COUNTRY REPORT : UPDATE ON THE SHALE BASIN MAPS
Basins with Shale Potential
Geologic Setting
Major Structural Features
Exploration Activities
UC Update
Basins with Shale Potential

- Sedimentary Basins of the Philippines
  - Onshore – Eight (8)
    - Cagayan Basin
    - Central Luzon Basin
    - Southeast Luzon Basin
    - Mindoro-Cuyo Platform
    - Masbate-Iloilo Basin
    - Visayan Basin
    - Cotabato Basin
    - Agusan-Davao Basin
Cagayan Basin

- Geologic Setting
  - Cordillera Central on the west
  - Nueva Viscaya or Caraballo Ridge to the south
  - Sierra Madre Range in the east
  - Sicalao Ridge-Cassigayan High to the north
Cagayan Basin

- **Major Structural Features**
  - Characterized by several fold regime ranging from non-folded, homoclinal, moderate to strongly folded belts.
  - Folds generally North-South in the main basin
  - Folds strikes East-West in the sub-basin
  - Folds are either fault induced or are of diapiric origin
Cagayan Basin

❖ Exploration Activities

➢ Pre-1949

* Drilling shallow wells near to the occurrence oil and gas seeps in the western foothills of the basin emanating from Middle to Late Miocene & Pliocene rocks

➢ Petroleum Act 1949 to 1972

* Carried out geological fieldwork, gravity survey, seismic data acquisition, and subsequent drilling operation

* Acquired 333 ln-kms & 448 ln-kms (onshore & offshore respectively) seismic data from 1956 to 1971

* Drilling activities based from surface delineated anticline with some seismic postulated reefal build-ups

* 17 wells drilled; 2 dry gas discoveries in 1958 (Ipil-1 and Abaca-1 wells that flows 1.1 MMscfgpd & 6.1 MMscfgpd respectively)
Cagayan Basin

 Exploration Activities

 ▶ Service Contract Era (1973 to present)
   * Acquired 4,632 ln-kms and 4,346 ln-kms of 2D seismic data over offshore and onshore areas respectively
   * 18 wells drilled
     - Cowrie-1 well, the only offshore well drilled by Total in 1981 to test the Miocene reefal build-up flowed 98% methane
     - San Antonio-1 flowed 11.35 MMscfgpd from Miocene Callao limestone
     - Produced 3.54 BCF gas with 187.48 GWHr power generated

 ▶ Current Exploration Activity
   * SC-37 under PNOC-EC
     - Drilled Mangosteen-1 exploration well in March 2015 with 2,423.48 meters depth and encountered gas column
     - More detailed study to determine commercial viability of the prospect
Central Luzon Basin

- **Geologic Setting**
  - Zambales Range to the west
  - Sierra Madre to the east
  - Caraballo Mountains and southern end of Cordillera to the northeast
  - Manila Bay & part of Batangas to the south
Central Luzon Basin

- Fringed westward by the Manila Trench (subduction zone)
- Eastward by the incipient subduction system of East Luzon trough
- The southern boundary of the block is the left-lateral WNW-ESE Verde Passage Fault
- To the west by a complex graben structure of Macolod Corridor
- To the east by the Legaspi Lineament, left-lateral strike-slip fault trending WNW-ESE
Central Luzon Basin

**Exploration Activities**

- **Petroleum Act to Service Contract (1949 to 1973)**
  - 1st drilling (Macabebe-1 & Minalin-1) in 1950 conducted by Philippine Oil Development Company (PODCO) in which were based on the reported presence of gas seeps
  - Systematic field geological & geophysical surveys (airborne and land magnetometer & gravity surveys) and seismic data acquisition conducted
  - 951.94 ln-kms and 458.00 ln-kms in offshore and onshore areas
  - Stratigraphic holes were drilled between Zambales Mountains and Lingayen Gulf to augment the data acquisition prior to the drilling of exploration wells
  - Subsurface structures were identified and delineated, mostly anticlines were subsequently drilled
  - Methane gas encountered by succeeding 5 wells between 1960 to 1964
Central Luzon Basin

 Exploration Activities

Service Contract Era (1973 to present)

