A Study by Gamma-, Alpha- and Mass- Spectroscopy Measurements of Uranium Isotopes Activity and Mass Ratios in Dust, Soil and Water Samples Obtained from Craters Produced by Israeli Bombardments on Lebanon during the July\August Conflict 2006.

By

Dr. Mohammed Ali Kobeissi (Prof of Physics and Independent Researcher)

PS: The interpretations in this report are the sole responsibility of the author. Any comments or critic toward this report is welcomed.

“IT IS THE TRUTH WHICH MAKES YOU FREE MAN”

“DIE WAHRHEIT MACHT EUCH FREI”

"ان قول الحقيقة هو الذي يجعلكم أحرارا"

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ABSRACT: In this report we present results of the investigation on the possible use of depleted and non-depleted uranium by the Israeli bombardments on Lebanon during the July/August conflict 2006. The study was made on two dozens of dust and soil samples collected from appropriate craters of several areas in Lebanon using Gamma- Alpha- and Mass-spectroscopy techniques. Most of the results show no contaminations by DU except in Khiam crater area where high radio activity of uranium was present, which might indicate the use of weapons equipped with DU and dirty natural uranium.**

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* University Professor of Physics and Independent Researcher, email :makobeissi@yahoo.com

** Detailed information on data and results can be obtained from the author.

A MISSILES ON RASHAYAH IN SOUTH LEBANON

1-Introduction:

a)- In the war Zone in South Lebanon

The 33 days war waged on Lebanon by Israel starting on July 12th-2006, has left a large part of the Lebanese infrastructure in a complete destruction. Weapons of highly powerful explosives were used with a tremendous efficiency, so that homes, high rise buildings and highway bridges have been flattened to the ground. Road communications between the cities in south Lebanon and elsewhere in the country were cut using weapons such as bunker busters. Hundreds of thousands of civilians of the population were forced to leave the south to other safe community places in the country. Children suffered the most and many were killed and some were burned in indiscriminate attacks.

During the first 20 days of the war, I remained in my residential area in Nabatyeh in South Lebanon witnessing the Israeli war planes throwing missiles on towns including schools, markets, moving cars and fleeing civilians. The craters caused by these missiles ranged from small size of depth of 4 meters to about 10 meters and larger in some cases.

b) South Beirut under Attacks

On August 2, I moved to a residential place in the suburb of Beirut on a hill, overlooking the southern city. During the following days, south Beirut was rained by the Israeli missiles causing huge clouds of dusts mixed with flames of fires.

Being a nuclear physicist and knowledgeable in nuclear radiation, these phenomena brought to my mind the possible use of missiles by the Israelis and bombes equipped with Depleted Uranium (DU) as was the case in the war on Irak.

Directly after the cessation of the bombardment on August 14th-2006, and knowing the effect of the use of DU on the health of the

ATTACKS ON SOUTH BEIRUT

population, I went to South Beirut to explore the situation there. The whole section looked like Berlin during World War II as was presented by the media; flattened high rise buildings were sandwiched to the ground, black dust, suspected to be Uranium Oxides, covered the remaining of concretes, and bad smells originated from dead human bodies buried under the ruins and from the weapons chemicals.

2-Radiation Activities in the Craters of the Khiam Town in South Lebanon

On August 20th and after I returned to my residence in the south, I received a telephone call from the town of Khiam stating that they are detecting radiations in one of the missiles craters in a residential area of the town and asking for my help. Using a very sensitive Geiger-Muller counter(GM), I went down to the bottom of that crater. The counter registered doses between 750 and 850 nSV/h (850 nSV per hour) at the deep point. This dose was 14 times more than the measured dose value of 50 nSV/h I have obtained at the surface area in the surroundings of that crater. This event was reported in the Lebanese press in the next day (Daily Star, Al-Akhbar, An-Nahar). This news prompted several Organizations abroad to follow up such an event with the thought that the Israelis might have used weapons equipped with depleted uranium (DU).

(**THE AUTHOR MEASURING IN** THE CRATER **A** IN JALLAHIEH, KHIAM)

(One of the Measured Dose Values)

Thereafter I have taken the decision to set up a research plan to investigate Depleted Uranium (DU) in the target sites and carry it out in reputable research Laboratories supervised and run by colleagues of mine who are experts on uranium in Europe.

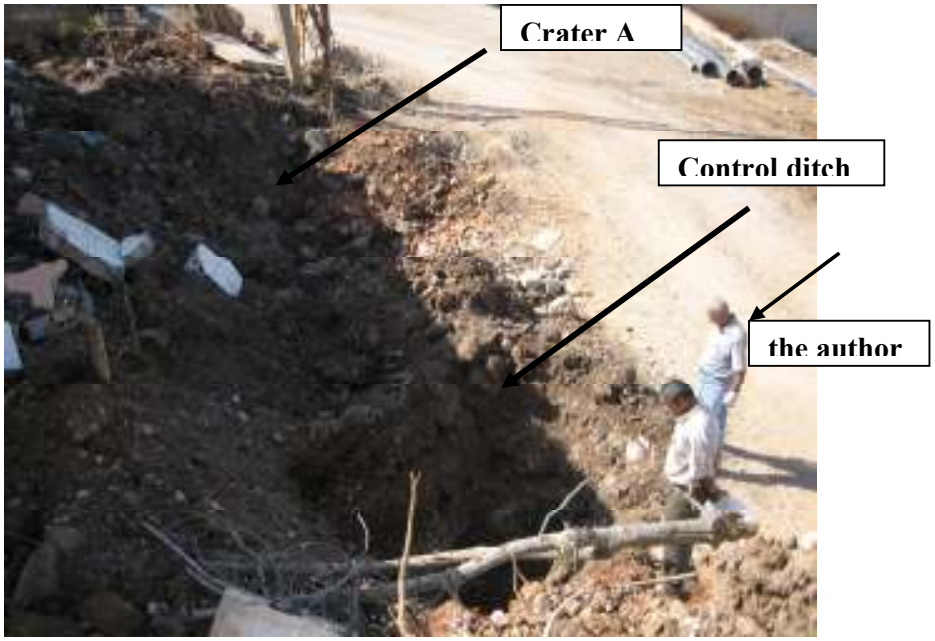
3-The Running after the DU and collection of samples for investigation:

In the following day, I have decided to collect soil samples from that crater, coded crater A in this report, and other craters in the town and outside it. To make sure that I do collect the right samples, I called Dr. Doug Rokky, a former US Army expert on missiles containing DU, describing to him the appearance of the craters soils and asking him

for advice on which soil samples are appropriate to be taken for the investigation.

3-1. Samples collection and the creation of a reference artificial ditch.

In order to have reliable scientific and accurate results, I have decided during my samples collection in Khiam area to ask the municipality to dig for me a large ditch at a distance 5 to 6 meters away from the missile crater **A** and of equal depth and size, where the depth was 3 meters at the lowest point of the ditch.. This was done in order to investigate the nature of the nuclear radiations in that area and use that ditch as a reference and control for my measurements. I took samples from the bottom of that ditch at 3 meters depth.



(**The author, second**)(THE ARTIFICIAL DITCH AS CONTROL)

At the time of my testing the radio activities in that area, using GM instrument, I found that the dose in the artificial ditch was about 410nSV/h, this is half the dose I have measured in the missile crater **A**.

The measurements were done at a depth of 3 meters in the ditch and the crater.

At about 25 meters from crater A, a house has been there and it was hit by a large missile and so a missile crater, coded **B,** was created in place of that house. The house itself disappeared completely from the place. A nearby 25 cm in diameter water pipe, which supplied the town of Khiam, was destroyed and water flowed into the crater forming a small pond. I took soil sample from that crater, and pond water sample coded KO-WH. Also I took water from the same then repaired pipe as a control sample coded KO-WHC.

THE HOUSE CRATER **B** : THE HOUSE DISAPPEARD

Thereafter, I extended my samples collections to other towns in the south such as Froun, Ghandouria, Teery, Bint-Jbeil and Ainata. In addition I collected dust samples from South Beirut buildings. During the

samples collections, radiations in all locations were tested by the same GM detector. The measured doses in the chosen craters were about 3- 5 times more as the surface dose and not as high as the one I have measured in the very first crater **A**.

The samples collections were done in the period of **22-26 of August 2006 and were kept and ceiled in glass jars to avoid moistening and other contaminations**

To carry out such a task of research, as I have mentioned above, I contacted my colleagues in Europe and elsewhere to help in such investigation, **using Gamma, Alpha and Mass-Spectroscopy methods.** At a later stage things developed to extend these contacts to the United Kingdom.

