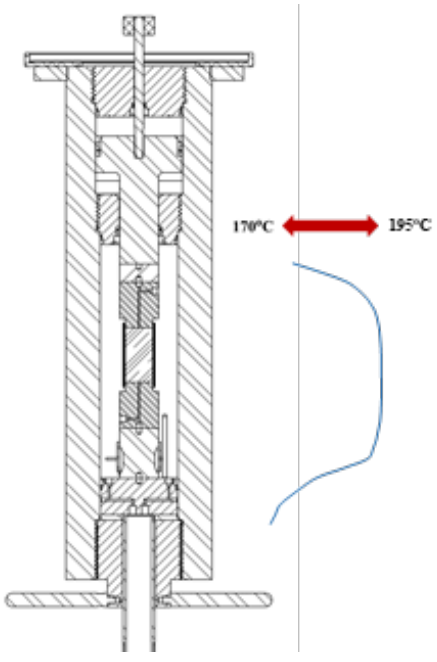
Laboratory Systems: High Temperature AutoLab

High Temperature High Pressure AutoLab

There is growing interest in expanding the temperature range of test platforms to simulate in situ conditions at greater depths in the crust. Temperatures to 300°C, and pressures to 200 MPa and above, are required to support research in geothermal energy, earthquake mechanisms at mid crustal depths, rock fluid interactions. To satisfy these requirements, NER has adapted its triaxial AutoLab Series and velocity, permeability, and deformation options to function at these conditions.

New England Research, Inc. (NER) offers a range of laboratory systems to measure elastic, electrical, and flow properties measured at in situ conditions, for specific applications and over complex loading trajectories at reservoir pore pressures, confining pressures, and temperatures. NER's systems are the result of years of experience performing rock properties measurements. Progressive improvements in technique, analysis software, and hardware are incorporated into the design of each unit. Since each product we offer is used at NER, qualified technical support is constantly available.

A distinguishing feature NER's AutoLab triaxial series is the design. The AutoLab uses high pressure servo hydraulic intensifiers to control the axial load (or axial displacement) and confining pressure in a pressure vessel divided into two coaxial chambers as illustrated in the schematic below. An instrumented sample is sealed in the lower chamber which is independently pressurized to simulate the overburden (confining pressure). High pressure fluid is injected into the space between the top closure nut and the top of the piston to generate force on the sample assembly. A sealing bushing divides the upper and lower chambers and guides the axial loading piston. A temperature profile through the axis if the vessel is shown in the schematic.



Key Features

- Deformation experiments for conventional and specialized loading paths
- Servo-hydraulic control of strain rate, force, confining pressure, pore pressure and flow rate
- Combined external and internal heaters to generate temperatures of 300°C
- Pore pressure intensifiers compatible with water, brine, oil, gas (including CO2)
- AutoLab software for system control and data

acquisition

- Control of pressures and temperature at reservoir conditions
- Velocity transducers for compressional and torsional shear velocities
- Steady state permeability (with water, brine, oil, gas including CO2) between 0.1 millidarcies to 500 millidarcies
- Low Permeability (0.01 microdarcies to 50 microdarcies)
- Electrical resistivity (formation factor)

With the incorporation of proprietary internal heaters, the temperature rating of the AutoLab triaxial systems is increased to 300oC at a confining pressure of 200 MPa. Increasing the temperature rating necessitated a design modification of the velocity transducers as well as changing the bore length and diameter to accommodate sample dimensions specified by the customer.

Typical waveforms measured at 195oC with NER's PS2 transducers are shown below on the left. In contrast, the high temperature waveforms for a shale at 270oC are shown on the right. They have longer wave train and different coda. In order to keep the piezoelectric crystals at a temperature below the Curie temperature, signals are propagated through long wave guides positioned on each end of the sample. The travel time is much longer and the P wave is more emergent than for the standard transducer. The torsional wave is non-dispersive, so the first arrival is much more easily observed. Numerical models were developed to aid in the transducer design, to predict the shape of the waveforms, and to predict the first arrivals.

Not all the standard measurement options are supported at temperatures above 150°C.