* Seismic data acquisition yielded 2,232.55 In-kms and 2,958.52 In-kms in offshore & onshore areas respectively, with 2,905.00 In-kms of aeromagnetic data
* Seismic interpretation identified faulted dome or domal structures with sandstone as reservoir
* Significant HC encountered from Victoria-1 well in 1979, flowed 1.2 MMscfgpd (33,99.3m3/day) of dry gas from Late Miocene sandstone
* 23 wells drilled from 1950 to present, mostly onshore with 1 discovery, 11 wells encountered minor gas shows

Current Exploration Activity

* SC-70 under Polyard Petroleum International Co. Ltd. (PPIC)
* Conducted integrated study of Petroleum Geology & reprocessed ~400 In-kms of seismic data
* Carried out petrophysical and reservoir engineering studies
* Preparation to drill an exploration well (A-1)
Iloilo-West Masbate Basin

Geologic Setting

Iloilo Basin

* Antique Range on the west
* Eastern Panay Range & Guimaras Island on the east
* Highlands of Aklan & Capiz on the north
* Broad westward-tilted submarine high on the south

West Masbate

* Separated from the Iloilo basin to the south by the east-trending highlands of Aklan & Capiz
* Masbate Island to the east
* Romblon, Tablas & Sibuyan Islands to the west
* It merges with the SE Luzon basin to the north
Iloilo-West Masbate Basin

- **Major Structural Features**
  - It consists of a main trough which extends from onshore Panay Island to northern Panay Gulf, and a sub-basin formed south of Guimaras Island.
  - The main basin is marked by well-defined shelf and slope basinal areas.
  - The shelf edge coincides with the western margin of the present Iloilo plain and trends North-Northeast to North-Northwest.
Iloilo-West Masbate Basin

 Exploration Activities

- Petroleum Act (Pre-1949)
  * 130 ln-kms of reflection seismic data acquired from 1940-1941 over onshore south-central Panay Island

- Petroleum Act to Service Contract (1949 – 1973)
  * From 1953- 1973, delineation and testing of anticlinal structural traps by surface geology and seismic data; drilling carried out in the SE or shelf area of Iloilo basin and Panay Gulf Sub-basin
  * 1st well (Oton-1) was drilled in 1953 by PODCO thru seismic & geological works
    - 1,937 meter total depth that reached Early Miocene carbonates & logged oil show in Late Miocene limestone section
  * Aeromagnetic, gravity and supplemental seismic surveys carried out from 1956-1959
    - 1,035.32 ln-kms seismic data acquired (654.4 onshore & 380.92 offshore)
  * Two (2) wells drilled to test the Miocene clastics & carbonates of seismically delineated anticline (Tigbauan-1 and San Miguel-1 wells)
Iloilo-West Masbate Basin

**Exploration Activities**

- **Service Contract Era (1973 to present)**
  - Definition and testing of reef stratigraphic traps carried out from 1974-1980
  - 361 ln-kms of seismic data acquired in onshore Panay Island and 3,321 ln-kms of seismic data acquired in offshore areas
  - Ten (10) wells drilled (7 wells with insignificant gas and/or oil shows)
  - Tigbauan-1 well flowed 9,200m³/day (324,858cfgpd) of methane for 2 days
- In SE part of the basin in Panay Island, 9 wells drilled and 860 ln-kms of seismic data acquired, 2 wells recorded minor oil shows
- In Panay Gulf Sub-basin, 1 well drilled with 1,695 ln-kms of seismic data hence underexplored
- Iloilo Basin marginally explored
- West Masbate with 1,250 ln-kms of seismic data is unexplored since no exploration drilling has been conducted
Mindoro-Cuyo Basin

Geologic Setting

Southwest Mindoro Basin (East Mindoro Depression)
* Busuanga & Cuyo Platform defined the western & southern margins
* West Philippine Sea thru the southern end of the Manila Trench to the north
* Broad metamorphic basement highlands of central Mindoro Island to the west
* Islands of Marinduque, Romblon, Tablas and Sibuyan to the east

Cuyo Platform
* Shallow offshore area between north Palawan, Mindoro and Panay Islands
* It occupies the southeastern part of the Kalayaan-Calamian microplate
Mindoro-Cuyo Basin

**Major Structural Features**

- **Southwest Mindoro Basin (East Mindoro Depression)**
  * Busuanga & Cuyo Platform defined the western & southern margins
  * West Philippine Sea thru the southern end of the Manila Trench to the north
  * Broad metamorphic basement highlands of central Mindoro Island to the west
  * Oriented NW-SE and characterized by en-echelon sinistral strike-slip faults

