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Assessment of four years continuous radon variability in the borehole in Garhwal Himalaya

Vinay Mohan Choubey, Naresh Kumar, Baldev Raj Arora, and Leena Kamra
Wadia Institute of Himalayan Geology, 33, General Mahadeo Singh Road, Dehradun 248001, India (vchoubey@wihg.res.in)

The Multi parametric geophysical observatory (MPGO) established at Ghuttu in Garhwal Himalaya, India is designed to study the earthquake precursors in an integrated manner. The observatory is equipped with overhouser magnetometer, flux gate magnetometer, superconducting gravimeter, ULF-VLF magnetometer, radon and water level monitoring system, seismographs and GPS system.

A 68 m deep borehole, penetrating into the water table is incorporated for taking continuous radon monitoring at two depth points from the surface. One measurement is taken at 10 m (in the air column) and the second one at 50 m (within water column) depths. Besides radon concentration, air temperature, water temperature, atmospheric pressure, rainfall and water level fluctuations are also recorded in the borehole site with sampling interval of 15 min.

The continuous time series of radon variation along with other environmental parameters of 4 years (2007 to 2010) shows a rich and complex pattern of temporal changes in radon including well-defined seasonal and diurnal variation. The radon data is non-stationary and exhibit non-constant variance with very low changes in background level in winter and highly fluctuation in summer. The radon measurements at 10m depth show a well-defined diurnal pattern in concentration that is having minimum value in the early morning and maximum in the afternoon. The analysis of three years data indicates that this daily variation is well correlated with atmospheric temperature. Examination and correlation of radon with environmental factors has revealed that when atmospheric temperature is less than that of water temperature in the borehole, the variation from background level is negligible. However, when the atmospheric temperature surpasses the borehole water temperature, peaks diurnal pattern are observed in summer. Although the similar higher atmospheric temperature exists during rainy season also but following continuous rainfall, once the soil/rocks are saturated with water, radon concentration show fair stability with high value than average. Long pauses in rainfall give jerky variability during rainy season with no clear pattern of daily variation.

The recorded radon data strongly suggest that the atmospheric temperature and rainfall influence the variability of radon emanation therefore these anomalies has to be removed first while searching precursory signature in this continuous radon data.