Signals that the Earth sends out –
Opportunity for NASA and for Ames

Some Ideas and Suggestions for more than one ROSES call

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We’ve made progress in understanding processes in the Solid Earth that have relevance to more than one ROSES program.

• Rocks, when subjected to tectonic stresses, turn into a battery.

• They produce electric currents in the Earth’s crust, millions of amperes strong.

• This discovery can lead to proposals for the following ROSES calls:
C.4 Planetary Geology and Geophysics
C.12 Mars Fundamental Research
A.15 Earth System Science Research using Data and Products from the Terra, Aqua, and ACRIMSAT Satellites
A.11 Earth Surface and Interior
Block of Sierra Nevada granite

1.2 m long
10 x 15 cm² cross section
air-dry
loaded at one end
Electrons are flowing out of the Source.

Holes are flowing through the rock.

Current [A km⁻³]

Time [min]

Stress [MPa]

"Sierra White" Granite

4th loading

Load

A

Piston

Capacitive Sensor

Insulation

Rock

Back Electrode

Front Electrode

A
Gabbro Tile, loaded in center 6 MPa/min

red: current to edge  
blue: current to piston

Source volume

A

Frame

Insulation

Piston

Rock

A

Frame

Insulation

Piston
Ionosphere
Atmosphere
Earth's Surface

Deformation activates p-holes.

Compressed Rock

Mid-IR Emission
M=7.6 Gujarat earthquake
Jan. 26, 2001, northern India

MODIS night-time mid-IR data
(courtesy of Dimitar Ouzounov, GSFC/SSAI)

Rapid changes of the IR intensity
several days before main shock
outlining the hidden faults
60 cm

~ 1 m

11.5 cm Ø

Rock

Piston

Piston

BOMEM Spectrometer

electrical insulation

30 cm

Rock

~ 1 m
Pre-loading and loading spectra

Anorthosite Run #12
Anorthosite Run #12

Excess IR Emission during first 4 min after start of loading in O-O region

Pre-loading and loading spectra

Difference spectra

Secondary Si-O and Al-O bands?

O-O combination bands with lattice modes?

Primary O-O hot bands plus O-O fundamental?

narrow bands
Anorthosite IR Emission

Intensity [K]

Wavenumber [cm$^{-1}$]

Pre-Load Spectrum

Excess Emission

Difference [mK]
Anorthosite IR Emission

Pre-Load Spectrum

Excess Emission

GOES-R IR channels
Conclusions:

We start to understand the physics

We can design protocols for measuring (and re-evaluating) many processes that are linked to or influenced by the electronic charge carriers activated deep in the Earth’s crust.