CAESIUM AND STRONTIUM ISOTOPES CONCENTRATIONS IN SOME ENVIRONMENTAL SAMPLES AND GAMMA RADIATION FIELDS IN (HANOI, HAIPHONG AND VIETTRI) CITIES, NORTH VIETNAM, 1980-1990

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Abstract. We describe present activities in environment radioactivity studies in Vietnam, namely on anthropogenic radionuclides in environment samples and γ surveys in gamma radiation field. Radioactivity measurements of environmental sample have defined the concentrations of ^{137}Cs and ^{90}Sr in tobacco, in mineral water of Haiphong city and in the diet and foodstuffs from Hanoi markets and Haiphong factory collected during the period 1980-90. The total ^{137}Cs concentration in mineral water and tobacco from Haiphong city was 0.6 mBq/ml and 3.9mBq/g, respectively. The ^{90}SR concentration tobacco was 3 mBq/g in 1981. The total ^{137}Cs concentration in diet collected in Vietnam after the Chernobyl accident was relatively low compared with values in Europe and Japan. Total γ measurements of the ground surface in Haiphong,Viettri and Hanoi were carried out and surface γ radiation was shown to the geological and environmental features of these areas.

1. Introduction

Radioactive contamination of the environment, which was caused by radioactive fallout including atmospheric nuclear testing and the Chernobyl accident, is one of the serious problems for human–beings.World-wide monitoring of environmental radioactivity has been carried out by US (USDOE Report, EML-460, 1986 and cited herein) and UK (HARWELL, AERE-R11915, 1985 and cited herein). However, there are relatively few data related to radioactivity in environmental samples from the southeast Asia. Now the introduction of nuclear-power plants has begun in the southeast and east Asian countries. This means that the potential for radioactive contamination will increase in these regions. Therefore, it is necessary to the construct a monitoring system and study the present levels of anthropogenic radionuclides in the environmental samples.

In Vietnam, studies of environmental radioactivity have not yes been carried out in the whole country because Vietnam has no nuclear power reactors. In 1958, total beta activities in rain water samples collected in Vietnam were measured by using Russian equipment. Studies on radioactive contamination in the environment have been started as one of many state projects since the early 1980s. The first government project, in which the study of environmental radioactivity involved

measuring radioactivity in soils, rain water and air samples, and the gamma survey in the gamma radiation field in the north Vietnam was conducted in the period 1980-85. The second government project involved study of radioactivity in foodstuffs for period 1986-90. According to Pham Zuy Hien (1994), in a preliminary radiation survey in Vietnam during 1982-85, environmental levels of ^{137}Cs, which were detected, were quite low, eg. 0.2÷0.3mbq/m^3 in aerosol, 0.1÷0.2Bq/m^2 per moth for fallout, 2÷4Bq/kg in surface soils and 0.1÷0.2Bq/kg in cereals. In this report, we describe briefly the results of the present studies on anthropogenic radionuclides in environmental samples collected in Vietnam and on the gamma survey in the north Vietnam.

2. Sampling and methods

Samples

Tobacco and mineral water samples were collected in Haiphong city in 1981, and diet and foodstuffs were collected in Hanoi markets and Haiphong factory in Vietnam during 1986-90. The sampled amounts of tobacco and mineral water were 500g (dry weight) and 1.0 liter, respectively.

Methods

^{137}Cs and ^{90}Sr in samples were separated radiochemically. For ^{90}Sr, activities were measured after radioequilibrium with ^{90}Y . This process was carried out at the Hungarian National Institute of Radiological Sciences. β counting was carried out three to four times for each sample by using a low background β counter. The counting time was 600 min. ^{137}Cs activities were measured by low background γ spectrometer with a Ge semiconductor and a 4096 channel pulse high analyzer, which belong to VINATOM (provided by IAEA). The FWHM was about 2.0 keV at γ ray energy of 1.33 Mev (^{60}Co). Detection limits for Caesium isotopes in foodgrains and foodstuffs, and surface soils were 1 Bq/kg and 0.5 Bq/kg, respectively. Samples of dried foodgrains and foodstuffs which were pulverised and put into a cylinder pot (4π) of low background γ spectrometer. The process of empirical data was carried out by existing informatic softwares of γ spectrometer of VINATOM.