THE AUTHOR AT FROUN TOWN CRATER

4- Motivation of the Task

At the time of my detection of high level of radiation in Khiam and the media presentation of such event, I have been a member of the Board of the Lebanese Council for Scientific Research, and as a nuclear physicist and knowledgeable of the nuclear radiation, I was member of the committee for basic sciences to help evaluate research projects and other scientific affaires in the Council. Administratively the Council is directly under the auspices of the Lebanese Cabinet. Therefore I have received a letter from the president of the Council requesting not to give any statements or information about the presence of radiations in my position as a member of the Council.. This request has motivated me to quit the Council and keep my free route for research and investigation of the radiation problem caused by the war action of Israel on Lebanon.

Thus having detected such high level of radiations and knowing the effect of such findings on the health of the Lebanese people and the toxicity of the radio active Uranium and Depleted Uranium (**ref.1-4**), I was prompted to take the initiative, as independent researcher, together with the collaboration and support of the **Green Line Organization** in Lebanon to set up a research project and to carry out measurements on soil samples I have taken from craters of various areas in the country and specially the one from Khiam crater which showed the high activity. I went to Europe to execute such project in three reputable laboratories using Gamma-,Alpha-,and Mass-Spectroscopy Techniques in order to establish whether DU ammunition was used by the Israelis during their attack on Lebanon. It is well known that uranium is toxic and has very damaging effect on the body biology(**Ref.2,3**), but it must be noted that Uranium Health Effect is not completely understood yet and thus it is necessary to monitor such substance in the environment of the war action in Lebanon.

5-Properties of Uranium:

5-1-Radio active decay of Uranium: **The decay chains**

Uranium is composed of several isotopes, such as uranium, U-238, U-235 and uranium U-234. The main component in this metal is the isotope U-238 which is radio active emitting alpha and gamma radiation in the process of its decaying into several elements called its progenies or daughters. These daughters are also radio active, emitting alpha, beta and gamma radiations. **Table I-R** shows the decay chain of the isotope U-238 and its daughters. Alpha particles are the most energetic ones and most

Tabale I-R shows the decay chain of the Uranium Isotope U-238

Half life	Isotope Decay	α (MeV)	β (MeV)	γ (keV
$4.470x10^{9}$ y	$_{92}$U-238	4.198 (79) 4.151 (20.9)		49.55 (0.062) 113.5 (0.0102)
24.10 d	$_{90}$Th-234		0.199(70.3) 0.104(19.2) 0.103(7.6)	63.29(4.1) 92.37(2.41) 92.79(2.39)
1.17min.	$_{91}$Pa-234m		2.290(98.2) 1.228(1.007)	1001.03(0.839) 766.36(0.316)
6.70h	$_{91}$Pa-234		0.472(31)	945.91 (0.034)
$2.455x10^{5}$y	$_{92}$U-234	4.7746(71.38) 4.7224(28.42)		53.20(0.123)
$7.538x10^{4}$y	$_{90}$Th-230	4.6877(76.3) 4.6205(23.4)		67.67 (0373)
1600 y	$_{88}$Ra-226	4.7843 4.601		186.21
3.8235 d	$_{86}$Rn-222	5.4895 4.986		510
3.10 min.	$_{84}$Po-218	6.0024		No γ-Rays
26.8 min.	$_{82}$Pb-214	6.694	0.728 0.670 1.030	351.93 295.22 242.00
19.9 min.	$_{83}$Bi-214	5.450 5.513	3.275 1.542 1.508 1.425 1.894	609.31 1764.49 1120.28 1238.11 2204.21
1.3 min.	$_{84}$Po-214	7.6869	4.209 1.863	799.7 799.7
22.3 y	$_{82}$Pb-210		0.017 0.063	46.54
5.o13 d	$_{83}$Bi-210		1.162	
138.376 d	$_{84}$Po-210	5.3043		803.10
Stable	$_{82}$Pb-206			

damaging radiation to human cells at very close contact. This decay chain ends up with the element Lead **Pb-206**, which is stable.

The next radio active isotope in the uranium composition is uranium-235(U-235). We show its decay chain in **Table II-R** with all its daughters produced during its decay process, which ends with the stable Lead element **Pb-207.**

Table II-R shows the decay chain of the isotope U-235 and its progenies and the characteristic radiations of its daughters.

Half life	Isotope Decay	α (MeV)	β (MeV)	γ (MeV)
7.038x10 ^{8} years	$_{92}$U-235	4.3987 4.3661 4.2147 4.5964		185.72 143.76 163.33 205.31
25.52	$_{90}$Th-231		0.288 0.305 0.206 0.287	25.64 84.21 89.95 81.23
3.276x10^{4} years	$_{91}$Pa-231	5.0138 4.9513 5.0284 5.0586 4.7360		27.36 300.07 302.65 283.69 330.05
21.773 years	$_{89}$Ac-227	4.9533 4.9407	0.046	No γ - Rays 100
18.72 d	$_{90}$Th-227	6.0380 5.9971 5.7569	1.13	235.97 50.13 256.25
11.435 d	$_{88}$Ra-223	5.7162 5.6067 5.7470 5.5398		269.46 154.21 323.87 144.23
3.96 s	$_{86}$Rn-219	6.8191 6.5526		271.23 401.81
1.781ms	$_{84}$Po-215	7.3862		438.8
36.1m	Po-211		1.378 0.525	404.85 832.01
2.14	$_{83}$Bi-211	6.6229 6.2782	0.584	351.06 No γ - Rays
4.76 m	$_{84}$Po-211 $_{81}$Tl-207		1.436	897.77 897.8
Stable	$_{82}$Pb-207			

5-2-pyrophoric characteristics:

It is well known that uranium has high pyrophoric nature. It can burn to generate aerosol particles of uranium oxide. Because it is pyrophoric, when depleted uranium is heated in air at temperature of 500 degree centigrade, it can oxidize rapidly and sustain slow combustion. Thus, when a missile equipped with DU hits a solid target, a high enough temperature is created to cause explosive burning of uranium creating tremendous high temperatures to cause rapid oxidation of DU in the air. (**ref.4**).

5-3- Composition of Natural and Depleted uranium

Table I-A summarizes the isotopic composition of Natural uranium and Depleted Uranium. A trace of the isotope U-236 from reprocessed nuclear fuel may be present in some of the DU stockpile.

Table I-A: composition of natural uranium and depleted uranium

	U-234	U-235	U-236	U-238
NATURAL URANIUM	**0.0055 %**	**0.7196 %**	**0.0000 %**	**99.2749 %**
DEPLETED URANIUM	**0.0008 %**	**0.2015 %**	**0.0030 %**	**99.7947 %**

Uranium-238 (U-238) is mainly an alpha emitter with some gamma emission and with rare spontaneous fission. The alpha half-life of U-238 is 4.5×10^9 years. It decays to thorium-234 (Th-234), which has a half-life of 24.1 days and is an alpha and beta emitter, as shown in the decay chain above. Thorium-234 decays to protactinium-234m (Pa-234m),an isomer of Pa-234,which has half-life of 1.17 minutes and is a beta emitter.Protactinium-234m decays to Pa-234,which has half-life of 6.7 hours and is a beta emitter. Pa-234 decays to Uranium-234 (U-234), which has half-life of 2.4×10^5 years. This decay chain continues to the last element which is the stable lead as can be seen in **Table I-R**.(see also **Ref.4**).

Similar process takes place for uranium U-235 as we mentioned above and presented in **Table II-R**.
Alpha particle is a fast helium atom with its two electrons removed. A beta particle is a high speed electron and a gamma ray is like x-rays with much higher energy. The isotopes Th-234, Pa-234m, Pa-234 and U-234 etc. are called the progenies (or daughters as mentioned above) of the parent atom U-238. In nature these decay products of U-238 are in secular equilibrium, which means that the decay progenies of U-238 are being replaced at the same rate they are decaying.

5-4-What is Depleted Uranium?

Depleted Uranium is an industrial term for uranium waste from the enrichment of uranium ore, which concentrates the isotope uranium U-235 into the total uranium composition so that remaining uranium as a waste contains only 0.205 percent U-235 of its original value of 0.720% in the natural uranium.

The enriched uranium contains 3-5 percent the U-235 isotope for the nuclear power reactors and much higher percentage for nuclear weapons (about 90%).During the chemical process to obtain enriched Uranium all the radio active daughters in both decay chain are eliminated and therefore depleted uranium is less radio active(about 60%) of the original value.

