THE SULU SEA / EAST PALAWAN BASINS RESOURCE ASSESSMENT

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OUTLINE OF PRESENTATION

- Basin Overview
- Data Coverage
- Petroleum System
- Resource Assessment

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BASIN DESCRIPTION

TOTAL AREA: 207,000 sq km

Basin	Sub-basins	Type	Area (sq km)		Max. sediment thickness (km)
Sulu Sea	Sandakan	backarc	115,000	90% offshore	6
East Palawan	Balabac and Bancauan	forearc	92,000	100% offshore	3.5

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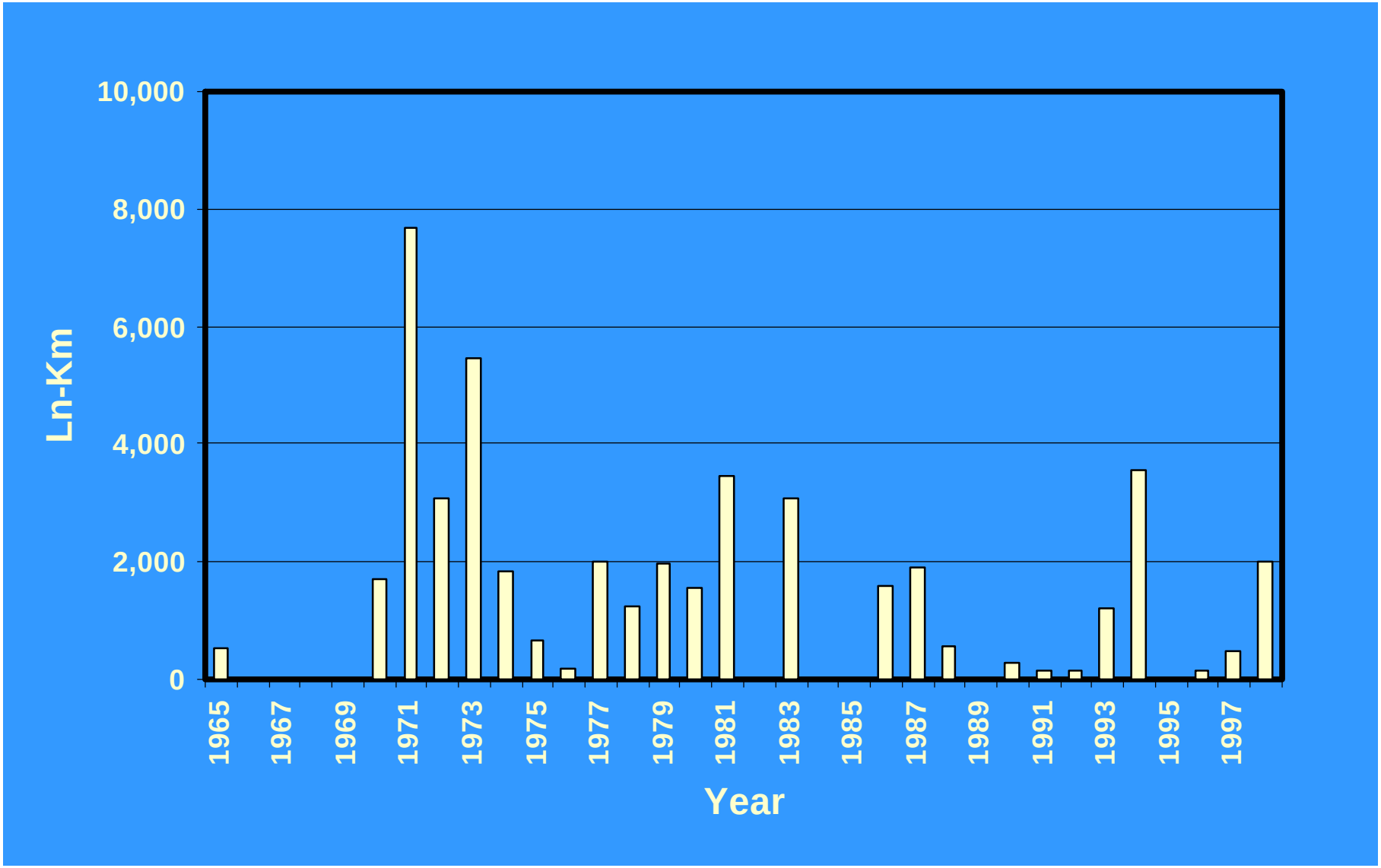
SEISMIC ACQUISITION



