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Solar radiation tidal forcing of radon signals in subsurface air

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Radon (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 (and progeny) in geogas exhibits systematic temporal variations composed of periodic and non-periodic signals spanning several orders of magnitude in time – from annual to daily and sub-daily duration. Analysis of extensive data sets from three key sites 200 km apart in the arid desert of southern Israel demonstrated that the periodic variations, observed to a depth of >100 meter, are related to an above surface driver (1-3).
The issue of external forcing of radon signals was tested experimentally using alpha and gamma detectors recording radiation emitted from radon in a confined volume of Air. The setup consisted of an isolated volume (640 L) of air with radon, the latter diffusing from U bearing ground phosphorite (376 Kg) into the upper test volume. Alpha and gamma radiation emitted from radon in the tank air varies spatially and temporally. A 4-year time series shows that the variation is composed of multi-day signals and especially of periodic signals of annual and daily scale. The diurnal variations are dominated by periodicities of 24-, 12-, 8- and 6-hours which are attributed to the Solar tidal constituents S1, S2, S3 and S4. Periodicities indicative for diurnal gravity tide (O1, M2; Lunar influence) are clearly lacking. Profound external geophysical influence is further indicated by compounded relations that occur as annual modulation of the amplitude and phase of the diurnal constituents S1, S2 and S3.
Further insight is derived from the long term variations in time series from the geological environment and from an experiment. In addition to the annual periodicity clear semiannual and ternary annual signals are demonstrated. They are attributed to the solar tidal constituents Sa, SSa and STa.
Experimental observations confirm the unique properties of the temporal variation of radiation from radon in air. Based on the characteristics of the annual and daily scaled periodicities as well compounded relations among them, it is suggested that a component of solar radiation tide forces these phenomena. The widespread systematic occurrences indicate that a component of solar radiation is driving the system by interacting with radon in air. It is manifested in the multi-scale temporal pattern of the radioactive decay of radon and its progeny in geogas, to a depth of >100 meters.
New combined prospects for the research are indicated in terms of the radioactive behavior of radon in air and an above surface geophysical driver for this behavior.

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