The freshly produced depleted uranium is composed mostly of U-238 becomes a mixture of U-238, Th-234, Pa-234m, Pa-234 and U-234 through the continuous decay transformation after it reaches secular

equilibrium in four to six months as is shown in **Table-IIB**. Also at secular equilibrium, the activities of the above mentioned isotopes are equal. This property will be used in our measurements to determine the contaminations of the environment by DU.The first two decay products, TH-234 and Pa-234, along with U-238 account for most of the alpha, beta and small amount of gamma radio activities of the mixture (**Ref. 4**)

Table II-B Disintegrations/Second in 1 gram of U-238 with no Progeny initially present
α = Alpha emission , β = Beta emission, γ = Gamma emission.

	4.47×10^9 years	**24.10 days**	**1.17 minutes**	**2.46×10^5 years**
WEEKS	**U-238** α +γ	**Th-234** β+γ	**Pa-234** β+γ	**U-234** α
0	**12 430**	**0**	**0**	**0.000**
1	**12 430**	**2270**	**2150**	**0.000**
5	**12 430**	**7890**	**7840**	**0.001**
10	**12 430**	**10770**	**10750**	**0.004**
15	**12 430**	**11830**	**11820**	**0.007**
20	**12 430**	**12210**	**12210**	**0.010**
25	**12 430**	**12350**	**12350**	**0.013**
30	**12 430**	**12400**	**12400**	**0.017**

As I have mentioned above, with the impact on a hardened target, uranium bursts into flame. The temperature of this spontaneous metal fume produced by DU is between 3000 and6000 centigrade. This is in contrast to the 575 centigrade fire produced by TNT in the wars. At this high temperature the uranium oxide becomes ceramic-like, and insoluble in the body fluids. For this reason and once it is inhaled, it provides a chronic source of uranium heavy metal and contact radiation and poisoning within the body.
Based on the above effects on humans, I have undertaken the task upon myself and as independent researcher to carry out investigation on whether the Israelis have used weapons equipped with DU during their attacks on Lebanese lands, villages and cities.

6- .The measurements.

6-1.The Gamma-Spectroscopy: A Brief Theoretical Aspects on the Radio active Decays of Uranium U-238 and U-235.

In the gamma spectra, peaks of U-235 and Pa-234m are usually compared to get a value for the isotope ratio of the activities of U-235 and U-238. As indicated above the isotope U-238 with a half life of 4.47 billion years decays to Th-234 with a half life of 24.1 days. The isotope Th-234 decays to Pa-234 (Protactinium) and Pa-234m, which is used to calculate the half-lives of Th-234.
The first step is to derive a formula comparing the number of atoms of U-235 and U-238 which depends on the enrichment **e**. This is obtained by forming the following relation among the number of decays N of the nuclides U-238 and U-235, which is given by

$$N_{U-235} = e \cdot (N_{U-235} + N_{U-238}) \qquad (1)$$

or

$$N_{U-238} = ((\mathbf{1-e})/\mathbf{e}\ )\ N_{U-235.}$$

From **A**= λN, where **λ** is a decay constant, one gets: N=A/ln2)$T_{1/2}$
where A is the activity of the nuclide and $T_{1/2}$ is its half-life.
Combining these formula one obtains:

$$A_{(Pa-234)}.T_{1/2(U-238)} = ((1-e)/e).A_{(U-235)}.T_{1/2(U-235)}$$

For the ratio of activities of Pa-234m and U-235 depending on the enrichment, one obtains

$$A_{(Pa-234)}.=0.158.\ ((\mathbf{1-e})/\mathbf{e}\ ).\ A_{(U-235)}.$$

Here we have taken into consideration the relation of N and the activity A and the half-life of the nuclides U-238 and U-235 and with some calculation we get:

$$f = 0.158 \cdot \frac{1-e}{e} \qquad (2)$$

or

$$\mathbf{e = 0.158/(f + 0.158)} \qquad (3)$$

where

$$\mathbf{f = (A_{Pa-234})/A_{U-235} = (Au_{-238})/A_{U-235}}$$

and (A_{Pa-234}) and A_{U-235} are the activities of Pa-234 and U-235 respectively. In secular equilibrium, $(A_{Pa-234}) = (A_{U-238})$
For natural uranium with an enrichment of 0.72%, (**e** = 0.0072) we get

$$\mathbf{f} = \frac{A_{Pa-234}}{A_{U-235}} = 21.7 = \mathbf{(Au_{-238})/A_{U-235}}$$

and for enrichment of 0.40% (**e** =0.004) we get f = 40, which means depleted uranium. For enrichment of 1% (e=0.01) , as is the case in the consumed and wasted nuclear reactor fuel, we get a value **f=15.6**

Thus the factor f varies with the enrichment **e** and therefore the factor $f = 0.158 \cdot \frac{1-e}{e}$ can be used to analyze the enrichment of the uranium content in the soil sample and to distinguish between natural, depleted and enriched uranium.
In our analysis by gamma spectroscopy method we have used such procedure.

6-2-Gamma Measurements and Procedure

These measurements were taken in two stages. The first one was carried out in the Laboratory of the Radiometric Seminar (Germany) and the second one at the Atomic Institute of the Austrian Universities in Vienna (Austria)

a)-Measurements in Stage I :

In this stage, samples measurements and their screening were carried out by the author in the Laboratory of the Radiometric Seminar mentioned above. The Spectrometer used was a Gamma Spectrometer made by Ortec. Diameter of the detector is D =55mm, and height H=68mm and possessed high purity Germanium n-type, coaxial, and efficiency 34% referred to 3"× 3" NaI. Lead thickness was 5 cm and internal diameter was 30 cm. The samples were set in a one liter (1L) Marinelli container. All spectra of the samples were taken for 10 hours. Background was taken in the vicinity of the detector .

In this stage of measurements eleven samples were investigated and screened. The activities of their nuclides content were determined .Several samples showed very low activities of U-238 and U-235 and were subject to a larger statistical errors than those with high activities. Other samples showed natural content of uranium while the remaining samples indicated high activities and were investigated in stage II in order to be measured for longer time (24 hours) and to obtain more accurate value for the factor f.

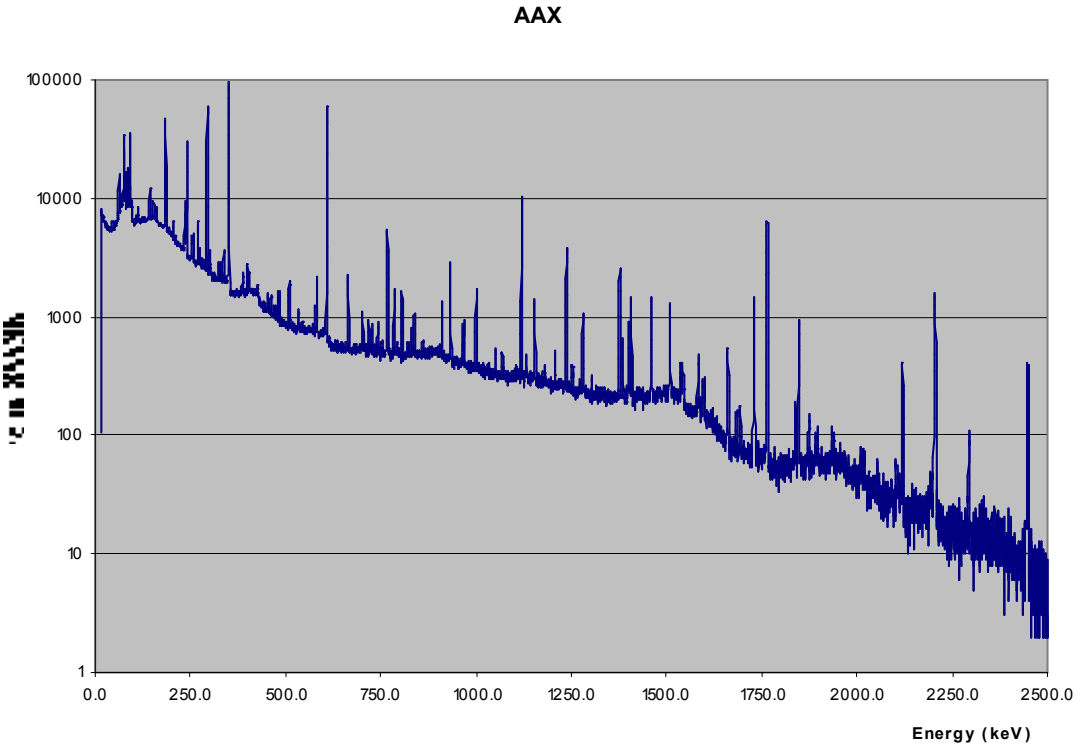
b) - Measurements in Stage II were carried out at the Atomic Institute of Austrian Universities

The measurements of the remaining soil samples from the first stage were analyzed also with gamma spectroscopy to investigate whether depleted uranium is present in those samples. Here a High Purity Germanium detector has been used and samples were set in Marinelli container as before. The measuring time for the samples with relatively high activity was 24 hours..

