ROCK PHYSICS CHARACTERIZATION OF
THF HYDRATE-BEARING SEDIMENT

Marisa B. Rydzy, Michael L. Batzle
Center for Rock Abuse, Department of Geophysics
Colorado School of Mines
Golden, Colorado
USA

ABSTRACT
The applicability of THF hydrate as a proxy for methane hydrate has often been questioned. To better understand how hydrate distribution and location in the pore space impact the physical properties of the THF hydrate-bearing sample ultrasonic velocity measurements were performed on THF-hydrate-bearing sandpacks in conjunction with imaging techniques such as Micro-X-Ray Computed Tomography (MXCT) and Magnetic Resonance Imaging (MRI). THF-H₂O solution was injected into sandpacks comprised of Ottawa Sand F110. The saturated sample was then subjected to a freezing-thawing cycle. P- and S-wave velocities were recorded continuously throughout the entire experiment. MRI images were recorded during the dissociation process and the hydrate saturation was determined based the average MRI intensity. The relationship between measured ultrasonic velocities and the THF hydrate saturation agreed reasonably well with the model predictions for non-cementing hydrate. Location and distribution of the THF hydrate in the sand was characterized using MXCT, a micro-scale imaging technique that only recently began to be utilized in characterizing hydrate-bearing porous media. To enhance the density contrast between water and the THF hydrate, 10 wt% BaCl₂ had to be added to the THF-H₂O solution, which suppressed the melting point of ice and dissociation temperature of the THF hydrate by ~10.5°C. The MXCT images showed that THF hydrates formed in the center of the pore space and were distributed homogenously throughout the sample.

Keywords: hydrate-bearing sediment, ultrasonic velocities, imaging

INTRODUCTION
The use of tetrahydrofuran (C₄H₈O or THF) as a hydrate former in laboratory experiments is convenient as it forms hydrate at atmospheric pressure and relatively high temperatures around 4°C. It is completely miscible in water, thus forms hydrate out solution and promises homogeneous synthesis of THF hydrate in sediment [1]. The composition of THF-H₂O mixture thereby controls the hydrate volume fraction as well as the hydrate stability conditions (Figure 1). A mixture containing 19 wt% of THF and 81 wt% H₂O yields a hydrate saturation of 100%. Increasing either the THF or H₂O content will cause hydrate formation to occur in the presence of excess THF or H₂O, respectively, as well as a depression of the hydrate formation temperature. Consequently, hydrate saturations lower than about 40% cannot be achieved without ice formation.

A handful of studies on elastic properties of hydrated sediments have been conducted on sediments containing THF hydrates. Early experiments were performed on THF hydrate-bearing consolidated sediments such as Berea sandstone [2] or synthetic rock samples [3],