

HT-HP experiments in supercritical conditions

Benoît Gibert, Université Montpellier 2



Objectives of HITI (WP3):

Electrical resistivity : a tool to evaluate the reservoir properties: it depends on porosity, pore space topology, fractures

But:

- *Depend also on rock alteration and fluid nature*
- > *Calibration needed in supercritical conditions (high ionic charge of fluid and minerals alteration)*

>Adaptation of the Montpellier Paterson press (deformation apparatus up to 3000 bars -1300°C) to measure the electrical resistivity of rocks in supercritical conditions.

Electrical resistivity of
basalts in SC conditions



PhD Student

HITI (WP3)

*Thermal transport at HT-
HP+fluids and supercritical
conditions (B. Gibert)*

*Rheology of rocks
at HT-HP+fluids*

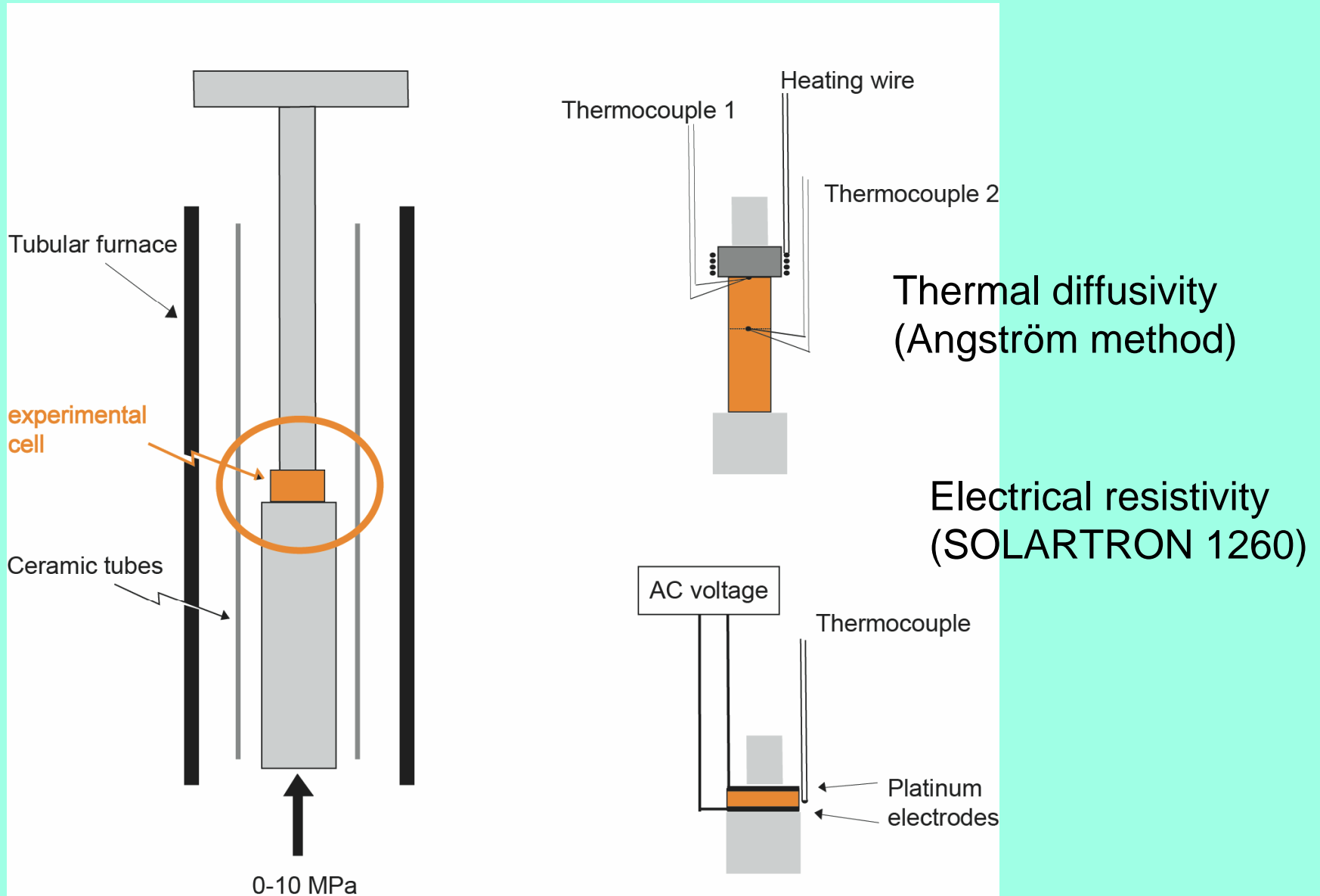
(D. Mainprice)

