Geophysical Research Abstracts
Vol. 15, EGU2013-1249, 2013
EGU General Assembly 2013


# Registration in a radon system of signals related to the Tohoku Earthquake

Gideon Steinitz, Oksana Piatibratova, and Peter Kotlarsky
Geological Survey of Israel, Natural Hazards, Jerusalem, Israel (steinitz@gsi.gov.il, 972 2 5380688)

The behavior of radon (Rn-222) within confined volumes of air is examined experimentally at the GSI (Jerusalem) since several years. In these experiments a relatively high level of radon is maintained by diffusion from a source via a tube and radiation from it is measured using nuclear detectors. In difference with the expected, nuclear radiation from the radon (progeny) shows: a) temporal variations (signals) spanning annual to daily scale; b) directionality of the nuclear radiation reflected as inverse signal patterns in the east-west versus north-south directions. The experimental setup at the GSI lab consists of a leak tight stainless steel (SS) canister (3.53 l) fed with radon by diffusing via SS tube (0.8 m) from a commercial source (RaCl2; 103 kBq). Four identical gamma detectors (2×2") were placed around its central horizontal plane of the canister, at the primary geographic directions, and a further detector (36×76 mm) was placed along the vertical axis of the canister. Count rates (1-minute intervals) were acquired by a datalogger. The system was used in this configuration in a series of experiments conducted from May 2009 to June 2012.

An experiment was operating from 30.1.2011 to 22.3.11. The host gas in this experiment was argon at a pressure of ∼1 atmosphere. Distinctive short term periodic (STP) signals with periods of 2-3 hours (frequencies in the range of 9-12 CPD) occur in a time interval of three days in association with the Tohoku earthquake (TE; 11.3.2011) and possibly also with its pre-shock. The STP signals occur from around 6 hours prior to the TE and are maintained to around 48 hours after the TE. These signals are observed at all five sensors and are superimposed on the DR signals with relative amplitudes of around 20%. They exhibit differing forms and phase at the different sensors, located at different directions around the canister. The pattern is similar but not identical to the spatial manifestation of form and phase of the DR signal in such experiments, indicating a communality of the driving mechanism.

Similar short term signals have not been encountered in other experiments using this configuration, nor at any of the other configurations. Both DR and STP signals are due neither to mechanical nor to local environmental influences on the experimental system. The DR signals have recently been interpreted to be due to a remote influence on the radon system, possible by a component in solar irradiance.

Concerning the TE the implications are:
1. The overall progression of the TE (Mw=9) event is also associated with a non-mechanical geodynamic process which is reflected by nuclear radiation features of radon in air. This process is modifying (superimposed) the driver of the primary DR signal of the radon system.
2. The influencing process is operating at a global scale, but at this stage it remains open whether the effect is transferred to the experimental setup via the solid earth and/or the atmosphere.
3. Detection of such phenomena is possible in radon systems of specific configuration the parameters of which are so far undetermined.
4. The possibility is raised that a pre-cursor of the TE has been detected.

Concerning the radon system the implications are:
1. Results obtained by the GSI group indicate that nuclear radiation from radon (and progeny) inside a confined volume of air varies spatially and temporally at time scales from annually to daily. The geophysical drivers of these signals are unclear at this stage. The new experimental results demonstrate that the same radon system is responding to further geophysical drivers operating at a time scale of 2-3 hours.
2. The results further demonstrate the potential of investigations utilizing enhanced radon levels within confined volumes for detection of a new type of time varying geophysical phenomena.

References:

Steinitz, G., Piatibratova, O., Kotlarsky, P., 2011. Possible effect of solar tides on radon signals. Journal of Environmental Radioactivity, 102, 749-765. doi: 10.1016/j.jenvrad.2011.04.002.

Sturrock, P.A., Steinitz, G., Fischbach, E., Javorsek, D. and Jenkins, J.H., 2012. Analysis of Gamma Radiation from a Radon Source: Indications of a Solar Influence. Journal of Astroparticle Physics, 35/1, 18-25.