Eagle Ford shale has been of importance in the oil and gas industry with the new advent of unconventional technology in recent years. Previous studies have shown that Eagle Ford shale is a world-class source rock. Rock physics models help characterize the elastic properties of conventional and unconventional reservoirs. In this thesis, I present a novel rock physics model for organic-rich shales.

The extended Maxwell homogenization scheme is utilized as a rock physics model for transversely isotropic media. Since shales have complex structures, different components of the rock are modeled as multiple inclusions. First, I estimate the anisotropic clay matrix. This is then used as the host matrix, and quartz, calcite, kerogen, and fluid-filled pores are modeled as inclusions with different aspect ratios. Representation of multiple inhomogeneities with different aspect ratios is non-trivial. Yet, I suggest a solution to the representation difficulty using this new model. The Maxwell homogenization scheme honors the aspect ratio of each inclusion embedded in an effective inclusion domain.

Combined rock physics models have been used to obtain elastic properties of clays and shales. Notwithstanding, there is no consistent method for modeling both. The developed rock physics model and workflow thoroughly handle the estimation of elastic stiffness coefficients of both clays and shales in anisotropic media. This study shows that this rock physics model can be readily applied to other unconventional reservoirs.

Dipole sonic log and core measurements of the Eagle Ford shale field are utilized to constrain the modeling results. I process and interpret dipole sonic logs to obtain elastic stiffness coefficients C33 , C55 and C66 . Subsequently, I use these coefficients to validate theoutcomes of the Maxwell homogenization scheme. To my knowledge, this is one of the first studies that verify the robustness of this rock physics template with field data. After obtaining the elastic stiffness tensor of the Eagle Ford shale in VTI media, I estimate the Thomsen parameters (i.e. anisotropy parameters). Anisotropy parameters ϱ, γ and δ, on average, are 0.19, 0.29 and 0.04, respectively based on my modeling results in Eagle Ford shale. Anisotropic modeling results exhibit a good correlation with dipole sonic logs. Both dipole sonic log analysis and rock physics results demonstrate that clay content is the main driver of anisotropy in the field, and there is a direct relationship between clay volume and anisotropy parameters of ϱ and γ.