POST-CHERNOBYL FALLOUT IN ROMANIA

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As part of the Romanian environmental radioactivity monitoring programme, fallout samples have been systematically collected and analyzed for gamma emitters. Chernobyl fallout space-time patterns, radionuclide concentration ratios and deposition velocities have been determined. The resuspension process has been studied, environmental half-lives for ^{137}Cs and resuspension factors have been evaluated. Hot particles have been identified in some of the deposition samples.

INTRODUCTION - OUTLINE OF THE ROMANIAN ENVIRONMENTAL RADIOACTIVITY MONITORING PROGRAMME

In 1962, in response to the need for monitoring global fallout resulting from nuclear weapons tests, the National Environmental Radioactivity Surveillance Network (NERSN) was created in the frame of the existing Meteorological Network.

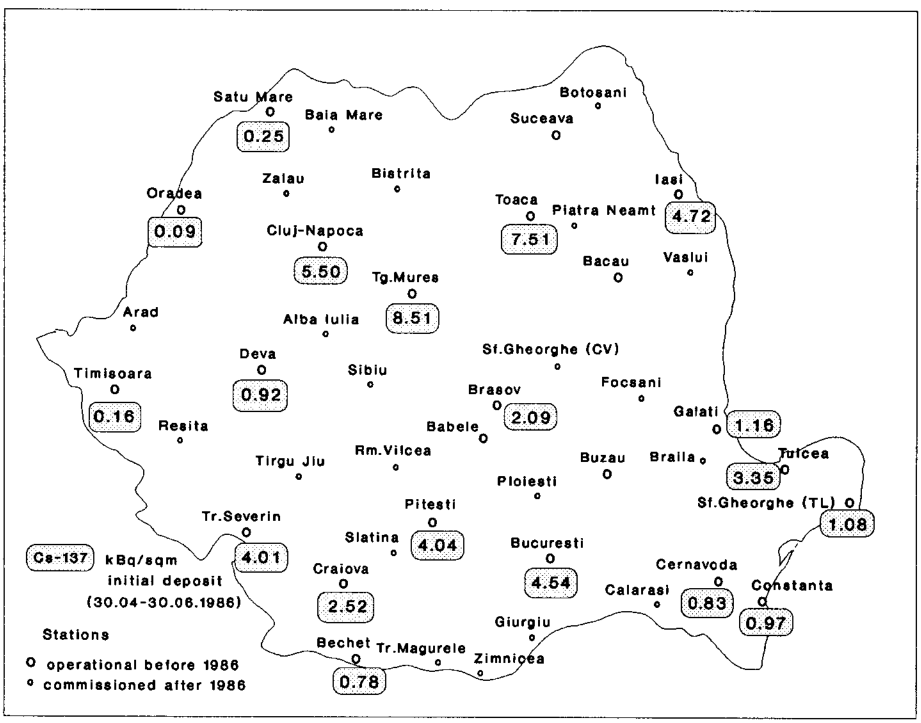

Fig.1. Stations of the Romanian National Radioactivity Surveillance Network. ^{137}Cs in fallout collected during 30.04-30.06.1986.

The NERSN has developed gradually, reaching a number of 23 stations in 1986. Following an increased interest of the public and of the counties' authorities for more detailed information regarding environmental radioactivity and radiological hazards associated with it, the number of stations has more than doubled in the years following the Chernobyl accident (Fig. 1) and activities at the Environmental Radioactivity Laboratory (ERL), which co-ordinates the Network, have been developed accordingly. Presently, the stations are affiliated to the counties' Agencies for Environmental Surveillance and Protection and report to ERL and the Ministry of Environment.

All stations follow a unitary methodology and programme in collecting and preparing samples, performing measurements and reporting data [1]. They sample atmospheric aerosol and deposition, soil, vegetation and surface, well and drinking water, perform gross beta measurements and forward the samples to the ERL for radionuclide analyses.

Among studies at ERL, those on fallout, hot particles and resuspension present a special interest due to the long-term radiological exposure pathways associated to them.

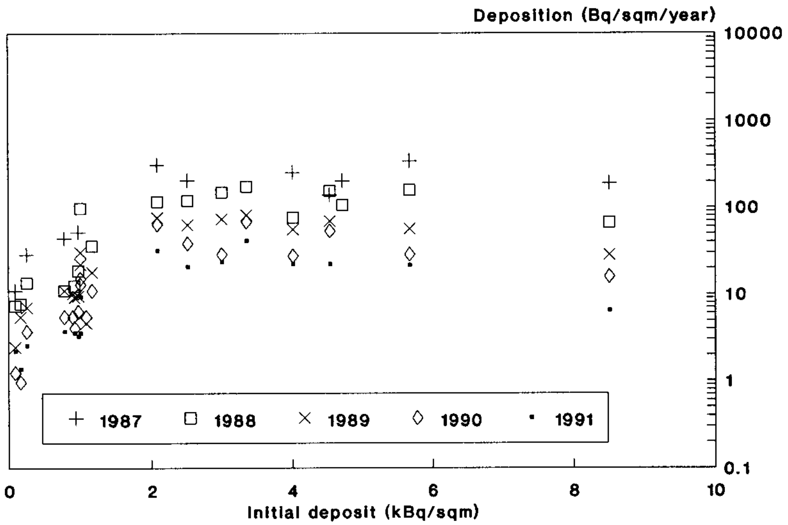

Fig.2. Annual ^{137}Cs deposition vs. ^{137}Cs in fallout collected during 30.04-30.06.1986, for several locations in Romania

METHODS OF SAMPLING AND MEASUREMENT

Fallout has been sampled employing 0.3 m^2 collectors. For most sites wet and dry deposition have been cumulated. For gamma spectrometrical analyses, monthly and annual samples have been prepared using samples collected daily. Exceptions were made in 1986, when fallout has been cumulated over shorter periods in the first month after the Chernobyl accident, as well as with some individual daily samples showing relatively high activities, occurring in the following years. The latter have been successively divided and the resulting sub-samples analysed, some of them being thus demonstrated to contain hot particles.

