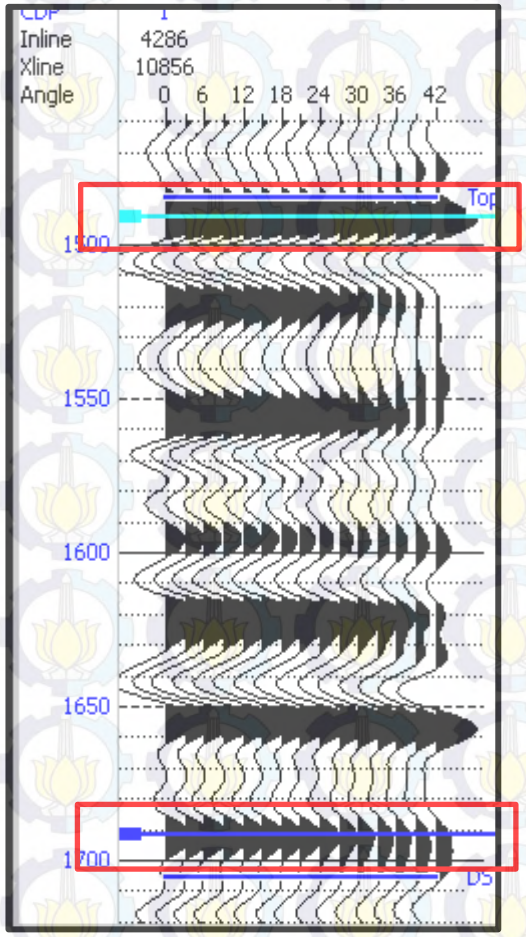
Kosong

PERTAMINA EP

ANALISA GRADIEN AVO

Data sumur

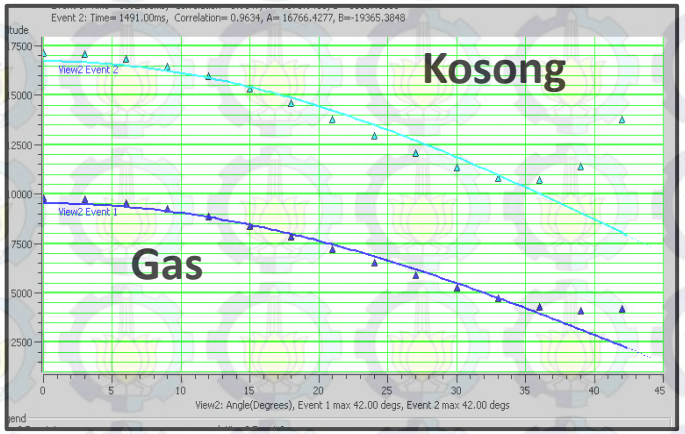
Seismogram sintetik



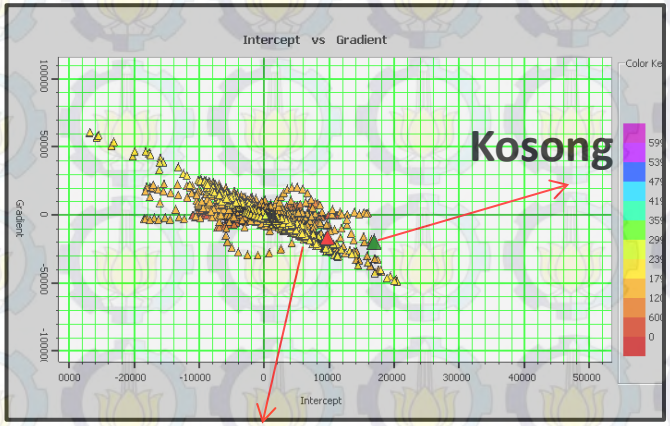
Parigi Fm

DST 2, Baturaja

Amplitudo vs sudut



A vs B



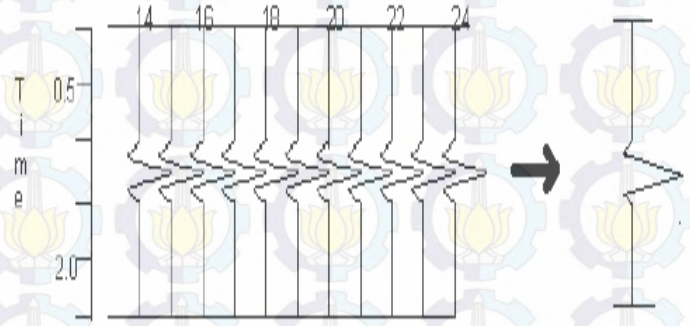
Gas

PERTAMINA EP

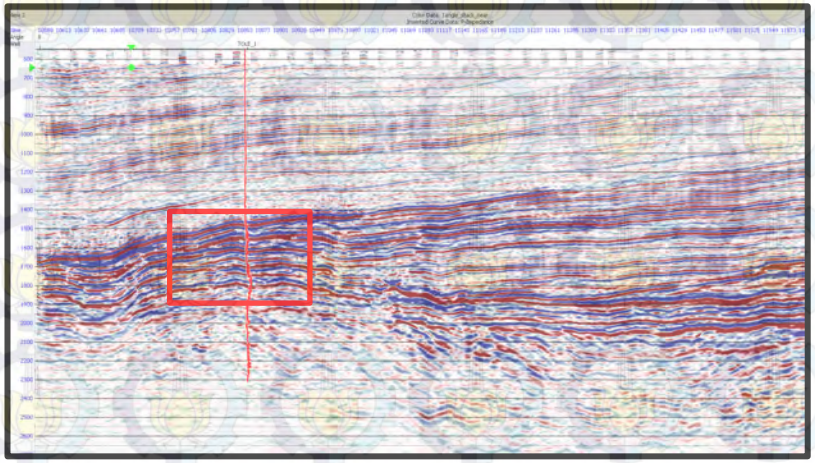
ANGLE STACK

Angle Range Limited Stack

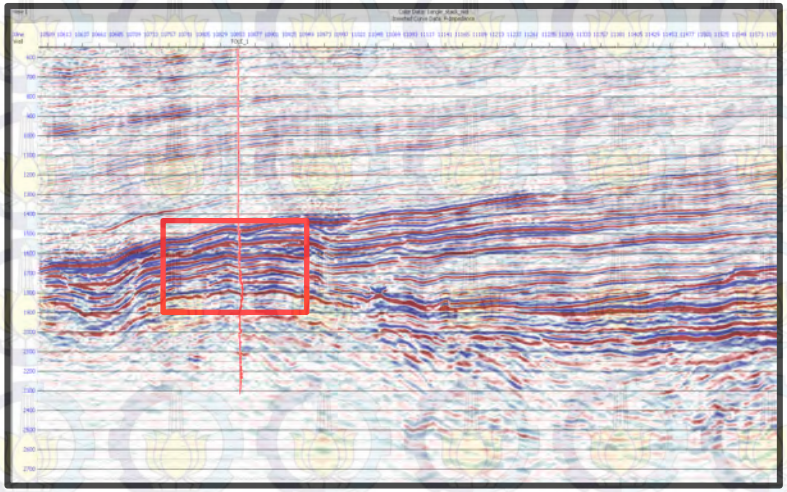
Stack data seismik



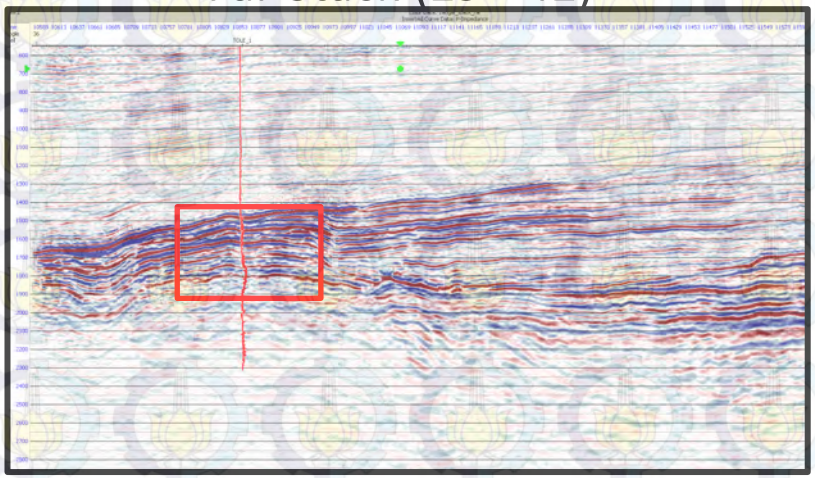
Near Stack (1 - 15)



Mid Stack (15 - 29)



Far Stack (29 - 42)

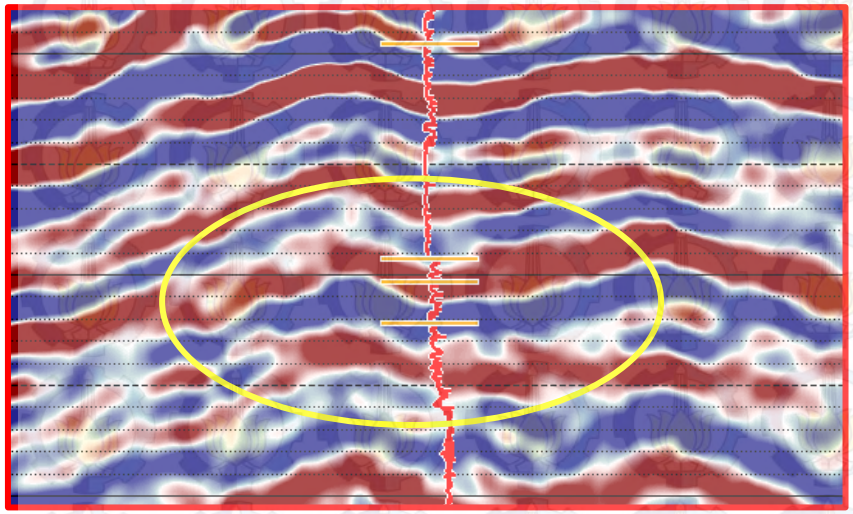


PERTAMINA EP

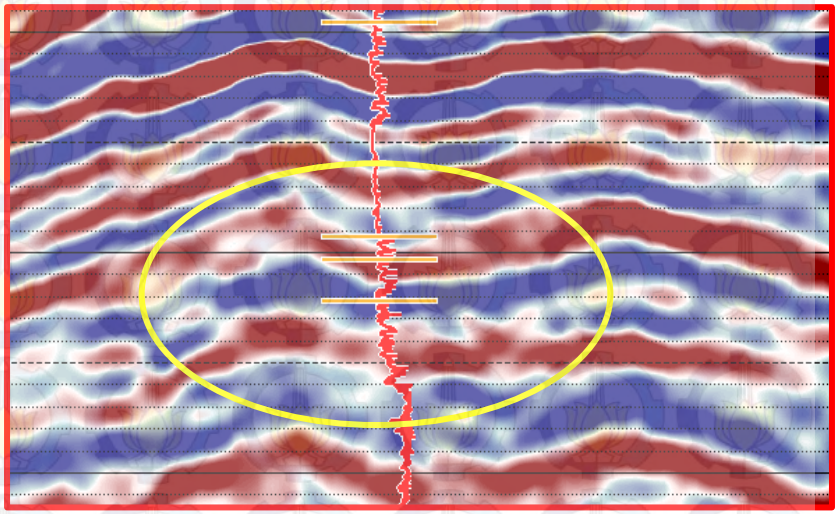
ANGLE STACK

Angle Range Limited Stack

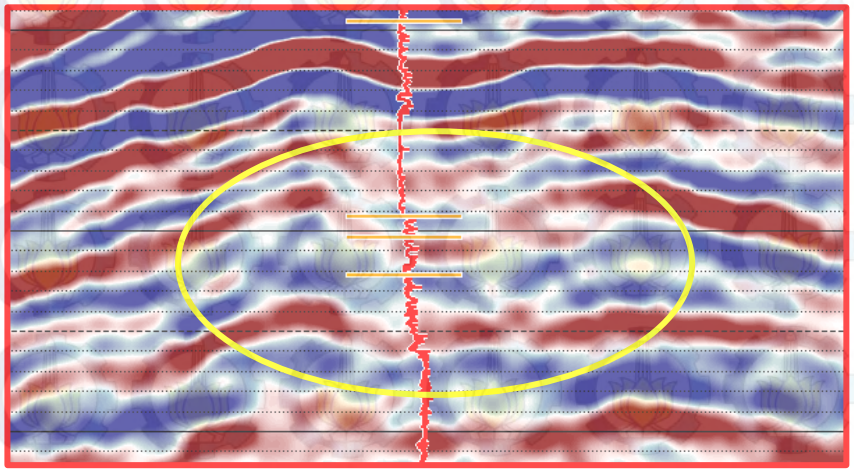
Near Stack (1 - 15)



Mid Stack (15 - 29)



