Rock Physics and AVO effects in Midale Vuggy and Midale Marly Beds in Williston Basin- a case study

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ABSTRACT

The Mississippian Madison Group Midale Marly and Vuggy Beds in the Williston Basin are studied in regards to the sensitivity of seismic and AVO methods to detecting variations in these carbonate and evaporitic reservoirs. The major lithologic divisioning of the overlying Midale Marly Beds, a dominant dolomitic Marly mudstone with varying lenses of dense carbonate mudstone, to the Midale Vuggy which is an ooid to peloidal mud, wacke to grainstone reservoir is illustrated. This case study is interesting for a variety of reasons. First, the Midale Vuggy Carbonate has very high porosity (28%). Second, the carbonate sequences usually studied are in the vicinity of the Rocky Mountains and this basin is located in the plains of Saskatchewan. Finally, carbonates are usually encountered at depths of 3 000 m or more. In this case, Midale Vuggy carbonate formation is encountered at a depth of about 1500 m.

Seismic exploration in this basin is aimed at finding oil-filled porous carbonates within the Midale and Frobisher formations. Rock physics analysis indicated that it could be difficult distinguishing the Midale Marly and Frobisher carbonates from their encasing carbonates in terms of velocity and impedance. Elastic modulus crossplots, e.g. Lambda*Rho-Mu*Rho, showed that the reservoir and non-reservoir rocks have better separation. However, tuning could influence the seismic response due to the high carbonate velocities and relatively thin layers of Midale Marly and Midale Vuggy Beds. Modelled seismic gathers indicated that the thickness and porosity can have a significant effect on AVO. So AVO analysis was carried out on the data, with the objective of carrying out reservoir analysis. The change in porosity is determined based on the LMR (Lambda-Mu-Rho) analysis on the data. This study can distinguish between limestone, dolomite, anhydrite, fractured and dense from excellent reservoir.