T2.2-P15

Variations of ^{137}Cs Background of Global Fallout at OSI Site as the Signature to Radiation Anomaly or the Artefact

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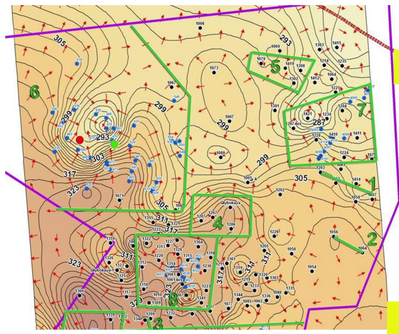
- Main goal of the OSI is search and locate radiation anomaly. The radiation anomaly search usually, as an area or a site with increasing level radiation. However may be and another situation, when the radiation level is less than in around of. As an example , we can cite the results of our research at the Semipalatinsk Test Site (STS). Earlier in the end of 80s of last centuries when we were developed of the OSI methodology has been detected, that after nuclear explosion in a shaft (large vertical hole) on STS ^{137}Cs background of global fallout has noticeably decreased.

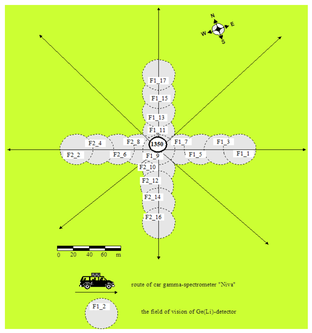
For example, underground nuclear explosion ion the shaft № 1350 (Joint Verification Explosion –USSR –USA (JVE), in Sept.1988) was full contained without noble gas seepage. After 1 year, KRI team found ^{137}Cs background at this technical site with radius 100 m became less than before JVE explosion, and decreased almost 2 -10 times. It was negative radiation anomaly.



Test Field "Balapan" structure of the STS

On this Test Field were conducted 131 UNE in the large vertical holes (shafts).

Mobile gamma - spectrometer "Niva" at former Semipalatinsk Test Site, 1997-99



This mobile laboratory has NaI(Tl)-spectrometer (4 detectors , total volume 12 litres) and 2 Ge(Li)-spectrometers. It carried out gamma measurements at 64 points along 8 radial profiles. Velocity car was 10 km/h during survey.

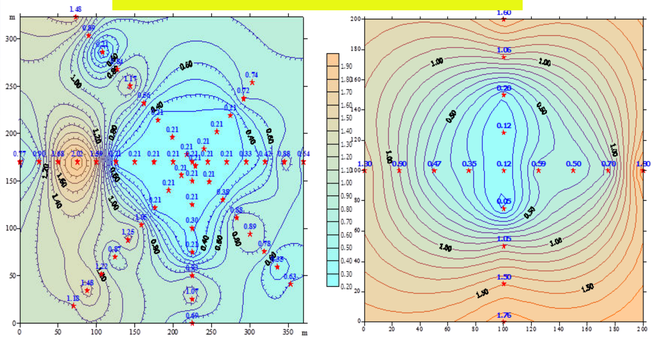
Scheme of radiological survey around the shaft 1350 (JVE), by "Niva-2"- and Ge(Li) spectrometer

In 1997 - 1999 has been surveyed 13 technical sites on "Balapan" Test Field of former STS on which remains 10 new unused and many nuclear tested shafts.

Three old tested shafts №№1350(IVE),1412 and 1365 were chosen for survey taking into account radiation situation at the moment of the explosion (no plume, no noble gas seepage). Gamma spectrometric measurements around shafts № № 1350,1365 and 1412 at "Balapan" Test Field are conducted simultaneously by two spectrometers with Ge(Li) detectors installed at 17 points and also in 64 points along eight radial profiles, using carborne NaI(Tl)-spectrometers "Niva". Near every shafts were stratified soil sampling at the depth of 20 cm (4 layers 5 cm each) for the laboratory analysis.

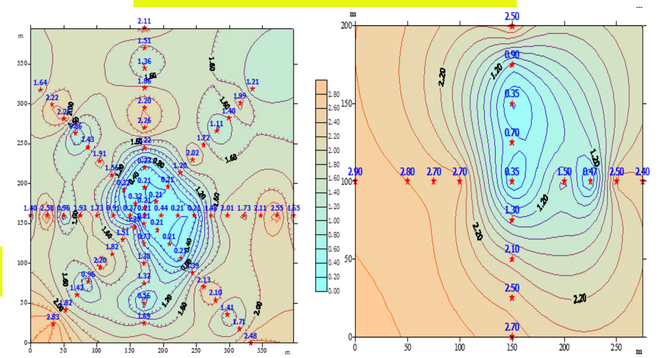
The analysis shows that within the radius of ~100 m around shafts the ^{137}Cs activity surface became much less than the background of global fallout ^{137}Cs in the Semipalatinsk region and former STS what was on 1997-99 about 2.0-2.5 kBq/m^2 (2,7-3,3 kBq/kg).

