Geophysical Research Abstracts
Vol. 14, EGU2012-1209, 2012
EGU General Assembly 2012

Corroboration for the influence of a component of solar irradiance on subsurface radon signals

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Rn-222 occurs at highly varying levels as a trace component in subsurface air (geogas). This high variability is traced by alpha and gamma activity due to the decay of radon and its progeny. Nuclear radiation from radon in geogas and in experiments using air+radon within a confined volume exhibits systematic temporal variations. These variations are composed of periodic and non-periodic signals spanning several orders of magnitude in time – from annual to daily and sub-daily durations. Analysis of extensive data sets from three key sites 200 km apart in the arid desert of southern Israel [1-3] and from a 5-year experiment using alpha and gamma detectors [4] demonstrate that the periodic variations, observed to a depth of >100 meters, are related to an above surface driver probably due to a component of solar irradiance. Insight was also derived from the long term variations in the geological and the experimental time series [5], indicated by the occurrence of multi-year variations, and clear semiannual and ternary annual signals which are in addition to the annual periodicity.

New confirmations are based on recognizing further cyclic phenomena, some of which are not linked with Earth related periodicities. A likehood analysis of the alpha and gamma time series in a long-term experiment is performed. A Combined Power Statistic formed from the gamma, alpha-H and alpha-L sensors inside the experimental tank shows that the time series of the gamma radiation contains an annual periodicity as well as a clear semi-annual and possibly a ternary-annual periodicity. The same analysis also resolves additional periodicities in the frequency range of 10-15 yr-1 in the gamma time series which are indicative of a relationship to rotation of the sun around its axis [6]. Observation of solar periodicities in the temporal pattern of the nuclear radiation of radon is a significant independent substantiation for the notion of the influence of a component in solar irradiance.
An independent confirmation of the solar effect in the experimental data is obtained by observing day time and night time patterns. “Specgrams” of the power as a function of frequency and hour of day show that the peak of the annual periodicity occurs at daytime while the semi-annual and solar periodicities are seen to be prominent at night. This is interpreted to indicate a differentiation in the nuclear radiation from radon as a function of rotation of Earth. – i.e. when Earth faces the sun and when the sun is completely obstructed. This feature is also demonstrated using Continuous Wavelet Transform (CWT) analysis on separate time series composed of day-time and night-time measurements. Applying the CWT analysis yields different frequency-time variation patterns for day-time and night-time measurements in the experimental data. This confirms the utilization of the CWT analysis for detecting the phenomena.
Using the CWT analysis tool the day- and night-time difference in radon time series is also detected at subsurface geological sites from Israel, Tenerife and Italy. These sites are from different geological and geophysical scenarios, different elevations and span depths from several meters to around 1000m below the surface.
New multi disciplinary prospects for the research are indicated in terms of a) the radioactive behavior of radon in above surface and subsurface air, b) an above surface geophysical driver for this behavior and, c) the influence of a component of solar irradiation.

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