A measurement of the background was used to determine the contamination of uranium isotopes in the vicinity of the detector, which showed that no contamination was detectable.

As an example for the method of our analysis we present the following plot of the spectrum AAX for the sample A taken from crater A which shows a large number of peaks. These peaks could be identified to a large extent as daughters from natural uranium (U-238 , U-235) and Thorium Th-232.

The U-235 activity was described by the peaks at 163.33 keV and 205.31 keV while
Pa-234m was analyzed at 1001.3 keV to get the activity of U-238. The data were obtained by computer-based analysis.



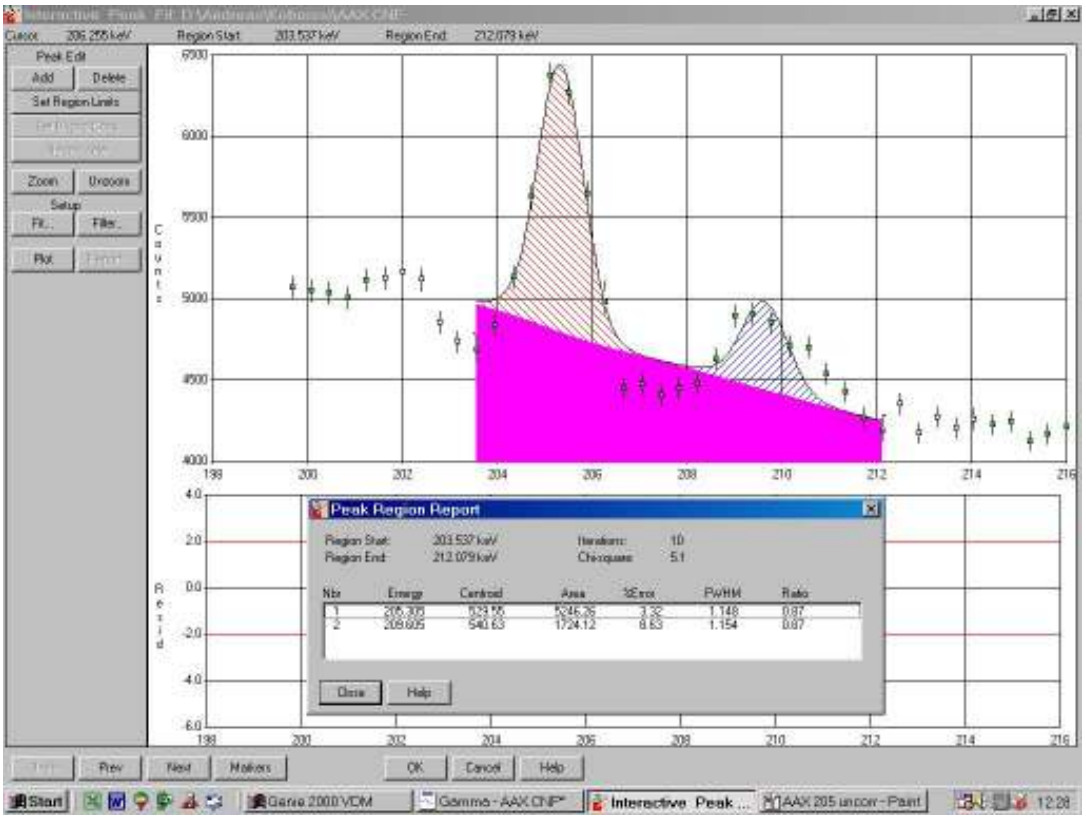


Figure I: Uncorrected peak-fitting

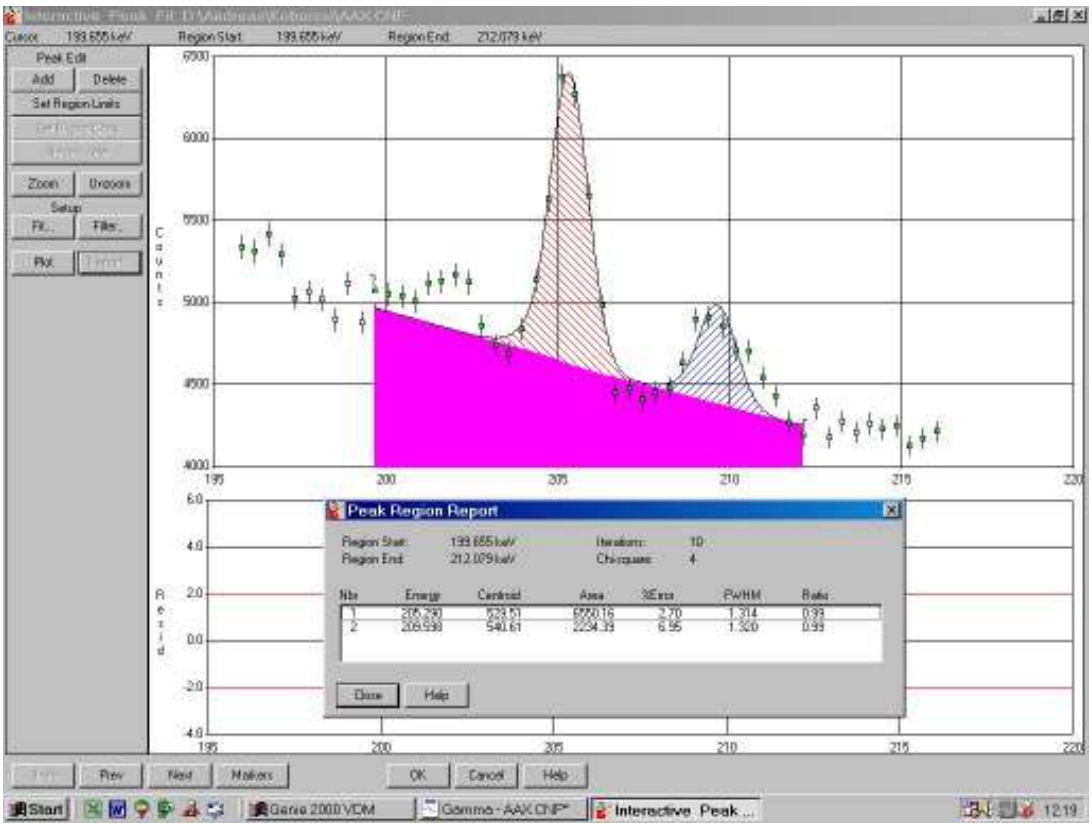


Figure II :Corrected peak-fitting

Nevertheless the data, especially at 205 keV, had to be corrected manually to get a correct background subtraction and correct and precise evaluation of data in regard the possible contamination with DU. The corrected and uncorrected peaks are shown in Figures I and II.
Since Gamma quanta are emitted with certain branching ratios, therefore the obtained count rates have to be corrected with the following data presented in the following list. These data were used to evaluate the results for the samples measurements:

Nuclide	Energy (keV)	Branching Ratio (%)
Pa-234m	1001,03	0.83700
U-235	205,31	5.01000
U-235	163,33	5.08000

To get the activity in Bq from „counts per second“ one must also evaluate the detector efficiency. This value depends on the detector geometry.

In the case of the Pa-234m peak at 1001.3 keV one gets an efficiency of 0.94 %.

The same procedure can be used for the other uranium peaks, to get the following table:

Sample	Nuclide	Energy (keV)	cts/s	Err (%)	Br. Ratio (%)	Eff. (%)	Bq
AAX	Pa-234m	1001,03	7,78E-02	1,54	0,837	0,94	989,1
	U-235	163,33	8,00E-02	2,89	5,08	3,59	43,8
	U-235	205,31	7,61E-02	2,7	5,01	3,32	45,8

The factor f can easily be obtained by division of the activities:

$$f = \frac{A_{Pa-234}}{A_{U-235}}$$

and with

$$e = \frac{0.158}{f + 0.158}$$

one can get the enrichment **e** from f.

The following table, **Table I,** shows the results of the measurements on the samples obtained from the craters and other locations: AAx (Khiam crater A in Jallahieh), BBx (is a sample from the same crater as for AAx), FFx (sample from Froun Town), GGx (sample from the surface of a crater in Froun), Ex(control sample for AAx and BBx), where the sample was obtained from the surrounding surface of the crater and it might be contaminated by DU. SP(Metal* samples of a missile shrapnel).

