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Correlation of Radon Anomalies with Earthquakes in the Kangra Valley

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Abstract—During the last two decades more than a dozen earthquake precursors which hold out considerable promise have been identified. Radon monitoring for earthquake prediction is part of an integral approach since the discovery of coherent and time-anomalous radon concentration prior to, during and after the 1966 Tashkent earthquake. Our own programme is based on radon recording using electronic α-counters, emanometers and plastic track recorders. Radon concentrations have been monitored daily in soil gas and groundwater since August 1989 in the Kangra Valley, Himachal Pradesh (India) which is identified as a highly seismic zone in the Himalayan belt. Radon anomalies have been recorded in both soil gas and groundwater. The effect of meterological variables on radon emanation rate have been studied. It is observed that radon anomalies correlate with some of the earthquakes which occurred in the region.

INTRODUCTION

Earthquakes constitute one of the worst natural calamities on Earth. In India, where 55% of the land area falls under active seismic zones, considerable destruction was caused by the earthquakes of Shillong (1897), Kangra (1905), Bihar-Nepal (1934), Assam (1950), Koyna (1967) and Bihar-Nepal (1988). With a population growing towards one billion by the end of this century, damage to life and property is likely to increase unless success in earthquake prediction is achieved in the near future.

Over the past two decades, a number of earthquake precursors have been identified. The discovery of anomalous concentrations of radon in mineral waters prior to the great Tashkent earthquake in 1966 by Ulomov and Mavashev (1967) has established radon as a useful precursor. Since then a number of workers have reported results on radon monitoring in well water and soil gas for earthquake prediction (Sadovsky *et al.*, 1972; Naguchi and Wakita, 1977; King, 1980; Birchard and Libby, 1980; Mogro-Campero *et al.*, 1980; Teng, 1980; Hauksson, 1981; Ghosh *et al.*, 1987 and Singh *et al.*, 1988a).

EXPERIMENTAL TECHNIQUES

Radon monitoring in soil

The radon monitoring is carried out by using two different types of α-detector, *viz.* the plastic track detector LR-115 type 2 and the silicon-diffused junction detector. Plastic detectors are capable of recording average values of radon over long periods but they are insensitive to transient variations that last only several hours or less. In order to seek and study such variations, the silicon-diffused junction detector has been used since this can record integrated radon values over short time-periods. This detector is connected to an automated battery-operated system (α-logger), which can also record environmental parameters such as atmospheric pressure, air temperature, wind velocity, relative humidity and rainfall.

The track-etch technique is especially appropriate for radon detection in soil gas because of its low cost, ruggedness and negligible background of spurious signals. The measuring device is known as radon–thoron discriminator (Ghosh *et al.*, 1987). The upper detector records α-tracks due to

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