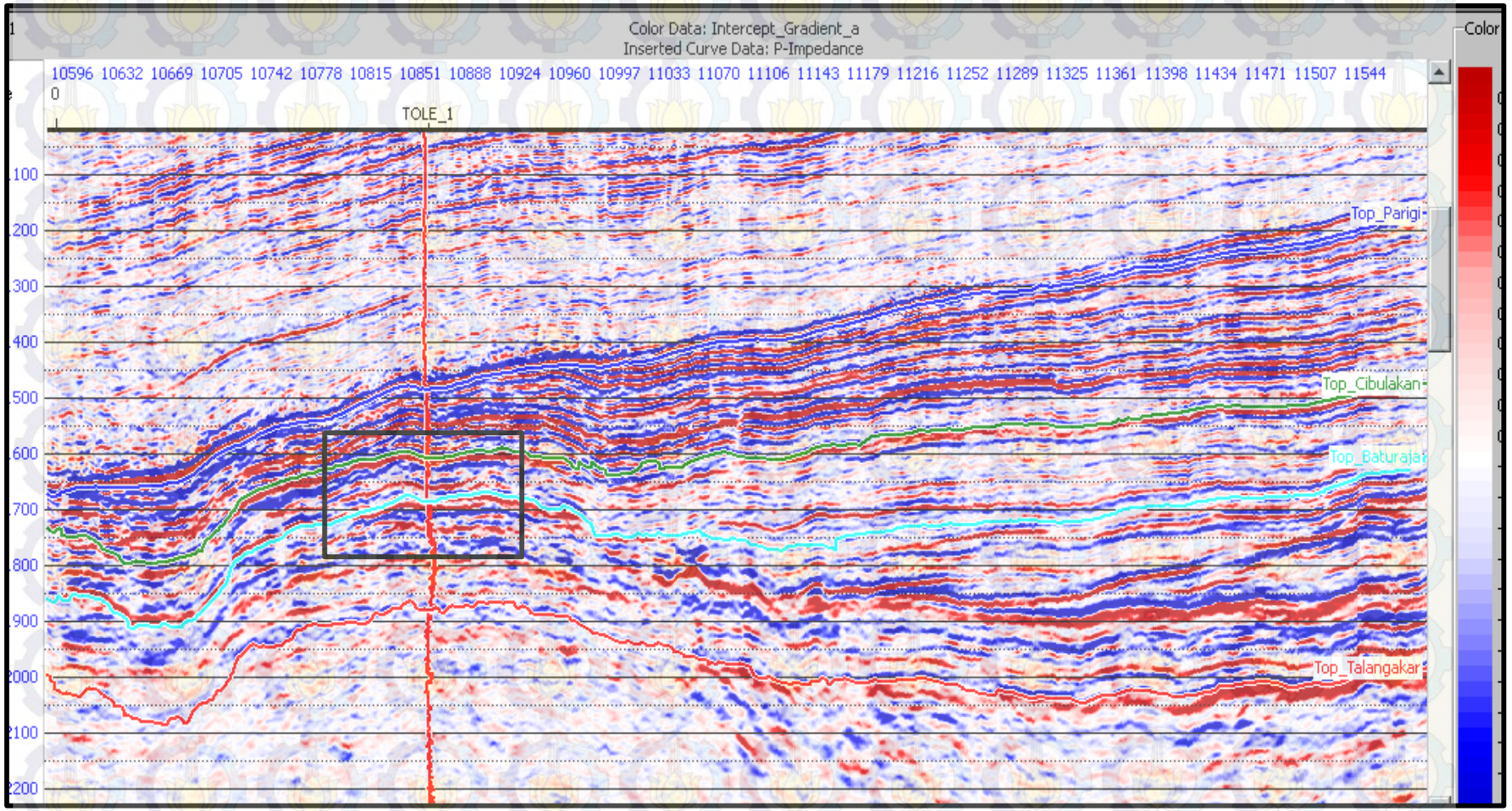
Far Stack (29 - 42)



PERTAMINA EP

Atribut AVO

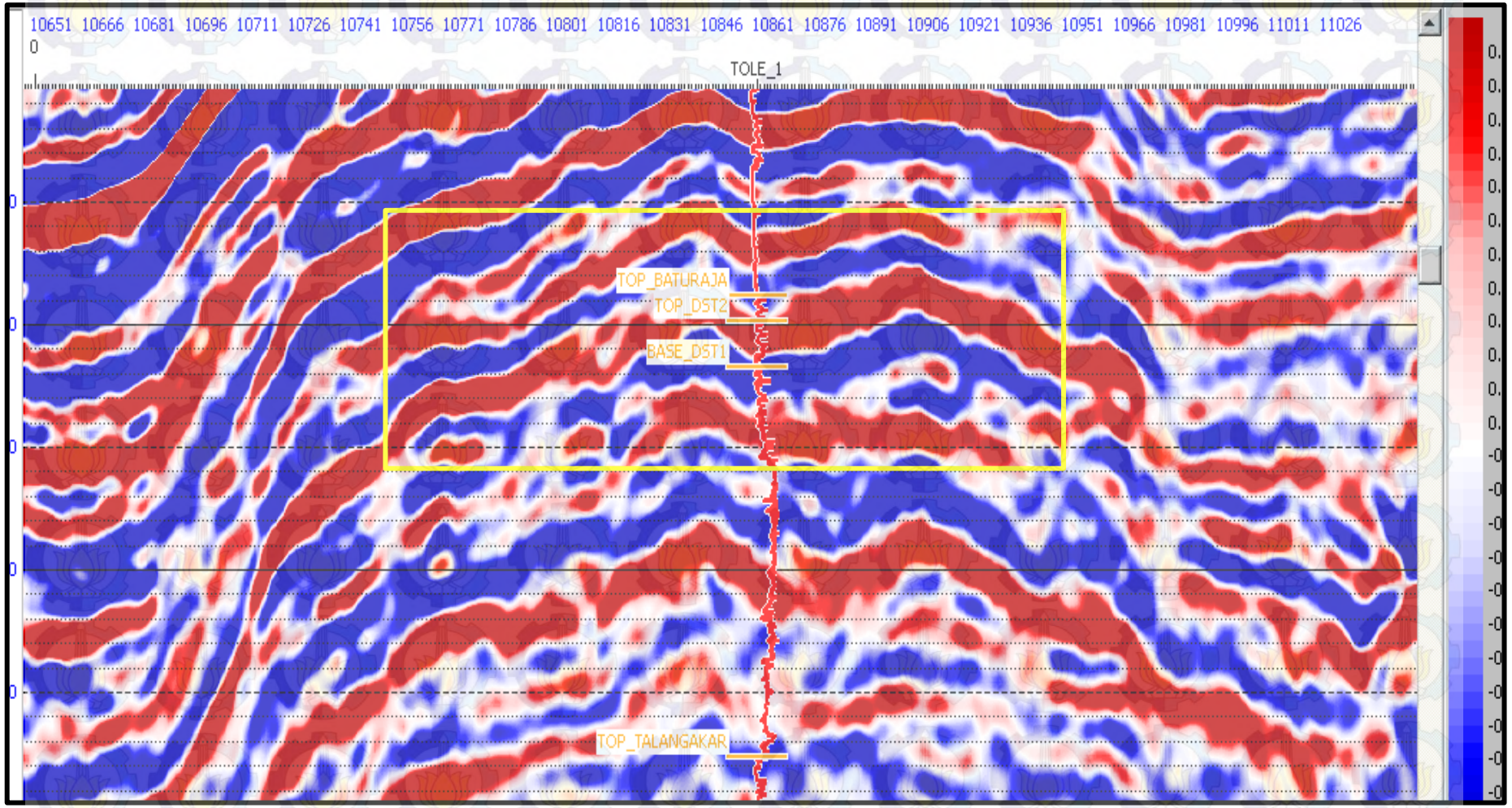
Intercept (A)



PERTAMINA EP

Atribut AVO

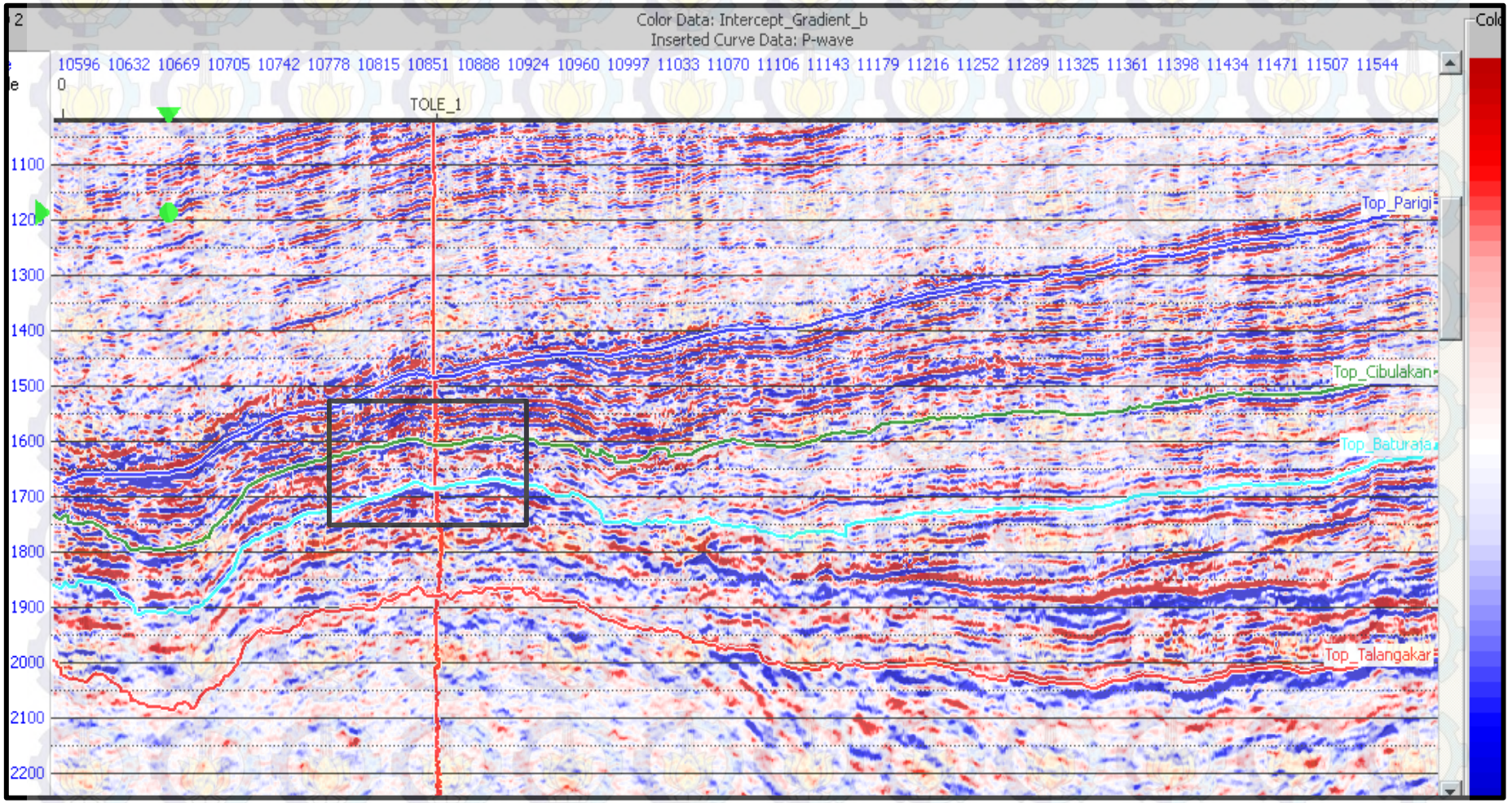
Intercept (A)



PERTAMINA EP

Atribut AVO

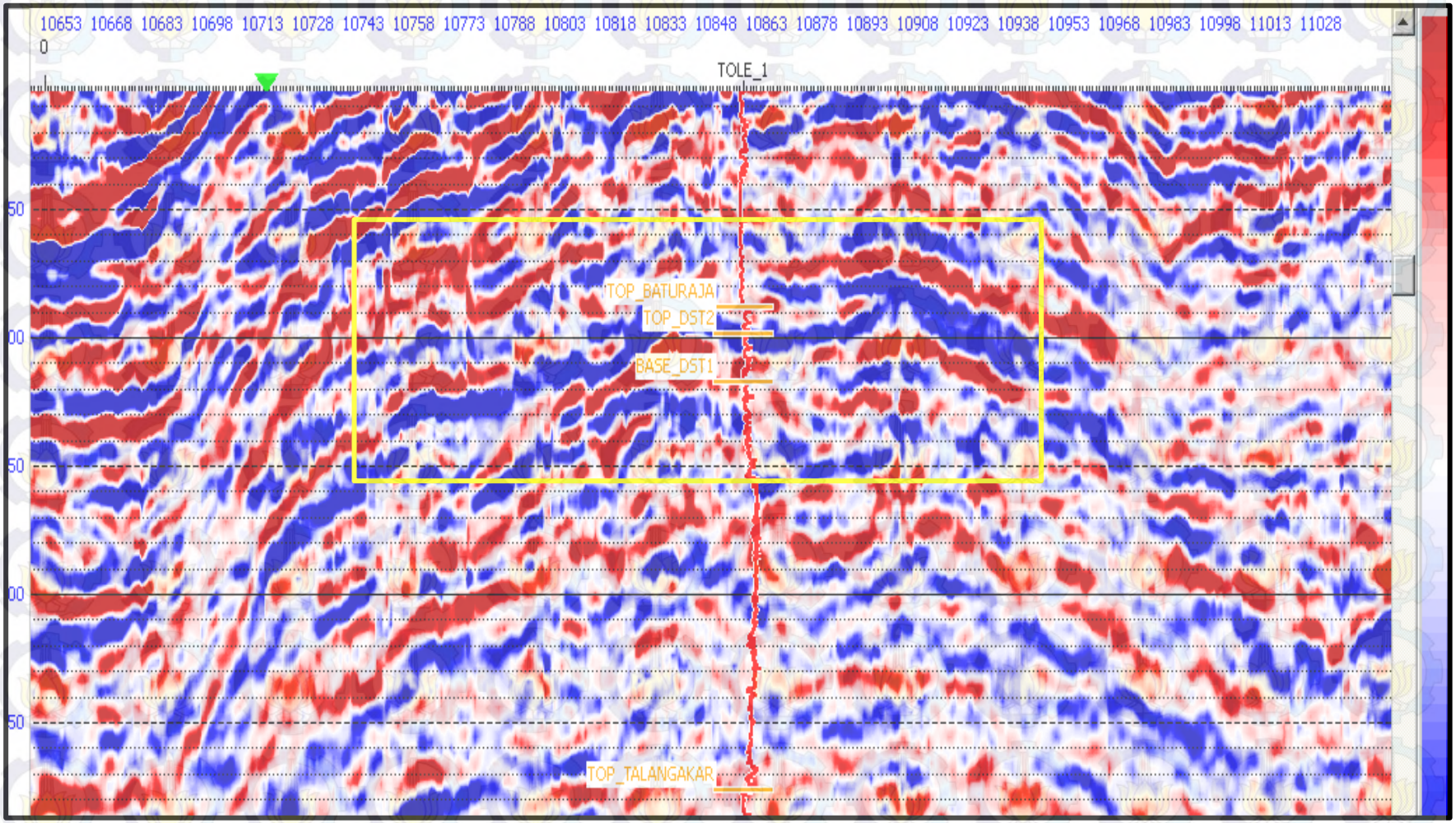
Gradient (B)