Sample	Nuclide	Energy (keV)	cts/s	Err (%)	Br. Ratio (%)	Eff. (%)	Bq
AAX	Pa-234m	1001.03	7.78E-02	1.54	0.837	0.94	989.1
	U-235	163.33	8.00E-02	2.89	5.08	3.59	43.8
	U-235	205.31	7.61E-02	2.7	5.01	3.32	45.8

f	e	
22.1	0.71	%

Sample	Nuclide	Energy (keV)	cts/s	Err (%)	Br. Ratio (%)	Eff. (%)	Bq
EX	Pa-234m	1001.03	1.87E-02	10.62	0.837	0.94	238.1
	U-235	163.33	1.70E-02	7.29	5.08	3.59	9.3
	U-235	205.31	1.85E-02	20.01	5.01	3.32	11.1

f	e	
23.3	0.67	%

Sample	Nuclide	Energy (keV)	cts/s	Err (%)	Br. Ratio (%)	Eff. (%)	Bq
BBX	Pa-234m	1001.03	6.63E-02	5.93	0.837	0.94	842.2
	U-235	163.33	6.17E-02	3.41	5.08	3.59	33.8
	U-235	205.31	5.06E-02	3.99	5.01	3.32	30.4

f	e	
26.2	0.60	%

Sample	Nuclide	Energy (keV)	cts/s	Err (%)	Br. Ratio (%)	Eff. (%)	Bq
GGX*	Pa-234m	1001.03	0.00E+00		0.837	0.94	0.0
	U-235	163.33	0.00E+00		5.08	3.59	0.0
	U-235	205.31	0.00E+00		5.01	3.32	0.0

f	e	
n.a.	n.a.	%

* No Pa-234m (U-238) or U-235 detectable after 7.5 hours measuring time

Sample	Nuclide	Energy (keV)	cts/s	Err (%)	Br. Ratio (%)	Eff. (%)	Bq
Metal*	Pa-234m	1001.03	0.00E+00		0.837	0.94	0.0
	U-235	163.33	0.00E+00		5.08	3.59	0.0
	U-235	205.31	0.00E+00		5.01	3.32	0.0

f	e	
n.a.	n.a.	%

* No Pa-234m (U-238) or U-235 detectable after 14.4 hours measuring time

Sample	Nuclide	Energy (keV)	cts/s	Err (%)	Br. Ratio (%)	Eff. (%)	Bq
FFX*	Pa-234m	1001.03	0.00E+00		0.837	0.94	0.0
	U-235	163.33	0.00E+00		5.08	3.59	0.0
	U-235	205.31	0.00E+00		5.01	3.32	0.0

f	e	
n.a.	n.a.	%

* No Pa-234m (U-238) or U-235 detectable after 4.4 hours measuring time

Table I:Gamma Measurements of the Samples showing ratio factor f and enrichment e.

The errors of the measurements in **Table I** result from uncertainties of the detector efficiency in combination with the sample geometry and the low sample-activity. The total error of the factor **f** can be estimated as below 20%.

6-3-Results and Discussion of the Measurements obtained in Stage I and II:

The table above shows the values of the ratio factor **f** and the enrichment factor **e** of the measured samples in the Austrian Laboratory. Values of the measured activities to evaluate the factor **f** in these measurements showed either very low activities or natural uranium contents. Only the two samples A and B collected from the Khiam crater **A** indicated high activities in both stages of measurements.
Sample E was used as a control sample for samples A and B from the Khiam crater **A**. It shows, within the experimental error, a natural uranium content behavior with **f** = 23.3 and **e**=0.67 %, which indicates possible contamination by DU. Sample A gives f=22.1 and **e** = 0.71, which conform with natural U content, but sample B gives value **f**= 26.2 and **e**= 0.60 %, which tends to indicate contamination of the crater with Depleted Uranium. This affair will be discussed bellow concerning an inhomogeneous distribution of contamination.
In order to have comparative measurements for the samples regarding depleted uranium content in the soils, measurements on uranium glasses and depleted uranium glasses have been performed. Values for the ratio factor **f** were obtained as **f**=25 for uranium glass and **f**=38 for depleted uranium glass. This corresponds to enrichment of **e** = 0.65 and **e** = 0.41 respectively.

These results put the enrichment value for the sample B as being between depleted uranium glass enrichment of 0.41% and natural uranium enrichment of 0.72%
To check on the justification of our gamma spectroscopy measurements we have performed Alpha measurements on the same samples and on dust samples obtained from the bombarded areas of SOUTH BEIRUTE..

7-The Alpha Spectroscopy Method.

In the decay chain of natural uranium, secular equilibrium is maintained among the progenies(daughters) products of the isotope U-238. In this decay chain the radio active isotopes U-238 and its daughter U-234.emits alpha particles. Thus forming the ratio of their activities is a measure of contamination or non-contamination by DU of the materials to be investigated. Forming the ratio of the specific activities $\mathbf{A}_{\alpha}$(U-238) and $\mathbf{A}_{\alpha}$(U-234) of these two isotopes one gets :

$$F_{\alpha} = \mathbf{A}_{\alpha}(\text{U-238})/\mathbf{A}_{\alpha}(\text{U-234}) \qquad (8)$$

In this case the ratio of the specific activities of the isotopes U-238 and U-234 must be equal to **one(1.0)** for the secular equilibrium (see **Table II-B**). If the soil is contaminated with depleted uranium then there will be an increase in the quantity of the isotope U-238 and thus increasing its specific activity in the samples leading to a larger value than one for the ratio F_{α} , which will indicate the presence of DU in the samples

7-1.Measurements of the alpha specific activities in the collected samples

We have undertaken measurements of the activities of the isotopes U-238, U-235 and U-234 in several appropriate soil samples taken from different missiles craters including the Khiam one. Also dust samples taken from the roofs of the remaining high rise buildings in South Beirut (Dhahieh) were investigated also by Alpha radiation. To obtain a clear picture of the samples activities, a screening procedure by gamma

method was performed. **Table II** shows the results of the measurements of the gamma specific activities of the samples. Notice that the sample **JJ** was obtained from the Khiam crater **A** as crashed soil sample and it produces the highest gamma activity among the measured samples. This is consistent with the

Table II: Gamma measurements in the collected samples: SB1-Sb7 and XSB11 are dust samples collected from high rise building in South Beirut (Dhahieh).GH= dust from Ghandourieh town crater. GL= dust taken from crater A surroundings in Khiam town. JJ= crashed soil sample from crater A. FF+Soil1+Soil2+ soil samples collected from Froun town craters.

TABLE II A-Gamma-Spectroscopy

Sample	U-235 [Bq/kg]	U-238 [Bq/kg]	Pb-214 [Bq/kg]	Ra-226 [Bq/kg]
SB1	< 7.60E+00	< 3.92E+01	2.45E+01	2.53E+01
SB3	< 1.78E+01	< 1.05E+02	4.19E+01	3.59E+01
SB4	< 5.28E+00	< 2.60E+01	2.48E+01	2.43E+01
SB5	< 9.20E+00	< 4.37E+01	3.21E+01	2.82E+01
SB7	< 3.99E+00	< 3.44E+01	1.90E+01	< 6.52E+01
GH	< 1.07E+01	< 1.12E+02	2.76E+01	< 1.74E+02
XSB11	< 1.02E+01	< 6.18E+01	1.95E+01	< 1.67E+02
GL*	1.69E+01	1.85E+02	1.48E+02	1.49E+02
Soil 1	< 8.58E+00	< 8.99E+01	7.08E+01	7.04E+01
Soil 2	1.27E+01	1.03E+02	1.18E+02	1.25E+02
JJ-Powder*	6.73E+01	8.54E+02	5.45E+02	5.83E+02
FF	5.94E+00	6.97E+01	5.79E+01	6.27E+01

* have high specific activity

measurements obtained in stage I and II (see Table I). The dust sample GL taken from a destroyed house near crater **A** in Khiam town shows also high activity relative to the background.

In **Table III** we present the results of the Alpha radiation activities in the samples. It is seen that most of the activity ratios are close to one indicating the natural uranium content excepting the samples GL and JJ from Khiam, where they indicate DU presence . Alpha specific activity is the highest in the JJ sample obtained from Khiam crater **A** and is consistent with gamma results (see table II).During the samples collection from roofs of the attacked section of the South Beirut housing, I have taken into consideration the downwind directions based on the observation I have monitored during the Israeli attacks.