NEW SEISMIC SURVEY

WesternGeco *2D acquisition (2003)*

- **New 2D data in the Sulu Sea and East Palawan basins have been acquired by Western Geco, covering more than 5,700 line kilometers**
- **This supplements the existing 220,000 line kilometers of 2D vintage data in the Philippines**

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WELL DATA

- WELLS
  - 16 wells, 4 wells w/ gas or oil shows
  - Hippo –1 and Wildebeest wells, last two wells drilled by ARCO

WELLS DRILLED

WELL NAME	LOCATION	DATE SPUDDED	DEPTH (M)	RESULTS
Sulu Sea A-1	Sulu Sea	12/22/1972	2,617	DRY
Sulu Sea B-1	Sulu Sea	03/01/1973	2,221	DRY
PEC 333-1 Sulu Sea	Sandakan	10/30/1973	4,101	DRY
PEC 409-1 Sulu Sea	Sandakan	03/23/1974	4,601	DRY
PEC 389-1 Sulu Sea	Sandakan	04/03/1975	3,666	DRY
Coral-1	Balabac	08/13/1975	3,063	DRY
Roxas -I	NE Palawan	09/04/1979	2,022	DRY
Dumaran-1	NE Palawan	10/17/1979	2,088	DRY w/ shows
Paly-1	NE Palawan	08/07/1981	2,098	DRY
Clotilde-1	Sandakan	02/23/1982	2,286	DRY
Sentry Bank Reef-1 (SBR-1)	Sandakan	02/12/1987	1,462	DRY
Sentry Bank Reef-1 ST (SBR-1 ST)	Sandakan	03/14/1987	1,459	DRY
Sentry Bank Reef-1A	Sandakan	04/16/1987	1,779	DRY
Dockan-1	Sulu Sea	06/29/1989	2,479	DRY w/ gas shows
Hippo-1	Sandakan	02/13/1998	3,939	Gas & oil shows
Wildebeest-1	Sulu Sea	07/09/2000	3,709	DRY w/ gas shows

PETROLEUM SYSTEM

SOURCE ROCKS

Early to Late Miocene fine-grained sediments

- Early Miocene – poor source quality w/ very lean organic content
- Middle Miocene – average to above average organic content w/ vitrinitic kerogens; fair to good hydrocarbon potential; Coral –1 well has oil-prone amorphous kerogen
- Late Miocene – predominantly humic kerogen w/ poor to fair hydrocarbon source potential

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PETROLEUM SYSTEM

RESERVOIR ROCKS

Sulu Sea Basin:

- Early to Middle Miocene quartzose sandstone in PEC 333-1 well, 17-18% porosities, 30-107md permeabilities; 19-35% porosities in Late Miocene rocks
- Sandstone in PEC 409-1 well, 18-24% porosities in Middle Miocene; 11-26% porosities in Late Miocene rocks
- Sentry Bank –1 well, 13-22% porosities in Middle Miocene; 20-34% porosities in Late Miocene rocks

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PETROLEUM SYSTEM

RESERVOIR ROCKS

East Palawan Basin

- Sulu Sea A-1 well, 22-30% porosities, low permeability on DST of Mid Miocene sandy limestone
- Coral-1 well, 26-34% log porosities of Mid to Late Miocene sandstones

SEALS

- interbedded Early to Late Miocene claystone and siltstone

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PLAY TYPES

- Sulu Sea Basin
  - Reef Buildup (RB)
  - Anticline (AN - confirmed)*
  - Fault Block (FB - confirmed)*

    * *based on Nymphe Northe-1 oil and gas discovery and Nymphe-1 gas producer both on the Malaysian side of the basin*
- East Palawan Basin
  - RB (unconfirmed)
  - AN (unconfirmed)
  - ST (unconfirmed)

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METHODOLOGY

Since the basins are poorly to moderately explored giving low to moderate level of knowledge, we find the following approaches most appropriate:

