Petrophysical Controls on Effective Thermal Conductivity Estimates

Thesis submitted in accordance with the requirements of the University of Adelaide for an Honours Degree in Geophysics

Alicia Pollett

November 2015

THE UNIVERSITY of ADELAIDE

PETROPHYSICAL CONTROLS ON EFFECTIVE THERMAL CONDUCTIVITY ESTIMATES

PETROPHYSICAL CONTROLS ON THERMAL CONDUCTIVITY

ABSTRACT

This study focuses on the Thermal Optical Scanner devised by Popov (used for thermal conductivity estimates) and whether this method should use more than one type of means calculation when using individual measurements made upon a core sample to produce a single mean, representative thermal conductivity for the sample. The study stems from the well-known theory that different means can be used to calculate the mean thermal conductivity for variations in grain and bedding orientations exhibited by varying lithologies and investigates whether the use of different means can result in more physically accurate and representative thermal conductivity averages for various lithologies. Through the analysis of the individual measurements made upon each of the samples, the arithmetic, geometric and harmonic means were calculated to determine whether a significant difference could be observed between the three means. The largest difference observed was 0.19W/mK^{-1}, which was considered to not substantiate a significant enough difference between the means to make recommendations of changes to how the computer program associated with the scanner calculates the final mean thermal conductivity output. As this analysis included the measurement of thermal conductivity upon 85 samples across three drill holes from central Southern Australia, the study also investigates the links between particular petrophysical characteristics including porosity and grain size and the exhibited thermal conductivities of these samples. The strongest correlation was observed between porosity and dry thermal conductivity, where porosities greater than 10% (total sample volume) resulted in evident decreases in exhibited thermal conductivity. No correlation was determined between average grain size and the standard deviation of the thermal conductivity and they also displayed no correlation with thermal conductivity measurements.

KEYWORDS

Thermal Conductivity, Thermal Optical Scanner, Petrophysics

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES