* Electric transport in different granitic rocks

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Outline

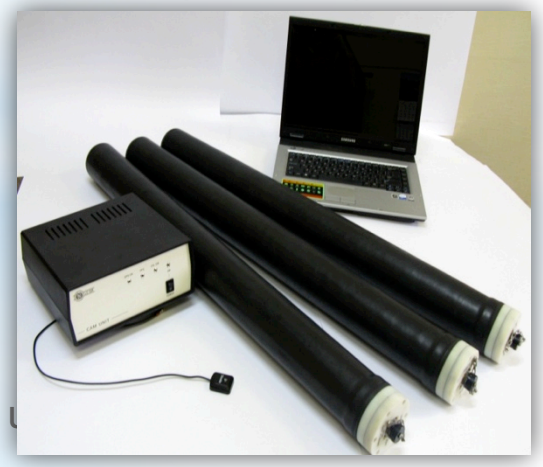
1. Project
2. Samples
3. Samples preparation
4. Measurements:
    - 4.1. Impedance spectroscopy (ε-*f*)
    - 4.2. I-V characteristics
5. Conclusions and future work

Our project

Atmospheric electric field sensor.

Radio receiver for very low and low frequencies.

Magnetometers for ultra-low frequencies (planned).



Meter of atmospheric Radon levels (in installation).

Our project

Nat. Hazards Earth Syst. Sci., 11, 987–991, 2011
www.nat-hazards-earth-syst-sci.net/11/987/2011/
doi:10.5194/nhess-11-987-2011

Atmospheric electrical field decrease during the $M = 4.1$ Sousel earthquake (Portugal)

H. G. Silva[1], M. Bezzeghoud[1], A. H. Reis[1], R. N. Rosa[1], M. Tlemçani[1], A. A. Araújo[1], C. Serrano[1], J. F. Borges[1], B. Caldeira[1], and P. F. Biagi[2]

Natural Hazards and Earth System Sciences

Nat. Hazards Earth Syst. Sci., 11, 241–248, 2011
www.nat-hazards-earth-syst-sci.net/11/241/2011/
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Seismo-electromagnetic phenomena in the western part of the Eurasia-Nubia plate boundary

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Nat. Hazards Earth Syst. Sci., 11, 333–341, 2011
www.nat-hazards-earth-syst-sci.net/11/333/2011/
doi:10.5194/nhess-11-333-2011

The European VLF/LF radio network to search for earthquake precursors: setting up and natural/man-made disturbances

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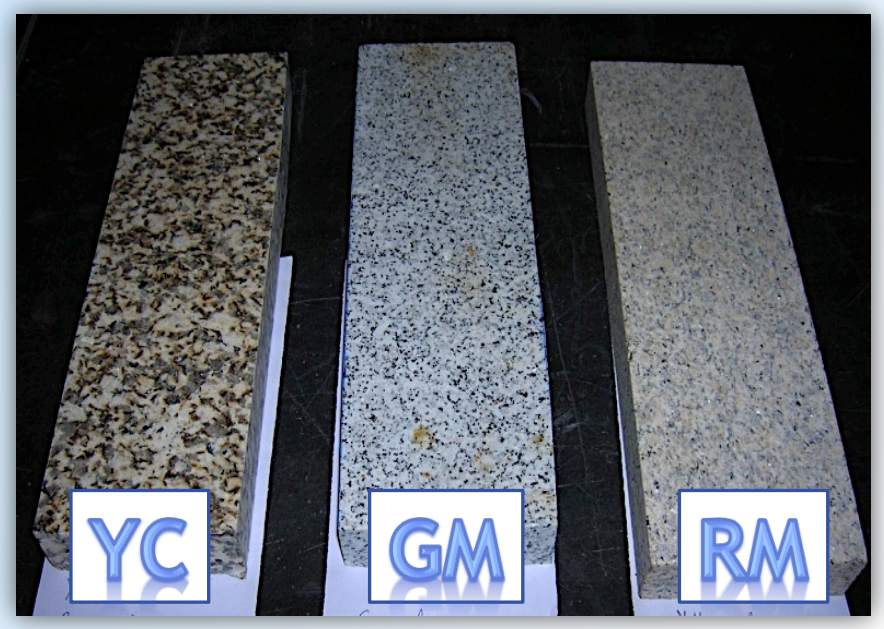
*Samples



