Ocean bottom nodes
New technique to acquire seismic data for reservoir monitoring

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Method utilized for O&G exploration since 70’s – 2D and 3D;

Method utilized for Reservoir Characterization and Monitoring since 90’s – 3D and 4D;

Method still utilized today for most of the projects in O&G E&P.
2D seismic acquisition principle
3D seismic acquisition principle
3D seismic acquisition principle
4D seismic principle
3D seismic issues
Subsalt illumination issues
4D issues
Non-conventional seismic acquisition with Ocean Bottom Cables - OBC
Non-conventional seismic acquisition with Ocean Bottom Cables - OBC

◆ Method utilized mainly for reservoir characterization and monitoring;

◆ Seismic Source detached from the Receivers;
  ▪ More flexibility to acquire on obstructed areas

◆ Receivers in OBCs coupled on the sea floor;
  ▪ Capability to acquire the shear wave

◆ Wide azimuth data acquisition
Ocean Bottom Cables – OBC
Flexibility to operate on production infra-structure
Ocean Bottom Cables – OBC
Record the shear wave
Ocean Bottom Cables – OBC
Wider azimuths collected than tow streamer
OBC issues

- Water depth capability only up to 1000m;
- Wide not Full azimuth;
- No flexibility on under water infra-structure;
- Sensors on the sea floor not coupled well for shear wave record.
OBC issues – wide but no Full
OBC issues – no flexibility on subsea infrastructure
Oceanic Nodes

◆ Method utilized mainly for reservoir characterization and monitoring;
  ▪ Ultra deep water capability up to 3000 m
  ▪ Sub sea infrastructure
  ▪ High repeatability

◆ Seismic Source detached from the Receivers;
  ▪ More flexibility to acquire on obstructed areas
Oceanic Nodes

- Full Azimuth data for sub salt sediments imaging

- Receivers well coupled on the sea floor:
  - Capability to acquire the shear wave
  - No vector fidelity issues
  - Fracture reservoir detection
Flexibility over ultra deep water subsea infrastructure
High Repeatability in the receiver positions for 4D monitor surveys
One Vessel crew
Full Azimuth Capability for sub salt imaging
3- components receivers well coupled
Shear wave and Z component P wave better recorded
Existing units

- OYO Geospace
- CGGVeritas
- Fairfieldnodal
- Fugro
Oceanic Nodes issues

- Non conventional data processing;
- Battery life time;
- Efficiency in deployment and recovery;
- Availability of nodes in the market;
- Three nodes crew available in the market;
- Geophone low frequency;
Non conventional data processing

- Project conducted by Geonunes/Petrec/FINEP
  - Sparse receivers Imaging;
  - Sparse receiver velocity analysis;
  - Converted wave processing;
  - Nodes data pre-processing;
Market situation

◆ Shell predicts: 50% of all offshore seismic will be with nodes within 10 years

◆ 100% of Shell’s surveys during 2011/2012 in the Gulf of Mexico was with nodes (Fairfield).

◆ Total seeks a multi year contract with a node provider for the North Sea and Nigeria (3000 sq.km)

◆ BP seeks a node provider for surveys for the North Sea and probably Gulf of Mexico
Market situation

- Agbami field (Nigeria) has two 4D monitors with nodes;
- Seabed (Fugro) is acquiring a monitor survey with nodes in Frade field (Campos basin);
- Two surveys with nodes for sub-salt sediments in Atlantis field, GofM.
Brasil situation

- Pos-salt fields being developed with 4D seismic are fully obstructed on the sea floor, e.g. Marlim, Albacora, Marlim Leste, Roncador, Parque das Baleias, etc.

- Fracture detection in fracture reservoir (Marlim Leste);

- All the above fields are located in deep water and ultra deep water.

- Pre-salt fields require full azimuth data to characterize the sediments below salt domes.
Project proposal

- Develop a node of reduced size as compared to existing similar system
- Implementation of low frequency geophones
- Long battery lifetime (150-200 days)
- Next generation of high accuracy clocks (low power consumption)
Brasil situation

- Focus on a large number of small sized planted nodes of higher operational efficiency
- Flexible solutions for different types of surveys, sizes and water depths
- Develop a permanent node system using the same building blocks
- A fully integrated company, offering acquisition, processing and interpretation
Thank you!

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