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Assessment of radon concentration and external gamma radiation level in the environs of the proposed uranium mine at Peddagattu and Seripally regions, Andhra Pradesh, India

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ABSTRACT

In the environs of uranium mineralized terrain, a little higher ambient radon concentration and airborne gamma radiation level may be expected in comparison with natural background. It is necessary to determine the radon concentration and gamma radiation level in comparison with natural background radiation for future control or to minimize the health risks. The present study gives a brief account of atmospheric radon concentration, gamma absorbed dose rate and radiation dose received by the members of public in the vicinity of the proposed uranium mine area of Nalgonda district, Andhra Pradesh, India. The ambient radon concentration in the air in the study area was found to vary from 1.74 to 25.6 Bq m^{-3} with geometric mean of 8.88 Bq m^{-3} and geometric standard deviation of 1.75 Bq m^{-3}. The measured gamma absorbed dose rate in air at 1 m above the ground ranged from 4.6 to 29.8 μR h^{-1} with an overall arithmetic mean of 16.63 ± 1.39 μR h^{-1}. The mean annual effective dose received by the members of public from inhalation of radon and its progeny and external gamma exposure was estimated to be 0.23 mSv $year^{-1}$, which is falling well under the annual effective dose limit of 1 mSv $year^{-1}$ recommended by ICRP.

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1. Introduction

Knowing the baseline level of radioactivity in areas naturally enriched in radionuclides is important in the uranium mining context to assess radiation doses to humans and the environment both during and after mining. The exposure of human beings to ionizing radiation from natural sources is a continuing and inescapable feature of life on earth. There are two main contributors to natural radiation exposures: high-energy cosmic ray particles incident on the earth's atmosphere and radioactive nuclides that originated in the earth's crust and are present everywhere in the environment, including the human body itself. Radon gas and its progeny are naturally occurring radionuclides formed within the decay series of ^{238}U present in all natural sources of the atmosphere. Inhaled radon progeny is the major source of background radiation exposures that account for more than 50% of the radiation dose to the general population (Nagaraja et al., 2006). Radon is an inert gas and diffuses through and emanates from U rich soils and rocks without undergoing chemical reactions. The radon flux density depends on the type of soil (sandy, silty etc.), its porosity and moisture, the uranium and radium content, and the depth of the water table, which impedes the flow of soil gas Irradiation of the human body from external sources is mainly by gamma radiation from radionuclides in the ^{238}U and ^{232}Th series and from ^{40}K. About 20% of the natural radiation dose is due to external radiation from terrestrial radioactivity (Rana et al., 2011). Clarification on the behavior of radon-related radioactivity in air is an issue of wide importance in the field of radiation protection, earthquake prediction and atmospheric conductivity. ^{222}Rn is a ubiquitous radioactive inert gas with a half-life of 3.8 d existing in variable quantities throughout the world. It is radiologically important because exposure to radon and its progeny is associated with cancer and other diseases of the respiratory tract (Ashok et al., 2011). It has also been found that the radon and its progeny are responsible for 5–20% of all lung cancer deaths (Myres & Newcomb, 1979) and hence about 21,000 lung cancer deaths occur annually from radon-induced lung cancer in USA, according to the study conducted by EPA (USEPA, 1997). The earlier studies in this area had been reported, about 43% of the groundwater samples had uranium concentration above the drinking water standard level of 30 ppb set by the USEPA (Raghavendra et al., 2013). Hence, it is very important to know the levels of radon and its progeny in the living environment. In this study the base line survey had done to determine the pre-mining radiological conditions of atmospheric radon, external gamma radiation level and assessment of radiation dose at the Peddagattu and Seripally regions of Nalgonda district, Andhra Pradesh, India. This study can be used as reference information to assess any changes in the radioactivity level during and after post-operation phase of mining.

2. Materials & methods

2.1. Site description

The two study areas namely Peddagattu and Seripally are contiguous and bound by latitudes 16° 35′–16° 50′ and longitudes 78° 46′–79° 17′. Each study area covers nearly 30 radius kilometer area having intersection with each other as

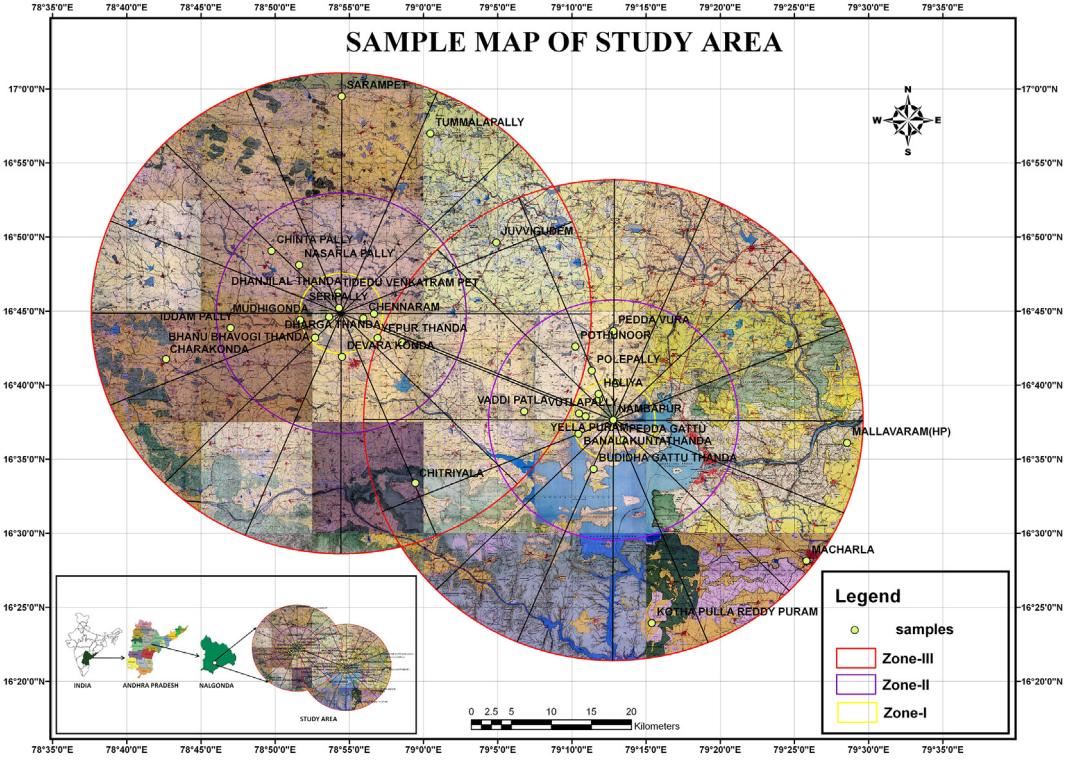

Fig. 1 – Map showing the study locations selected around the Peddagattu and Seripally regions of Nalgonda district.