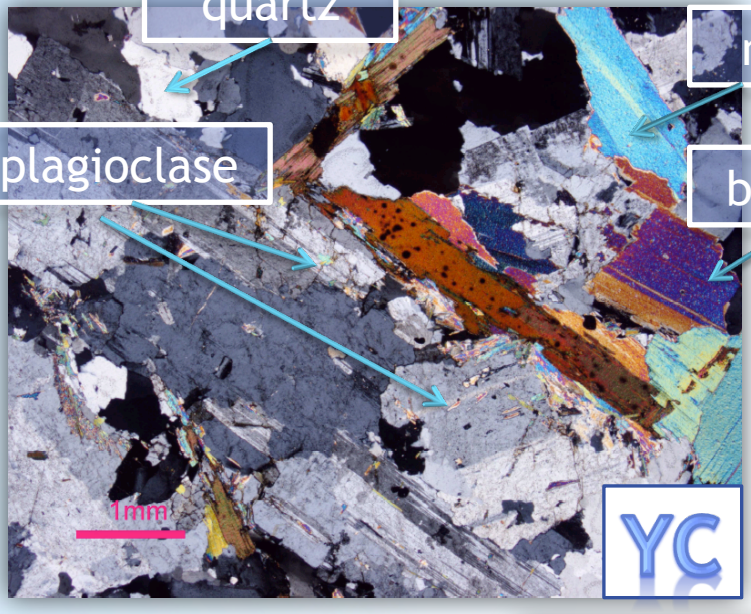
YC is a porphiritic coarse grained biotitic-muscovitic granite, yellow coloured and characterized by an abundance of large feldspar usually showing poorly defined shapes.

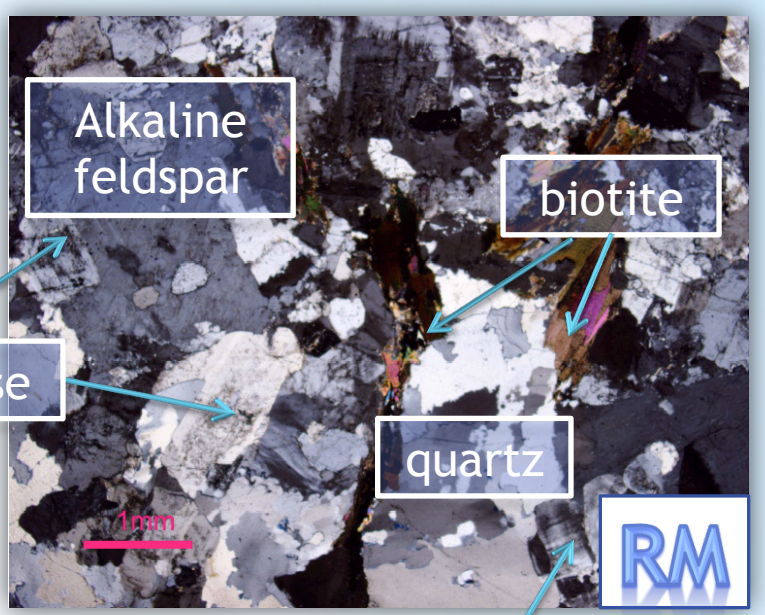
GM is a granodiorite grey coloured and medium grained rock with homogeneous appearance. Dark minerals is mainly biotite.

RM is a granite with a homogeneous medium grained matrix (occasionally coarser grained quartz) and light rosy coloured determined by the tonality of the feldspar crystals that stand out from a greyish matrix.