*Chemistry of fluids,
dissolution processes,
hydrothermalism
(D. Bosch)*

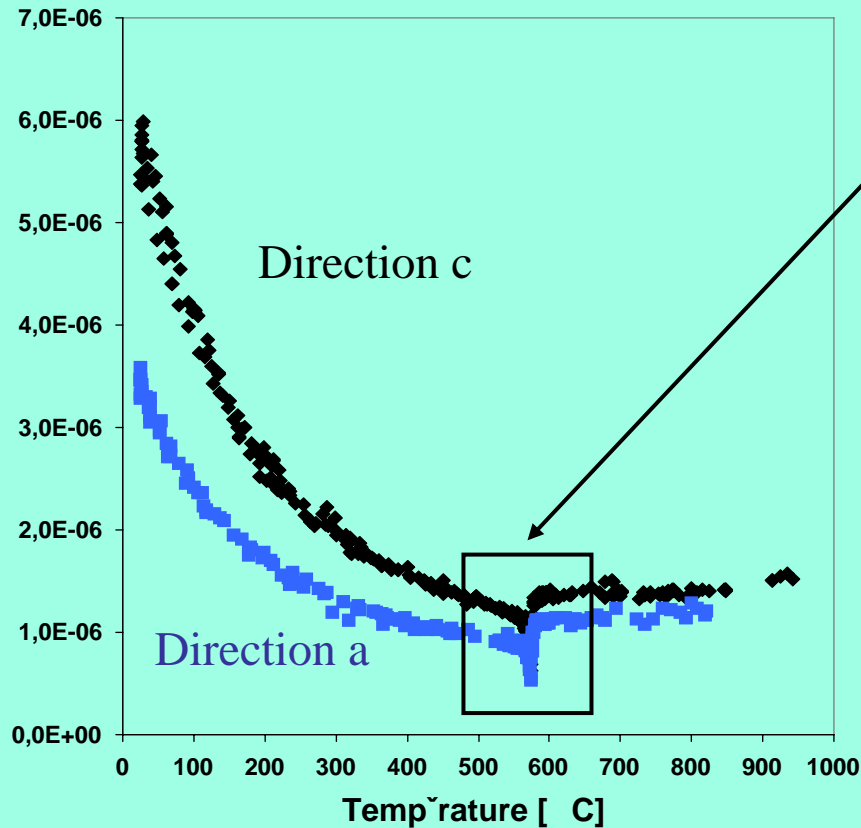
Experimental facilities at GM Montpellier

- HT-HP Paterson press (3000 bars -1300°C - fluid pressure)
- 1 atm furnace , $T > 1000^{\circ}\text{C}$
 - Electrical conductivity
 - Thermal diffusivity
- Acoustic velocities (Hoek cell - room T-1000bars)
- Permeability cell (room T-1000 bars)
- Electrical resistivity cell for saturated rocks (room T - 10bars).

