Atmospheric electric field before the 2005 off-Miyagi earthquake (M 7.2)

I. Tohbo*, H. Nagahama*, Y. Omori*, S. Masuda†, & Tohoku Electric Power Company‡
*Department of Geoenvironmental Sciences, Graduate School of Science, Tohoku University, Sendai, Japan, †Tohoku Intelligent Telecommunication Co., Ltd., Sendai, Japan, ‡Tohoku Electric Power Company, Incorporated, Miyagi Branch Office, Power System Div., Telecommunications Engineering Center, Sendai, Japan
E-mail : tohbo@dges.tohoku.ac.jp

1. Introduction

"The off-Miyagi earthquake" is one of the interplate earthquakes which occure repeatedly in Japan. That interval is about 25-40 years and M_W is around 7.0. It is said that next one will surely occure in a few decades.

Fig.1 Location

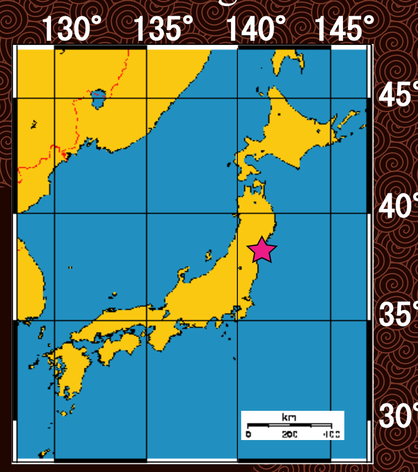
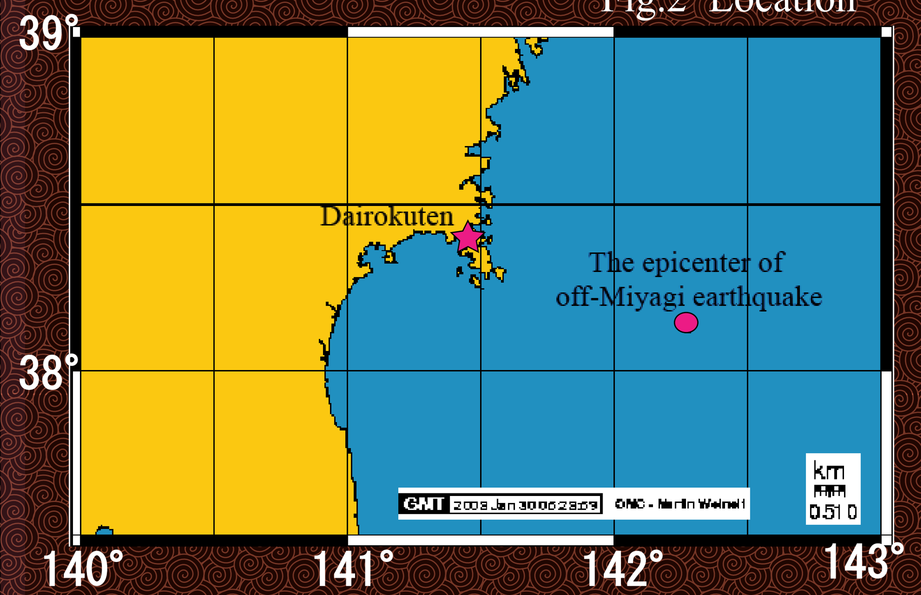