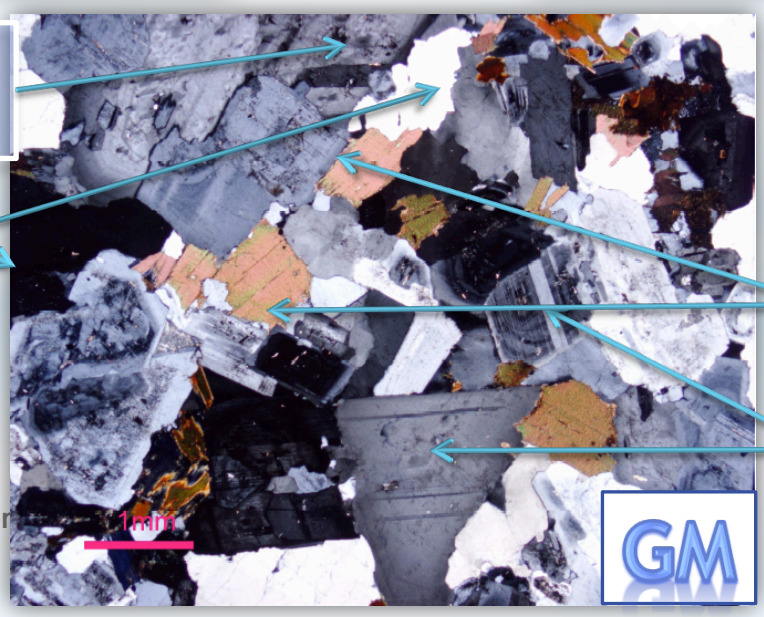
Samples

Samples microphotographs



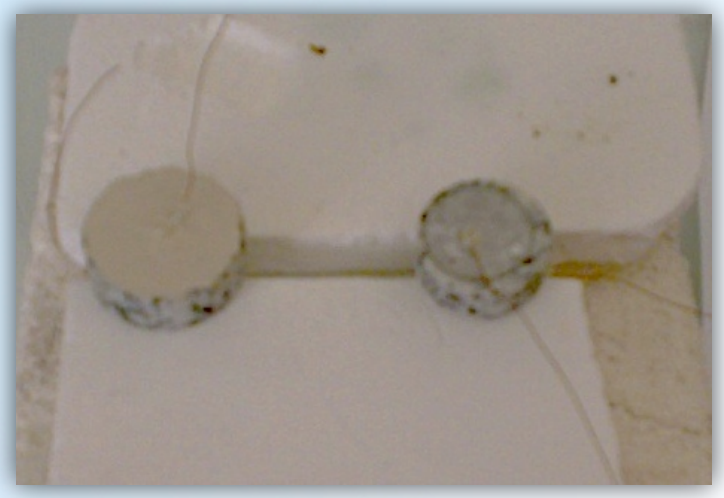


Alkaline feldspar



Alkaline feldspar

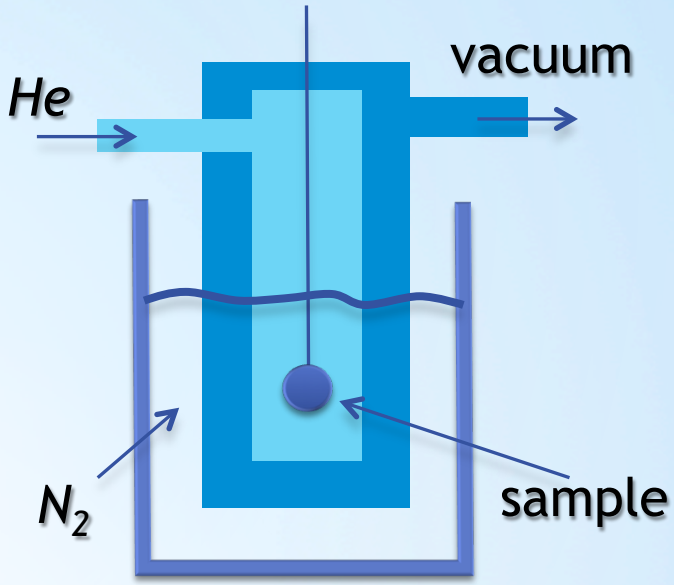
Samples preparation



Circular samples with approximately 24 mm diameter and 2-4 mm in thicknesses were prepared. Once cut and carefully polished (with a 15µm polishing disc) the samples here heated from room-temperature (RT) up to ~400 K and after cooled down again.

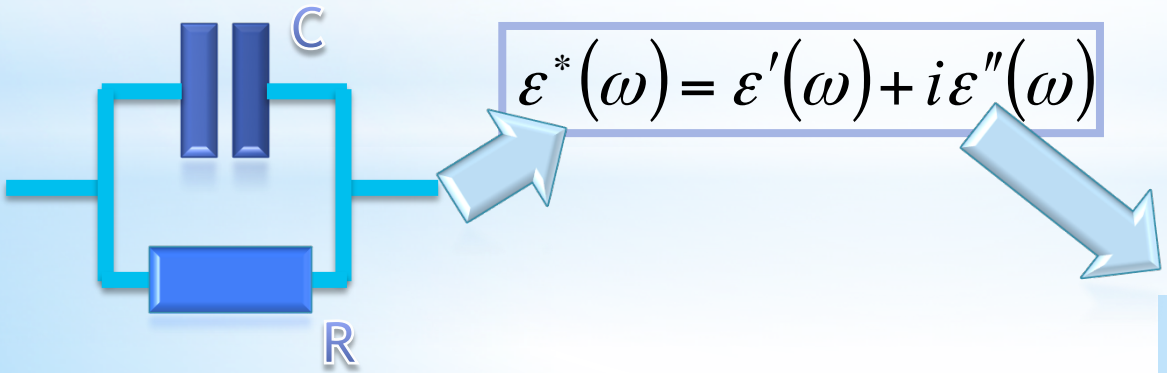
Circular electrodes with a diameter of 20 mm were then established using silver conductive paint (in the future, new contacts will be tested). The samples were submitted again to a heat treatment at ~400 K to evaporate the silver paint solvent.

Measurements



Current-Voltage characteristics (I-V): were done at stabilized temperatures ranging from 100 K to 300 K using a Keitheley 6487 Picoammeter/Voltage Source.

Impedance spectroscopy (ε-*f*): were done with V_{AC} = 1 V test signal in the frequency range of 40 Hz to 1 MHz at stabilized temperatures ranging from 100 K to 360 K. It was used an Agilent 4294A Precision Impedance Analyzer.