PERTAMINA EP

Atribut AVO

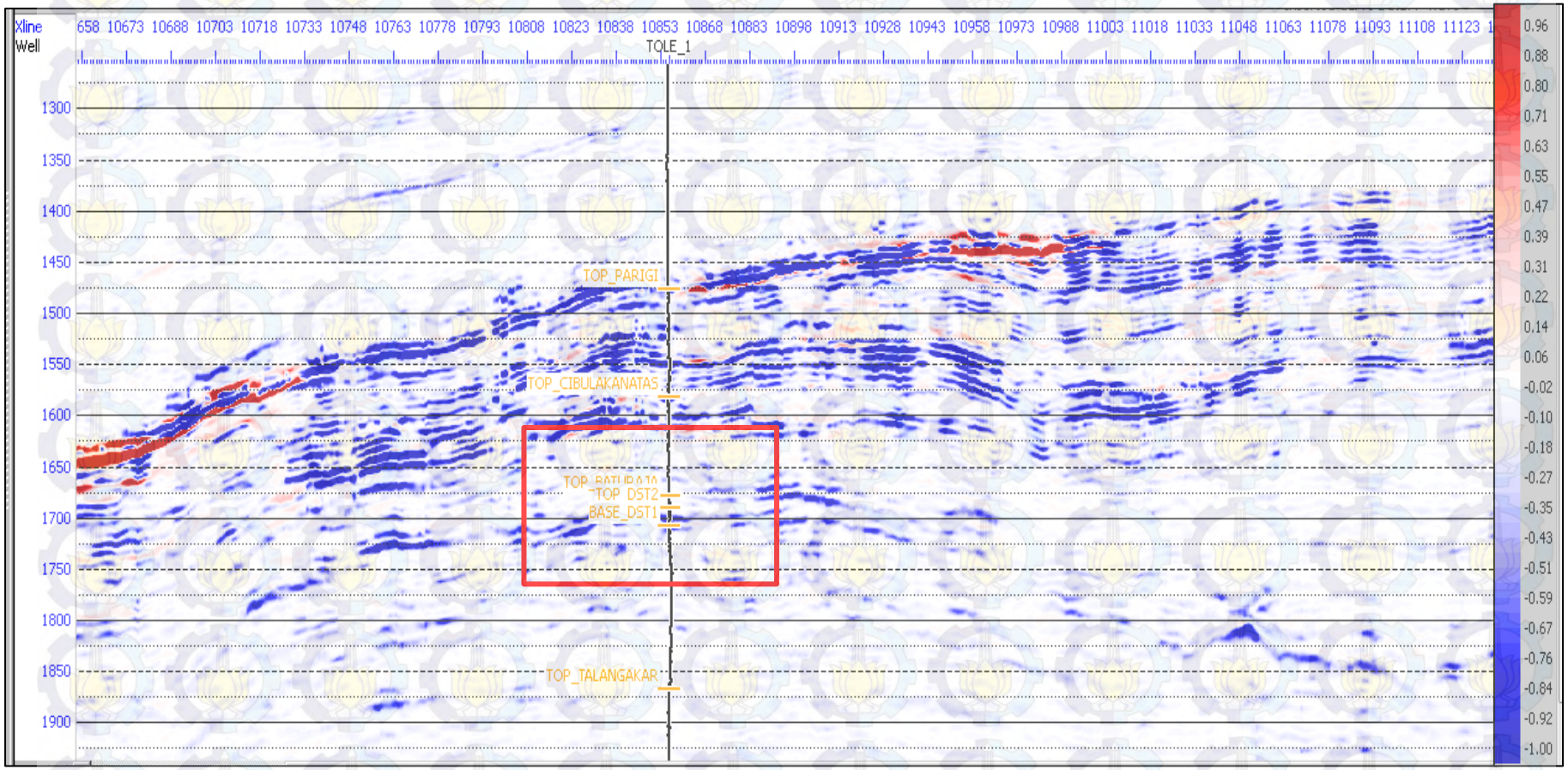
Gradient (B)



PERTAMINA EP

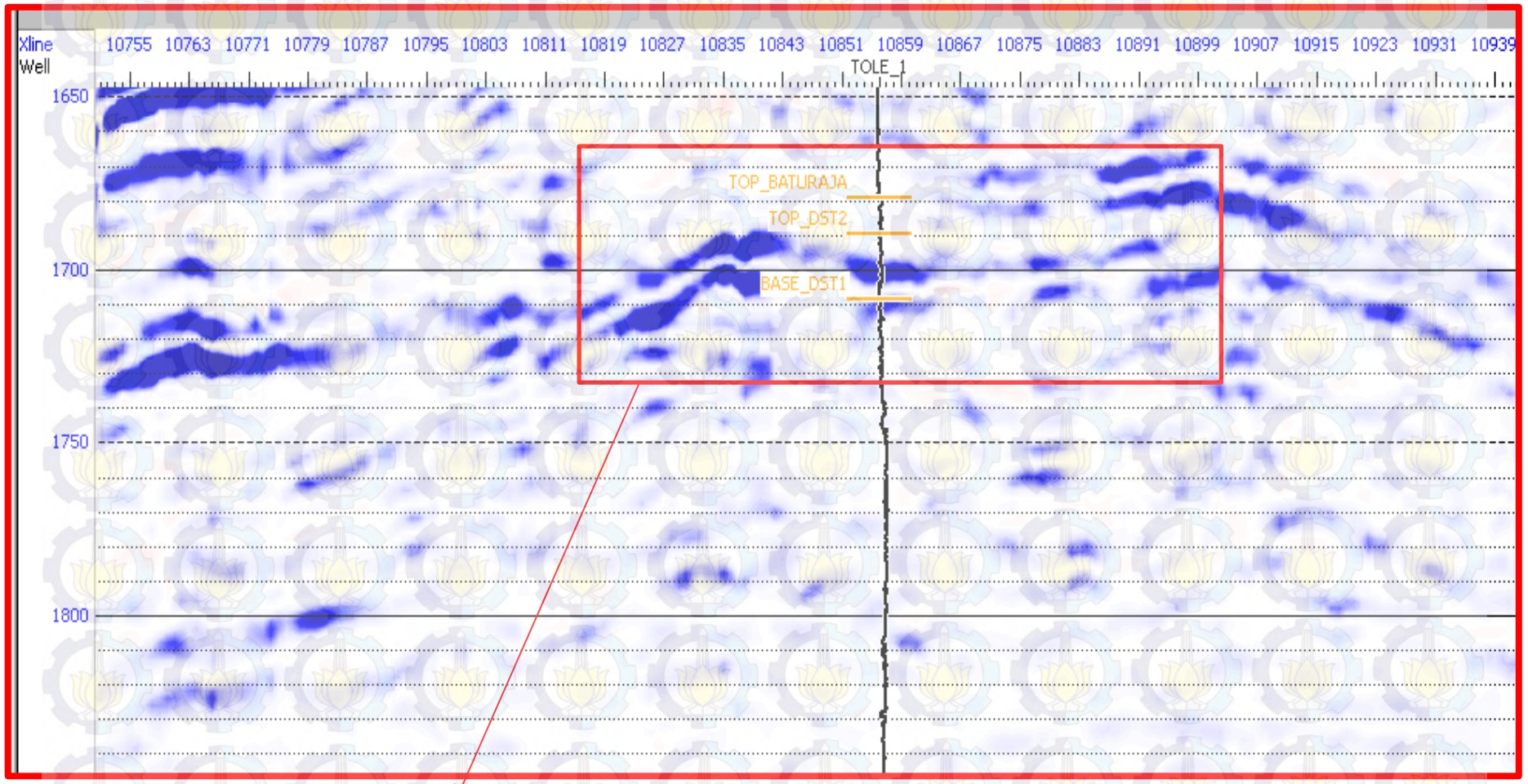
Atribut AVO

Product (A*B)



Atribut AVO

Product (A*B)



Intercept (+) * Gradien (-) = (-)

