**Dynamic Measurements of the**

**Mechanical Properties of Rocks**

Geophysics 457

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**Purpose:**

The purpose of this experiment is to make direct measurements of the velocity of compressional and shear waves. This is done for various samples, and from them we can calculate elastic constants. This experiment also examines the effects of varying confining pressures on seismic waveforms and the elastic constants themselves.

**Materials:**

- Olympus 5077PR Ultrasonic Transmitter and Receiver

- Tektronix DPO3014 Digital oscilloscope

- Hydraulic press

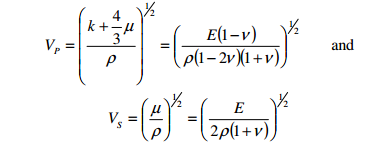
- High accuracy 24 bit A/D data acquisition converter

- LoadVue acquisition

- Mass scale

- Calipers

**Relevant Formulae:**



**Procedure:**

\*Refer to lab manual

**Analysis:**

1. and 2. are on excel spreadsheet.

3. Graph on excel. Some of the trends we can see on the graphs is that generally as axial stress increases, the P wave and S wave velocity stay relatively linear. Obviously the S wave plot is lower than the P wave plot, because P wave velocity is always higher than S wave.

4. On excel.

5. For the belly river sample specifically, as we increases the load stress, the P wave velocity began to increase as well. The S wave velocity stayed relatively the same. For the Bereta sample similar pattern was observed for the S wave form, and P wave exhibited that a little bit as well.

As for direct relationships between the elastic constants, we know that μ depends entirely on S wave velocity. If S wave velocity goes up, so does that.

k is larger if P wave velocity is large, and smaller when μ is large.

E depends on S wave velocity and v, if those two are large, it is also large.

6. N/A since we did not use perpendicular fiber sample.

7. The only sample that was the same from last lab was the belly river. From looking at last labs values, they do not match at all with this labs. All the elastic constants are quite off, along with the P and S wave velocities. I feel like this lab values are more on the correct side because they match more closely with the textbook/literature values, as we can see in the table down below.

**Lab 04**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| P wave velocity (m/s) | S wave Velocity (m/s) | P wave stress (Pa) | S wave stress (Pa) | μ | k | λ | v | E |
| 3885.47486 | 2897.916667 | 589954.2812 | 483572.9387 | 22606783455 | 10497762099 | -4573426870 | -0.1268 | 39480276469 |
| 3896.358543 | 2897.916667 | 760874.7357 | 663971.9873 | 22606783455 | 10725756828 | -4345432142 | -0.11898 | 39834105019 |
| 3907.303371 | 2897.916667 | 941038.5835 | 930454.5455 | 22606783455 | 10955675557 | -4115513413 | -0.11128 | 40182083387 |
| 3907.303371 | 2897.916667 | 1124801.004 | 1124730.444 | 22606783455 | 10955675557 | -4115513413 | -0.11128 | 40182083387 |
| 3918.309859 | 2897.916667 | 1305364.693 | 1380628.964 | 22606783455 | 11187539997 | -3883648973 | -0.10371 | 40524351467 |

**Lab 03**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | E (N/m2) | v | P (kg/m^3) | k  (MPa) | µ  (MPa) | λ  (MPa) | Vp  (m/s) | Vs  (m/s) |
| Bellyriver  Sandstone | 6.324 E9 | 0.3994 | 2628 | 2873 | 2260 | 1366 | 1497 | 927 |

**Literature/Textbook Values**

