A NEW PERMEABILITY PREDICTION FOR CLEAN SANDS USING 3D RECONSTRUCTION METHODOLOGY ON THIN SECTIONS

by

LULUAN ALMANNA LUBIS

A Thesis

Submitted to the Postgraduate Studies Programme

as a Requirement for the Degree of

MASTER OF SCIENCE

GEOSCIENCES AND PETROLEUM ENGINEERING DEPARTMENT

UNIVERSITI TEKNOLOGI PETRONAS

BANDAR SERI ISKANDAR,

PERAK

MAY 2012

ABSTRACT

There are several methods to predict permeability from thin sections. Conducting numerical simulation of laboratory experiments through 3D pore structure generated from thin section image is one of the methods. To implement this method on a standard personal computer and in real time, the size of the generated 3D should be limited to mm scale. This size is an order of magnitude smaller than the physical core plug. Computed permeability from this size may be over or underestimated when compared with the true laboratory measurement which is conducted at cm scale. The aim of this study is to develop a robust workflow to estimate permeability of reservoir rocks at core plug scale (cm scale) using full thin section images of sandstone which can be implemented in real time on a standard personal computer. The workflow is based on a combination of fluid flow simulation through 3D porous media generated from 2D images at mm scale and grain size vertical profile trends of entire image area of the thin section which covers an area in cm scale. For validation purposes the 2D to 3D porous media methods were tested on 2D images selected from 3D CT-Scan image. The results showed that this methodology had good agreement with the CT-scan data. The workflow was then applied on thin sections of the Berea core plug and three wells in the Malay Basin where their porosity and permeability were tested in the laboratory. The grain size vertical profile trends which cover the entire area of thin sections were used to define the heterogeneity of full thin section images at cm scale. The building blocks for upscaling purposes were created based on these trends. The representative image from each block was selected and the 2D to 3D porous media method was applied. From this information permeability at mm scale from each block was estimated and then upscaled from pore to core plug scale. The upscaling results on each thin section matched well with laboratory data.