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Scaling and Crossover phenomena in pre-seismic helium signal

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Anomalous fluctuations of helium concentration emanating from thermal springs have been observed on several occasions prior to major seismic events such as earthquakes. With a view to probe the scaling properties inherent to the helium time series and to explore the effect of anomalies the method of Detrended Fluctuation Analysis (DFA) has been employed. For the present study we have chosen a data set for six months (July – December, 2005) incorporating the anomalous fluctuations corresponding to the Pakistan quake (7.6M ; 34.493N:73.629E) occurred on October 08, 2005. The analysis captures the signature of crossover phenomenon and exhibits the long memory dependence of helium sequence. The technique permits distinction between two sets of helium signals derived from seismically active and quiet periods. A statistically significant correlation between the anomalous helium concentration and the fluctuation exponent is obtained. Such correlation also points towards fractal geometry of the underlying dynamical system. Our findings strongly express the possibility of a trade off between precursory anomalies and the ongoing process during the earthquake preparation stage within the crust. External seismic stimulation producing abnormal temporal variations sways the normal course of helium release from the earth's interior there by alters the scaling properties. Occurrence of crossover point could be the precursor of crustal instability due to transient response to the evolution of stress-strain episodes in the nucleation phase of the earthquake.. The scaling exponent at higher time scale is consistent with the persistent nature of the time series while that at the lower time scale resembles brown noise. This analytical approach turns to be promising in identi-

fying anomalous helium fluctuations as precursory signals with respect to the seismic disturbances like earthquakes and volcanism.