Fig.2 Location

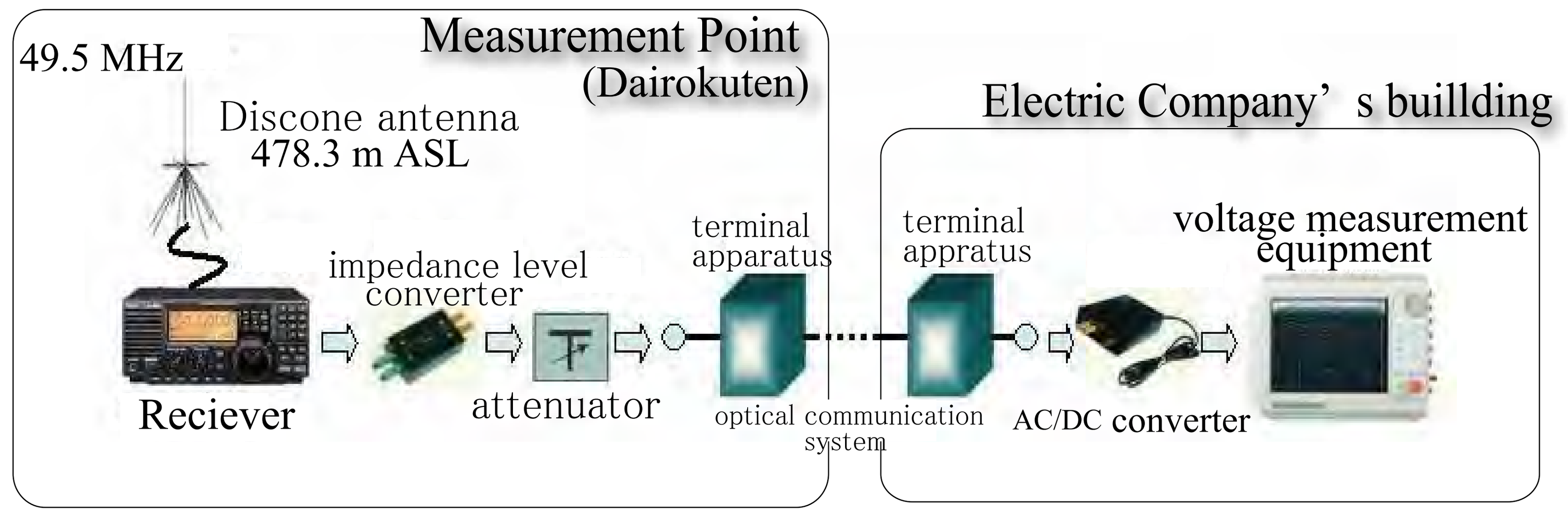


To predict this one, we have measured the electromagnetic noise in VHF band in the Dairokuten, Oshika Peninsula.

Before the 16. 8. 2005 off-Miyagi earthquake (M 7.2), we caught certain anomalies in noise data.

2. Methods

Fig.3 Measurement system. [1]



3. Results & Analyses

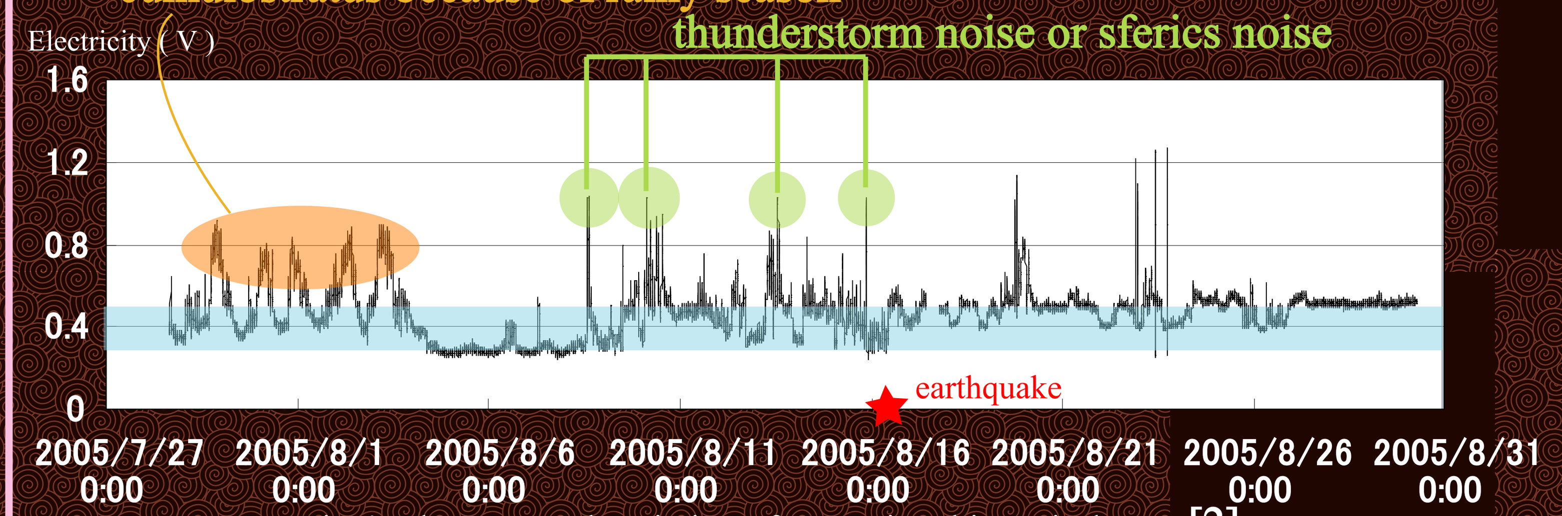


Fig.4 The temporal variation of VHF signal in Dairokuten. [2]

In spite of removing meteorological effects, noise width have some disturbances before the earthquake in fare weather.