The total fluxes of γ radiation in the gamma radiation field at 50 cm height above ground surface were measured by γ ray scintillation spectrometer (GAD-I and GAD-II with NaI(t1) 80×80 cm (Canada)), comprising four channels, which allow the estimation of the total and individual radionuclides uranium, thorium and potassium. Uranium, thorium and potassium in surface soils were identified by the 1.76 MeV photopeak of ^{214}Bi, 2.62 MeV photopeak of $^{208}T1$ and 1.46 MeV photopeak of ^{40}K, respectively. In order to determine the individual concentrations of uranium, thorium and potassium, a standard sample (government standard radioactive sample provided from Russia), which includes uranium at 250 ppm, thorium at 490

ppm and potassium at 49 wt%, was used to calibrate the GAD apparatus. By using matrix method and above mentioned standard resources we found parameters of the three following equations:

$$Q_U(ppm) = 4.6\ A_U - 4.1\ A_{Th}$$

$$Q_{Th}(ppm) = 8.3\ A_{Th} - 0.8\ A_U$$

$$Q_K(\%) = 0.54\ A_K - 0.55\ A_U + 0.031\ A_{Th}$$

where A_U, A_{Th} and A_K are counting rates (cps) of corresponding channels.

The concentration of uranium (Q_U), thorium (Q_{Th}) and potassium (Q_K) were given by the three above equations from the activities of corresponding photopeaks.

3. Results

Anthropogenic radioactivity of environmental samples

We determined ^{137}Cs and ^{90}Sr in tobacco produced in VinhBao and mineral water collected in Tienlang in 1981. The ^{137}Cs and ^{90}Sr concentrations in tobacco were 3.9 mBq/g and 3 mBq/g, respectively. The ^{137}Cs concentration in mineral water was 0.6 mBq/ml, whereas ^{90}Sr was less than the detection limit.

During 1987-89, ^{137}Cs in foodstuffs in Hanoi surveyed by γ -spectrometry. The results indicate detectable ^{137}Cs in dried and fresh tea leaves and bamboo sprout, whose ^{137}Cs concentration was 10Bq/kg. This result was as same as that of Pham Quang Dien who implemented in 1989 (Pham Quang Dien: 1990). Although the reason for the detection of ^{137}Cs in dried tea leaves is unknown, the ^{137}Cs in dried tea leaves may be affected by Chernobyl fallout. In 1989 and 1990, the ^{137}Cs concentration in some vegetable samples including cabbage, tomato, carrot, potato and in some rice samples collected from Hadong market was measured by gamma spectrometry but it was less than the detection limit. These findings suggest that there is a little affect of radioactive contamination in Vietnam due to the Chernobyl fallout.

4. γ -filed survey

We measured the total radioactivity and concentrations of individual radioactive components (potassium, uranium, and thorium) in the filed in Haiphong and Viettri by using the GAD-I during 1980-85. The number of sampling sites in Haiphong was 105. The results are shown Fig. 1. The average counting rate on the ground surface was 6,000 cpm. About 65% sampling sites were in the range 4,800 to 7,200 cpm. In Viettri, the number of sampling sites was 37. The results are shown in Fig. 2. The total γ-counting rate averaged 8,400 cpm but changed from place to place depending on the type of soil and construction materials. The highest count

rate (13,492 cpm) was observed at the place of Vinhphu Peoples Committee. About 60% of the sampling sites fell in the range 6,500 to 8,500 cpm. GAD-I provides practical values of potassium, uranium, and thorium in surface soils. In these sampling sites, the average contents of uranium and thorium were 8.23 and 17.3 ppm, respectively, and the content of K in surface soils changed from 0.01 to 3 wt%. The U contents in surface soils ranged from 2.4 to 15.2 ppm, which were slightly higher than the values in loess sample (1.8 to 3 ppm) (S.R Taylor, S.M.. Mclennan and M.T. McCulloch, Geochem: 1993) and granite (3 to 6 ppm) (K.H. Wodepohl: 1969). The Th contents in surface soils and building stones ranged from 5 to 20 ppm, near the values in the loess sample (5.4 to 14 ppm) (S.R Taylor, S.M.. Mclennan and M.T. McCulloch, Geochem: 1993) and in granite (10 to 20 ppm) (K.H. Wodepohl: 1969).

