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Radon signals at the Gavnunim site, southern Makhtesh Ramon, Israel

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High time resolution (15 minute) monitoring of radon, using electronic alpha detectors, is conducted since July 1996 in the in the southern part of Makhtesh Ramon, some 200 meters north of the Ramon fault, in boreholes at depths of 1.2 and 85 meters. The detectors are placed in the massive syenite of the Lower Cretaceous Gavnunim intrusion. Environmental parameters are also recorded.

Several systematic temporal variation patterns of radon occur at the Gavnunim site:

- Long-term variation, observed at 1.2m.
  A multi-year trend presented by gradual decrease of signal. At this stage it is unclear whether this is a true variation or related to an instrumental influence

- Seasonal signal, observed at 1.2m.
  Seasonality is prominent when plotting the long term temporal variation of the amplitudes of the 24- and 12-hour diurnal periodic components (see below). This seasonal pattern of the diurnal constituents is hidden within the measured signal, which by itself does not manifest seasonality.

- Multi-day signals, observed at 1.2 and 85 meters.
  Non periodic signals lasting 2 to 20 days – termed humps – are the most conspicuous variation pattern in both time series of the measured signal. They demonstrate a gradual multi-day rise and plateau which is terminated with a fast decrease lasting less the half a day. The multi-day humps are correlated between

the shallow (1.2m) level and the deep (85m) level, but it is evident that the sharp decrease of the signal at depth follows the decrease at shallow level with a time lag of several hours.

- Diurnal signals, observed at 1.2m.
  Prominent daily periodic signals occur at the shallow while absent at depth. Cyclic constituents are observed at 1 and 2 cycles per day. These periods are equivalent to S_1 and S_2 of solar tide. Cyclic daily periodic constituents such as principal lunar M_2(1.93 cycles/day) and principal lunar declinational O_1(0.93cycles/day) indicative for tidal (gravity) influence are absent. The amplitude of the semi-diurnal constituent (S_2) amplitude is always equal or larger than the amplitude of the diurnal constituent (S_1), and both clearly reflect a strong seasonal pattern (above).

- Sub diurnal signals, observed at 85m.
  Sub diurnal signals, termed spikes, occur as irregularly spaced intense variations lasting several hours. The time distribution of the spike peaks within the 24-hour diurnal cycle has a bimodal frequency structure, portraying a similarity to a diurnal and semidiurnal periodicity. This distribution is unrelated to instrumental artifacts, human activity and seasonal influence. Furthermore, it is difficult to envisage subsurface geogas flow patterns of short duration that can explain the fast intense variations and their temporal pattern.

The overall complex of observed patterns at the two closely related borehole locations, which exhibit multifaceted and systematic temporal variations, cannot be explained in the frame of recognized dynamic processes. Among the features the occurrence of S_1 and S_2 periodicities and sub-periodicities indicate a link to the rotation of Earth.