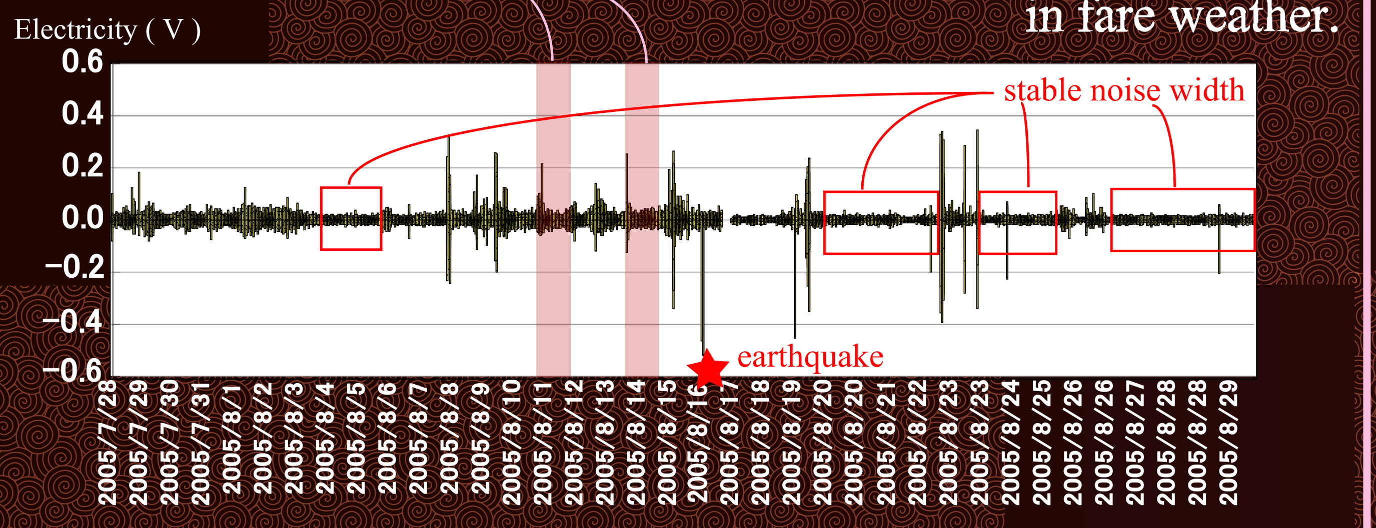


Fig.5 The difference between VHF data and 5-point moving average (the noise width)

4. Discussions

The preseismic radon emanation (see Tohbo et al., EGU 2008) makes ionized air.
Can this ionized air cause VHF signal anomalies?

There are two probabilities.
One is to reflect waves,
and the other is to change atmospheric electric parameters.

Reflection of radio wave

$$N_{\max} = 1.24\times10^{-2} f_c^2 \quad (1)$$

N_{max} : maximum density of electron
f_c : frequency of electromagnetic wave

The electromagnetic wave (49.5 MHz) cannot be reflected by the ionized air of this density.
× impossible!!

Maximum pulses [3] [4]

$$E_g = \frac{2R^2 \rho_a N_a Q g}{9\eta\left(\lambda_0 \dfrac{n}{n_0} + \dfrac{Q^2 N_a}{6\pi\eta R}\right)} \quad (2)$$

E_g : maximum pulse of atmospheric electric field
R : radius of large aerosol
ρ_a : aerosol mass density
N_a : large aerosol number density
Q : large aerosol charge
g : gravitational acceleration
η : air viscosity
λ_0 : normal atmospheric conductivity
n_0 : normal density of small ions
ε_0 : permittivity constant

$E_g = 10^5$ Vm^{-1} : this electricity is equal to that of thunderclouds appear.