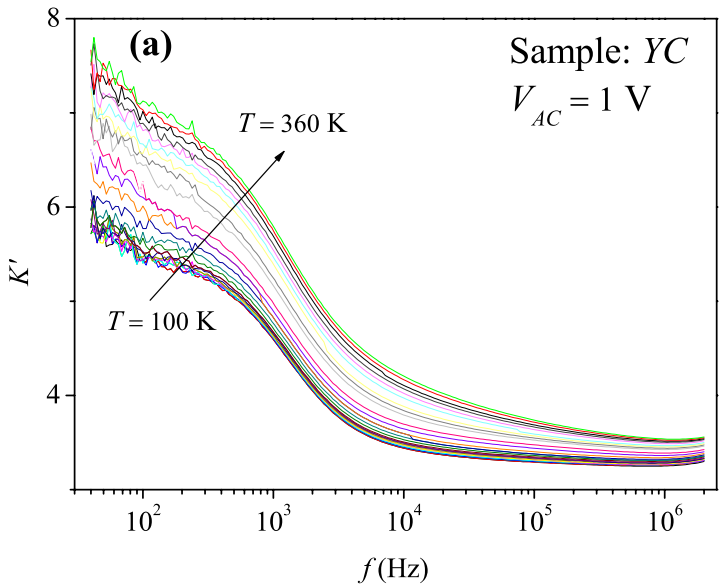
$$\varepsilon^*(\omega) = \varepsilon'(\omega) + i\varepsilon''(\omega)$$

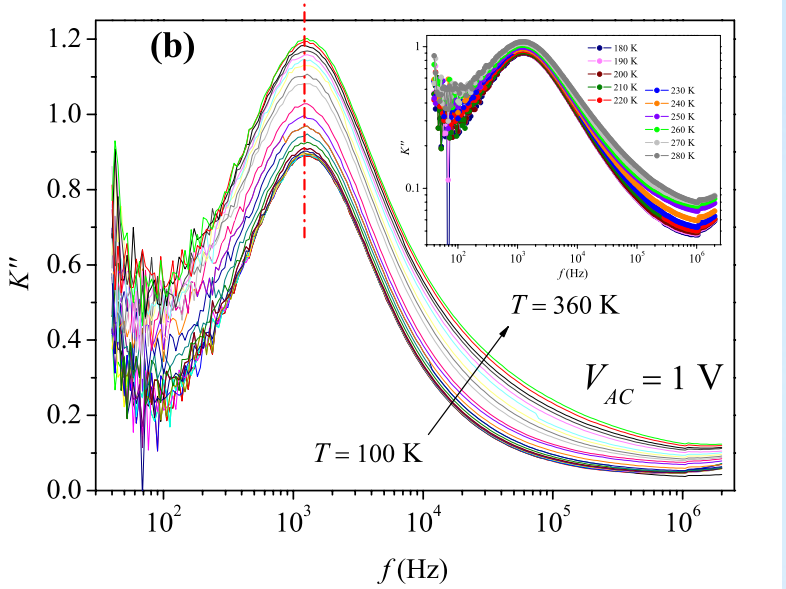
$$K'(\omega) = \frac{\varepsilon'}{\varepsilon_0} = \frac{d}{\varepsilon_0 A}\frac{\sin[\phi(\omega)]}{|Z(\omega)|\omega}$$

$$K''(\omega) = \frac{\varepsilon''}{\varepsilon_0} = \frac{d}{\varepsilon_0 A}\frac{\cos[\phi(\omega)]}{|Z(\omega)|\omega}$$