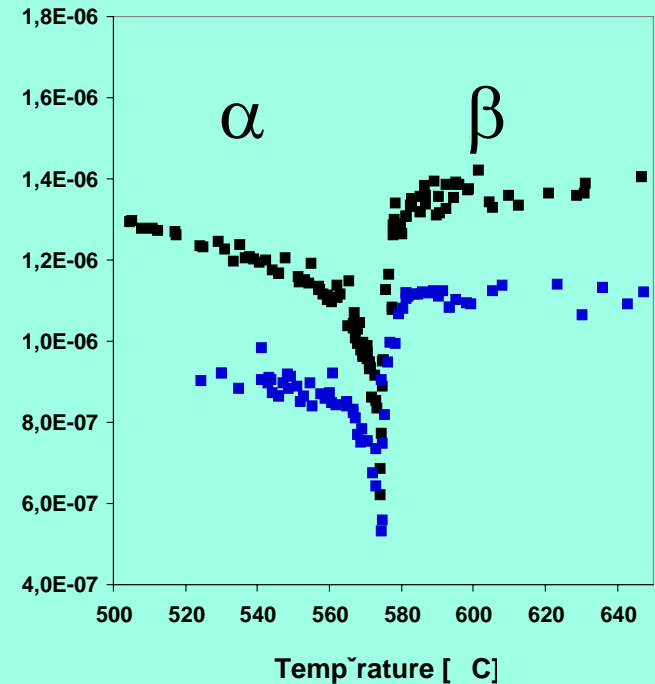
1 atm - HT experiments



Thermal diffusivity of quartz

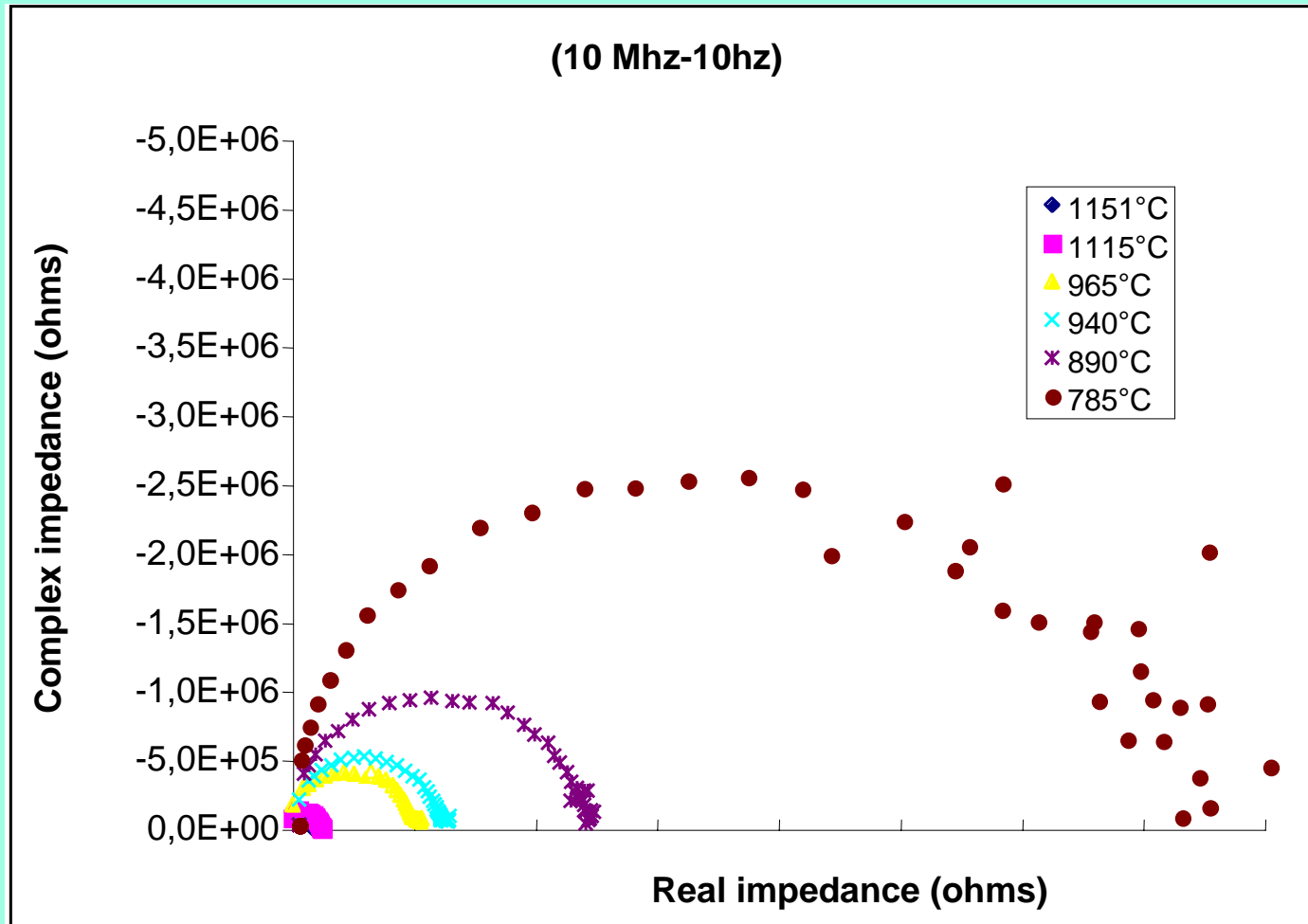


α - β transition at 573°C