Ionized air can behave like a capacitor. [3]

electrostatic field

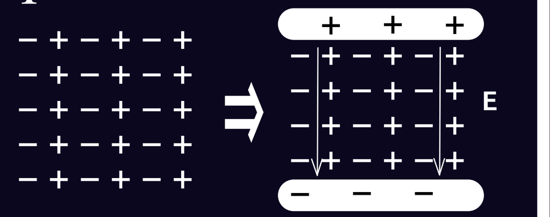
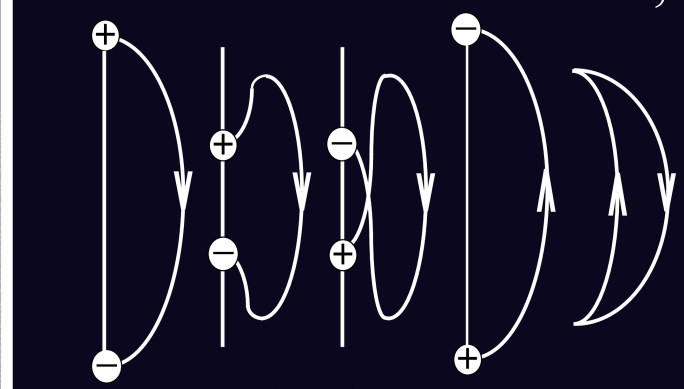


Fig.6 Schematic view of ionized air.

if the ionized air vibrate,



radio waves are radiated.

Fig.7 Radiation of electromagnetic wave. [5]

Application to the 'theory of global circuit' [6]