Table III: Samples from locations indicated in TABLE II:

Sample	U-234 [Bq/kg]	U-235 [Bq/kg]	U-238 [Bq/kg]	Ratio U-238/U-234
GL	1.76E+02	8.94E+00	1.90E+02	1.08E+00
SB3	1.84E+01	9.04E-01	1.88E+01	1.02E+00
Soil 1	5.28E+01	2.42E+00	5.39E+01	1.02E+00
Soil 2	5.13E+01	2.50E+00	5.21E+01	1.02E+00
JJ-Powder	1.85E+02	7.60E+00	1.97E+02	1.06E+00
FF	1.24E+01	7.23E-01	1.26E+01	1.02E+00

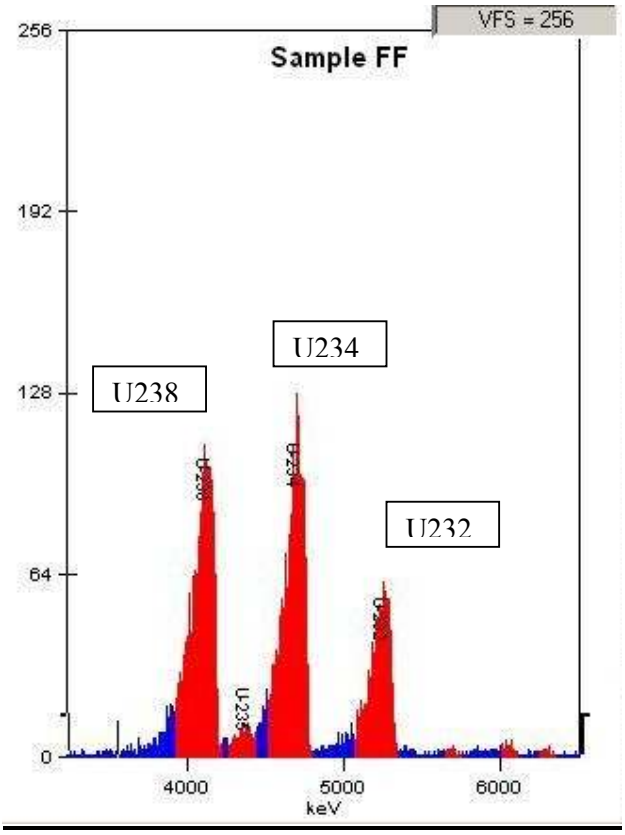
Acitivity Error: ca. 12% for U-234 and U-238; ca. 14% for U-235

In addition to the Table III shown, we present also the alpha spectra of the measured corresponding samples indicated in that table. The figures of the spectra show a visual pictures of the measurements..

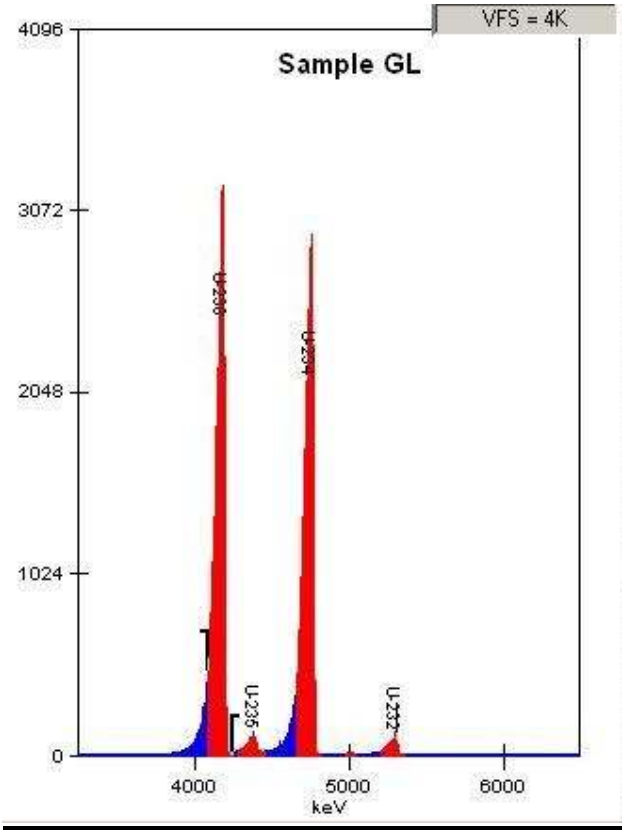
To confirm the validity of our results, we present a copy of a spectrum of measurements taken from the literatures showing a comparison of measurements of contaminated and non-contaminated soil samples. These samples were taken from the ground surface, where exercise with DU ammunition have been practiced by the army in an exercise field in Europe. By comparison with our spectra, it can be affirmed that our spectra show definite similar structure with the spectrum of the non-contaminated sample of that published research. But the structure of the spectra of Khiam sample GL might indicate DU contamination within the experimental error. Since our samples were taken directly from the surface of the deep locations of the craters, our results do assure the absence of DU contaminations in the craters soils and the dust samples taken from South Beirut. But in the Khiam case where much higher activity was present will be discussed below

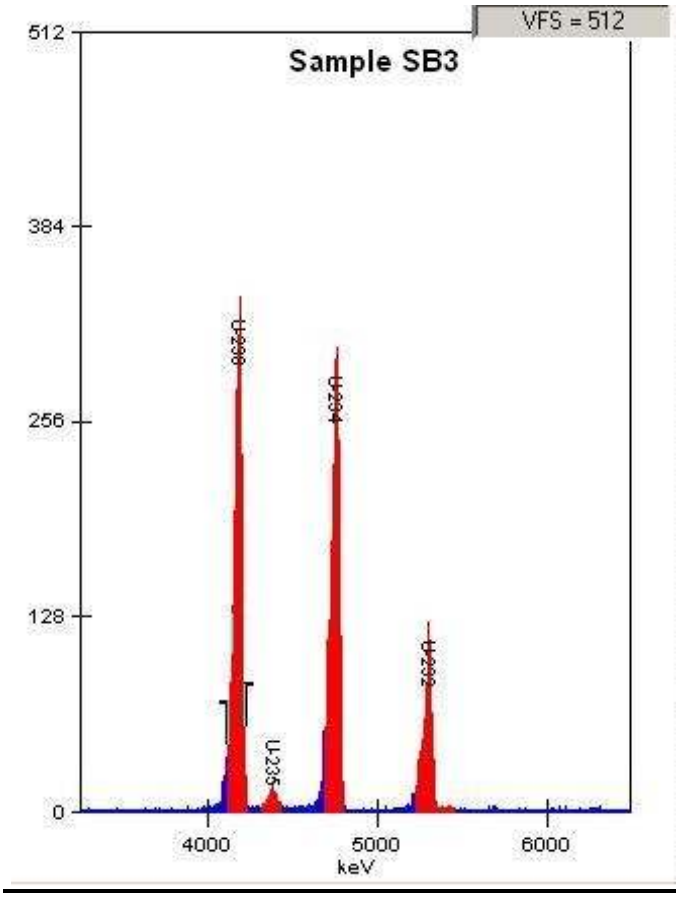
The following spectra are visual presentation for the alpha measurements of the samples indicated in the figures and table III:

The figures show the radiation intensities of the isotopes U-238 and U-234. The isotope U-232 is a standard.

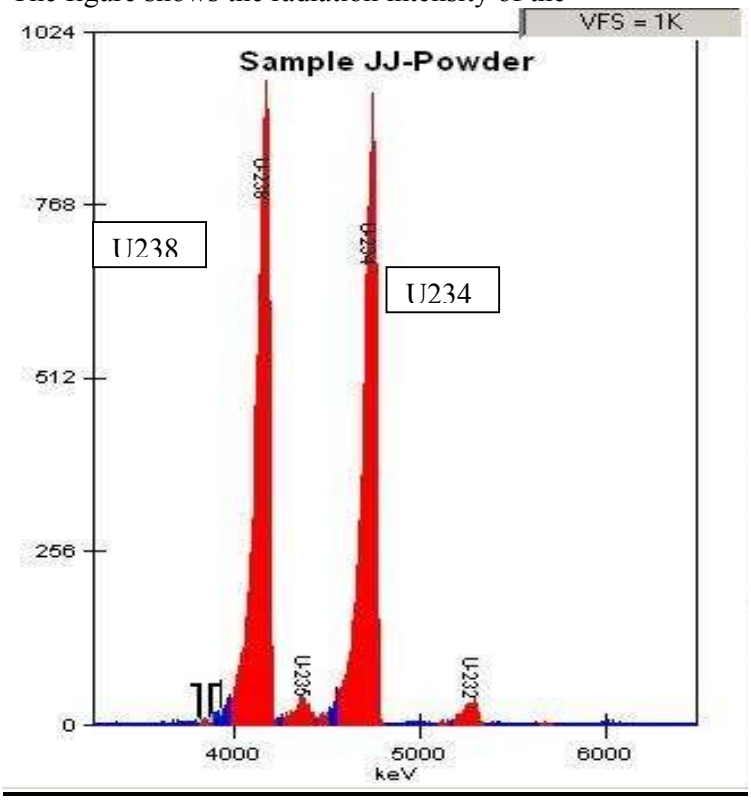


The figure shows the radiation intensity of the isotopes U-238 and U-234. (U-232 is standard