- Probabilistic prospect analysis (GeoX)
- Play analysis through analogue method

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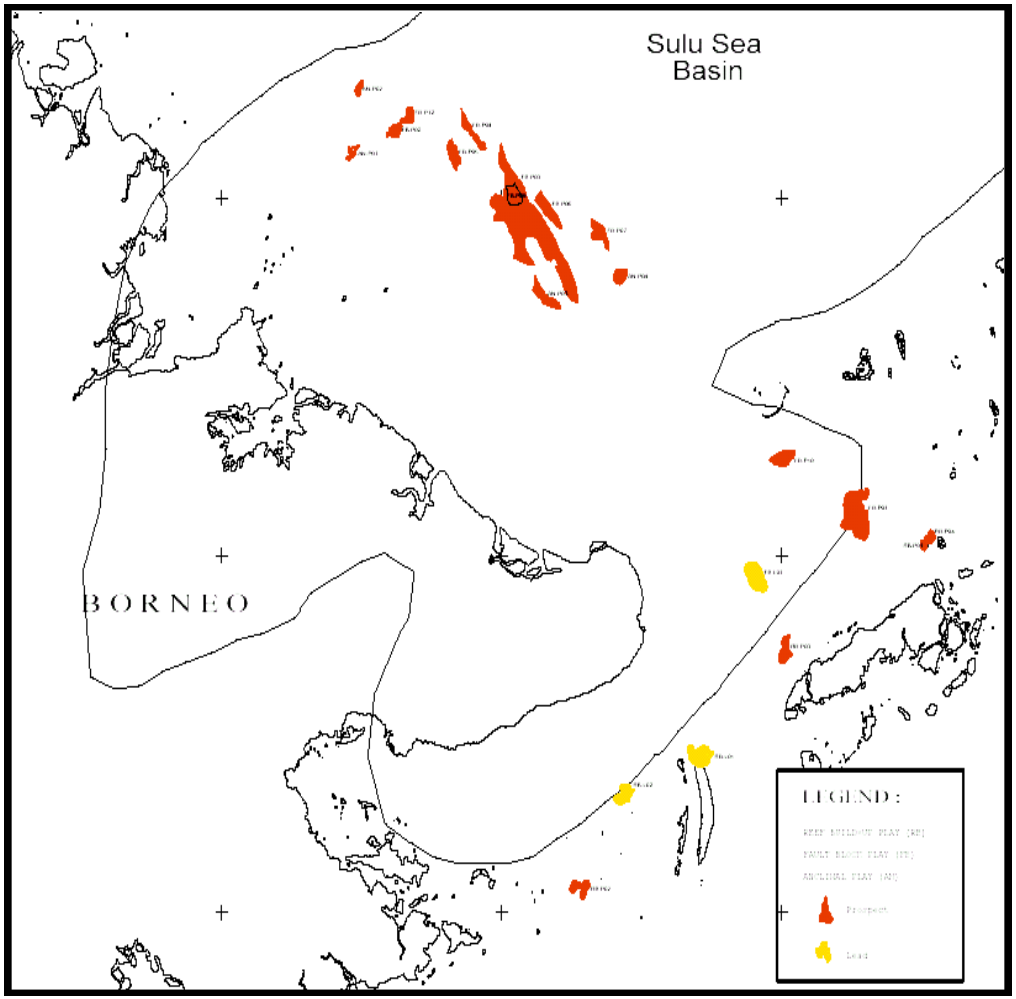
RESOURCE ASSESSMENT