^{137}Cs Distribution around of the Shaft 1350

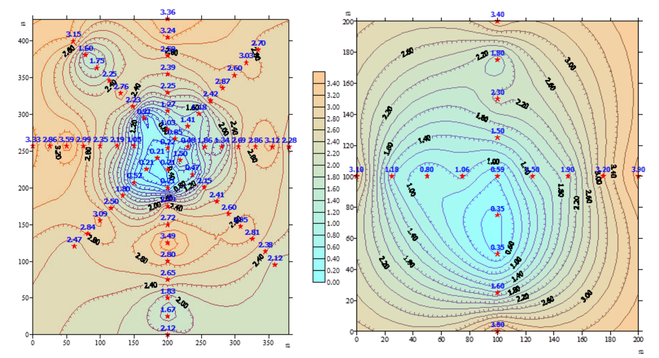


"Niva" measurements, kBq/m^2 Ge(Li)- spectrometers measurements, kBq/m^2

^{137}Cs Distribution around of the Shaft 1365



^{137}Cs Distribution around of the Shaft 1412



Shaft tops are located in the center of the diagrams.

Blue color – less than background 2,5 kBq/m^2
Pink color - ^{137}Cs background of global fallout

Table 1. The average ^{137}Cs activity surface on technical sites of unused shafts, кBq/m^2

№№ shafts	Mean±SD	Points of spectra	Activity variation	Survey in	Test data
1311	1.8±1.0	6	1,0 -3,7	1997	Nuclear test not conducted
1311	0.89±0.79	6	0,25 -2,1	1998	Destroyed by TNT
1349	2.1±0.4	6	1,4 – 2,3	1997	Nuclear test not conducted
1349	0.94±0.96	6	0,08 -2,6	1998	Destroyed by TNT
1381	1.8±0.4	6	1,4 – 2,4	1997	Nuclear test not conducted
1381	1.4±1.3	6	0,3- 3,4	1998	Destroyed by TNT
1071bis	1.22±0.33	14	0,7 -1,1	1997	Nuclear test not conducted "
1389	0.92±0.4	6	0,4-2,2	"	" " "
1074	1.45±0.58	6	1,0 – 2,5	"	" " "
1327	0.96±0.66	6	0,4 – 2,0	"	" " "
1330	1.31±0.53	6	0,5 – 1,8	"	" " "
1343	1.02±0.31	6	0,7 – 1,5	"	" " "
1383	1.57±0.55	6	0,7 - 2,0	"	" " "
1386	0.61±0.22	7	0,2 - 0,9	"	" " "
1409	1.69±0.78	6	0,8 - 2,6	"	" " "
Average	1,3 ± 0,5		0,2—3,7		

From the obtained results was seen that significant scatter and decrease of ^{137}Cs activity value exists at different points around shafts.

The analysis of obtained results shows that in the majority of cases the ^{137}Cs activity surface around shafts within the radius of ~ 50 - 100m is much less (up to 10 times) than the background of global fallout. ^{137}Cs global level is reached at boarder points, i.e. outside the engineering site. This is, of course, the result of engineering activity when boring and creating a test shaft, explosion in shaft and subsequent works.
At the same time the scatter of ^{40}K, ^{238}U and ^{232}Th at different points around shafts is relatively small.

Table 2. The average ^{137}Cs activity surface on technical sites of nuclear test shafts, кBq/m^2

№№ shafts	Mean±SD	^{137}Cs surface activity, Min - Max.,	Points of measure-ments	Survey period	Test data [4]
1071bis,1074, 1327, 1330, 1343, 1383, 1386,1389,1409,1419	1,3±0,5	0,2—3,7	6 -8	1997-98	Nuclear test not conducted
	Nuclear tests were conducted				
1350 (JVE)	**0,83±0,6**	**0,05 – 1,8**	17	1999	**14.09.88**
1412	**1,8±1,3**	**0,35- 3,8**	17	1999	**12.11.88**
1365	**1,8±1,3**	**0,35- 2,7**	17	1999	**19.10.89**

- The gamma spectrometric measurements conducted by two various techniques, has shown almost an identical picture decreasing of background of global fallout ^{137}Cs on all (15) surveyed technical sites .
- From the results was seen that significant scatter and decrease of ^{137}Cs activity value exists at different points around shafts.

Conclusion

1. The research on Balapan Test Field of former STS in 1997-99 have shown, that as a result of explosion of a full contained there is a distortion of a radioactive field and decrease of ^{137}Cs, background of global fallout caused as preparatory works, and owing to explosion. On sites of vertical shafts to which were unused (not nuclear explosion), also there is a decrease in ^{137}Cs background of global fallout owing to build of the shafts. Therefore, after an UNE in a shafts occurred as increasing the density of soil contamination ^{137}Cs, and its decreasing compared to the ^{137}Cs background of global fallout.
2. ^{137}Cs radiation field remained lower than the background of global fallout level in 50-100 m radius around the new unused shafts.
Radiation anomaly can appear as both radiation background increasing (positive radiation anomaly) and ^{137}Cs background of global fallout decrease (negative radiation anomaly) at the area under inspection. A similar effect can be expected on the portal rock area of tunnel if there have been a clandestine nuclear test .The indicated effect is suggested to be used as the search characteristic during the on-site inspection.
3. Thus, this technique with application mobile high-sensitivity scintillation and HPGe – spectrometers installed in a minivan will allow to conduct the high-quality radiation survey: namely, to reveal those areas on where the background of artificial radionuclides in a top (5-10 cm) soil layer is disturbed or changed.

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