Pergamon

0969-8086(93)E0003-H

Nucl. Geophys. Vol. 8, No. 2, pp. 185–193, 1994
Copyright © 1994 Elsevier Science Ltd
Printed in Great Britain. All rights reserved
0969-8086/$6.00 + 0.00

Investigation of Radon-222 in Soil-gas as an Earthquake Precursor

BALJINDER SINGH and H. S. VIRK

Department of Physics, Guru Nanak Dev University, Amritsar 143005, India

(Received 7 January 1992; in revised form 14 September 1993)

Abstract—Earthquake prediction is based on precursory phenomena and in recent years radon has emerged as a useful precursor. Radon emanation in soil-gas was continuously monitored from October 1988 to September 1989 at the Guru Nanak Dev University, Amritsar. Radon concentrations were measured using both instantaneous and time-integrated techniques. To eliminate the effect of spurious fluctuations, meterological parameters, viz. air temperature, barometric pressure, wind velocity, relative humidity and rainfall were also monitored, continuously. A correlation matrix was computed for radon data and meterological parameters to discriminate the signal from noise. Nine earthquake-related anomalies were recorded during this period. The anomalous increases in radon appear to be caused by strain changes, which precede the earthquake.

INTRODUCTION

The correlation between radon emission and earthquake occurrence can be traced to a study by Okabe (1956), who found a positive correlation between the daily variation of atmospheric radon content near the ground surface and the local seismicity at Tottori, Japan. Since then radon has been extensively monitored in many seismic areas of the world for the purpose of earthquake prediction. Many reports suggest that radon concentration in soil-gas or groundwater, or both, may provide a useful early warning of imminent seismic activity (Noguchi and Wakita, 1977; King, 1978, 1980; Birchard and Libby, 1980; Mogro-Campero *et al.*, 1980; Shapiro *et al.*, 1980, 1981; Teng, 1980; Teng *et al.*, 1981; Wakita *et al.*, 1980; Hauksson and Goddard, 1981; Segovia *et al.*, 1986, 1988; Virk, 1986, 1990; Ghosh *et al.*, 1987).

Initially, the dilatancy diffusion model and several other similar models suggested that radon anomalies are related to mechanical crack growth in the volume of dilatancy, or to a change in flow rate of groundwater (Ulomov and Mavashev, 1967; Scholz *et al.*, 1973). The drawback with this explanation is that it often requires an unreasonably large change in strain far away from the subsequent epicentre. The aim of the present study is to examine the usefulness of radon monitoring for earthquake prediction. Daily, instantaneous and long term integrated measurements of radon in soil-gas were carried out at Guru Nanak Dev University Campus, Amritsar (31.61°N, 75.05°E) (Fig. 1).

The values of meterological parameters such as air temperature, barometric pressure, wind velocity, relative humidity and rainfall were also monitored. Information on these parameters helps to distinguish anomalies due to seismic activity.

RADON MONITORING TECHNIQUES

The concenration of radon in soil-gas is measured using instantaneous and time-integrated techniques. The detectors used for radon emanation employ a ZnS(Ag) scintillator and plastic track detectors LR-115 type II.