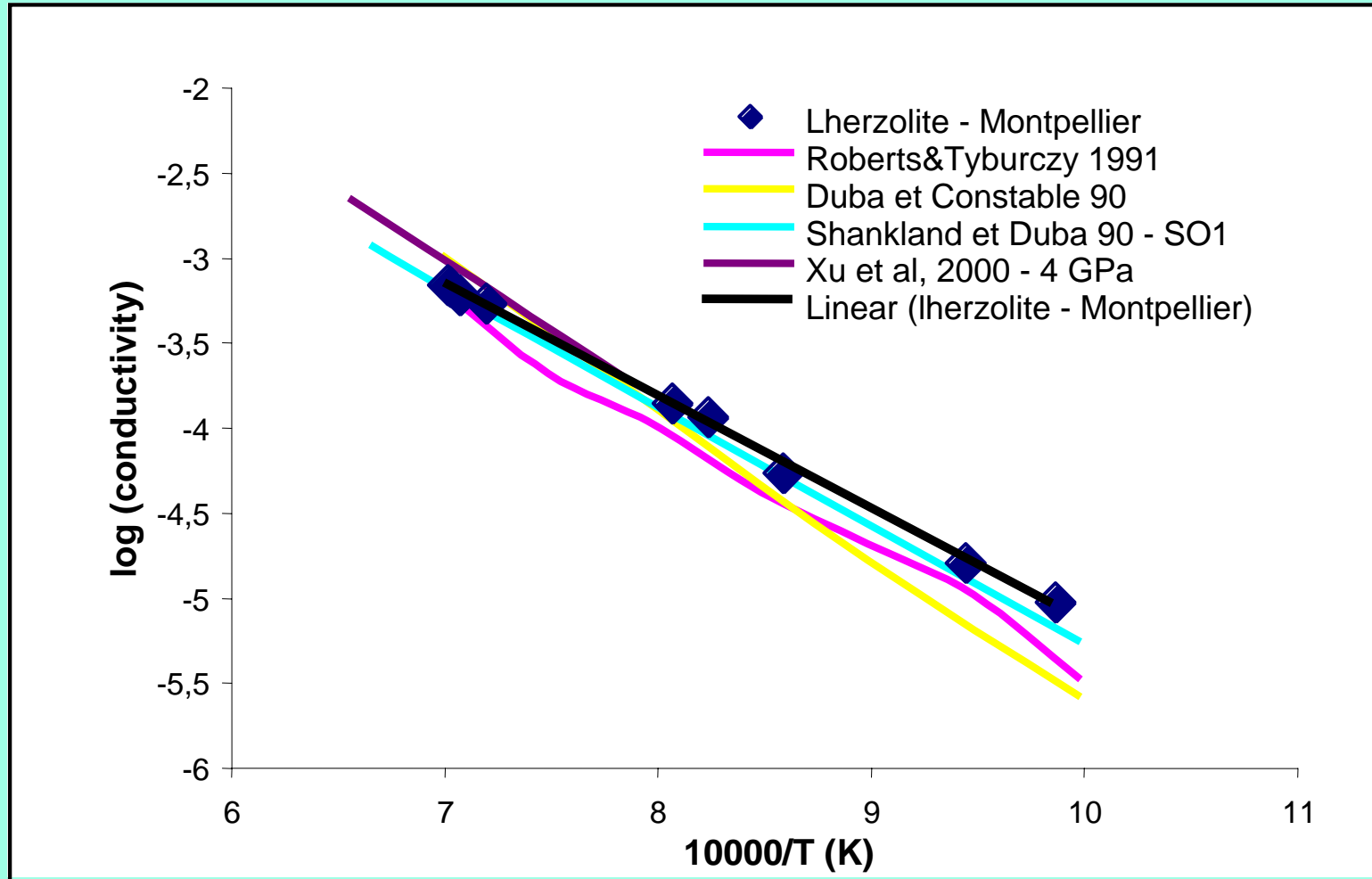
Analogy with water near the critical point : infinite heat capacity, low thermal diffusivity + piston effect (Masuda et al, 2002)

