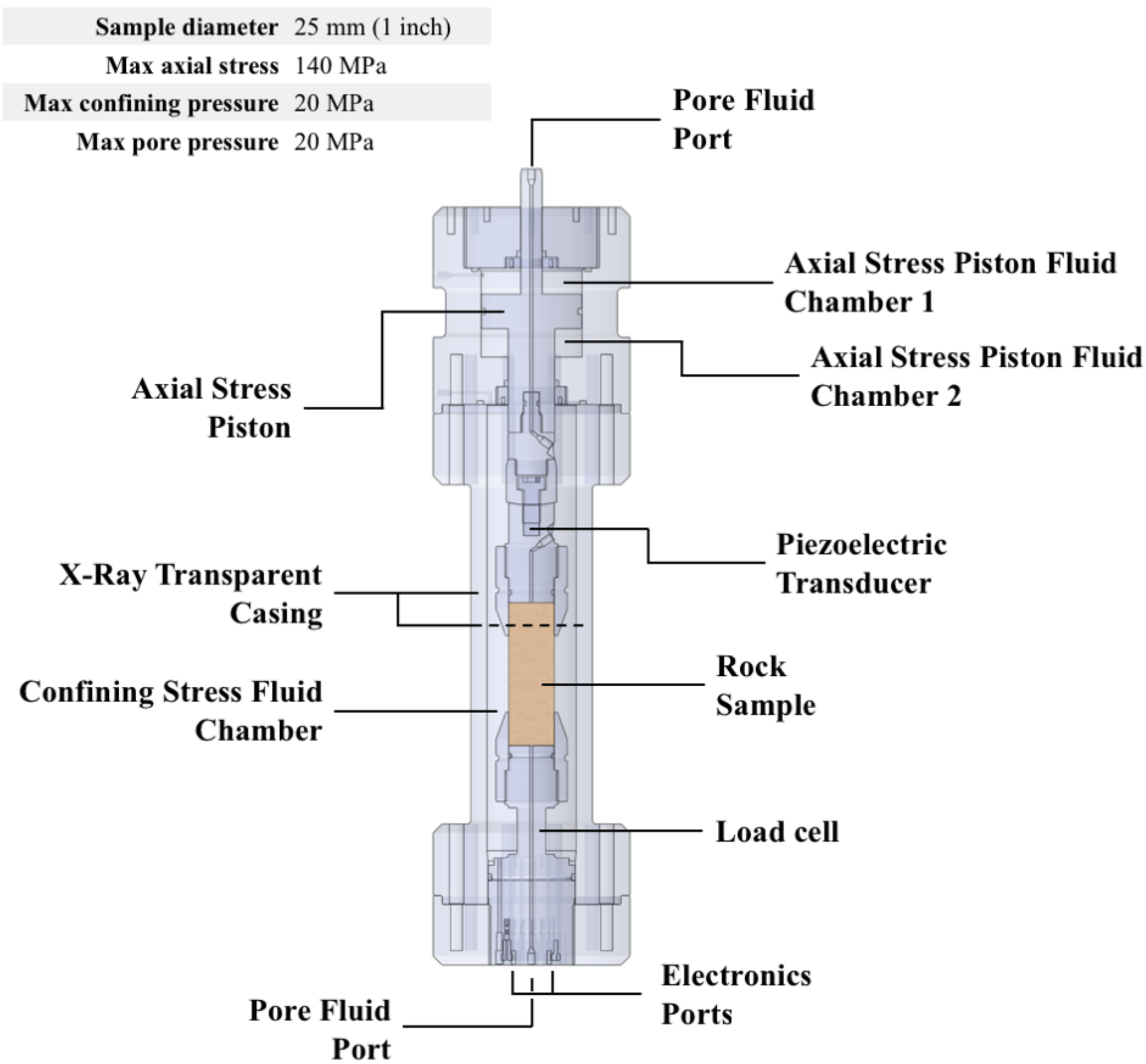
RESEARCH OUTLOOK: USING A NEW X-RAY TRANSPARENT TRI-AXIAL PRESSURE VESSEL FOR ROCK DEFORMATION STUDIES

Omar Alamoudi, Nicola Tisato

ABSTRACT

We are presenting the design of a new x-ray transparent tri-axial pressure vessel (XTTPV). We will be using it to conduct tri-axial experiments while simultaneously acquiring 3D x-ray microCT images of different rock samples. The standard rock sample that will be used is cylindrical in shape with 25 mm (1 inch) diameter, and a minimum length-to-diameter ratio of 2. The XTTPV allows us to impose axial stress about 150 MPa. The maximum pore pressure is 20MPa. The XTTPV also has embedded piezoelectric transducers that will be used to measure P and S wave velocities under different stress conditions. The first question that we would like to address is the change of shale permeability with increasing damage.

Considering the typical differential stress ($\sigma_1 - \sigma_3$) vs axial strain (ε_1) curve, we postulate that the permeability would first decrease or show no significant change within the linear elastic regime, it would then increase abruptly somewhere between the yield and fracture stress of the sample. Conducting this experiment while simultaneously acquiring 3D x-ray microCT images and acoustic emissions would allow us to observe the evolution of the fracture networks that causes the increase in permeability. This will provide insights on the evolution of hydraulic permeability in unconventional plays. Additional experiments could include the observation of millimeter-scale fracture healing to help understand hydrocarbon production from shales.



Sample diameter	25 mm (1 inch)
Max axial stress	140 MPa
Max confining pressure	20 MPa
Max pore pressure	20 MPa

A schematic of the x-ray transparent tri-axial pressure vessel (XTTPV). The XTTPV is composed of, from bottom to top, a rigid base with an embedded load cell, fluid ports that control the pore pressure through the bottom end of the rock sample, and electronic wiring ports, an aluminum (7075-T6) vessel that surrounds the fluids providing the confining pressure on the rock sample that is 1 inch in diameter, and at least 2 inch in length, a piston that provides the axial stress within which a piezoelectric transducer is mounted, and a fluid port that controls the pore pressure through the upper end of the rock sample.