- **Cuyo Platform**
  * Dissected by faults creating a series of horst & graben features
  * Normal faulting predominant although indications of strike-slip movement and deep-seated overthrusting are evident
Mindoro-Cuyo Basin

 Exploration Activities

- Petroleum Act to Service Contract (1949 – 1973)
  - Late 1950’s – geophysical survey carried out, seismic & gravity data were gathered and interpreted, oil and gas seeps investigation carried out
  - Drilled 2 stratigraphic wells (Natulo-1 & San Teodoro-1) to test the Eocene reefal quartz sands in onshore Northern Mindoro
  - 1st exploration well (Central-1) drilled in onshore San Jose, Occidental Mindoro at a depth of 6,286 ft (1,916 ms) by REDECO
  - From 1970-1971, 3,276 ln-kms of 2D seismic data were acquired along the offshore areas
Mindoro-Cuyo Basin

Exploration Activities

Service Contract Era (1973 to present)

* 1973–1998 (2D seismic survey) = 28,705 ln-kms (offshore); 2,395 ln-kms (onshore)
  (3D seismic survey) = 133.32 sq-kms or about 5,333 ln-kms (offshore)
* 1979 – drilled 3 wells (Roxas-1, Dumaran-1 in offshore NE Palawan & Mindoro-1) in onshore southern Mindoro
* 13 wells drilled – Maniguin-2 well drilled by PNOC-EC in 1994 with a depth of 5,150 ft TVD encountered waxy oil with 24.2°API density and 9.35-10.44 cp viscosity from Early Miocene sandstone reservoir
* Hydrocarbons are mainly methane gas with some significant heavy hydrocarbon gases (C3-C5)

Current Exploration Activity

* SC-53 Mindoro-Palawan Oil & Gas, Inc. (MPOGI)
  - Acquired 200 ln-kms of onshore 2D seismic data
  - Preparing to drill 2 exploration wells
Southeast Luzon Basin

- Camarines Norte-Caramoan-Catanduanes basement highs on the north and northeast
- Extends to Lamon Bay in the northwest
- Tayabas Isthmus basement highs on the west
- Marinduque, Tablas, Romblon and Sibuyan Islands on the southwest
- Sibuyan Sea and Northern Samar to the southeast
Southeast Luzon Basin

**Major Structural Features**

- Formed by a series of narrow, alternating NW-trending horst and graben features bounded by relatively stable platforms on 2 sides (Camarines Norte-Caramoan-Catanduanes on the north and Tayabas-Marinduque on the west).
- The deformation patterns of the sedimentary fill are results of extensional block-faulting and differential uplift respectively, and shear along individual faults of the Philippine Fault System which traverses the basin.
- Folds are small and mostly wrench-induced. In Central Bondoc Peninsula, the folds are attributed to Pleistocene diapirism.
Southeast Luzon Basin

**Exploration Activities**

- **Petroleum Act (Pre-1949) – 19 wells drilled**
  - 1906 – wells were drilled near to oil and/or gas seepages, 3 wells were based on surface mapping, 4 wells on surface-mapped anticlinal structures, 5 shallow wells were drilled on the surface-delineated Maglihi Anticline in the southeastern part of the Peninsula, and 7 more wells were drilled aided by seismic data
  - 17 wells encountered either oil and/or gas shows; 1 produced limited amount of oil during testing but none was proven commercially viable
  - Piña-1 and Bondoc-2 flowed appreciable amount of gas, Piña-1 with 92,000 cuft/day (2,600 m³) with minor oil show while Bondoc-2 flowed 250 bopd

- **Petroleum Act to Service Contract (1949 – 1973) - 25 wells drilled**
  - Acquired 308.4 ln-kms and 187.65 ln-kms of seismic data in onshore & offshore areas respectively
  - From 1954 to 1959, surface geological, gravity and seismic works were conducted and delineated a number of anticlinal features that were subsequently drilled
  - Exploration drilling consists of 8 shallow stratigraphic test wells; 12 shallow core holes; 1 gas test, and 2 medium depth wells
  - 23 wells drilled in Bicol and 2 wells in Bondoc Peninsula
Southeast Luzon Basin

