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Appraisal of Environmental Influence on Radon Variability in 10 m deep Borehole at Ghuttu, Northwest Himalaya, India

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Wadia Institute of Himalayan Geology (WIHG) has recently established the first Indian Multi-Parametric Geophysical Observatory (MPGO) at Ghuttu (30.53 N, 78.74 E) in Garhwal Himalayas (Uttarakhand), India to study the earthquake precursors in integrated manner. Given the rationale and significance of this inter-disciplinary approach, the paper with the help of recorded radon time series shall illustrate the complex time variability that needs to be quantified in terms of influencing environmental factors before residual field can be used to search anticipated earthquake precursory signals. Monitoring of 222radon (Rn) is carried out using a gamma ray radon monitoring probe based on 1.5" x 1.5" NaI scintillation. Measurement of radon concentration at 15 min interval has been done at 10m depth in air column above the variable water level in a 68m deep borehole together with simultaneous recordings of ground water level and environmental variables such as atmospheric pressure, temperature, rain fall etc. Apart from strong seasonal cycle in Rn concentration, with high values in summer (July to September) and low values in the winter months (January to March), the most obvious feature in the time series is the distinct nature of daily variation pattern. Four types of daily variations observed are a) positive peaks, b) negative peaks and c) sinusoidal peaks and d) long intervals when daily variations are conspicuously absent, particularly in winter and rainy season. Examination and correlation with environmental factors has revealed that when surface atmospheric temperature is well below the water temperature in borehole (later is constant around 19oC in all seasons) temperature gradients are not conducive to set up the convection currents for the emanation of radon to surface, thus explaining the absence of daily variation in radon concentration in winter. During the rainy season, following continuous rainfalls, once the soil/rocks are saturated with water radon concentrations show fair stability. Long pauses in rainfall give jerky variability during rainy season with no clear pattern of daily variation. During rest of the seasons when surface temperature are always higher that water temperature, the nature of observed pattern can be reconciled in terms of the form and amplitude of daily progression in temperature gradient. An accurate description of the effect of environmental variables is essential if we to wish decipher information related to stress/strain accumulation.