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Seismic Guided Pore Pressure Prediction In Deepwater Block Of Mahanadi Basin

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ABSTRACT

Mahanadi Basin is located in the northern part of the east coast of India and is bounded by the Bengal basin in the north-east and Krishna-Godavari basin in the south-west.Almost all the discoveries in the basin are confined to Pliocene and Miocene channel-levee plays and is principally in the form of biogenic gas reserves. In deeper stratigraphic level onset of high pore pressure, reported in drilled wells (e.g. Well-A) is one of the main impediment to drill deeper. Well-A could not be drilled to the targeted level in Paleocene due to high pore pressure encountered in Eocene. The study aims to generate 3D pore pressure model to mitigate associated drilling risk in deeper formations of Mahanadi deep offshore.

The pilot study area is located in the southern part of one deep-waterblock within water depth of 1200 – 2100 m and it is covered by 3D Q marine seismic survey. The imperatives for selecting area (Area-II) for pilot study are mapped exploratory leads within area and encountering high pressure during drilling up dip towards north of it in Area-I.

Within Area-II exploratory leads are identified through interpretation of 3D seismic. The high pore pressure encountered in Well-A and other wells, is likely to extend further south in deeper part of Area-II. The present study is focused to assess pore pressure, its generation mechanism and spatial distribution within area.

For seismic to log marker correlation, velocity and pore pressure calibration, the reference well is Well-A in Area-I as there is not any drilled well in area of study. The generated 1D pore pressure model in Well-A is well calibrated with recorded pressure in the well. The onset of overpressure is interpreted within Eocene Formation at depth 5452 m (MD). The calibrated velocity and pore pressure at Well-A were carried to Area-II along two north-south lines connecting Area-I and Area-II through re-picking of velocity over CMP gathers.

In Area-II velocity picking was done in a grid of 250m×250m to have higher spatial resolution required for enhancement of accuracy of pore pressure prediction. RMS Velocity output was converted into seismic interval velocity volume using Constrained Velocity Inversion (CVI). In Area-II, 4 pseudo wells are created and seismic interval velocity were extracted and Pore pressure is computed at these wells using parameters computed for Well-A. Subsequently, Hydrostatic pressure (HP) volume, overburden pressure volume (OBP) and normal compaction trend (NCT) volume are generated and then Eaton’s interval velocity method was used with exponent value E=3 to transform interval velocity volume to 3D Pore pressure volume.

Velocity vs Density crossplots (Hoesni Plot) suggest Disequilibrium compaction as the main over pressure generation mechanism in the study area. The overpressure starts with Eocene Formation and shows preferential spatial distribution pattern. In general, spatial positions of identified leads are stacked below these high pressure distribution geometries.

The generated pore pressure volume can be used a guidance for designing mud program for drilling future wells in the area. The pore pressure model can be further refined with inclusion of new data generated after drilling new wells.