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# Comparative assessment of natural radioactivity in fallout samples from Patras and Megalopolis, Greece

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**Abstract**

Bulk deposition samples were collected simultaneously from two Greek cities, Patras and Megalopolis, with different emission sources of natural radioactivity, on a monthly basis, during a whole year. Gross β-activity and $^{238}$U- and $^{232}$Th-activities were determined in a total of 95 samples of deposited dust. The results were statistically analyzed in order to determine the natural radioactivity levels and their variations in the above cities. No significant difference was found in deposited dust amount between the two cities, while the values of gross β-, $^{238}$U- and $^{232}$Th-activities were about 3, 71 and 4 times higher in Megalopolis than in Patras, respectively. This was attributed to the operation of lignite power plants A and B in the vicinity of the city of Megalopolis, while natural radioactivity concentrations in Patras' fallout samples were of natural sources.


*Keywords:* Natural radionuclides; Gross β-activity; Fallout; Coal power plant; Fly ash

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## 1. Introduction

Radioactivity in the atmosphere is due to many radionuclides, which result from natural processes, nuclear weapon tests, nuclear accidents and the operation of nuclear power plants. There are also some non-nuclear industries, such as coal power plants, that cause emission of radionuclides into the atmosphere. Coals (including lignites) contain traces of nearly all the elements. They also contain natural radioactive elements in concentrations, in some cases, higher than those in most sedimentary rocks. During combustion, a considerable amount of chemical and radiochemical pollutants are released into the atmosphere, while large amounts of these remain as bottom ash. The particulate emissions from coal-fired power plants, equipped with modern electrostatic filters, consist primary of submicron particles. As it is well established, these fine-sized fly ash particles are considerably enriched in several toxic trace metals and radionuclides (Klein and Russell, 1973; Coles et al., 1978; Roeck et al., 1987; Tadmor, 1986; Kolb, 1989; Manolopoulou and Papastefanou, 1992; Seames and Wendt, 2000). The submicron particles are of greatest concern from an environmental point of view, because they have high atmospheric mobilities and can be transported from their source over a wide range of distances. In addition, they are inhalable particles and deposited preferentially in the respiratory system (Smith et al., 1979; Clarke and Sloss, 1992; Harrison and Jones, 1995).

The activity of natural radionuclides discharged to the atmosphere depends on a number of factors such as: the concentration of radionuclides in coal, the ash content of the coal, the temperature of the combustion, the ratio between bottom ash and fly ash and the efficiency of the filtering system (Roeck et al., 1987). Several authors have reported the results of naturally occurring radionuclides in coal and the produced fly ash particles from many countries, including Greece (Alvarez and Garzon, 1989; Tso and Leung, 1996; Ayçik and Ercan, 1997). Greek lignites appear to have a high concentration of natural radionuclides, especially of $^{238}U$ (Papastefanou and Charalambous, 1979; Simopoulos and Angelopoulos, 1987; Dimotakis et al., 1988; Filippidis et al., 1996; Papastefanou, 1996). In Greece, about 70% of the installed capacity of electrical energy is produced from two main lignite power plants: one in northern Greece (Ptolemais, 3020 MW) and the other in southern Greece (Megalopolis S.E.S., plant A 550 MW and plant B 300 MW).

The main aim of this study was to investigate the influence of the power plants in Megalopolis on the radioactivity levels of the deposited matter in the city of Megalopolis. Megalopolis is a small city, with 10 000 inhabitants, and is located about 2.5 and 4 km NE to the lignite power plants A and B, respectively. For this purpose, atmospheric deposition measurements in Megalopolis were compared with those from Patras, which is a typical urban city of about 200 000 inhabitants. Both cities are located on the Peloponnese peninsula. In order to obtain total atmospheric loading, bulk deposition samples were collected at various sampling sites in Patras and Megalopolis simultaneously, on a monthly basis. Moreover, the measured values of radioactivity levels in Patras samples, which can be regarded as