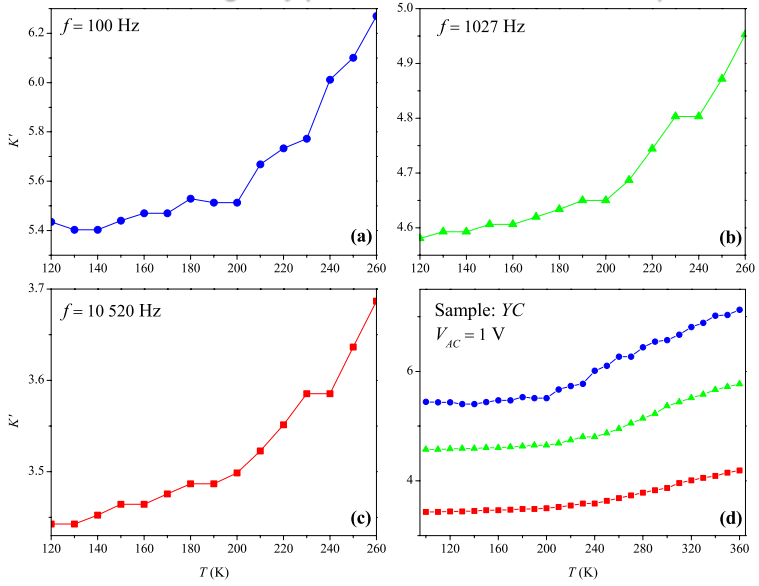
Impedance spectroscopy

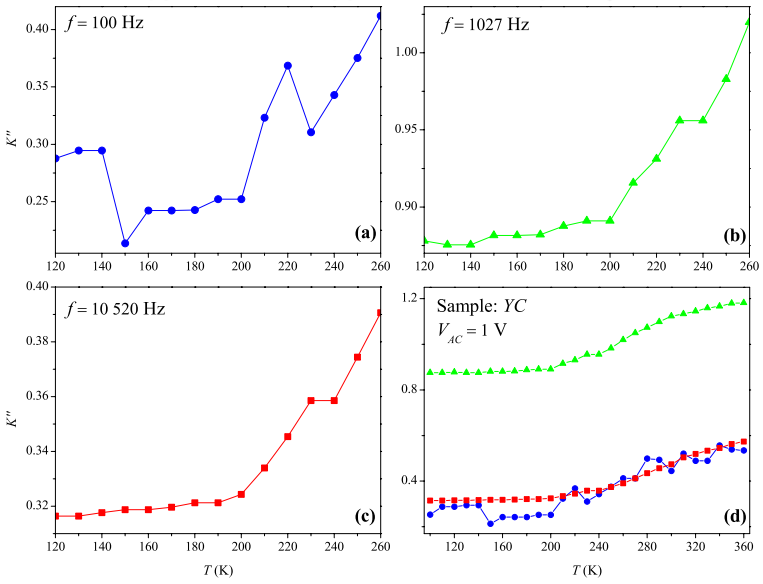
Impedance spectra at different temperatures: a) Real part of the dielectric constant; b) Imaginary part of the dielectric constant.





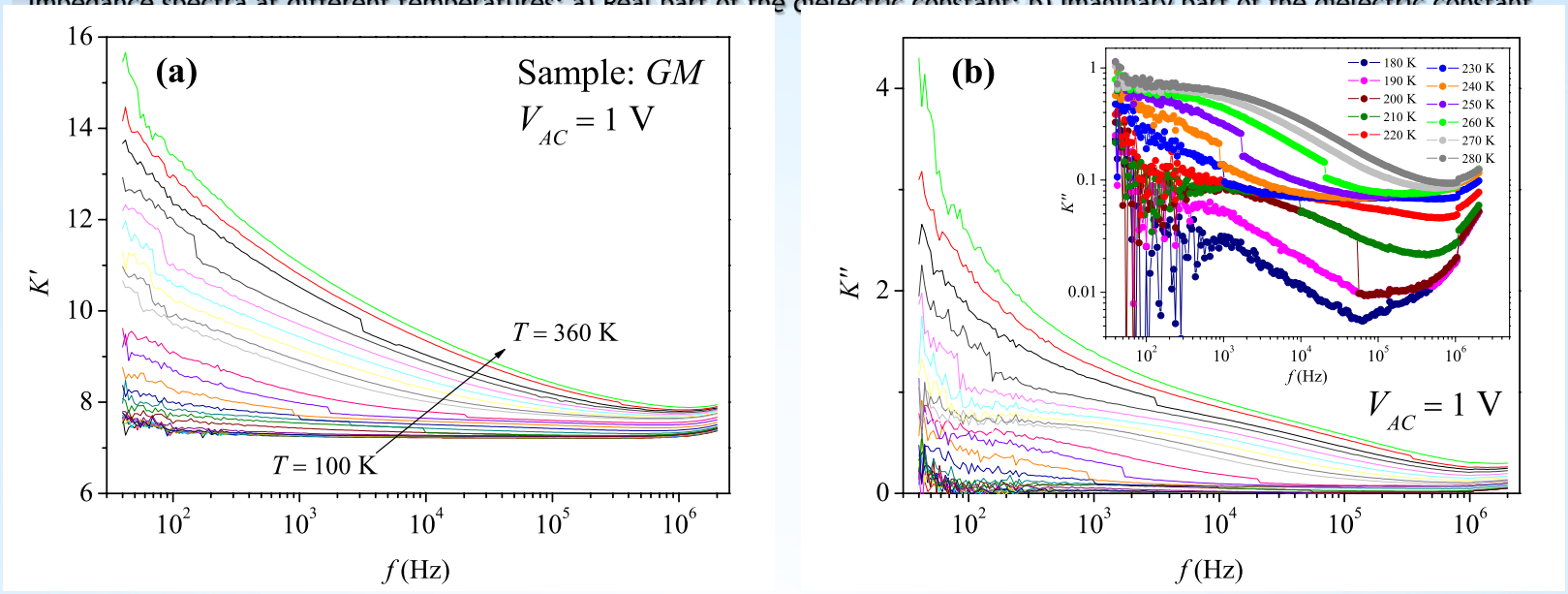
Real and Imaginary part of ε as a function of temperature: a) f = 100 Hz; b) f = 1027 Hz; c) f = 10 520 Hz; d) comparison.



