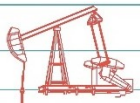

Master Thesis Description 2023
Petroleum Engineering / Geoenergy Engineering

Detection of minerals by implementing image analysis on µCT voxel data

A comprehensive morphological, geometrical, and statistical analyses (DSW-2)

Supervisor: prof. Kris Ravi
Co-supervisor/Advisor: Ass. prof Michael Prohaska

Dipl.-Ing Arash Nasiri

Chair of Drilling and Completion

1. Abstract

The application of computed tomography gained attention by the oil & gas industry in thelate 1980s ; it has been used generally for imaging and determination of fluid distribution and topology as well as quantifying petrophysical properties all of which are under digital core analysis studies. Since last decade the application of computed tomography has been expanded also to fishing expeditions and formation damage quantification. Here we are assessing a simple approach to identifying & quantify the minerals.

2. Problem Description

Naturally, one would anticipate that Computed Tomography (CT) would be capable of extracting mineralogical information, particularly in detecting minerals. However, this capability has been restricted due to the high computational costs or the presence of minerals with similar attenuations and densities. Although there is a recent rise of new techniques and algorithms for analyzing micro-CT datasets to detect minerals, these methods are often specific to the sample or require more advanced and time-consuming Dual Energy CT (DECT). The chair of drilling and completion has already developed a simple approach to identifying rock samples minerals (Tectosilicates, Carbonates, and Clay); however, the model's accuracy should be improved by introducing new factors into consideration. The process of identifying those factors demands some good work with image analysis software; provided that the investigation is successful the result is entirely novel.

3. Project Objectives

This thesis will continue the work of the previous thesis (DSW-1). Its main objective is to scale up the findings to the 3D voxel-based images in hope of finding another relevant factor for mineral detection.

4. Project Work Packages and Schedule

• Developing expertise (elementary) with ImageJ & DIANA [1 month]

• Developing expertise (medium) with PerGeos. [1 month]

• Developing a good understanding of morphological and geometrical factors (namely Euler characteristic and fractal dimension) on-going

• Create the digital Rock model out of our database [1 month]

• Investigate the database and calculate the Makowski functionals as well as fractal dimensionality for mineral phases. [3 months]

5. Project Milestones

• Kick-off meeting

• Introductory session to provide access to the image analysis software and DIANA

• Regular working in the workstation until delivering the objectives

6. Project Partners

Chair of drilling and Completion

7. Project Coordination and Thesis Advisors

University Assistant Dipl.-Ing Arash Nasiri as advisor and coordinator

8. Necessary Input by Project Partners

The chair will provide access to the database

9. Necessary Infrastructure and Software

The chair will provide access to PerGeos and DIANA FEA Software.

10. Related Projects at the Chair

The project is defined under the development of 3D Digital Sample Workflow, here so-called DSW-2. This is the second step; hence the database includes voxel-based µCT images. The next step will be then to create a mesh out of the digital sample structure and feed it into DIANA.

Examples of µCT images and the working environment: