

An Indian-Australian research partnership

Project Title: The geomechanics of reservoir due to the extraction of fluids or oil/gas

Project Number IMURA0492

Monash Main Supervisor
(Name, Email Id, Phone) Dr. Jian Zhao
jian.zhao@monash.edu *Full name, Email*

Monash Co-supervisor(s)
(Name, Email Id, Phone) Dr Qianbing Zhang
Qianbing.Zhang@monash.edu
Phone: +61 3 9905 4385

Monash Head of Dept/Centre (Name,Email) Professor Jeffrey Walker
eff.Walker@monash.edu
Phone: +61 3 990 59681 *Full name, email*

Monash Department: Civil Engineering

Monash ADRT
(Name,Email) Emanuele Viterbo *Full name, email*

IITB Main Supervisor
(Name, Email Id, Phone) Prof. Kumar Hemant Singh
Kumar.h.singh@iitb.ac.in
Phone: +91 (022) 25767283(O) +91 9619832641 (M)
Fax: +91 (022) 25767253 *Full name, Email*

IITB Co-supervisor(s)
(Name, Email Id, Phone) Prof. Trilok Nath Singh
tnsingh@iitb.ac.in
Phone: +91 (022) 25767271(O)

IITB Head of Dept
(Name, Email, Phone) Prof. G Mohan
gmohan@iitb.ac.in
Phone: +91 (022) 25767274(O) *Full name, email*

IITB Department: Earth Sciences

Research Academy Themes:

Highlight which of the Academy's Theme(s) this project will address?

(Feel free to nominate more than one. For more information, see www.iitbmonash.org)

1. **Advanced computational engineering, simulation and manufacture**
2. Infrastructure Engineering
3. Clean Energy
4. Water
5. Nanotechnology
6. Biotechnology and Stem Cell Research
7. Humanities and Social Sciences

The research problem

The evaluation of borehole stability and surface subsidence induced by hydrocarbon production has been one of the major concerns to oil companies and government environmental agencies. Exploitation of

subsurface natural resources (hydrocarbon) and water, including mining activities, may cause surface and subsurface deformation causing land subsidence. The land subsidence causes large stresses in the surface and near-surface structures. The elastic limit of several construction materials are compromised causing compressional failures and severe shear stresses. These phenomena must be understood in the light of petrophysical and geomechanical properties of the material both via simulation and experimental studies in the laboratory. This requires a detailed knowledge of stress magnitudes and its direction both in 1-D and 3-D which is prudent in understanding the reservoir mechanics of the region.

Project aims

Geomechanical information is required to assure borehole stability. This information prevents damages in the formation and later on to the casing. Before undertaking any drilling activity in an area, it is therefore required to know prevalent fault system, pore pressure, fracture gradient, over burden pressure and shear failure characteristics of the region. To generate these data in exploratory areas needs rigorous experimental and numerical modeling efforts.

1. Creation of 1D geo-mechanical models
2. Creation of 3D models of study area
3. Establishing general stress regime of the area and principal stress directions
4. Pore pressure map of field/block
5. Mud windows in 3D to evaluate various azimuths and deviations for stable drilling

Expected outcomes

1. Identification of areas with high drilling risk
2. Casing policy decision
3. Sand Production Prediction
4. Hydraulic Fracturing Optimization

How will the project address the Goals of the above Themes?

The key to development of oil and gas field in an area is to have ample information on the reservoir characteristics, stress state in all direction at all points within an oil field so that optimal mud weights, stable trajectories and casing set points can be pre decided before the drilling starts. This becomes more critical if the field is to be developed in deep water. Thus to maximise the productivity of a reservoir, this research will not only benefit the industry for better preparedness in exploitation of the hydrocarbon resources but also will help to explore for other oil fields. This project directly meets the objectives of the Advanced computational engineering, simulation and manufacture to address energy security issues for India and technology up gradation to accelerate domestic exploration and production of hydrocarbons.

Capabilities and Degrees Required

This research would likely be an extensive and exhaustive one that would involve two aspects. First, the project will involve numerical simulations to understand the geomechanical properties in 1-D and 3-D. Second, for performing experimental investigations in the lab along with testing and development of algorithms. Each of these aspects would require extensive scholarly support for which involvement of a student with the knowledge of numerical methods popularly used in earth sciences with computing skills.

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

None

Please provide a few key words relating to this project to make it easier for the students to apply.

Borehole Stability, stress tensor, 1D and 3D geomechanical modelling