Gamma spectrometrical analyses have been performed using high resolution, low-background systems. All spectra have been analysed automatically. Complex spectra have also been evaluated using a semi-automated procedure which allows visual check and separate treatment for each peak or multiplet.

RESULTS AND DISCUSSION

The following radionuclides have been identified in fallout samples collected after the Chernobyl accident: ^{54}Mn, ^{95}Zr, ^{95}Nb, ^{99}Mo, ^{103}Ru, ^{106}Ru, ^{110m}Ag, ^{125}Sb, ^{129m}Te, ^{131}I, ^{132}Te, ^{132}I, ^{134}Cs, ^{136}Cs, ^{140}Ba, ^{140}La, ^{141}Ce, ^{144}Ce, ^{144}Ce, ^{147}Nd, ^{154}Eu, ^{155}Eu, ^{239}Np. Activity ratios and deposition velocities have been evaluated using specific activity data.

The levels of Chernobyl-derived fallout radioactivity, as resulting from samples collected at NERSN stations, were lowest in the North-Western part of the country, highest in the central, Eastern and Southern plains and at high altitudes (Fig. 1). Analyses of soil samples (in progress) show a more complicated pattern of contamination.

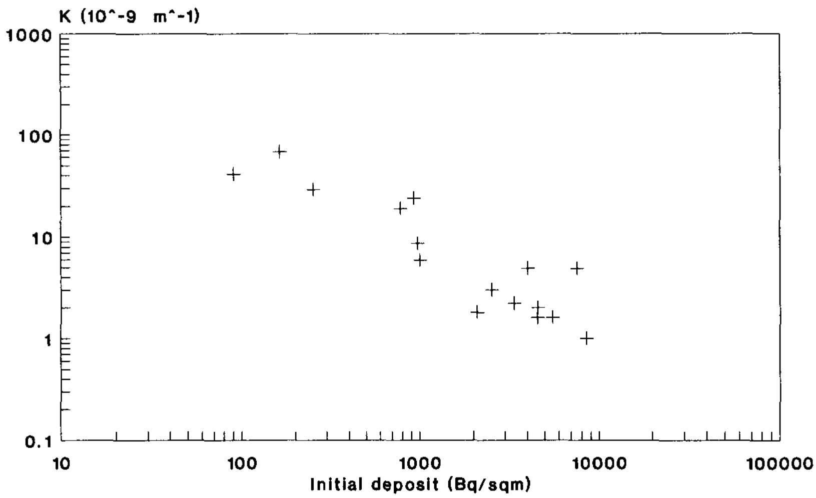

Fig. 3. Resuspension coefficient K vs. initial deposit of ^{137}Cs (30.04-30.06.1986) for several sites in Romania.

Measured monthly values of ^{137}Cs in atmospheric deposition show an exponential decrease with a site-dependent environmental half-life between 55-237 days during June 1986 - June 1987, and between 236-549 days during June 1986 - December 1991. Data on ^{137}Cs in yearly cumulated samples show that the magnitude of the initial deposit determines the magnitude of the subsequent deposition rate (i.e. sites with lower initial deposit associate lower deposition rates), but for values of the initial deposit above 2 kBq/sqm, the annual ^{137}Cs deposition does not vary with the initial deposit (Fig. 2). The resuspension coefficient K, defined in [2], decreases with increasing values of the initial deposit, as illustrated (Fig.3) by values computed for 1991, using yearly mean air concentration values [3]. K also decreases in time (Fig.4).

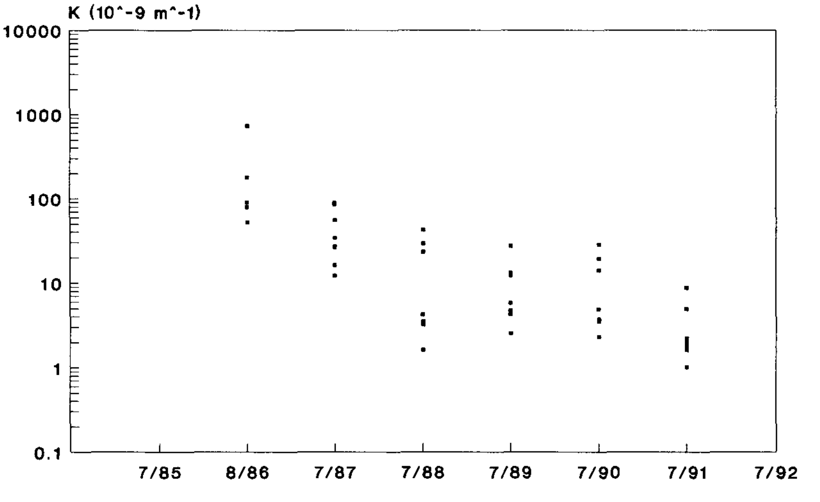

Fig. 4. Resuspension coefficient K, evaluated using ^{137}Cs data corresponding to several sites in Romania, vs. time.

During 1988-1990 several hot particles, with relatively high ^{144}Ce and ^{106}Ru activities, were identified in deposition samples, mostly originating from the Eastern part of Romania.

REFERENCES

1. *** - Procedures for environmental radioactivity measurements. Bucharest, 1987.

2. Nicholson K. W. - A review of particle resuspension. Atmospheric Environment 22, 2639-2651 (1988)

3. Sonoc S. - personal communication