Impedance spectroscopy on a lherzolite (10MHz -10 HZ)



*Effect of hydrogen on electrical resistivity in olivine and pyroxens
(CNRS funding)*

Electrical resistivity of a Iherzolite



*Effect of hydrogen on electrical resistivity in olivine and pyroxens
(CNRS funding)*

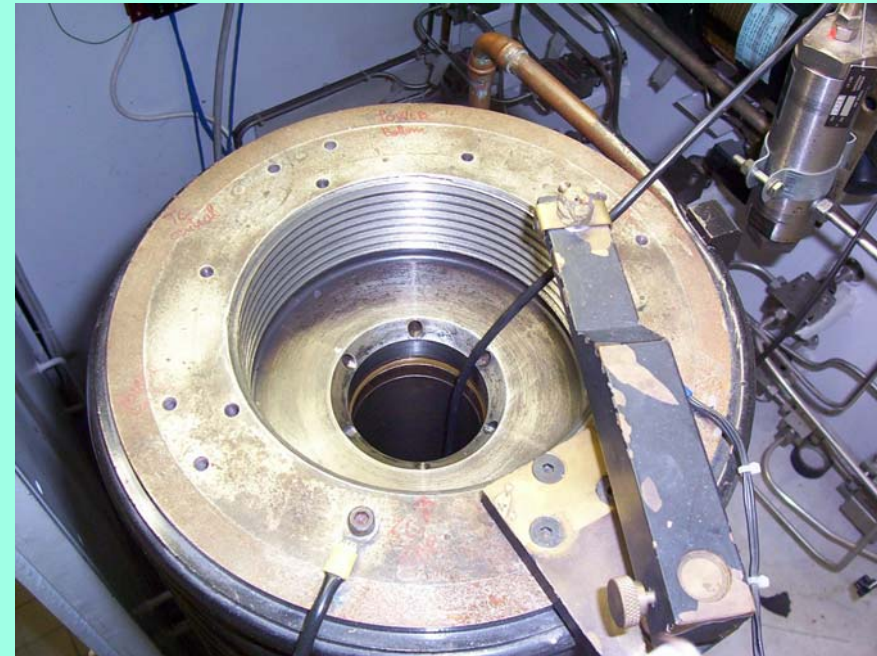
The Paterson press

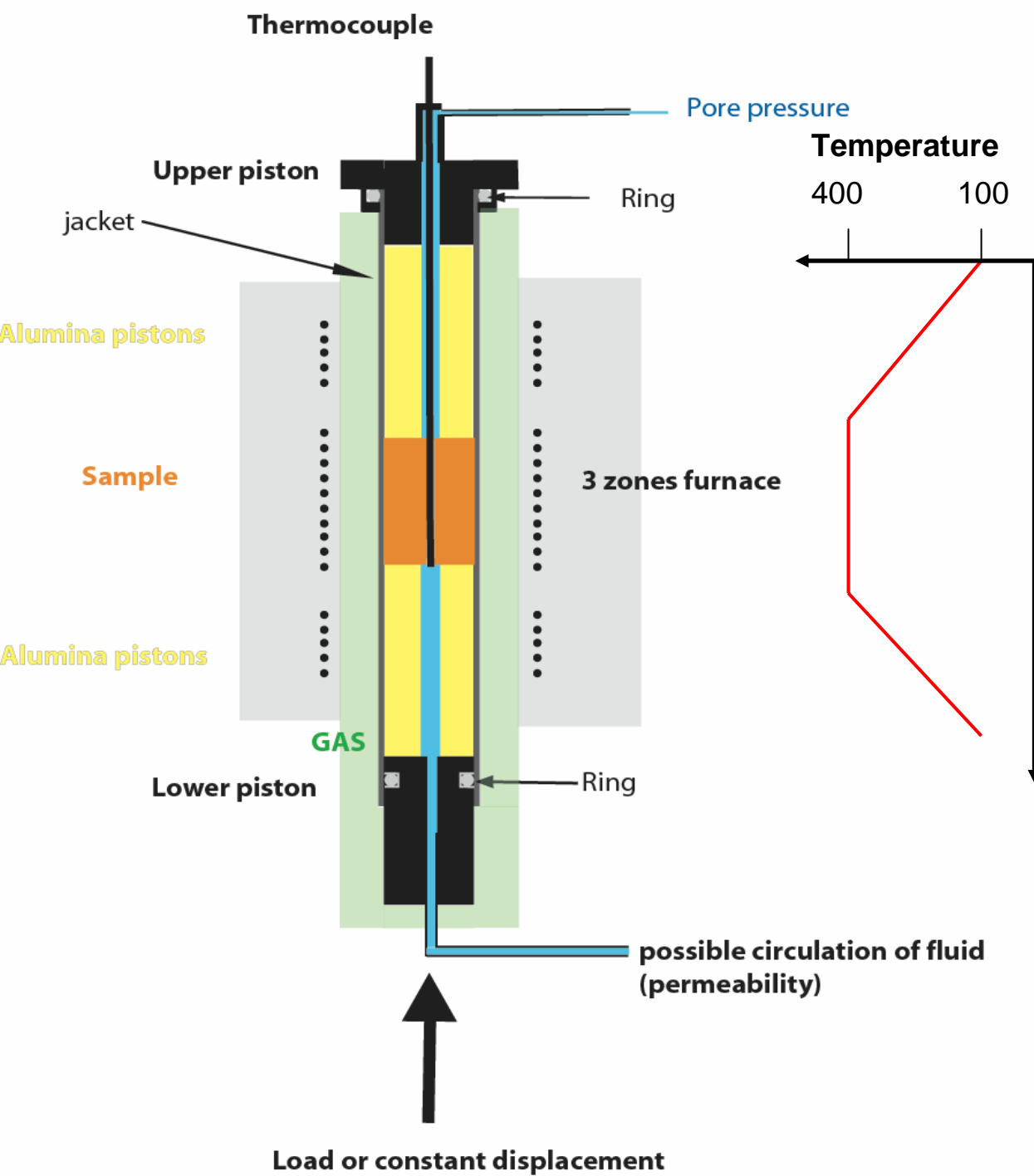
- Gas pressure apparatus: isotropic pressure
- Large samples: up to 15 mm in diam. and 30 mm in length
- 3 zones furnace: very low thermal gradient (<3°C over 30 mm).
- Deformation in compression or extension with a resolution of about 2 Mpa, up to 1 Gpa.
- **Possibility to adapt a pore fluid system**
- **Possibility to measure physical properties (possibility to introduce wires in the HP cell (thermocouples, electrodes...))**