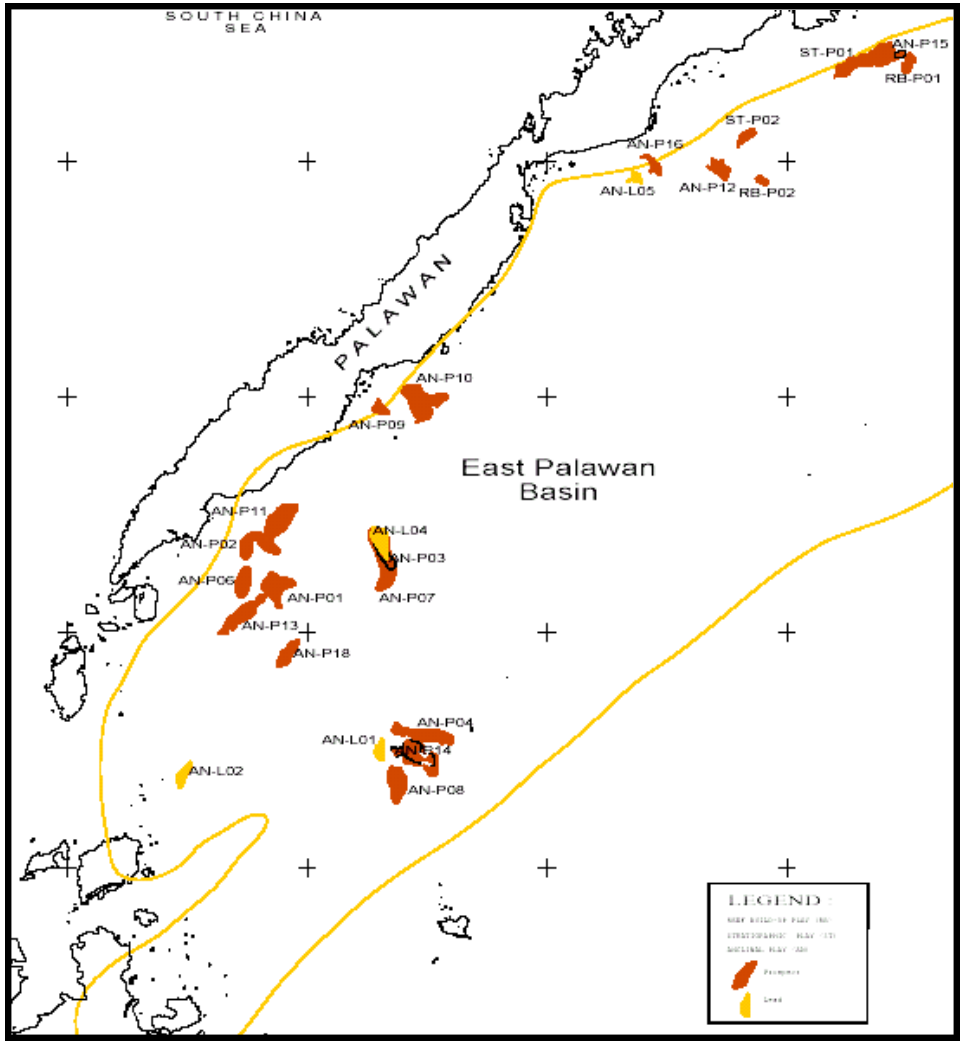
- **Sulu Sea Basin**
  - **Prospect level**
    - **18 prospects (10 FB, 4 RB and 4 AN)**
    - **3 leads (1 FB and 2 RB)**
  - **Average probability of discovery = 5%**
  - **Play level (use of analog)**



Sulu Sea Basin Prospects and Leads Map

RESOURCE ASSESSMENT

- **East Palawan Basin**
  - **Prospect level**
    - **20 prospects (2 ST, 2 RB and 16 AN)**
    - **4 leads (AN)**
  - **Average probability of discovery = 4%**
  - **Play level (use of analog)**



