ACOUSTIC IMPEDANCE INVERSION STUDIES FOR DELINEATION OF THIN SANDS, CHANNELS AND IDENTIFICATION OF LOW IMPEDANCE AREAS FOR THE DELINEATION OF HYDROCARBON PROSPECTIVE ZONES.

A Research Project Under

GERMI Summer Internship Programme (2014)

By

Mr. Punit Malik, M.Sc. Applied Geophysics
Student ID Number: GERMI/S-2014/82

Department of Earth Sciences
Indian Institute of Technology Bombay

Under the Guidance of:

Data Interpretation Centre
Petroleum Research Wing
Gujarat Energy Research and Management Institute
Research, Innovation and Incubation Centre
Gandhinagar-382 007, Gujarat, India

GUJARAT ENERGY RESEARCH MANAGEMENT INSTITUTE

GANDHINAGAR- 382007

GUJARAT, INDIA

Name of the Student	:	Punit Malik
Name of the Institute	:	Indian Institute of Technology Bombay
Project Title	:	Acoustic Impedance Inversion Studies (Coloured Inversion, for delineation of thin sands, channels and identification of low impedance areas for the delineation of hydrocarbon prospective zones.
Project Coordinator	:	Mr. P.H. Rao
Technical Guide	:	Mr. Santosh Dhubia, Mr. K. Ramachandran, Mrs. A. Boruah
Sponsored By	:	Gujarat Energy Research and Management Institute Research Innovation and Incubation Centre Gandhinagar- 328 007, Gujarat, India

ACKNOWLEDGEMENTS

I express my deep sense of gratitude to Dr. T. Harinarayan, Director, Gujarat Energy Research and Management Institute, Gandhinagar, for giving me an opportunity to participate in Summer Internship Programme, 2014.

I would like to express my heartfelt thanks to Mr. P.H. Rao, Head, Data Interpretation Centre, Germi for extending his knowledge, support and guidance throughout the entire period of the internship work.

I would like to express my sincere thanks to Mr. Santosh Dhubia, Scientist E1, Petroleum Research Wing, Germi for taking care of each and every aspect of the work.

I would like to convey my thanks to Mr. K. Ramachandran, Geoscientist, Petroleum Research Wing, Germi for his support and encouragement.

I would like to convey my thanks to Mrs. A. Boruah, Scientific Officer, Petroleum Research Wing, Germi for her timely help and support.

I would like to convey my deep sense of gratitude to dGB Earth Sciences, Norway for providing us the software.

I feel very happy to acknowledge my fellow colleagues with whom the entire period of work was immensely enjoyable.

I am also very thankful to Dr. G. Mohan, Head of Department, Earth Science, IIT Bombay for allowing me to join the summer training programme at Germi.

TABLE OF CONTENTS

ABSTRACT

The main objective of the current study is to understand lateral variation of impedance using 3D seismic data to identify possible hydrocarbon bearing zones. The study was carried out with 3D Kirchhoff PSTM Stack and well data in the study area. To interpret the data, a workflow was devised which essentially included conditioning of the seismic data, tracking of prominent horizons, identification of formation boundaries using seismic–well tie, well log analysis, seismic attribute analysis and finally acoustic impedance inversion studies to identify the low impedance areas for the detection of hydrocarbon.

To improve the data quality and resolution, dip steered median filter (DSMF), Fault enhancement filter (FEF) and seismic spectral bluing (SSB) were used. DSMF de-spikes the noises, FEF enhances the sharpness of fault boundary and SSB enhances the frequency content of the seismic data using the well log. Horizons were tracked on the enhanced seismic data corresponding to the major formations in the survey area.

Coloured, deterministic and stochastic inversion methods for seismic inversion were used in this study to create the acoustic impedance volume. The acoustic impedance is the product of P-wave velocity and density of the formation. As the variation in acoustic impedance is indicative of shale, coal, sand associated with gas and porosity variations, it can lead to identify prospective areas for hydrocarbon exploration. The coloured inversion gives the relative impedance values, helps in identifying the relative acoustic impedance variations. Deterministic and stochastic inversion gives the absolute impedance variation but with some uncertainty due to band limited seismic data.

The study has brought out a thin layer of coal in the study area and also demarcated possible shale and sand zones.

This study can be further extended to other formations of the field and more well control can be brought in to analyse the subsurface more precisely and to increase the level of confidence in the final results.