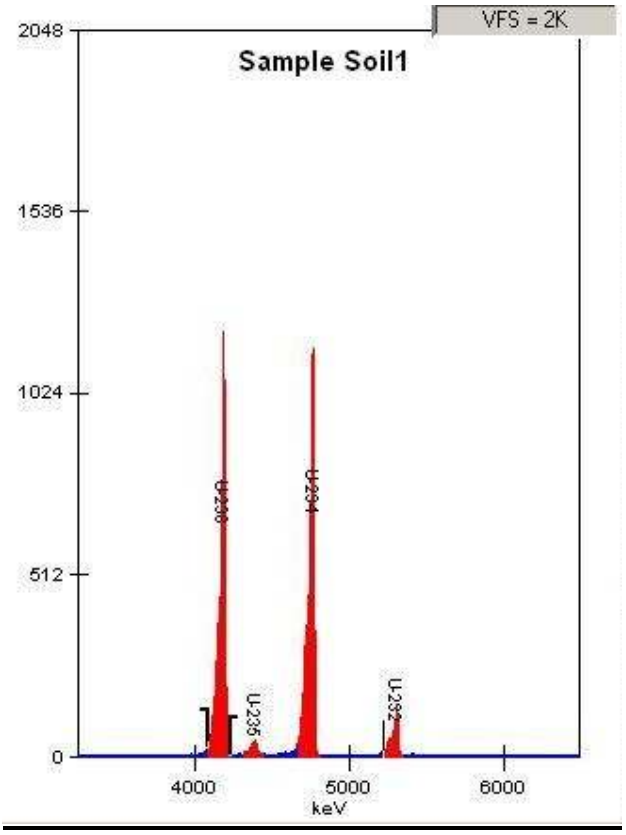


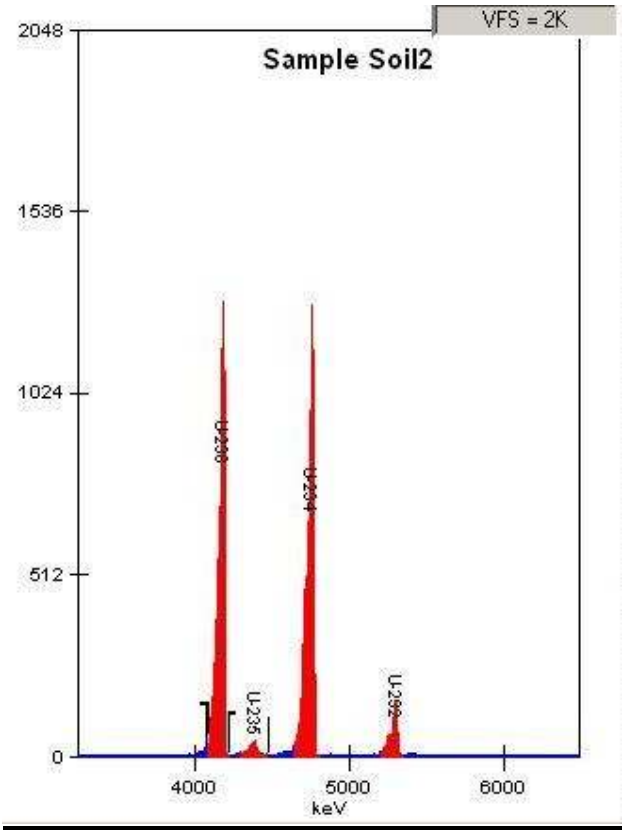


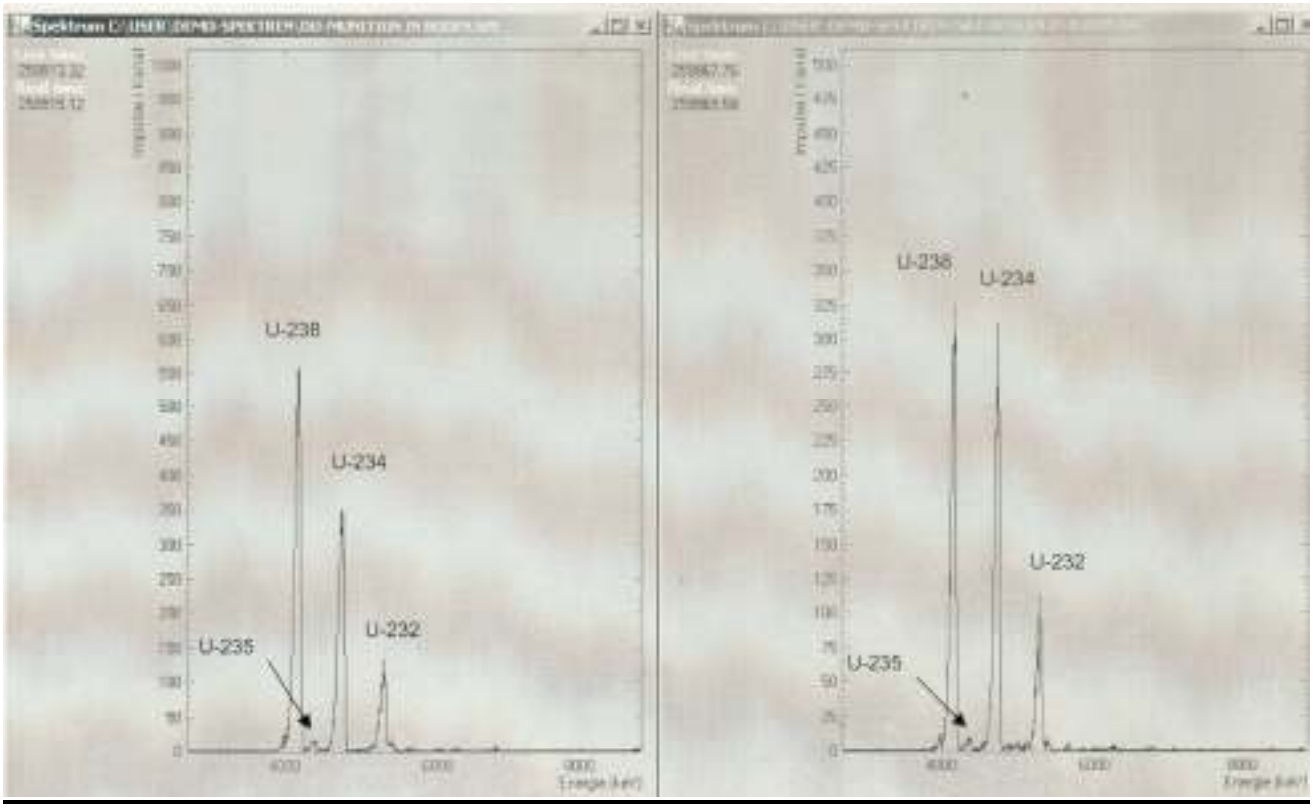
The figure shows the radiation intensity of the



isotopes U-238 and U-234. U-232 is a standard


VFS = 2K
Sample Soil1
2048
1536
1024
512
0
U-238
U-234
U-235
U-232
4000
5000
6000
keV


VFS = 2K
Sample Soil2
2048
1536
1024
512
0
U-238
U-234
U-235
U-232
4000
5000
6000
keV



A **B**

Figure 3: Spectrum A shows contaminated soil with DU taken from an exercise military field and spectrum B shows a natural soil having natural uranium content.

8- Mass Specroscopy Methode :

8-1 Mass-Spectroscopy (MS) formalism

For Mass-Spectroscopy (MS), we derive the following formula which is used in that technique in order to calculate isotopic ratios in uranium and compare our results with those obtained by other teams ,who investigated soil samples taken from the same area as ours. The relationship in the uranium enrichment is given by:

$$\mathbf{m(U\text{-}235)=e\{m(U\text{-}235)+m(U\text{-}238)\}} \qquad \mathbf{(5)}$$

with $\mathbf{e}=1/(1+F_m)$ (6)

and where

$$F_m = \mathbf{m(U\text{-}238)}/\ \mathbf{m(U\text{-}235)}\ , \qquad (7)$$

and $\mathbf{m(U\text{-}238)}$ and $\mathbf{m(U\text{-}235)}$ represent the specific mass content of U-238 and U-235 respectively.