East Palawan Basin Prospects and Leads Map

GeoX Input Figures for Sulu Sea and East Palawan Basins

Input Parameters	Type of distribution	Reservoir	Min	Mode	Max	Remarks
Net/Gross ratio (decimal)	Ln3Mod	carbonates	0.4	0.7	1	Min is average of Nido from SC14&38 fields; mode and max from Malampaya
		clastics	0.1	0.25	0.4	based on ARCO parameters and wells in the basin (including Malaysian wells)
Porosity (decimal)	Ln3Mod	carbonates	0.1	0.15	0.25	Min/mode from NidoLS, max from Sulu basin
		clastics	0.07	0.2	0.3	based on ARCO parameters and wells in the basin (including Malaysian wells)
HC Saturation (decimal)	Ln3Mod	carbonates	0.58	0.7	0.73	Based on MA-1 to -3 wells
		clastics	0.6	0.7	0.85	Based mainly ARCO parameters and wells in the basin
Trap fill	Constant		1			Assume trap filled to spill point
Fraction gas HCPV	Ln3Mod		0.4	0.5	0.6	based on success rate (50/50 oil and gas case in the Malaysian side of the basin)
Recovery Rate Oil (decimal)	Ln3Mod		0.2	0.3	0.4	Assume water flooding and horizontal well drilling
Recovery Rate Gas (decimal)	Ln3Mod		0.7	0.75	0.8	Based on Malampaya wells
Oil Form. Factor (Bo) (m3/m3)	Ln3Mod					Use Vasquez-Beggs equation
Gas Form. Factor (Bg*1000) (m3/1e3m3)	Ln3Mod	carbonates				Use Nido LS FVF table
		clastics				Use Galoc FVF table
Gas Oil Ratio (m3/m3)	Ln3Mod					Use Vasquez-Beggs equation
Condensate Yield*1000 (m3/1e3m3)	Ln3Mod		0.022	0.04	0.09	Min from Reed Bank, mode from Malampaya, max from Sabah

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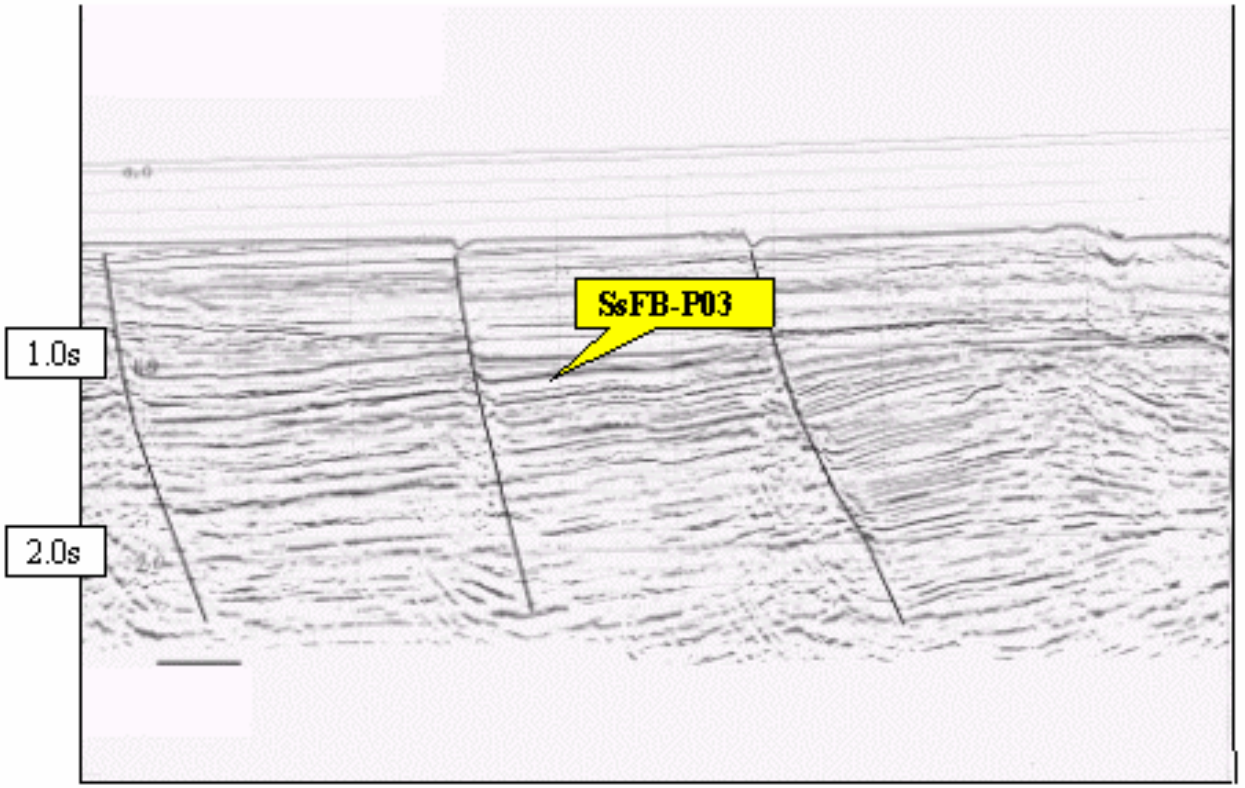
RISKING