PERTAMINA EP

Atribut AVO

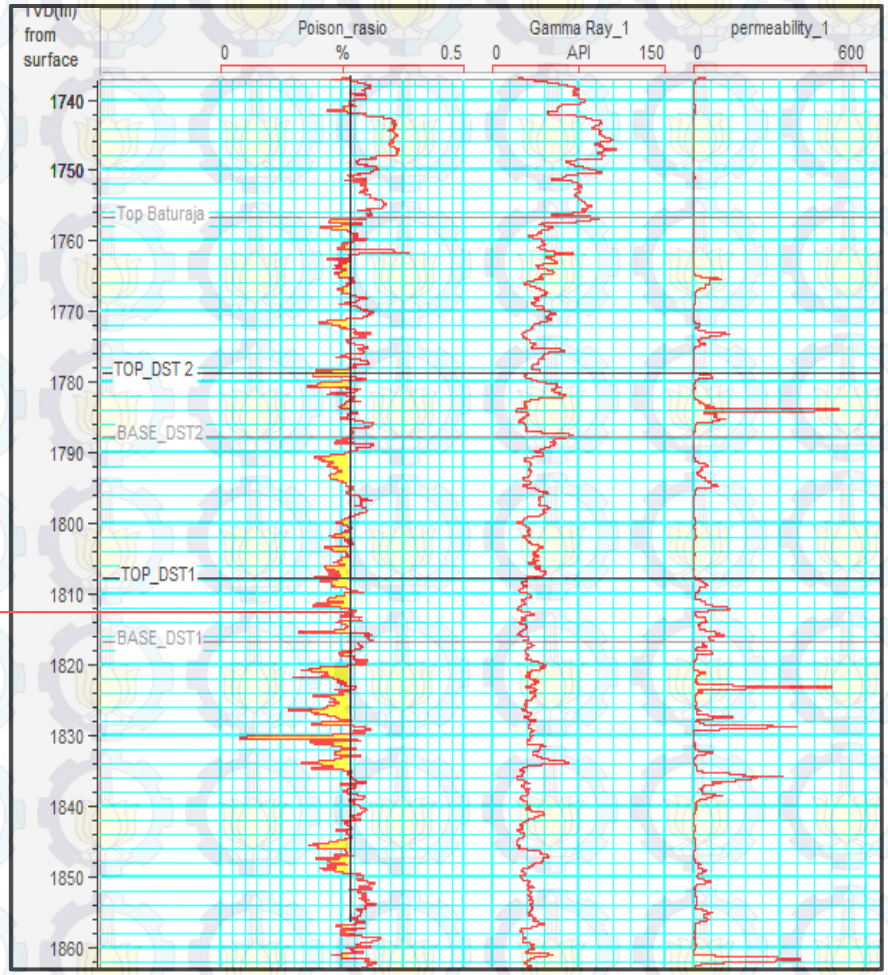
Log Poisson's ratio

Persamaan Poison Rasio

$$\sigma = \frac{\gamma^2 - 2}{2\gamma^2 - 2}$$

$$\text{where}: \quad \gamma = \frac{V_P}{V_S}$$

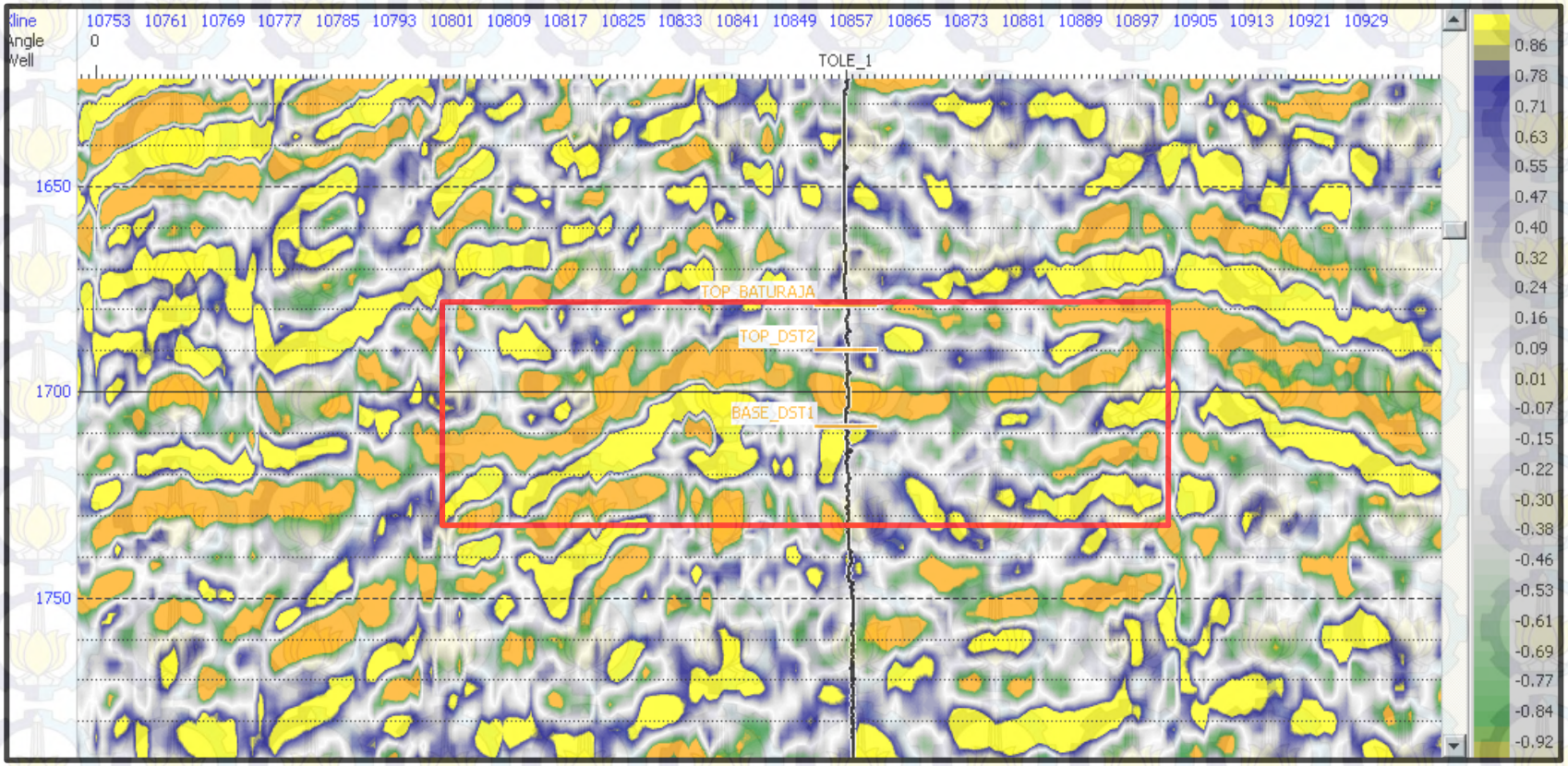
Digunakan cut off Poisson's ratio 2.6



PERTAMINA EP

Atribut AVO

Scaled Poisson's ratio (aA+bB)

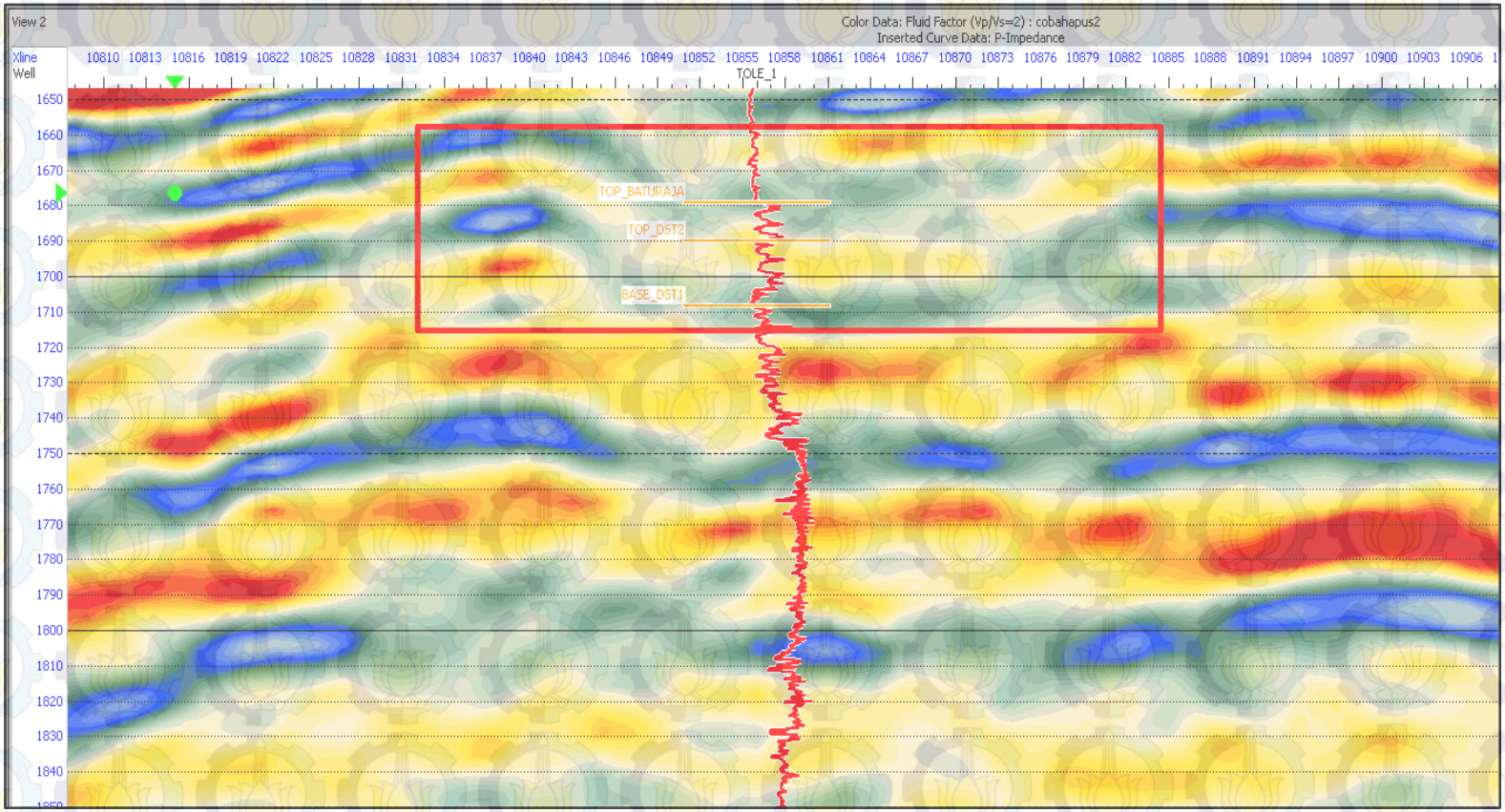


Atribut ini akan menunjukkan nilai negatif pada top reservoir dan nilai positif pada base reservoir (Ross, 2002)

PERTAMINA EP

Atribut AVO

Fluid factor

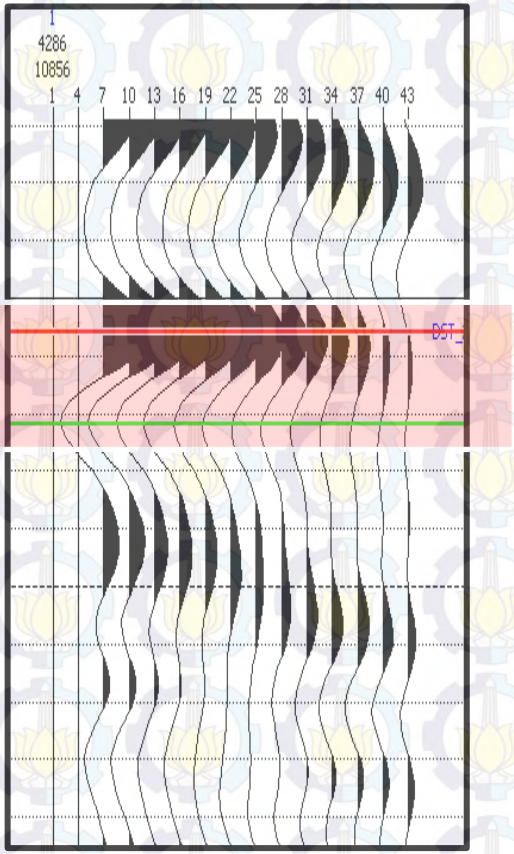


Zona reservoir akan menunjukkan kecenderungan nilai fluid factor negatif, Sedangkan reservoir berisi air meunjukkan nilai mendekati nol atau positif .