The Paterson Press

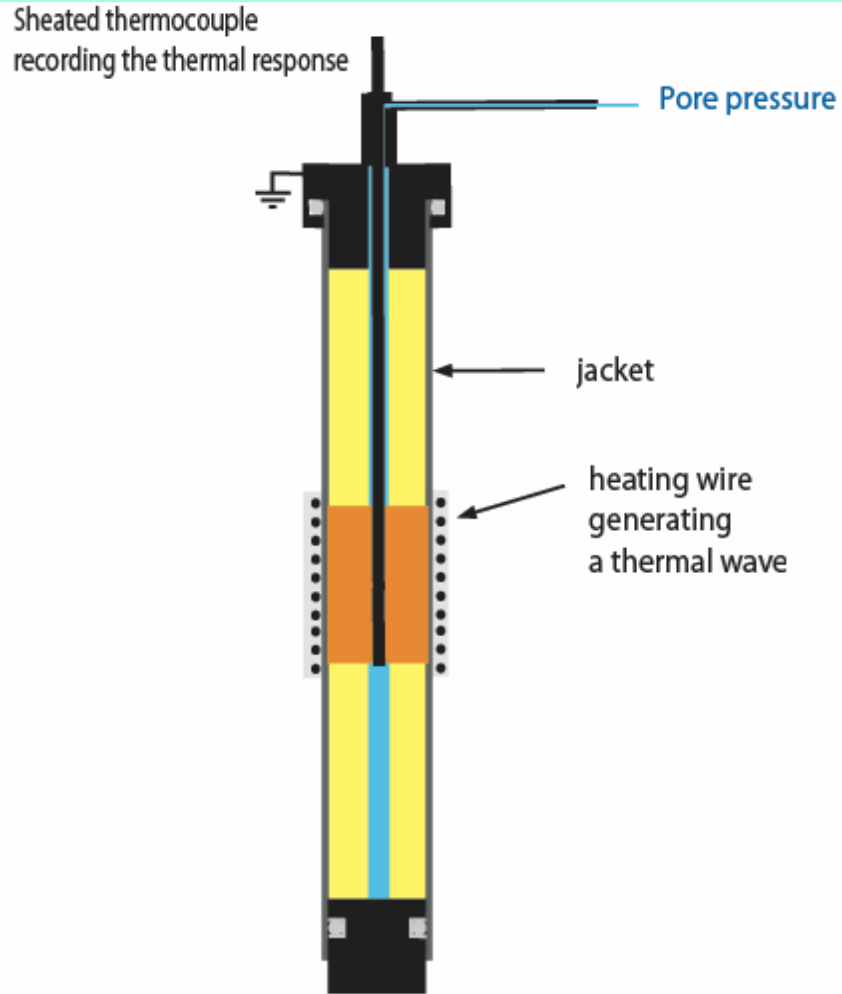
The large
volume
pressure
vessel



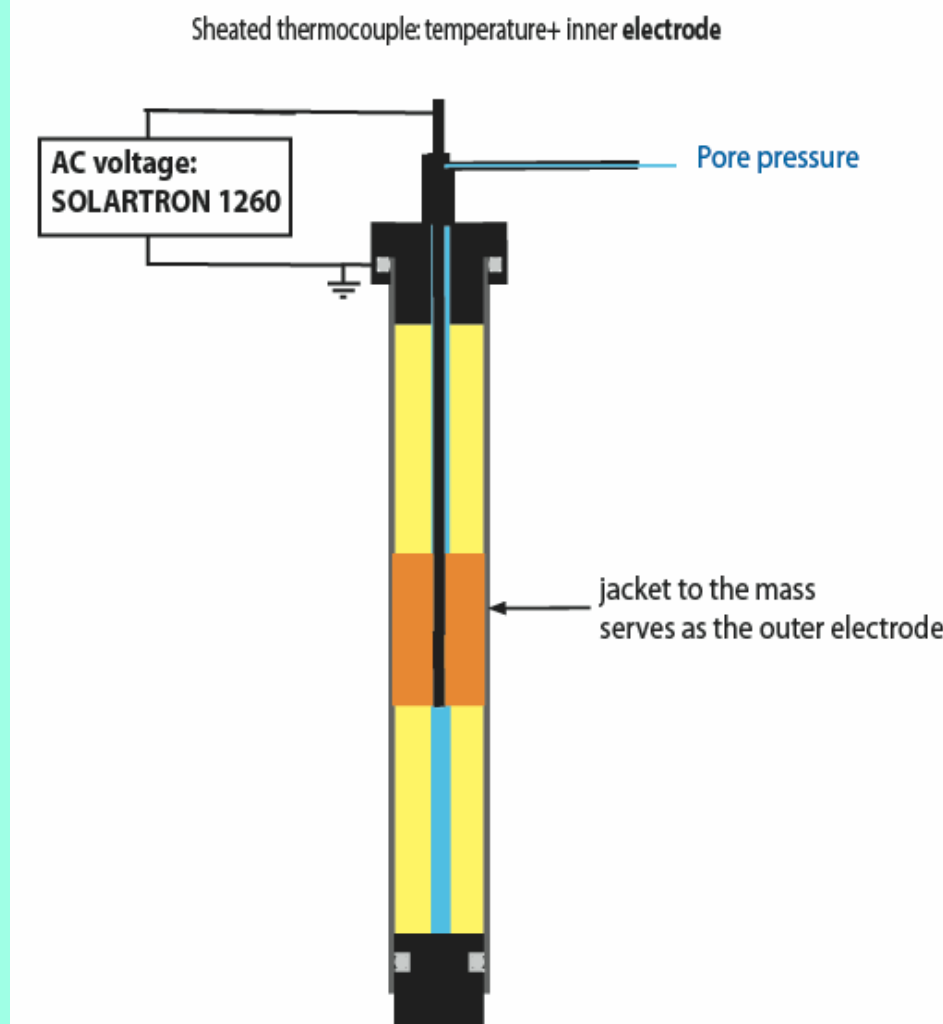


Effect of SCW
 (high ionic charge):
 dissolution of iron
 jacket, effect on
 pumps, on
 thermocouples... ?

Thermal diffusivity



Electrical conductivity



Experiments at 1 atm: sample characterization and rock (dry) contribution to physical properties (2007)

- Porosity/Electrical resistivity of basalts under saturation/ permeability (**PhD student**)
- 1 bar - HT (20-1000°C)/dry conditions
 - Electrical resistivity of basalts (altered or not) at high temperature (**PhD Student**)
 - *Thermal diffusivity of basalts (B. Gibert)*

Experiments at HT-HP (2007)

- *Rheology: deformation experiments to investigate the brittle-ductile transition in basalts (up to 150 MPa (5 km) and 600°C) (B. Gibert, D. Mainprice)*
- *Previous experiments (electrical resistivity, thermal diffusivity): calibration of the experimental set-up at high pressure (B. Gibert)*

Experiments at HP-HT-Fluids

- Develloperment of pore fluid system (**PhD Student**) (2007-2008)
- First experiments will be dedicated to fluid-rock interactions using geochemical tracers (isotopes, major and trace elements...) by sampling the fluid during experiments (in coll. with **D. Bosch** + analytical facilities of GM Montpellier)
- Measurements of physical properties (electrical, thermal, rheology)