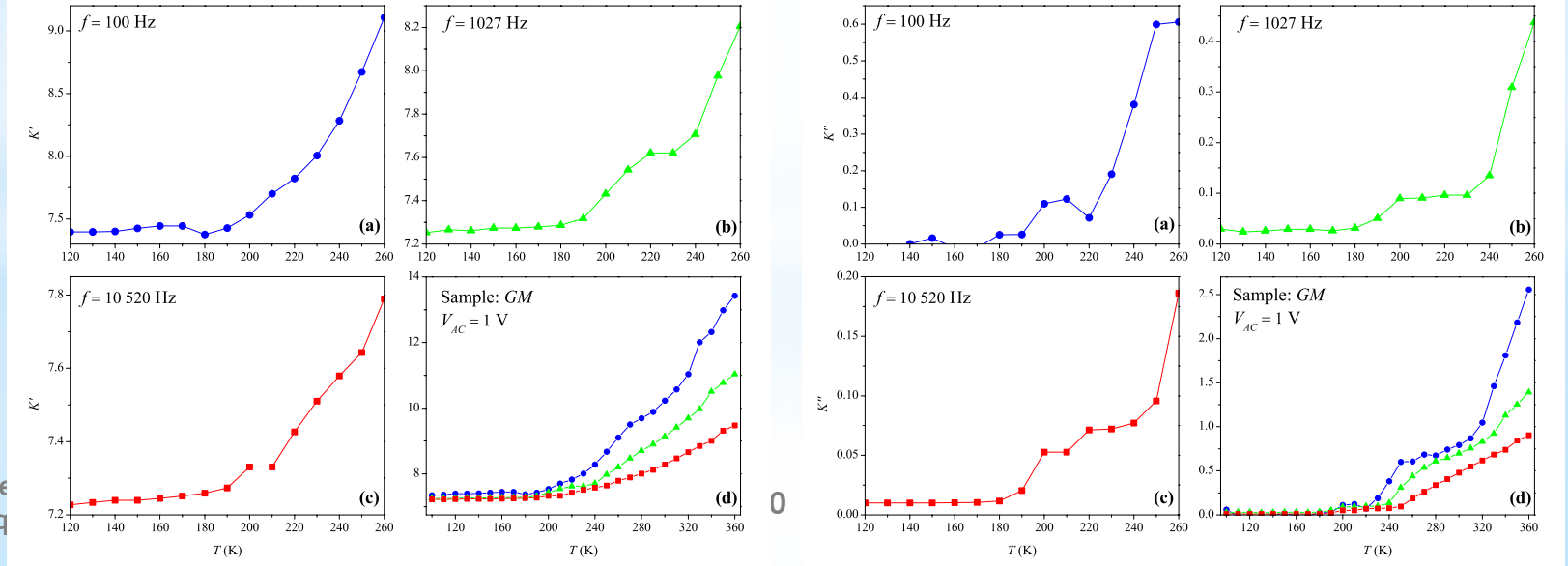


Impedance spectroscopy

Impedance spectra at different temperatures: a) Real part of the dielectric constant; b) Imaginary part of the dielectric constant