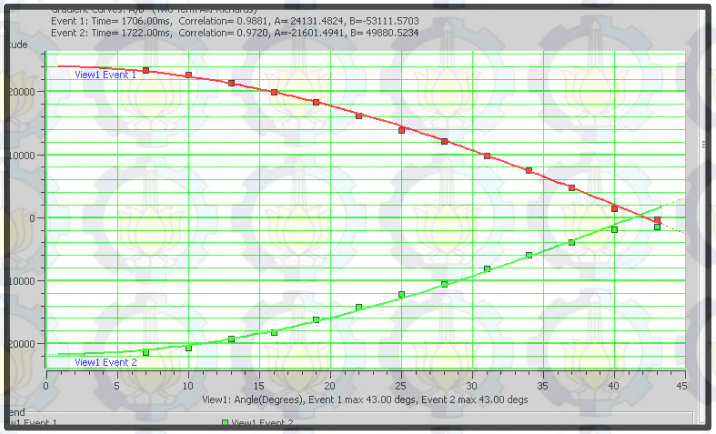
Atribut AVO

Analisa Top dan Base Reservoir

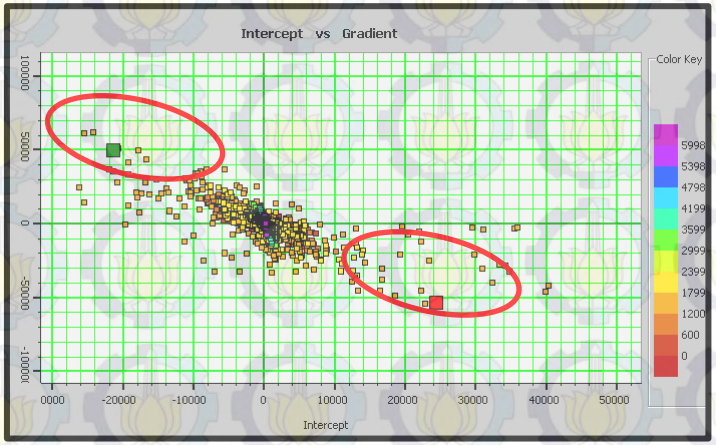
Seismik gather



Amplitudo vs sudut



A vs B

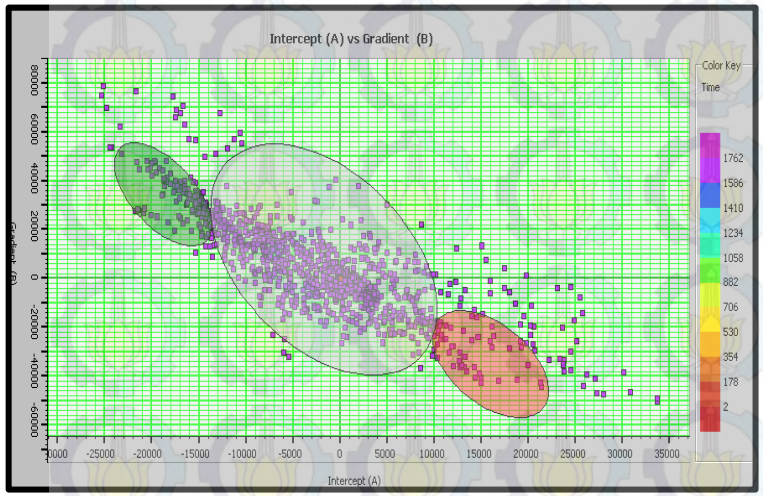


PERTAMINA EP

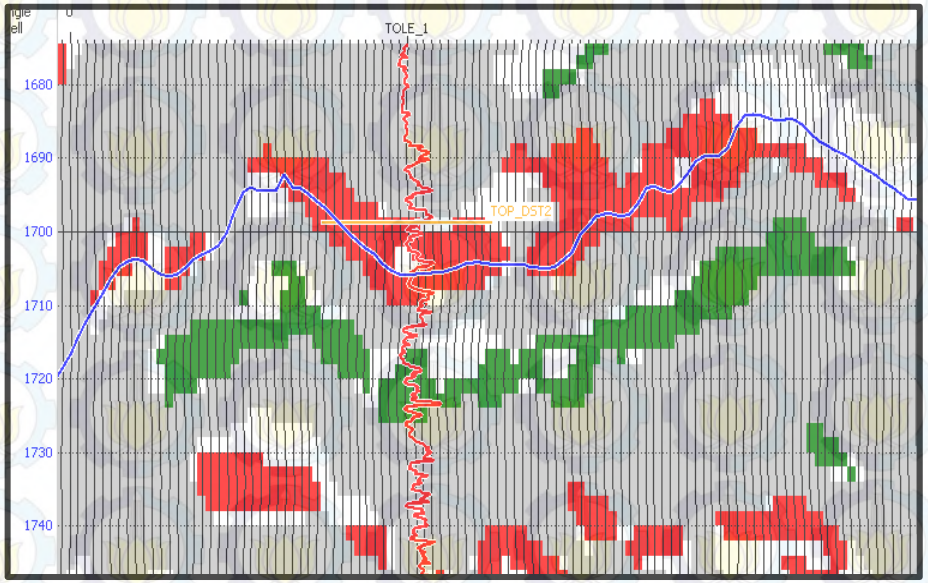
Atribut AVO

Analisa Top dan Base Reservoir

Crossplot seismik Intercept vs Gradien



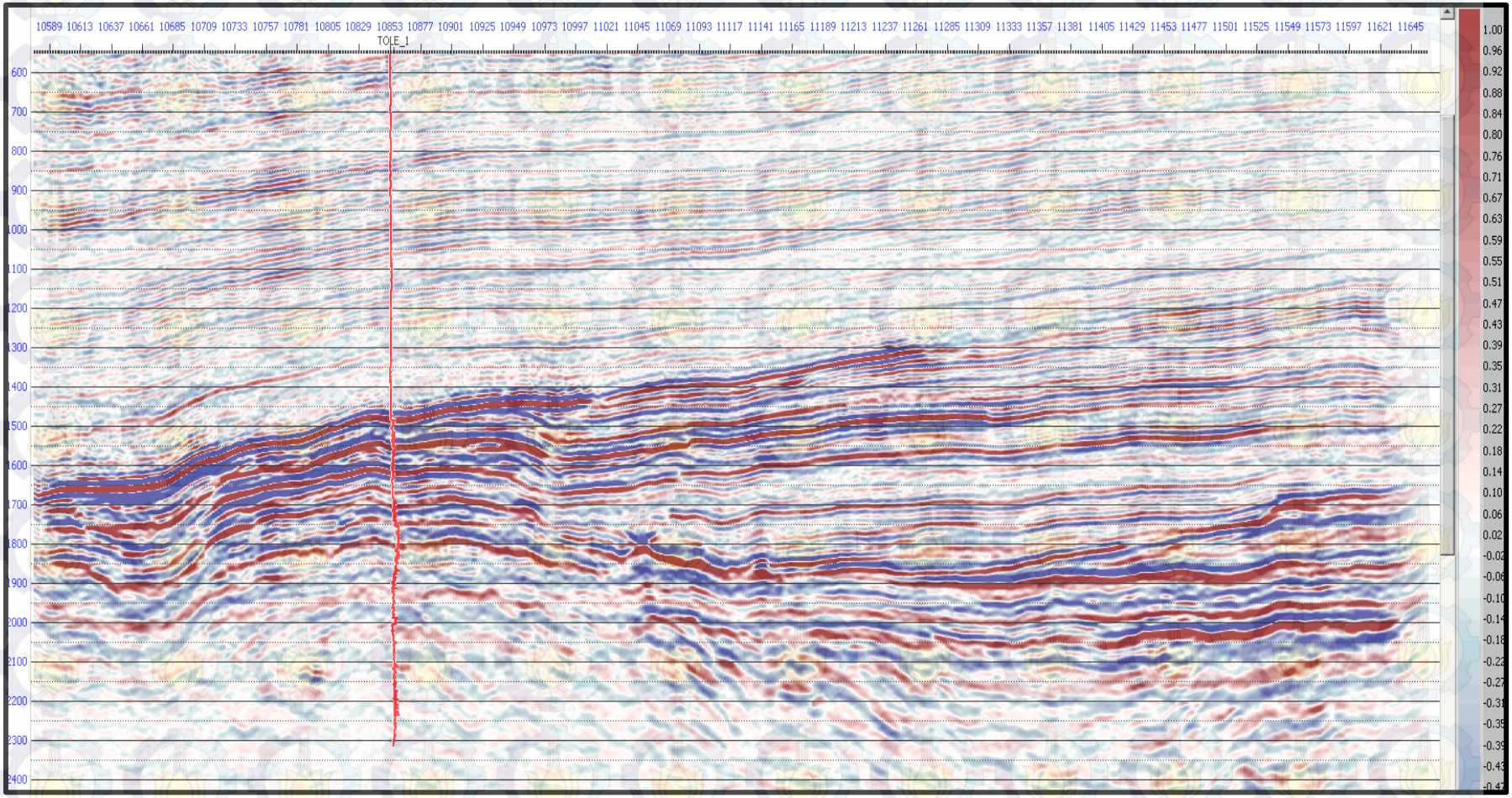
Cross section



PERTAMINA EP

Atribut Seismik

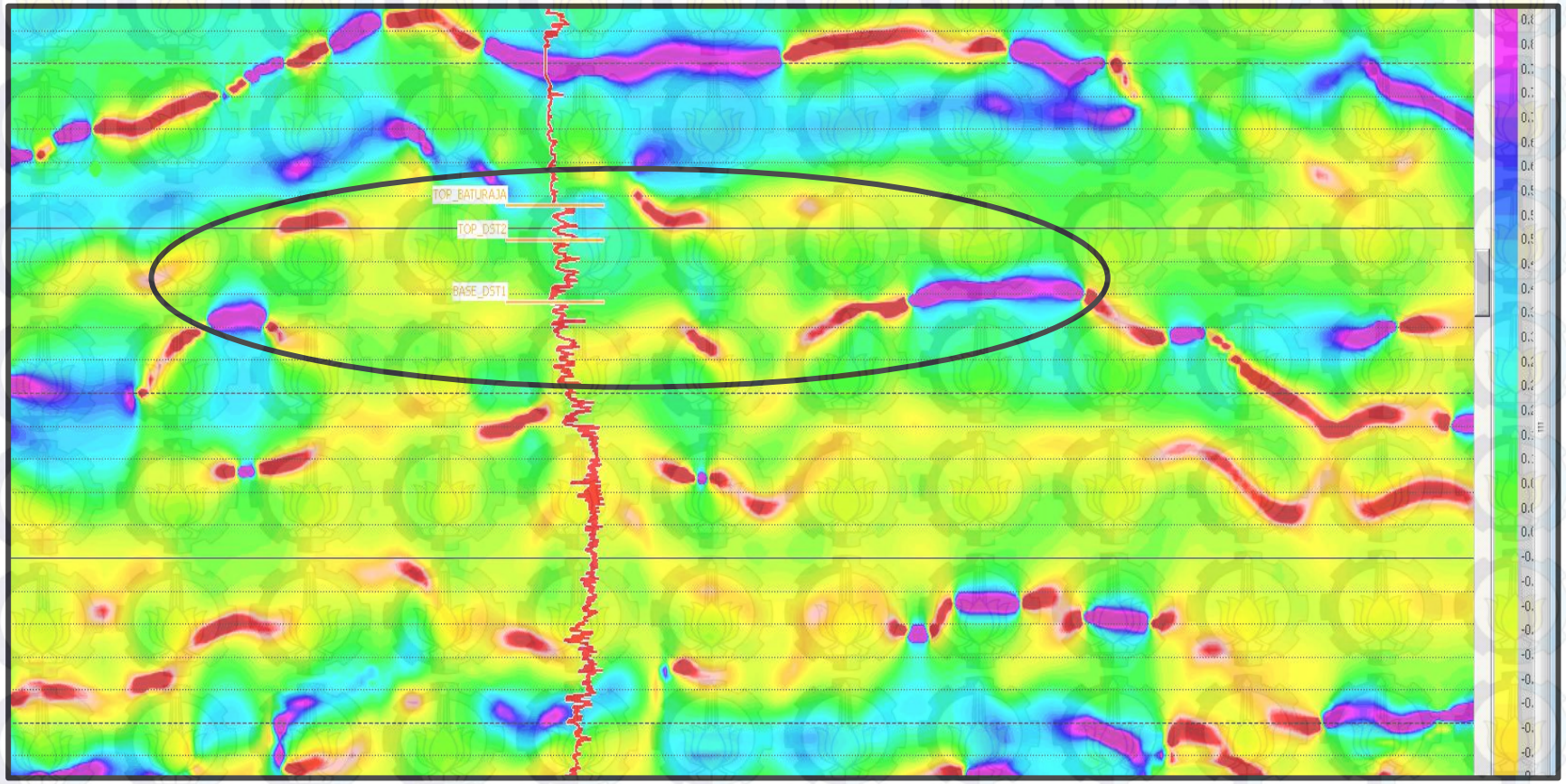
Penampang seismik Angle Stack



PERTAMINA EP

Atribut Seismik

Frekuensi Sesaat

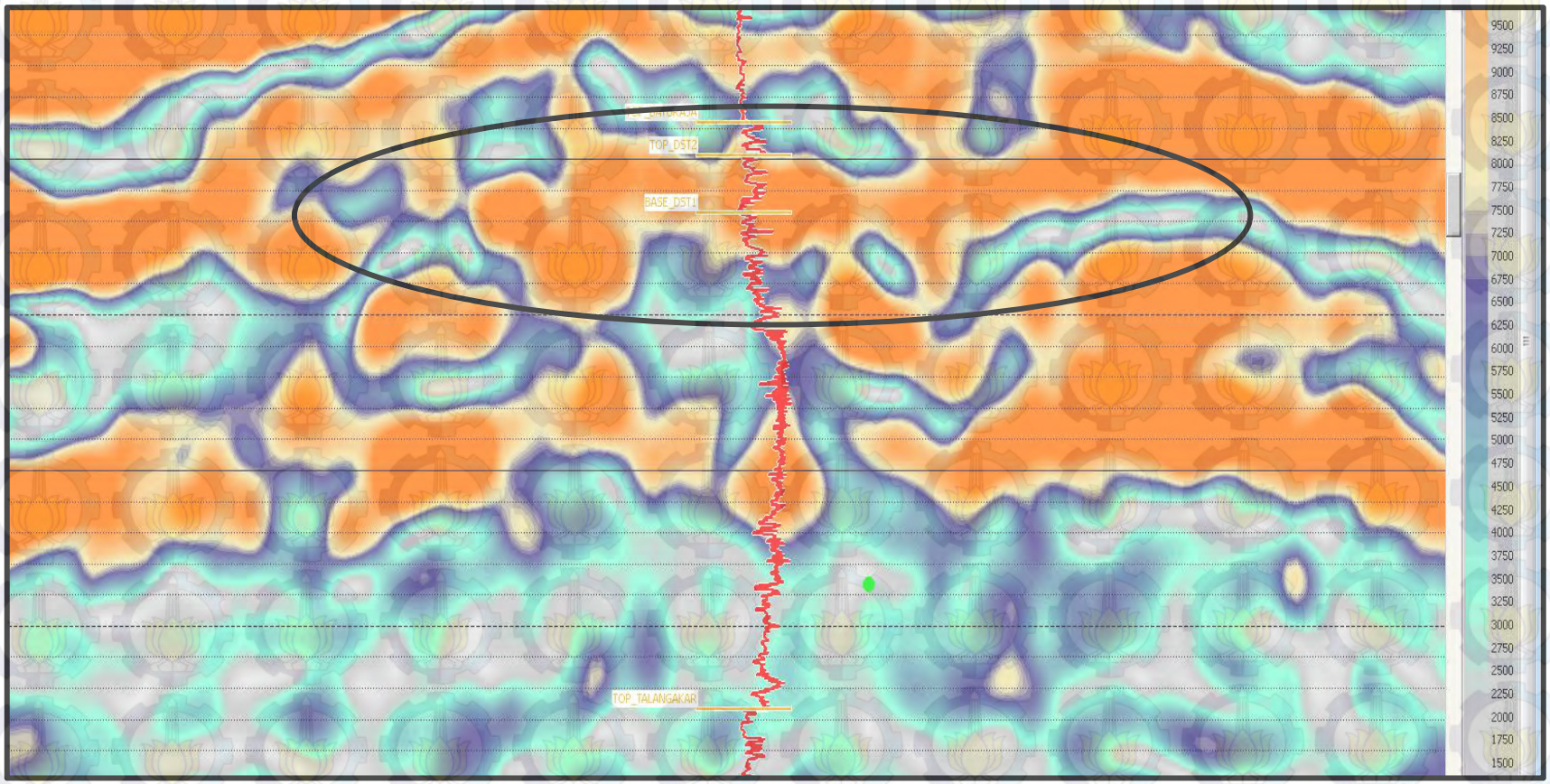


Daerah yang mengandung gas akan menghasilkan anomali nilai frekuensi sesaat rendah