 Exploration Activities

 Service Contract Era (1973 to present) – 4 wells drilled

 * Geophysical survey acquired 9,318 ln-kms of 2D seismic data (9,151.325 ln-kms offshore and 166.31 ln-kms onshore)
 * Drilling tested the Aurora Anticline with good oil and gas shows and the Late Miocene to Early Pliocene clastics
 * Monte Cristo-1 was the last well drilled in 2008
 * 4 wells were drilled of which 2 wells have oil/gas shows
 * Partially explored basin in view of drilling density, nature of wells and the untested offshore areas.
Visayan Basin

- **Geologic Setting**
  - It consists of a series of north to northeast trending interconnected depositional and structural troughs
  - Basement ridge in Masbate to the north
  - Philippine Fault Zone to the east
  - Quaternary volcanics of Negros to the west
  - Opens into the abyssal waters of Bohol Sea to the south
Visayan Basin

- **Major Structural Features**
  - Represented by a series of north to northeast-trending narrow structural troughs of varying sizes defined by, or occasionally super-imposed on 3 major and a number of minor basement lifts.
  - Basin deformation related to varying degrees to 3 major tectonic events:
    * Subduction/collision west of Panay Island
    * Subduction along the Philippine Trench
    * Sinistral wrench movements along the Philippine Fault Zone
Visayan Basin

Exploration Activities

Petroleum Act (Pre-1949)

* Drilling was based primarily on the presence of/or near oil and gas seeps and surface mapped anticlinal structures
* 12 exploration wells drilled in which 7 encountered oil and gas shows
  - Toledo-1 (1st well drilled in the Philippines) flowed & produced about 2 bopd at a depth of 268 m (880 ft) in the Malubog Formation


* Employed reflection seismic surveys to outline underlying structures
* Acquired 582 ln-kms and 3,579 ln-kms of 2D seismic data in onshore and offshore areas respectively
* 170 wells drilled with a number of non-commercial oil & gas discoveries
* Libertad, Maya, Lumpan & CMB wells flowed from 106 bopd to 605 bopd and about 70,000 cfgpd to 250,000 cfgpd
Visayan Basin

Exploration Activities

Service Contract Era (1973 to present)

* Marine seismic surveys were conducted
* 2D seismic data acquisition = 24,043 ln-kms (22,490 ln-kms in offshore and 1,553 ln-kms in onshore)
* Identified numerous anticlines and the ensuing drilling encountered other prominent seismic anomalies such as reef build-ups, non-reef carbonates and basement highs
* 46 wells drilled
  - 31 wells onshore
    - L-95-1 in the North flowed 1.4 MMscf/gpd in 1997
    - South Cebu-2 in the South flowed 38 MMscf/gpd & 6 bopd with 32.9°API density
    - Nuevo Malolos-1 encountered oil and gas shows
  - 15 wells offshore
    - 3 wells encountered gas shows (Anapog A-1X, Villaba-1 & Villaba-ST1)
Visayan Basin

Exploration Activities

Current Exploration Activities – Five (5) Service Contracts

* SC-40 Forum Exploration Inc.
  - Produced the Libertad gas field from 2012 to 2015 (200.989 MMscfg)
  - Undertaking land gravity survey in NW part of the block

* SC-44 Gas2Grid Ltd
  - Drilled Nuevo Malolos-1 well
  - Drilled 2 exploration wells (Jacob-1 and Gumamela-1)

* SC-49 China International Mining Petroleum Co. Ltd.
  - Drilled five (5) appraisal wells; Polyard-1, -2, -3, -6 and -8
  - Prepared Field Development Plan for Area 8 (Gas Field)
  - Converted the SC from exploration to production phase
Visayan Basin

**Exploration Activities**

- **Current Exploration Activities - Five (5) Service Contracts**
  
  * SC-51 Otto Energy Investment Ltd.
    - Carried out Microbial Geochemical survey
    - Conducted engineering study of Villa-1 gas discovery
    - Acquired 146 sq-kms of 3D seismic data
    - Drilled Duhat-1 and -1ST wells
    - Acquired 102 ln-kms of 2D seismic data

  * SC-69 TransAsia Petroleum Corporation
    - Completed prospectivity review
    - Reprocessed 2,792 ln-kms of seismic data
    - Acquired 890.65 ln-kms of 2D seismic data
    - Acquired 228.8 sq-kms of 3D seismic data
End of Presentation
Thank you for your attention