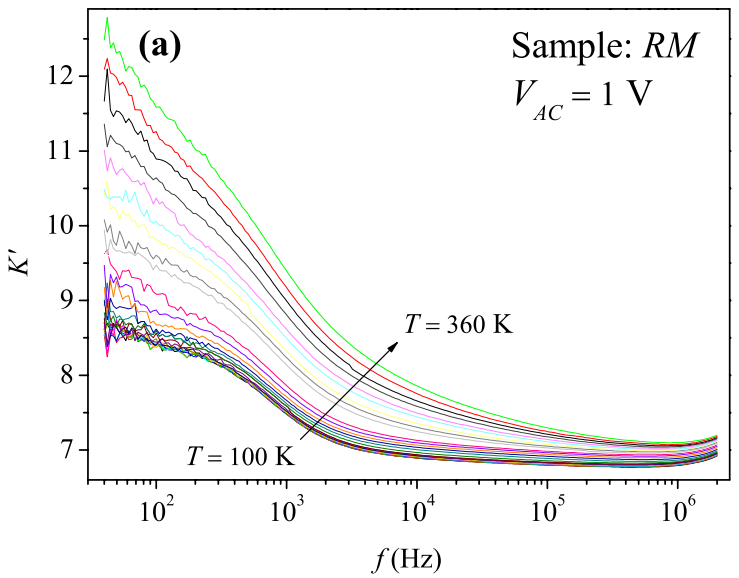


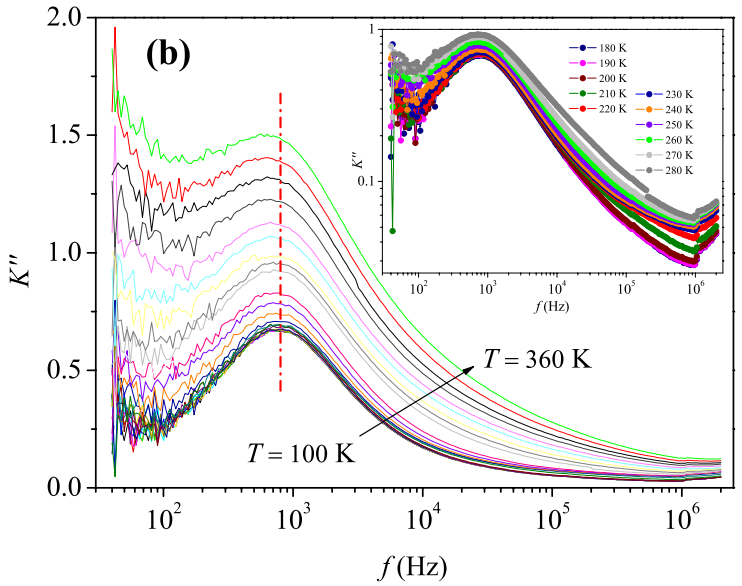
Real and Imaginary part of ε as a function of temperature: a) f = 100 Hz; b) f = 1027 Hz; c) f = 10 520 Hz; d) comparison.



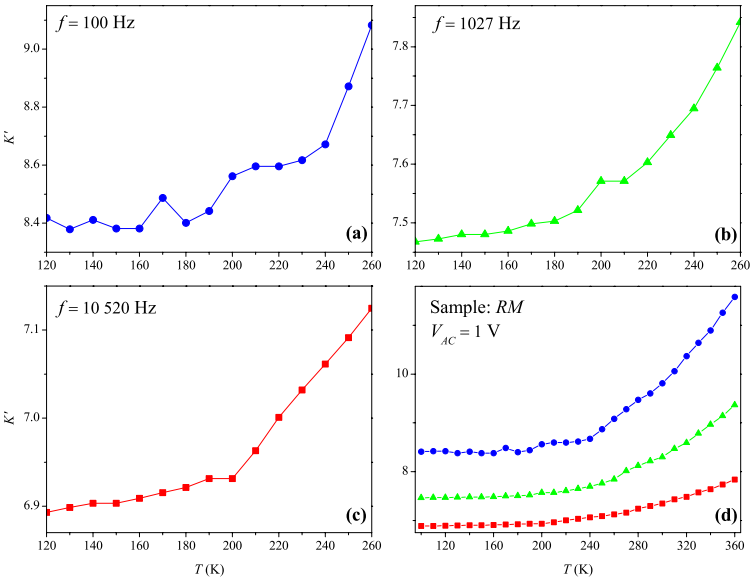
Impedance spectroscopy

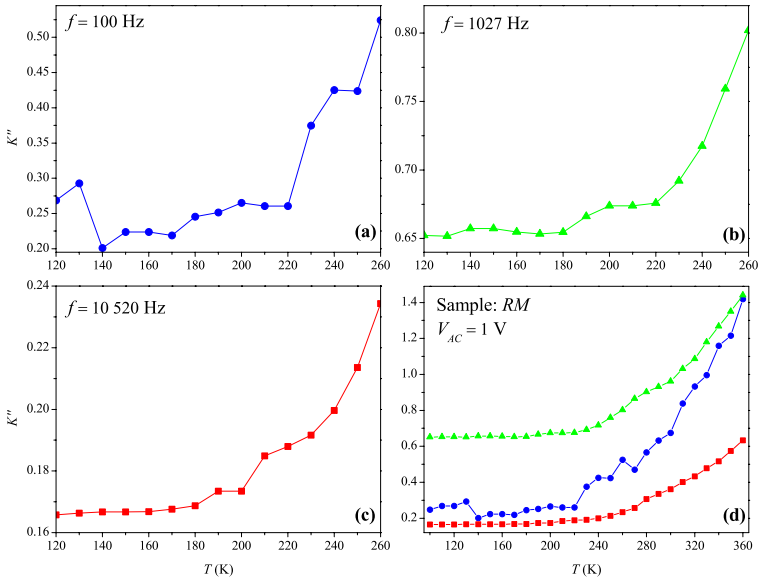
Impedance spectra at different temperatures: a) Real part of the dielectric constant; b) Imaginary part of the dielectric constant.