PERTAMINA EP

Atribut Seismik

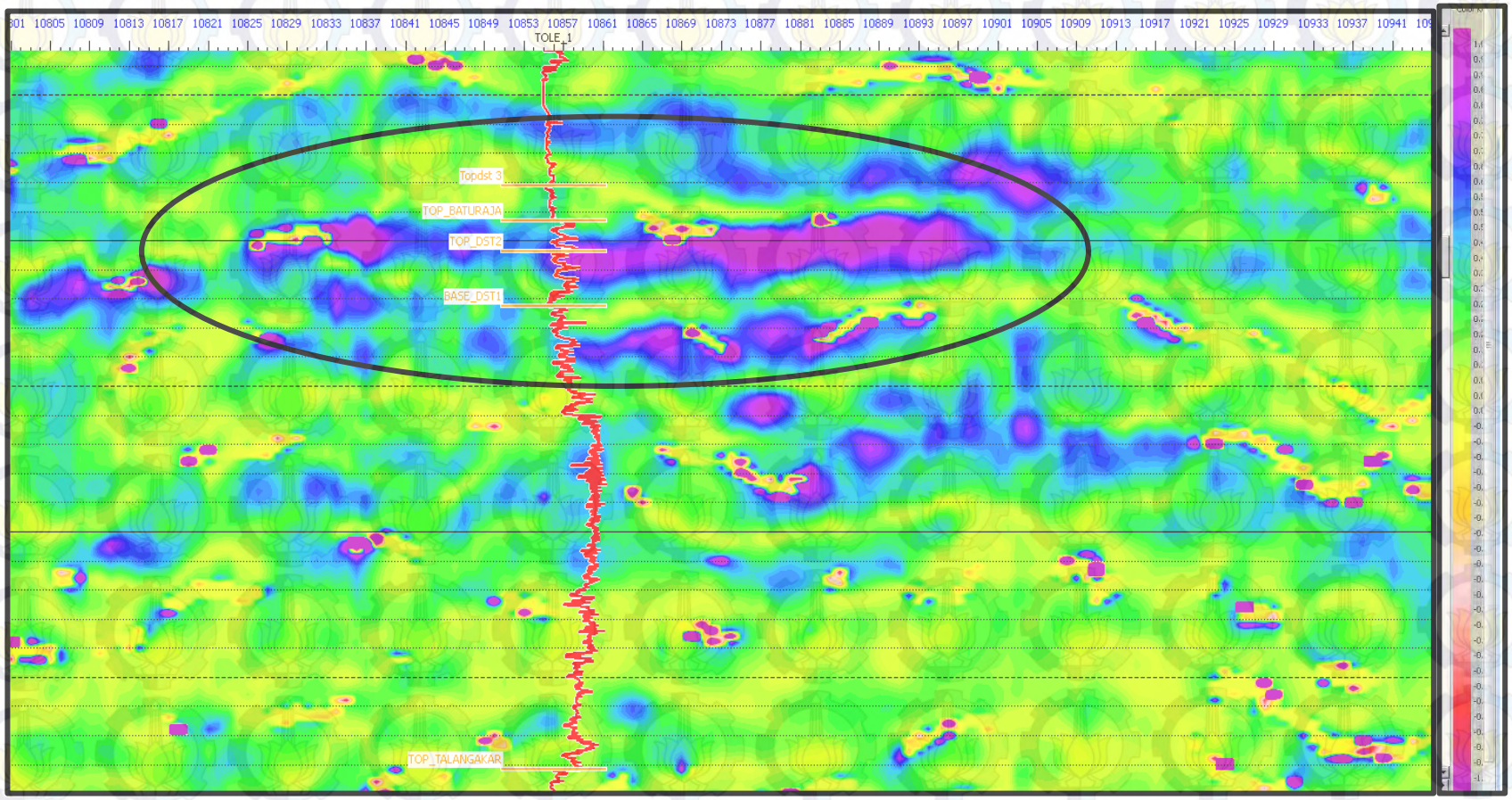
Envelope



Daerah yang memiliki kontras AI akan menghasilkan nilai anomali tinggi

Atribut Seismik

Envelope

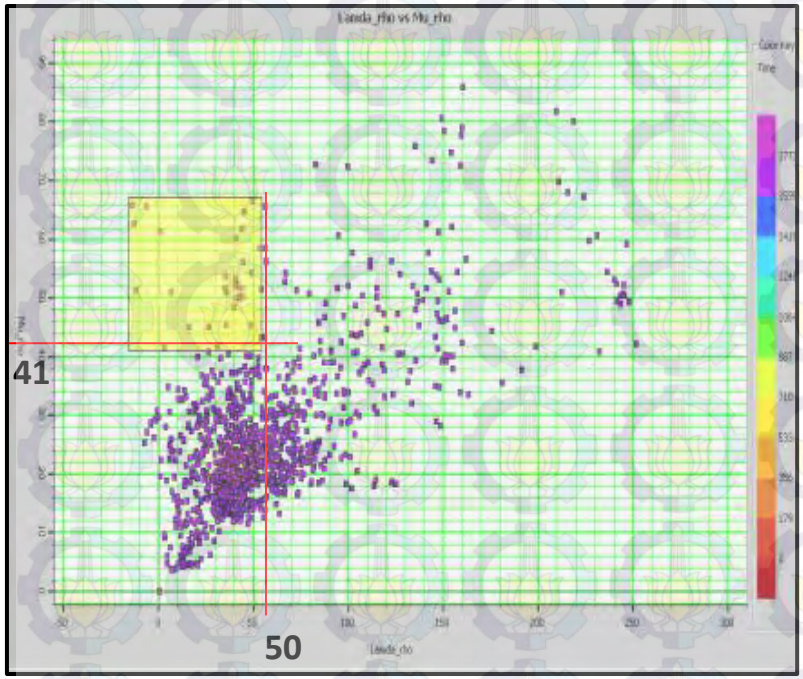


Akumulasi gas berasosiasi dengan anomali nilai tinggi atribut sweetness

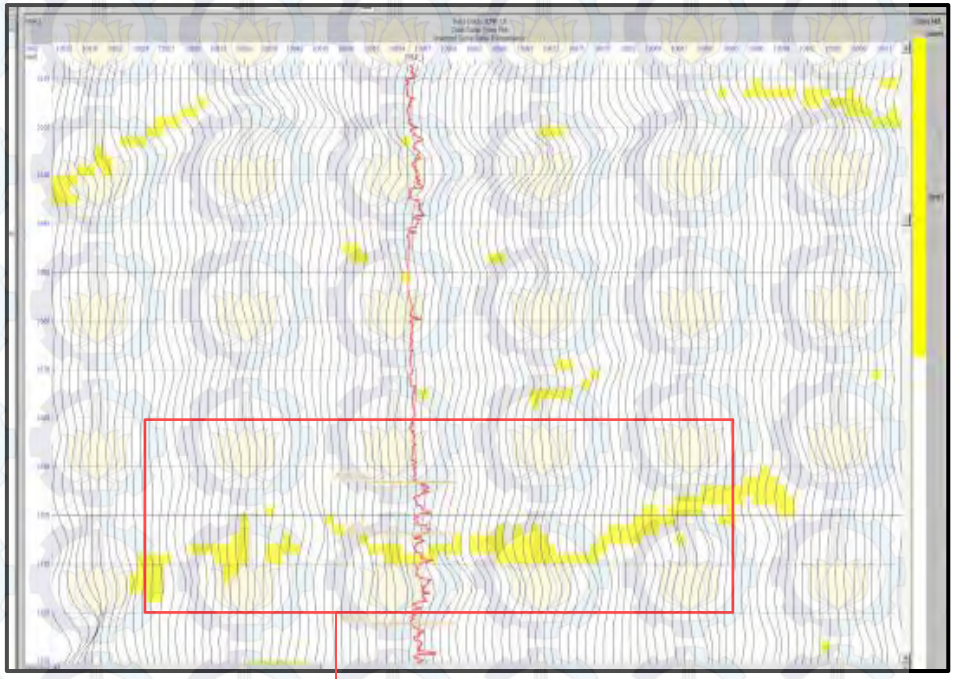
PERTAMINA EP

Transformasi LMR

Crossplot Mu rho vs Lambda rho



Persebaran data pada data seismik



CDP 10820 sampai 10890

OUTLINE

- PENDAHULUAN
- GEOLOGI REGIONAL
- TINJAUAN PUSTAKA
- METODOLOGI
- HASIL DAN PEMBAHASAN
- KESIMPULAN

Kesimpulan

- Zona potensi Gas terdapat pada kedalaman 1775 m -1850 m formasi Baturaja dengan, dengan tren nilai P-impedance, Sw dan Lambda rho rendah dan nilai porositas efektif, permeabilitas dan Mu rho tinggi
- AVO dapat membedakan respon fluida pada batuan Karbonat, pada karbonat zona gas mengalami pengurangan amplitudo yang lebih drastis dibandingkan zona yang kosong.
- Angle Limited stack dan atribut AVO memperlihatkan anomali gas memiliki karakteristik “Dim Spot”
- Atribut AVO baik dalam memperlihatkan respon gas karbonat
- Atribut seismik dapat memperlihatkan pengaruh respon gas, dimana atribut sweetness lebih bagus dalam memetakan gas.

Saran

- Dapat dilakukan analisa AVO pada reservoir karbonat yang berisi brine atupun minyak.
- Perlu dilakukan analisa dengan sumur tambahan untuk melakukan validasi terhadap persebaran anomali fluida

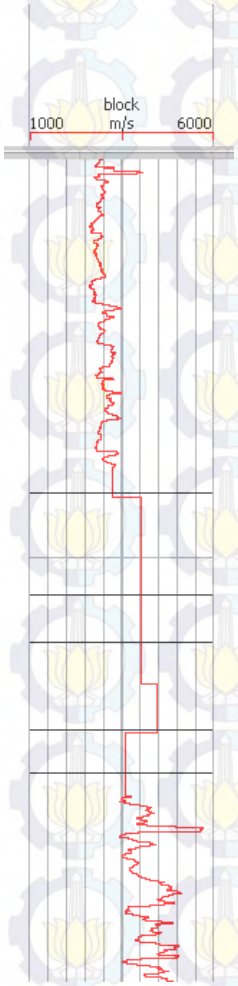
TERIMAKASIH

MATUR SUWUN

"The Future Of Indonesian's Energy Needs Is In Our Hand"

LAMPIRAN

Resolusi Vertikal



Thickness resolution $= \frac{1}{4}\lambda$

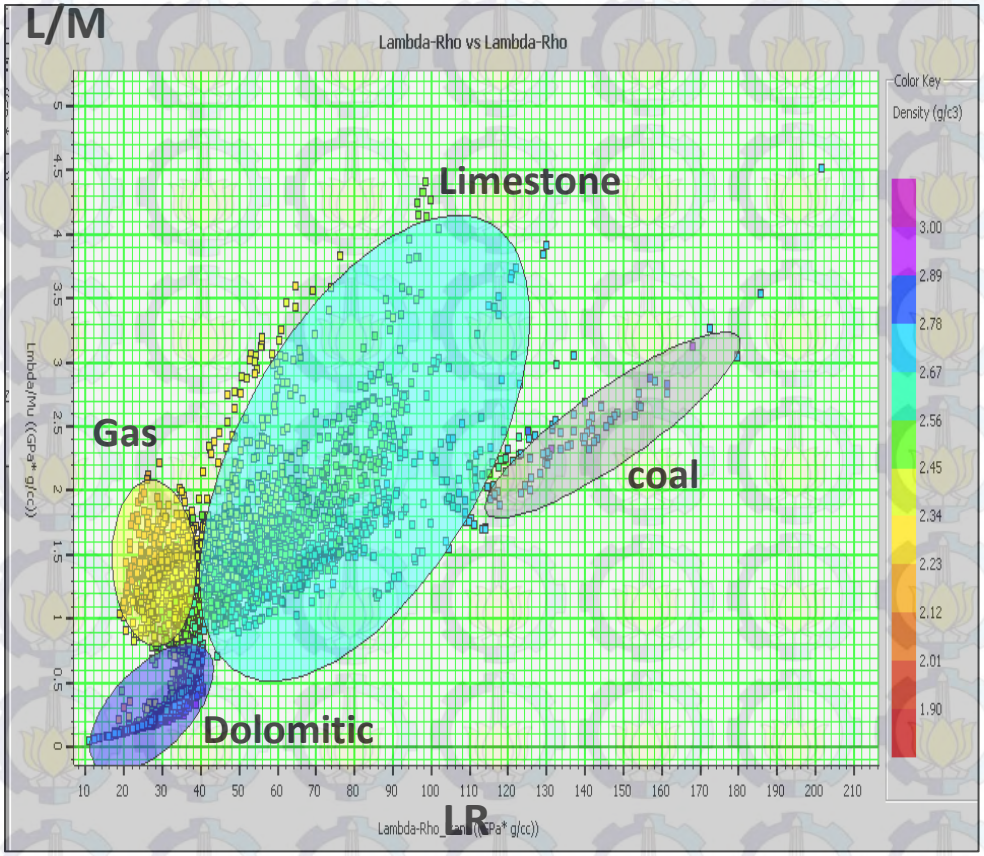
Dimana : $\lambda = \frac{v}{frequency}$

