Abstract
The margins of the Tethys contain large carbonate provinces. Many of these carbonates are hydrocarbon reservoirs. Understanding their petrophysical behavior is paramount for successful imaging and subsequent exploitation of these reservoirs. In these carbonates intrinsic and extrinsic factors control the petrophysical architecture of the reservoirs. Extrinsic factors such as climate variability and sea level changes control the sediment composition that together with subsequent diagenesis produces the final rock properties of the carbonates. The combination of porosity and pore type is the most important factor controlling velocity and permeability in carbonates. Consequently, rocks of similar porosity but with different pore types display different velocities and permeabilities. Understanding the influence of various pore types on the elastic properties in carbonates has the potential to relate sonic and porosity logs to permeability.

Pore types in carbonates are the result of cementation/dissolution processes. Depending on the diagenetic process, porosity is either created or reduced. In addition, diagenesis can change the pore structure. For example, a grainstone with interparticle porosity can by dissolution/cementation processes be transformed into a moldic rock with little connected porosity. Cementation transforms the sediment into a rock but the type of cementation is very important to determine the resulting elastic properties. For example, little amounts of meniscus cements are needed to produce a high velocity rock, while larger amounts of fibrous aragonite cement are required to generate a rock with similar velocity. In addition, variable pore types are responsible for deviations from the inverse relationship between total porosity and velocity and the positive relationship between porosity and permeability. In general, isolated pore types, such as moldic and intragranular, result in high velocities and positive deviations from Wyllie's equation while connected pore types as intergranular or intercrystalline produce low velocities and negative deviations.

Because permeability is also highly dependent on pore types, a good correlation exists between velocity deviations and permeability. Assessing and quantifying pore types is difficult from rock properties measurements. Digital image analysis can quantify pore types and relate them to permeability and velocity. Understanding these relationships is a first step for prediction of permeability from sonic and velocity logs and seismic data sets.