In Hanoi region, surface γ-ray measurements were carried out by using GAD-II. The number of sampling sites was 97. The result is shown in Fig. 3. The highest counting rate (5,310 cpm) was observed at So crossroads. The field γ activity in Hanoi was generally lower than that observed in Haiphong and Viettri. The average contents of K,U and Th in surface soils in Hanoi were 4.4±0.6%, 7±1 ppm and 17±2 ppm, respectively. The composition of uranium and thorium in Hanoi was similar to that observed in Viettri.

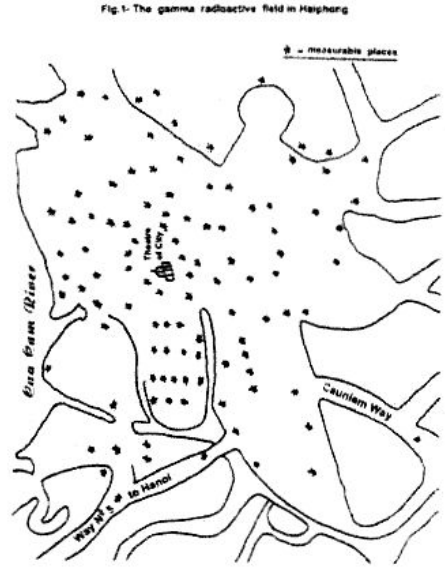


Fig 2: The gamma radioactive field in Viet Tri

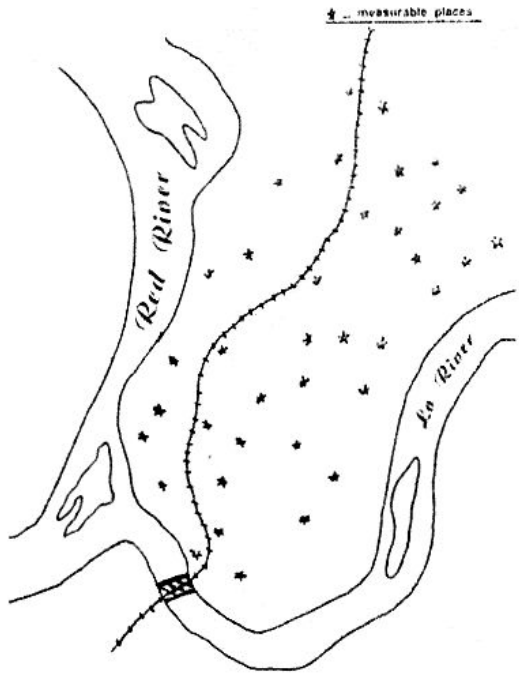
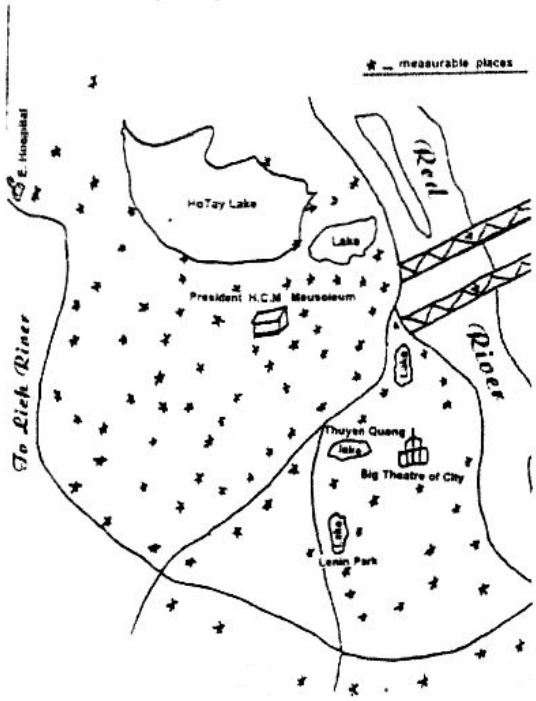


Fig 3: The gamma radioactive field in Ha Noi



5. Conclusion

In Vietnam, studies on environmental radioactivity have begun. So far, there has been no serious contamination by anthropogenic or natural radioactivity in studied environments in the north Vietnam. However, the potential for radioactive contamination in South East Asia has been existing. Consequently, it is necessary to construct a radioactivity monitoring system and develop future environmental radioactivity studies in Vietnam.

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