Sehingga resoluinya $= \frac{1}{4} * \frac{4060.23}{21} = 48$ m

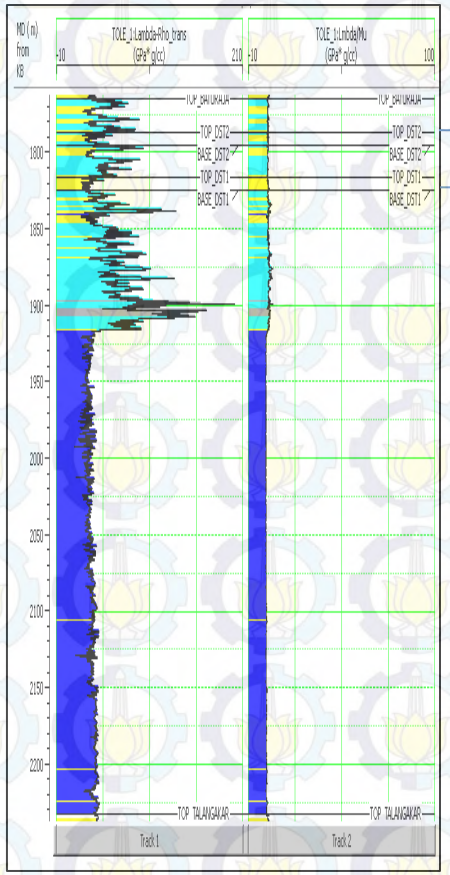
Analisa Fisika Batuan

Lambda-Rho vs Lambda/Mu

Crossplot



Cross section



DST_1

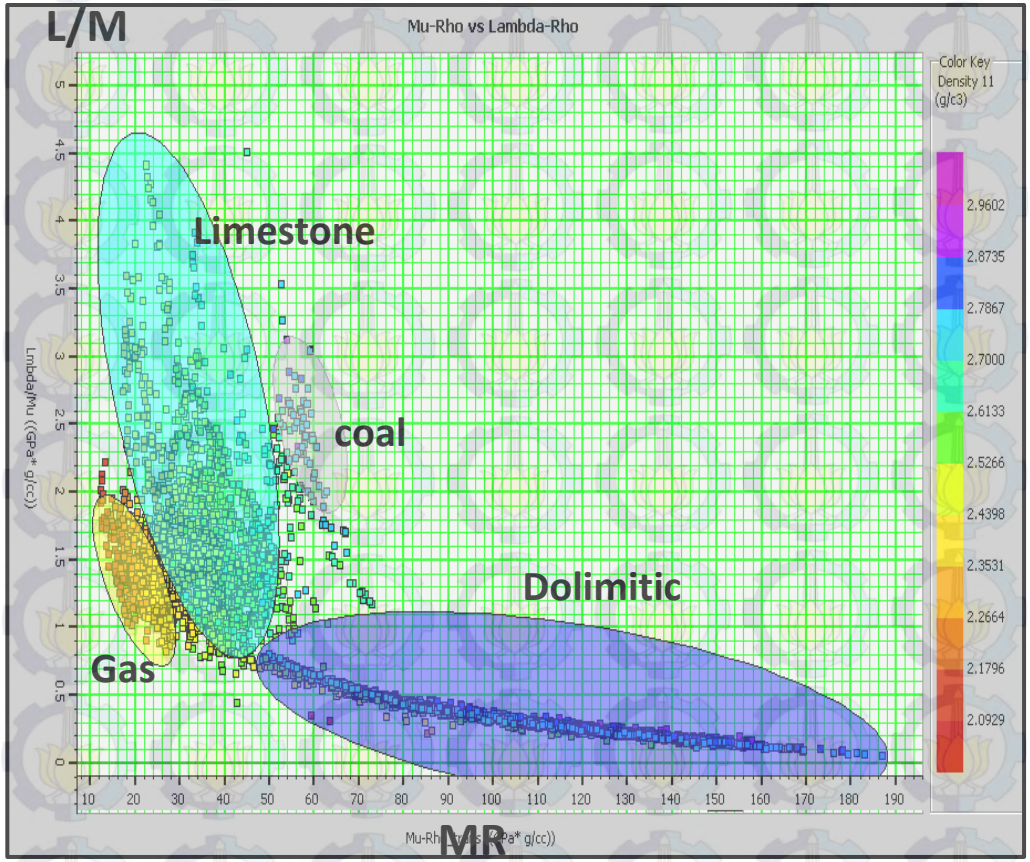
DST_2

PERTAMINA EP

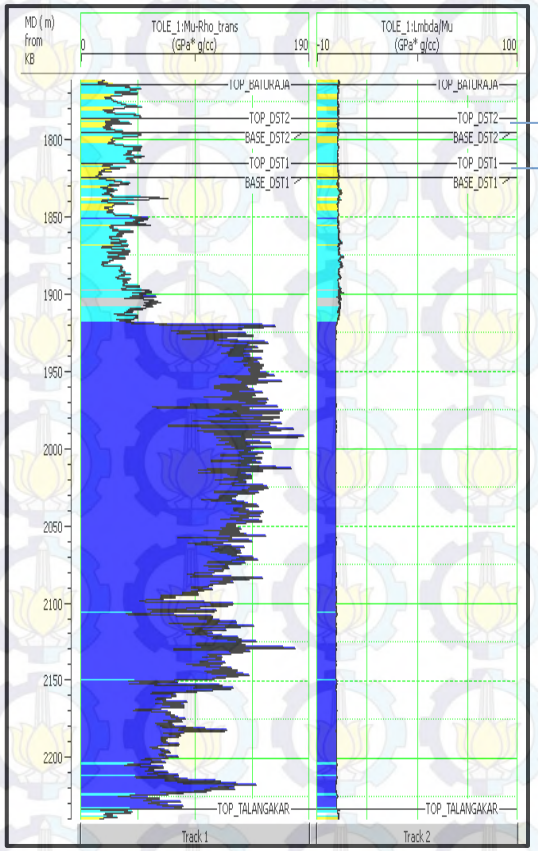
Analisa Fisika Batuan

Lambda/Mu vs Mu-Rho

Crossplot



Cross section



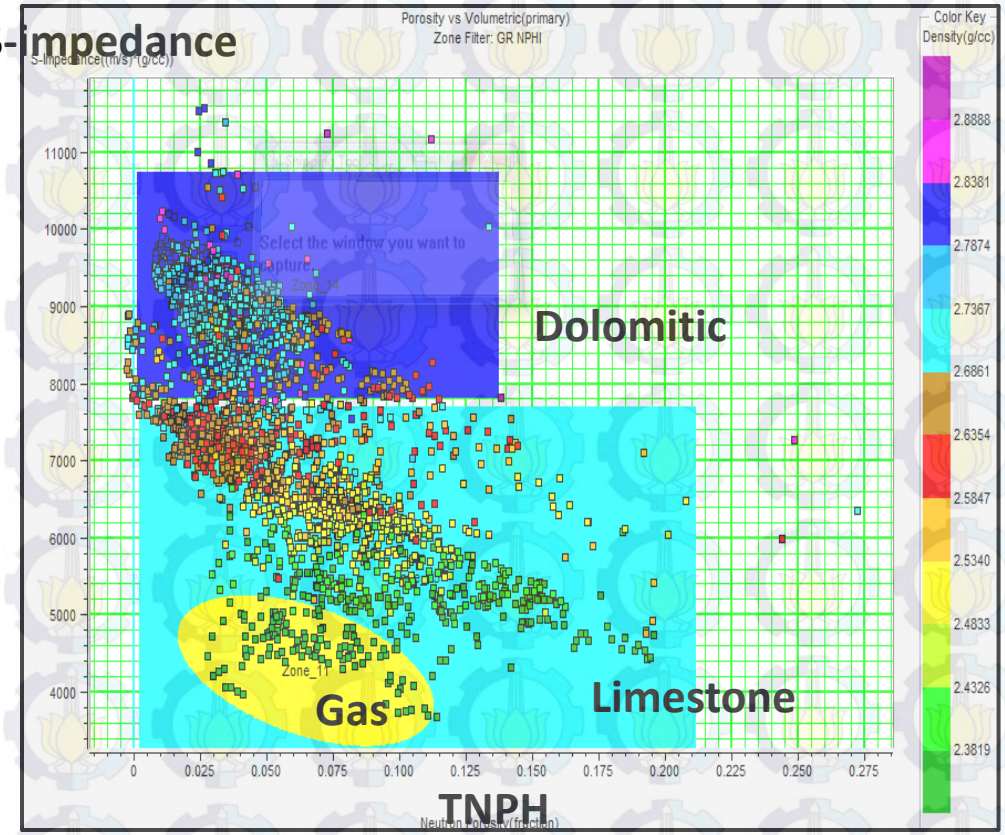
DST_1
DST_2

PERTAMINA EP

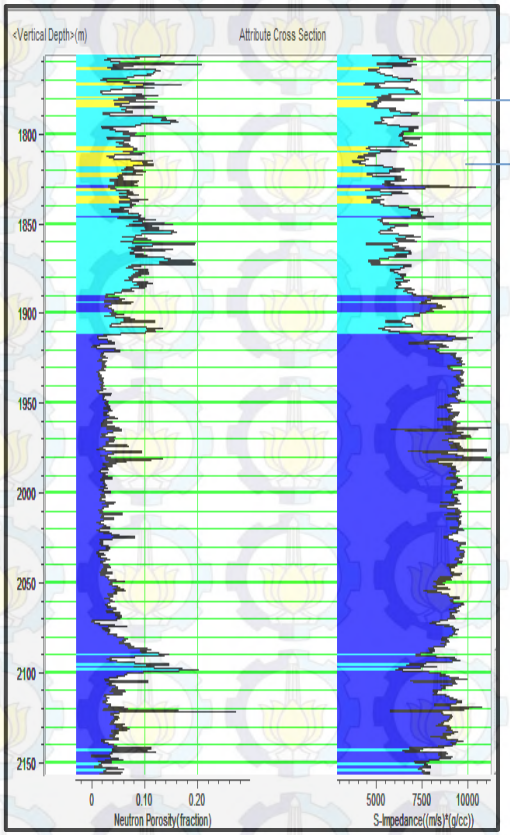
Analisa Fisika Batuan

S-impedance vs Porositas neutron

Crossplot



Cross section



DST_1

DST_2

Conditioning data seismik

Data 3D Gather

NMO

Bandpass Filter

Trim Static

INVEST

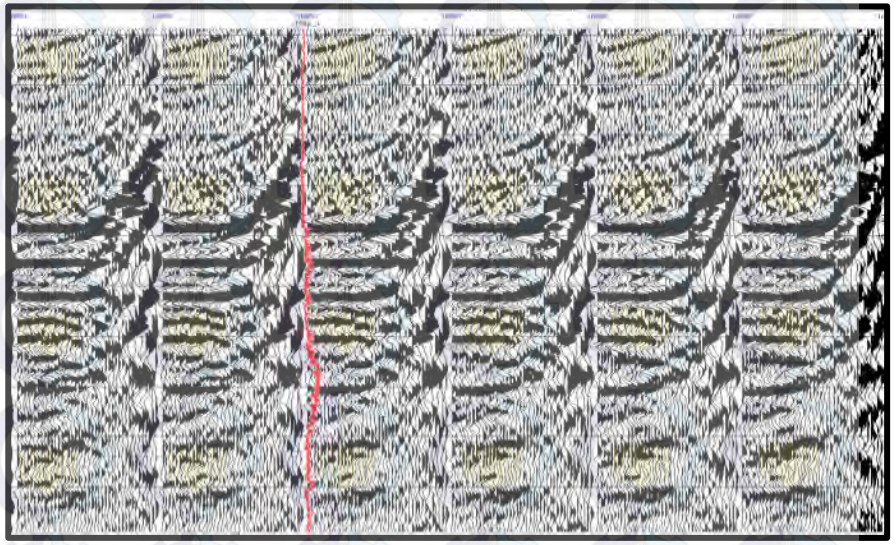
Mute

Super Gather

Trim Static

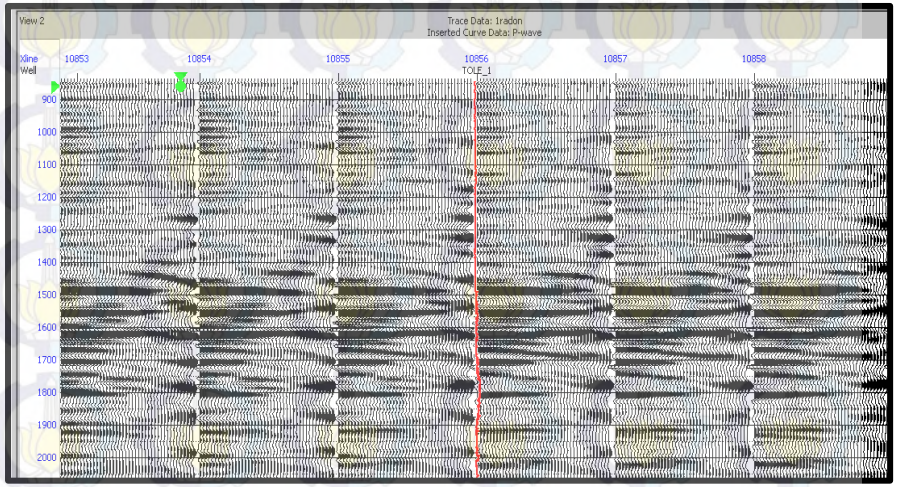
Angle Gather

Trim Static
(kontrol horizon parigi)



