Laboratory velocity analyses of sandstone core from the Blackfoot field, Alberta

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ABSTRACT

This short note describes elastic velocity experiments in progress, on core from the Blackfoot field, under overburden pressure, at the University of Calgary . We have built an ultrasonic measurement system in conjunction with the Porous Media Laboratory at the University of Calgary. Future experiments include both P and S as a function of differential pressure.

INTRODUCTION

The object of the experiment is to measure core velocities as a function of differential pressure. Both compressional wave and shear waves velocities were measured. The core is from the 08-08-23-23w4 well, which is in the Blackfoot Field,. The first core tested was from the reservoir level, and is a lower cretaceous glauconite sandstone.

METHODS

The experiment was conducted at the Porous Media Laboratory at the University of Calgary. A pressure vessel that can exert an over burden pressure of 2700 psi was used. A constant flow rate of a brine solution in the core was maintained at 100 psi throughout the experiment. The overburden pressure was increased in increments of 100 psi p to 1100 psi. The recording instrument used for the experiment was the Crewes physical modeling system, minus the motor drive units.

The core was placed in the pressure vessel between two stainless steel heads. (Figure 1) The heads are ported to accommodate the three high pressure lines; one for overburden pressure, one for inside pressure and one for fluid in and out. The heads were also modified with a seat in the center to accommodate our piezeoelectric transducers. The transducers emit a pulse with a center frequency of 300 kHz.

A calibration block made of 3.5 inch aluminum rod was used to test the system. Both P-wave and S-wave were transmitted through the aluminum in a transmission experiment. The inside pressure was maintained at 100 psi as the pressure was increased up to 2000 psi. The records from this test showed no change in velocity for the P-waves or S-waves sound transmission in the aluminum calibration block.

A glauconite sandstone core from the 08-08 well was tested in the pressure vessel in a P-wave configuration. The internal pressure was maintained at 100 psi and the overburden pressure was increased in steps of 100 psi up to 1100 psi. The transmission records show a slight increase in P-wave velocity as pressure is increased, a difference of approximately 75 meters/second. The velocity measured at 1000 psi differential pressure is 3546 m/s.

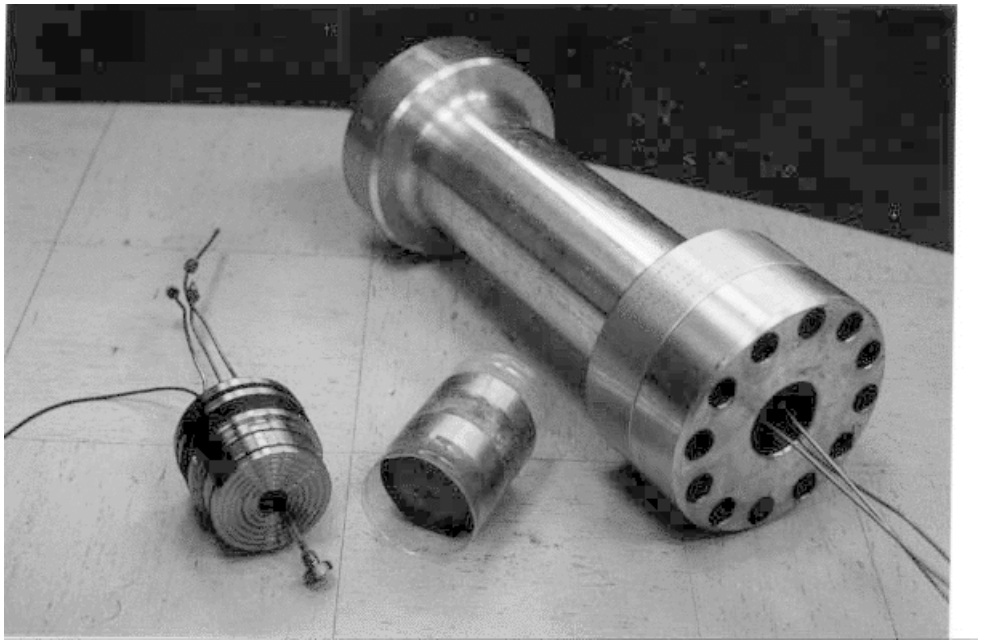

Fig. 1 The above photo shows the pressure vessel, (on the right), the sandstone core incased in plastic (center) and the stainless steel head (left). The transducer is also visible hanging out of the head.

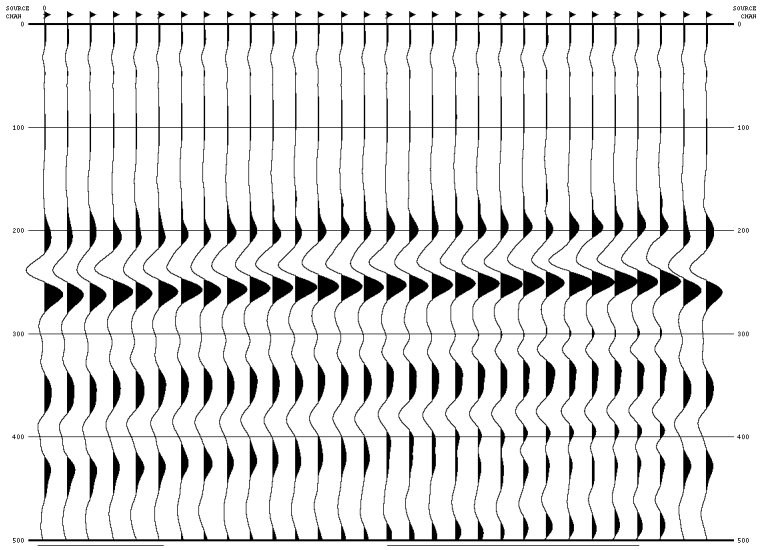

Fig 2: P-P survey of the sandstone core showing increase in velocity as overburden pressure is increased. The traces on the left of the plot start at 100 psi and increase in steps of 100 psi (up to 1100psi) moving to the right. The last 2 traces have the overburden pressure removed.

For future work we will do more tests, both P-wave and S-wave velocities and increase the overburden pressure to insitu pressures of about 2500 psi.

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