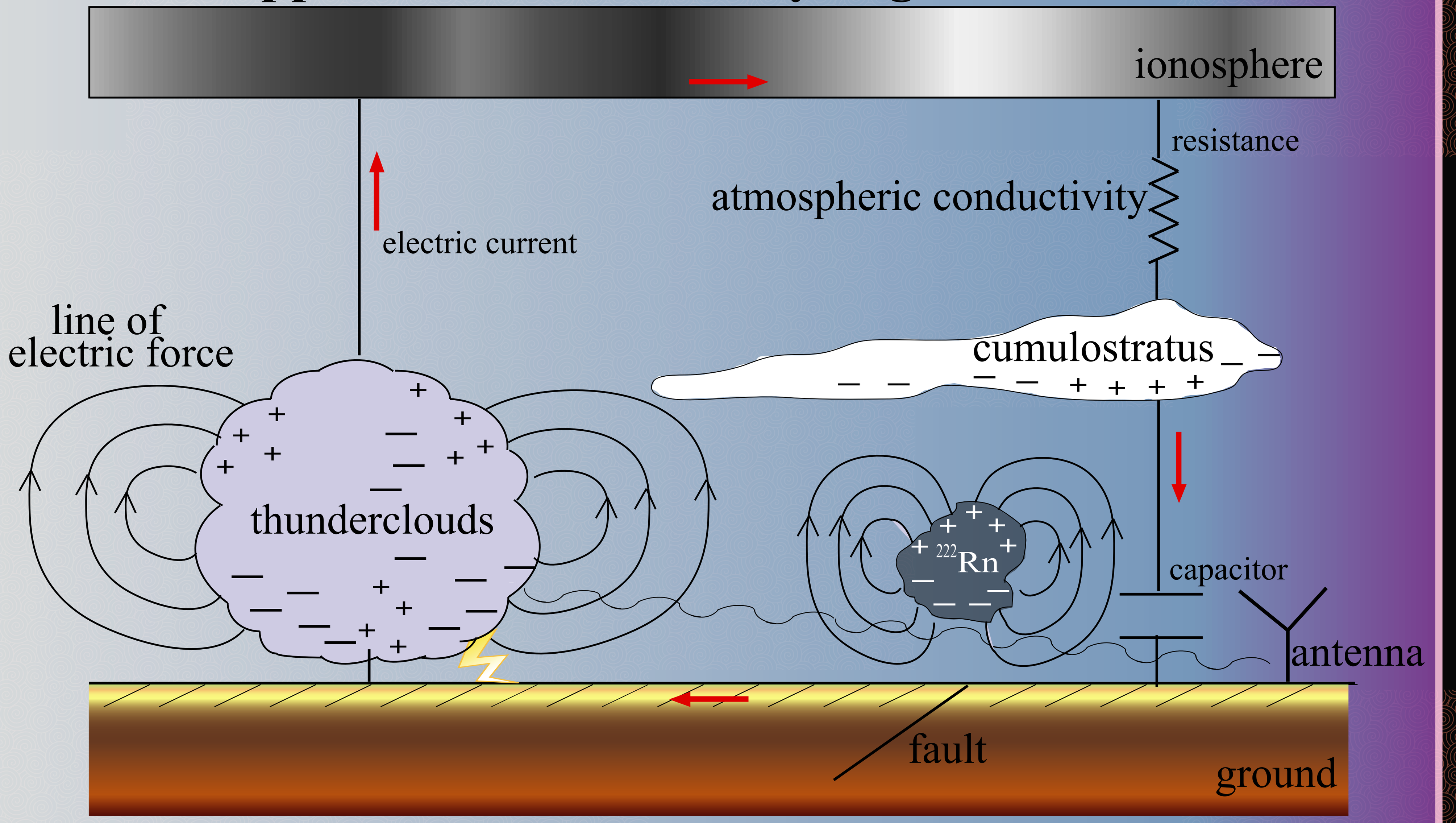


Fig.8 The concept of VHF signal anomalies.

The ionized air due ^{222}Rn emanation appears before earthquakes and causes VHF anomalies.

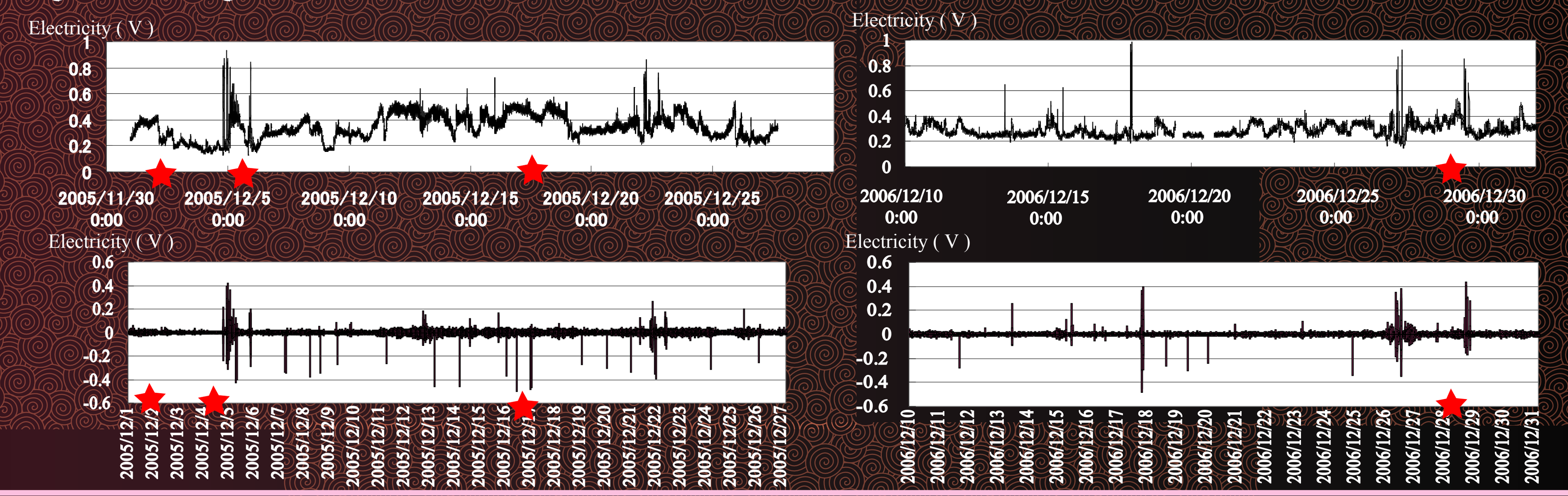
5. Conclusion

VHF signal anomalies before the earthquake can be attribute to the ionized air resulted from radon emanation.

electrostatic field
or
radiation of radio waves

associated with crustal dynamics

Other cases



References

[1]Masuda, S., http://www.mni.ne.jp/~aoimori/zishin/. [2]Yonaiguchi et al., 2007, NHESS, 7, 485. [3]Liperovsky, V. A., 2005, NHESS, 5, 783. [4]Omori, Y., et al., 2007, NHESS, 7, 629. [5]Nayfeh and Brussel, 1985, John Wiley & Sons, 619pp. [6]Markson, R., 1978, Nature, 273, 103.