Parabolic Radon Transform

Low Delta t = -20 ms
High delta t = 50 ms



PERTAMINA EP

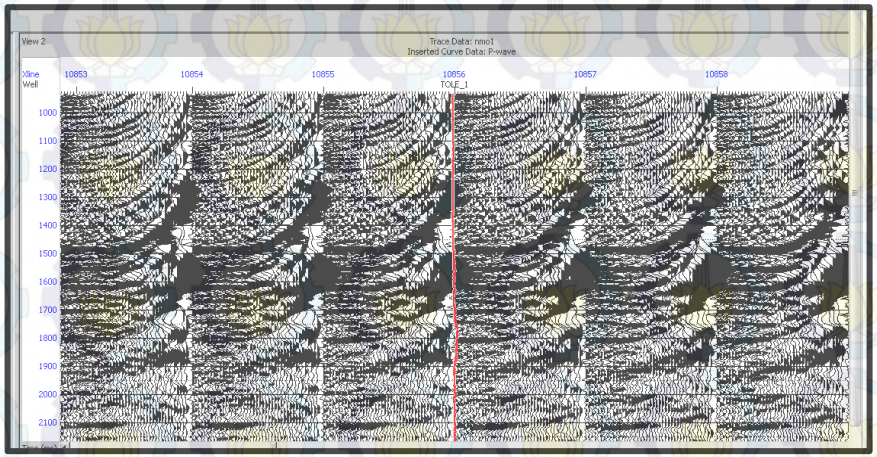
Conditioning data seismik

- Data 3D Gather
- NMO
- Bandpass Filter
- Trim Static
- INVEST
- Mute
- Super Gather
- Trim Static
- Angle Gather

Koreksi NMO

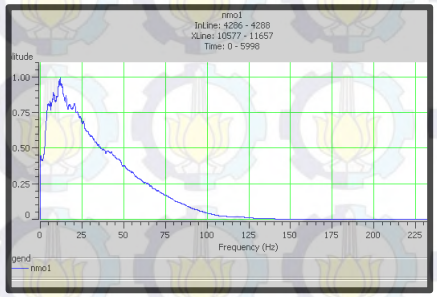
$$t_x = \sqrt{t_0^2 + \frac{x^2}{V_s^2}},$$

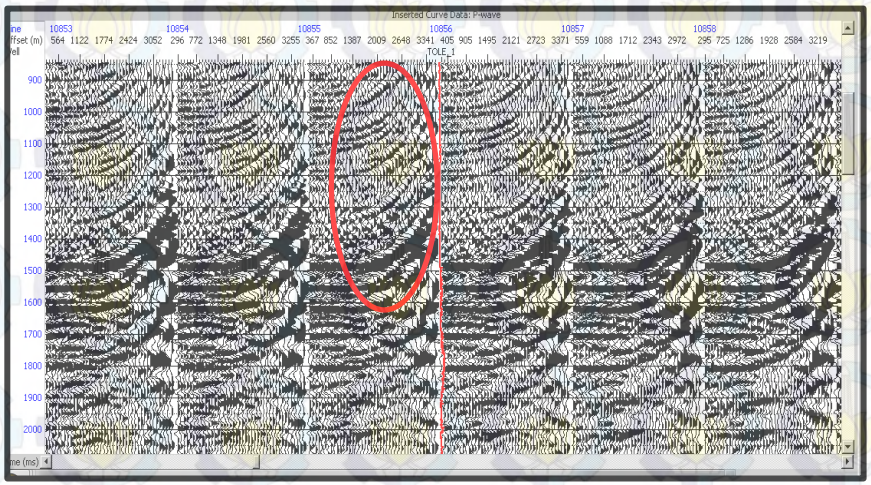
Persamaan Dix



Bandpass Filter

5/8 / 55/60 Hz

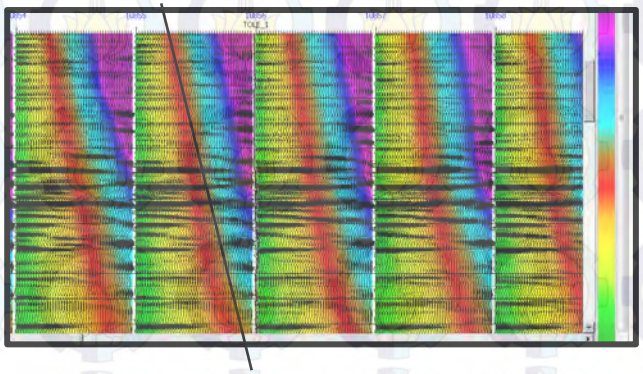


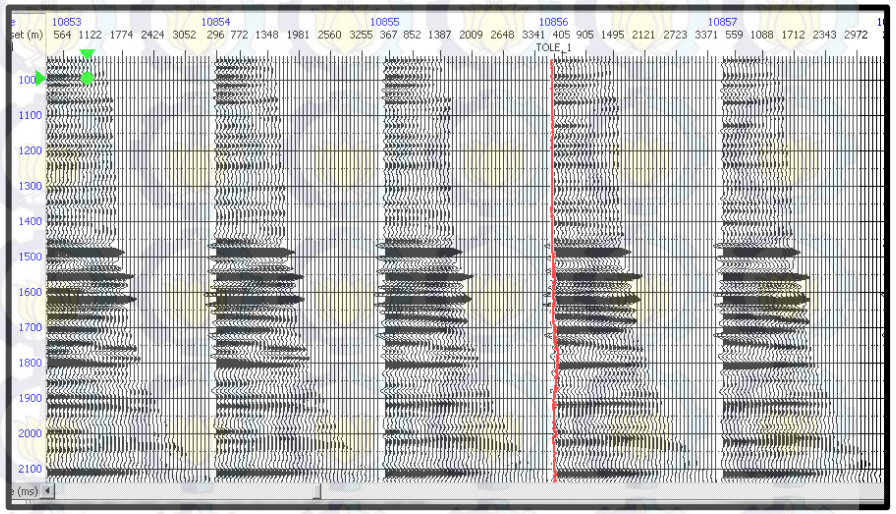


Conditioning data seismik

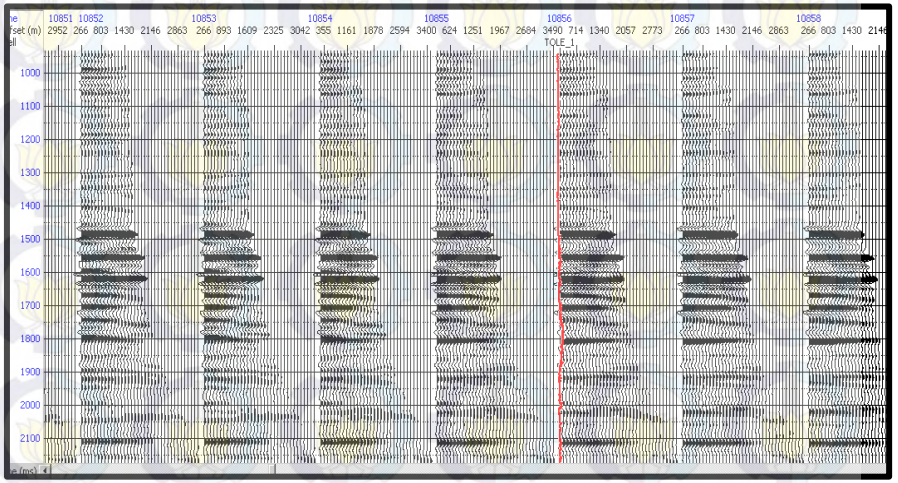
- Data 3D Gather
- NMO
- Bandpass Filter
- Trim Static
- INVEST
- Mute
- Super Gather
- Trim Static
- Angle Gather

Muting
(color key Incident angle)





Super gather
(jumlah offset 42)



Conditioning data seismik

Data 3D Gather

NMO

Bandpass Filter

Trim Static

INVEST

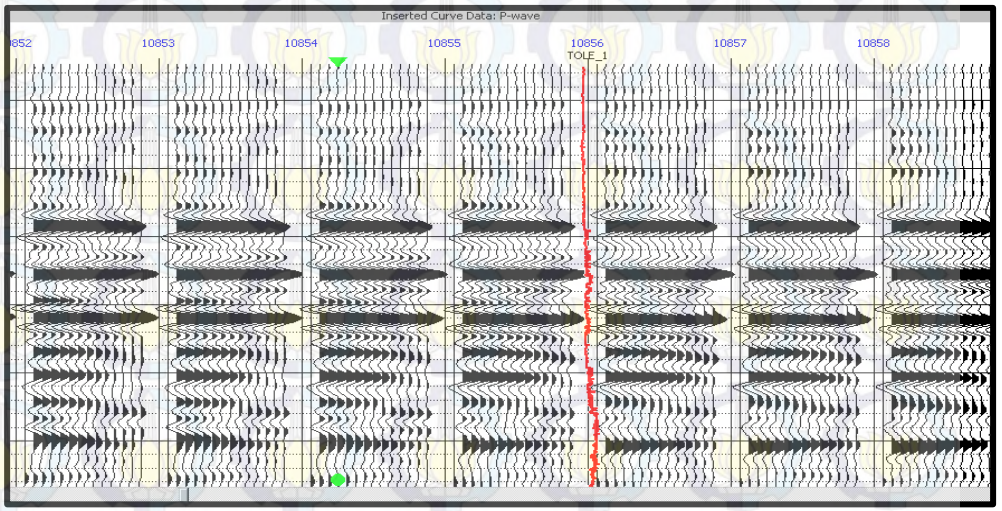
Mute

Super Gather

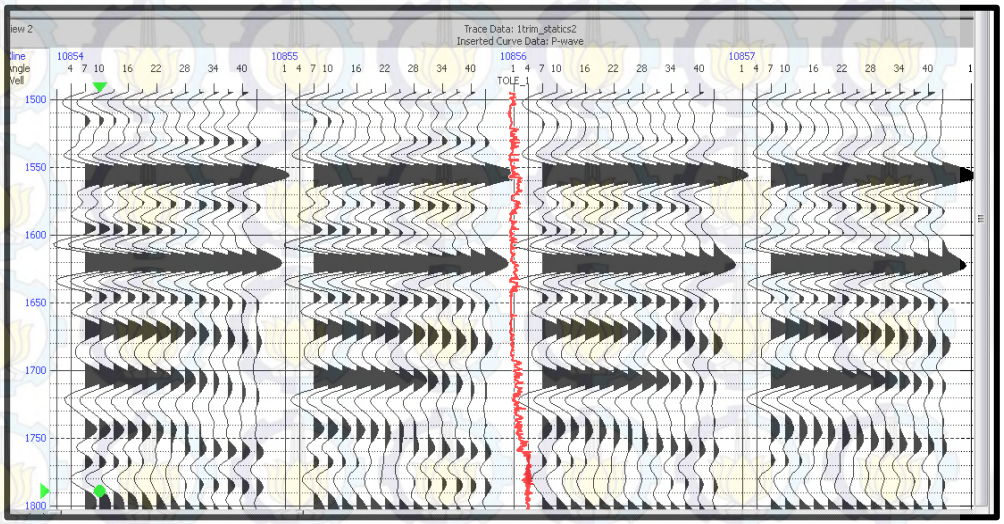
Trim Static

Angle Gather

Trim Static
(kontrol horizon sumuran kedalaman 1740 ms)

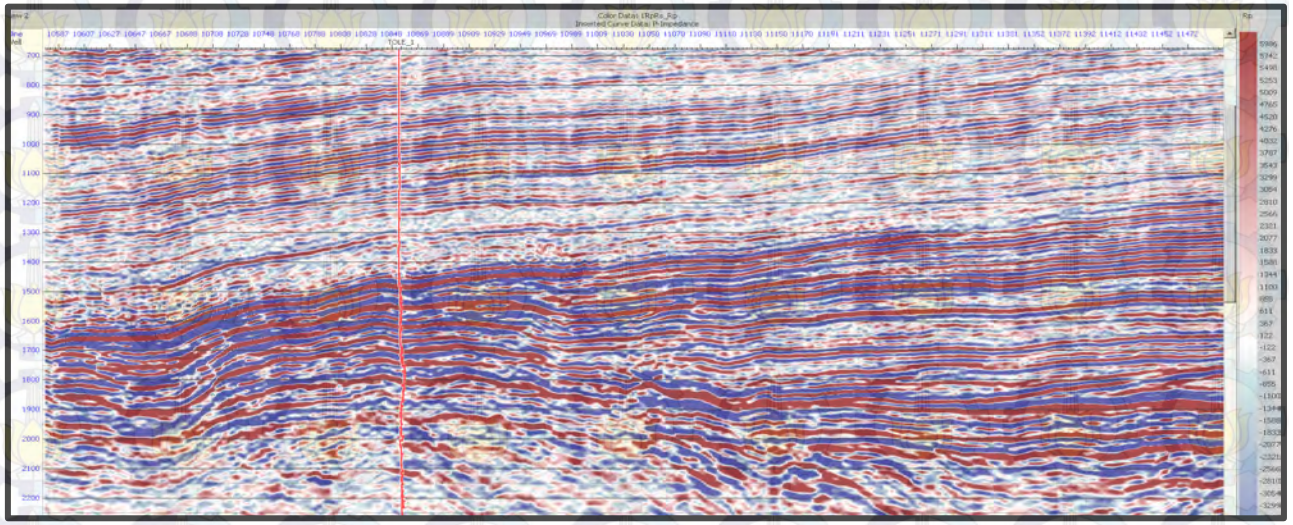


Angle Gather
(sudut 0 - 42)



Seismik Rp dan Rs

Penampang Reflektifitas P



Penampang reflektifitas S