SsFB-P03

Play probability: **1.0** *(confirmed play)*

Prospect probability: **0.108**

Pp (0.8) – *Based on* *Hippo and Wildebeest wells*

Pg, (0.8) - *Based on seismic (data coverage-0.9, data quality-0.9)*

Ps, (0.8) - *Thick overburden seen on seismic*

Pm, (0.3) - *due to reported overpressure in the area, dry wells nearby*

Pr, (0.7) – *considered as seismically active basin (Petronas, Malaysia Report, 1999)*

RESOURCE ASSESSMENT

Play analysis by analogy method

$$U.2_{AB} = U.2_{BB} * U.1_{AB} / U.1_{BB} * SV_{AB} / SV_{BB} * TSL_{AB} / TSL_{BB}$$

Where:

U.2 = Speculative Resources

U.1 = Hypothetical Resources

BB = Basis Basin (Southwest Palawan)

AB = Analogue Basin (Sulu Sea and East Palawan)

SV = Sediment Volume

TSL = Total Seismic Length

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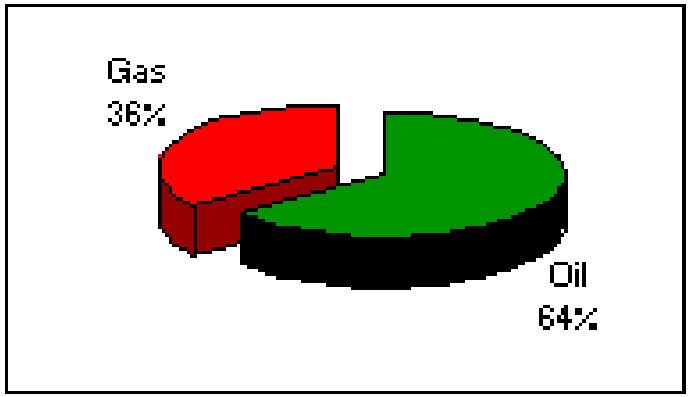
RESOURCE ASSESSMENT

SULU SEA BASIN *Resource Class*	Total Million Sm3 o.e. (Mean)	Oil Million Sm3 (Mean)	Gas Billion Sm3 (Mean)	Total Million bbl o.e. (Mean)
Total Resources	32	21	11	203
Undiscovered Resources	32	21	11	203
Hypothetical (Mapped) Resources	17	11	6	109
Prospects	14	8	6	89
Leads	3	3	0	20
Speculative (Unmapped) Resources	15	10	5	94

EAST PALAWAN BASIN *Resource Class*	Total Million Sm3 o.e. (Mean)	Oil Million Sm3 (Mean)	Gas Billion Sm3 (Mean)	Total Million bbl o.e. (Mean)
Total Resources	70	51	20	443
Undiscovered Resources	70	51	20	443
Hypothetical (Mapped) Resources	26	19	8	166
Prospects	24	17	7	152
Leads	2	2	1	15
Speculative (Unmapped) Resources	44	32	12	277

RESOURCE ASSESSMENT

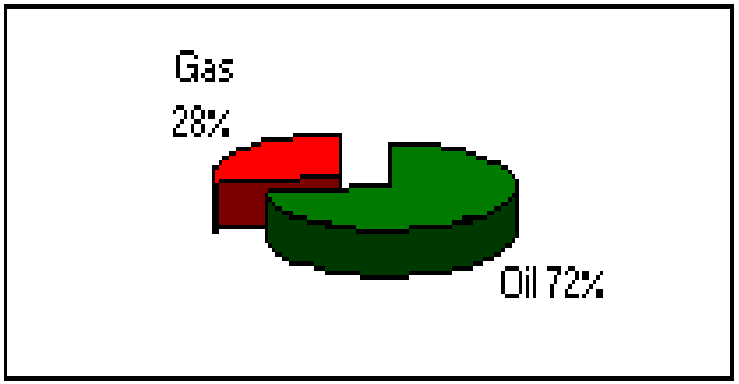


SULU SEA BASIN

ESTIMATED RESOURCES
TOTAL : 203 Million boe

EAST PALAWAN BASIN

ESTIMATED RESOURCES
TOTAL : 443 Million boe



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