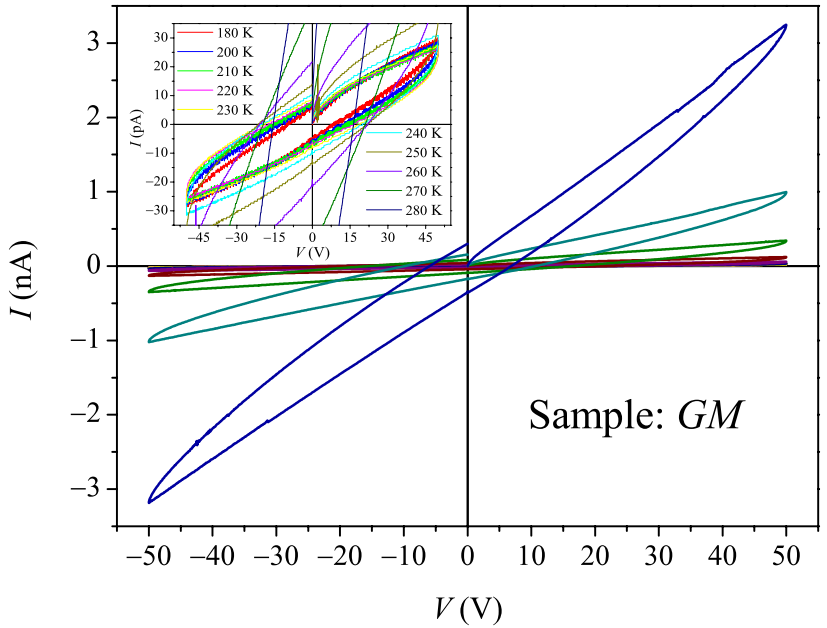


Real and Imaginary part of ε as a function of temperature: a) *f* = 100 Hz; b) *f* = 1027 Hz; c) *f* = 10 520 Hz; d) comparison.





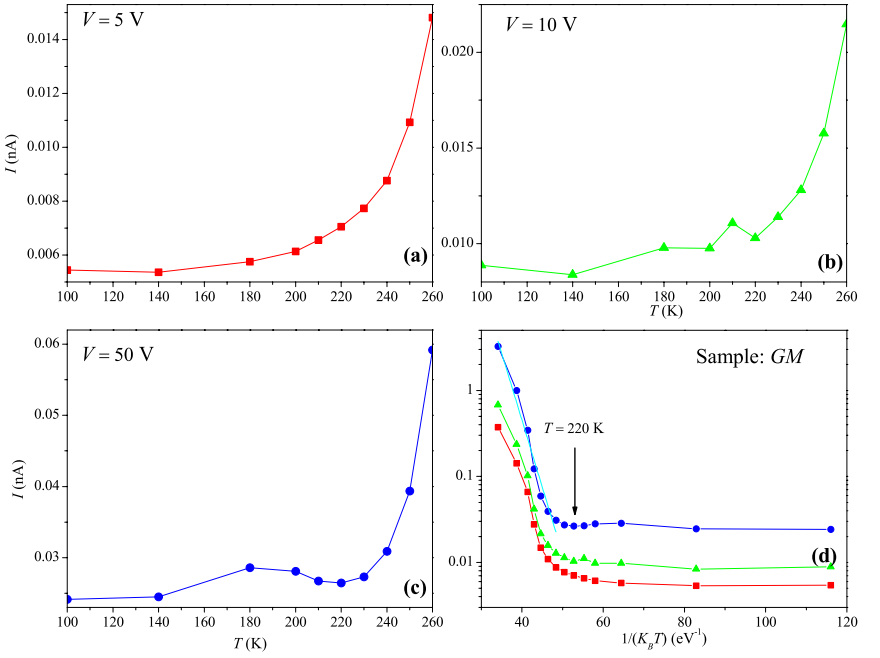
I-V characteristics



I-V characteristics for GM at different temperatures. The inset shows a detail of the I-V curves in the temperature range from 180 K up to 280 K.

GM

Current as a function of the temperature for different voltage levels: a) V = 5 V; b) V = 10 V; c) V = 50 V; d) Arrhenius plot with a linear fit (shown by cyan line).



E_a ~ 26 meV

Conclusions and future work

- ✓ An anomaly in the dielectric behavior near T~220 K is found.
- ✓ This temperature is typical of the super-cooled phase transition of strongly confined water affecting electronic devises.
- ✓ Samples YC and RM show a relaxation process taking place at f~10^3 Hz readily evidenced in the K'' curves here a significant peak appears at this frequency that does not change with temperature.
- ✓ The I-V curves of GM sample are strongly thermal activated with typical energy of E_a~26 meV.
- ✓ Our final objective is to Investigate possible mechanisms of charge creation in different crust materials and conditions (pressure and temperature).

Support

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http://en.wikipedia.org/wiki/Almendres_Cromlech

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