For natural uranium with an enrichment of 0.72%, we obtain for $\mathbf{F_m}$ a value of $\mathbf{F_m = 138}$ and a value $\mathbf{F_m = 285}$ for depleted uranium of 0.35%. ,

8-2 The Results of Measurements of Enriched Uranium found by the British Team in the Khiam crater A and others:

In the process of my samples collection in South Lebanon a member of Green Audit, Mr Dai Williams, has visited me on September 16th -2006 and asked to accompany me during that process. Dai is a member of a British research team formed by Dr. Chris Busby who are active doing investigation on the use of DU in war conflicts and other environmental problems. Dai Williams collected samples on his own, including the sites in Khiam such as crater **A** and **B** mentioned above.
Green Audit has made measurements on the sample taken from the crater A in Khiam town and other places in the South. The measurements were carried out at Harwell Laboratory using Mass Spectroscopy Technique(IC-PMS). Their results are shown in Table A and were published in the media (The Independent (UK, October 28-2006, and in the Lebanese paper AS-SAFIR October 30-2006). Using the authors value of 108 for F_m in their table, we get a percentage enrichment as **e** = 0.92, which indicates that the sample from that crater is contaminated by enriched uranium as the authors explained in their report and their published results (**Ref.6**). Thus the results show the presence of Enriched Uranium in Khiam as the table shows..

Table A :**Green Audit(GA) measurements of Khiam soil samples obtained from crater A in the first visit Sept.16th and second visit Nov.20th , 2006. LS6 sample, taken from the neighboring location of crater A, was believed to have been thrown from crater A by the explosion. The measurements were taken at Harwell Laboratory using ICP-MS. D= Duplicate. Natural f=21.7 (errors are based on lower than 20 %**

GA1st Visit Sept.16th .	GA code	U-238 $mgkg^{-1}$	U-238 Specific. activity $Bqkg^{-1}$	U-235 $mgkg^{-1}$	U-235 Specific activity $Bqkg^{-1}$	Ratio U235/U238 %	Specific. Activity ratio **f=** A(U238)/A(U-235	
. Khiam soil	LS6	13	161	0.12	9.6	0.92	16.8±3.4	enriched
Khiam soil	LS6D	13	161	0.12	9.6	0.92	16.8±3.4	enriched
GA 2nd Visit Nov.20th		U-238 $mgkg^{-1}$	U-238 activity $Bqkg^{-1}$	U-235 $mgkg^{-1}$	U-235 activity $Bqkg^{-1}$	Isotope ratio U235/U238 %	Activity ratio **f=** A(U-238)/A(U-235)	
Khiam soil sample	Crater A	25	310	0.18	14.4	0.720	21.53	Normal enrichment
Khiam soil sample	CraterAD	34	421	0.25	20	0.735	21.05	

Meanwhile and after the cessation of the conflict and upon the request of the Lebanese government, a team of United Nations Environment Program (UNEP) has conducted measurements of Uranium in dust smear samples collected from different areas in Lebanon in cooperation with the Lebanese Council for Scientific Research. Both institutions declared the absence of DU in their samples. Based on the news that depleted and enriched Uranium was found in the Khiam crater, the UNEP team went back to Lebanon to investigate

the problem and to take soil samples from the same crater **A,** which was believed by the British team to contain enriched uranium and by us to contain DU.
The team has dug out the crater after it was refilled by its own soil and soil from its edges. UNEP took soil samples from the surrounding as well as at different depths in the crater. I was visiting the town at that time and I have witnessed the UNEP performance. It was noticed that the samples taken by the team showed black spots, similar to the ones I have measured, which indicates the effect of the missile explosion on the soil. I shared with UNEP some of these samples. Also at 3 meters depth during the digging, water started to leak out from the bottom of the crater and UNEP took soil samples at that depth, including a water sample, to be investigated (see their results below). At that time Dai Williams has also accompanied UNEP and took water and soil samples from crater A and crater B. Green Audit conducted measurements on their samples at Harwell by ICP-MS. Their results from the samples of their second visit are presented in **Table B**. These results show again the presence of enriched uranium in contradiction with our finding of DU in crater A.

Table B: Green Audit(GA) measurements at Harwell Laboratory for **water** samples taken from Khiam craters A and B in their second visit. D= Duplicate. Natural isotope ratio is 138.

GA Code	U-238 μgL^{-1}	U-235 μgL^{-1}	Ratio U235/U238 %	Isotope Ratio U238/U235	
Crater A LBW#4	4.0	0.04	0.990	100.0	ENRICHED
Crater A LBW#4D	4.3	0.041	0.953	105	ENRICHED
Crater B LBW#3	6.4	0.06	0.937	107	ENRICHED
Crater B LBW#3D	6.4	0.06	0.937	107	ENRICHED

The publication of Green Audit results has caused alarming health concern among the Lebanese people and a puzzling situation for the scientific community about possible use of enriched uranium in the missiles weaponry.
.The report from Harwell Laboratory states also that the uncertainty error is 20%. Using this value we get an uncertainty error of 0.20 on their enrichment value, which means that ϵ=0.92±0.20. This value falls within the range 0.70 <0.92 <1.12 with the lower value close to the value of 0.72 for natural mineral uranium but it tends toward enriched uranium.

Taking also our results, where the enrichment was given as ϵ =0.60±0.120, will lead to a range of 0.48 <0.60 <0.72 which is still comparable with the natural value of 0.72 at its upper limit, except that in our case the value of ϵ tends toward Depleted Uranium and not enriched. Has the used missile in this location delivered a mixture of DU and EU?

A possible **hypothetical answer** to this question can be given through the fact that in the use of enriched uranium as a fuel in a nuclear reactor and during several years of consumption, fission process of the isotope U-235 takes place and the uranium in this case will deplete to about 1% enrichment. This value is close to Busby's results. If the fuel is not recycled but is taken as waste and added to the waste of depleted uranium, it is then very likely that the mixture is used as ammunition in the missiles production and that might explain Busby's results and ours. But this **can be proven by investigating the presence of the cesium isotope or other by-products of the fission or the presence of U-236.**

To clarify the contradiction is to perform the experiment on the same samples taken from the same crater using the technique adopted by Busby. This will lead us to conduct experiments with higher precision and obtain results with higher confidence as it will be discussed bellow.

8-3-United Nations Measurements

As we mentioned above, UNEP team has conducted Mass-Spectroscopy measurements on the samples at Spiez Laboratory in Switzerland. **Table IV**A shows their results for the mass content of the isotopes U-238, U-235 and U-234 in the soil samples of the disputed crater **A (Ref.5)**. The table shows also the ratio U235 / U238. These ratios agree very well with the ratio of natural Uranium of 0.723% and no indication of DU or EU in the studied samples.

For seeped water sample taken by UNEP at a depth 3 meter in the dug out crater **A**, the results are shown in **Table IVB**. The isotopic ratio U235/ U238 indicates the presence of natural uranium. All the results by UNEP contradicts those obtained by the British team, (The Green Audit).

In order to compare with the results of our measurements taken by alpha spectroscopy,(given in **Table VII below)**, I converted the UNEP measured isotopic masses into the specific activity in each soil sample and then I have formed the activity ratios $\mathbf{A(_{U238})/A(_{U234})}$ of the isotopes U-238 and U-234 and the activity ratio $\mathbf{A(_{U238})/A(_{U235})}$ for the factor **f**. This is shown in **Table V.**

TABLE IVA: UNEP ISOTOPE RATIOS OF SOIL SAMPLES RESULTS FROM CRATER **A** IN **KHIAM** AND FROM DARDARA FIELD IN KHIAM REGION **(Ref..5).** HERE WE TOOK ONLY THE CLOSE SOIL TO THE CRATER RELATED TO OUR WORK.

Location : Jallahieh soil	U238 mg/kg	U235 mg/kg	U234 ng/kg	U235/ U238 % ratio
Khiam crater A (0 m)	14.20±0.6	0.101	0.696	0.711±0.004
Khiam crater A(-1m)	35.10±1.5	0.249	1.724	0.710±0.007
Khiam crater A(-2m)	42.50±1.8	0.304	2.124	0.715±0.004
Khiam crater A(-2)*	52.40±2.2	0.372	2.624	0.710±0.007
Khiam crater A(-3)	19.20±0.8	0.137	0.814	0.713±0.004
Dardara	6.53±0.28	--	--	0.726±0.004
Dardara	6.57±0.28	--	--	0.728±0.005
* Close to a missile metal piece**(Ref..5)**				

TABLE IVB: UNEP ISOTOPE RATIO OF A **WATER SAMPLE** TAKEN FROM CRATER **A** DURING UNEP'S SECOND VISIT TO KHIAM **(Ref..5).** THE SAMPLE WAS TAKEN FROM THE SEEPING WATER AT 3 METER DEPTH.

UNEP Sample code	U238 **µg L^{-1}**	U235 **µg L^{-1}**	U235/ U238 % ratio	
NUC-2006-30-00010	5.3	0.0377	0.711± 0.02	

Table V: UNEP ACTIVITY RATIOS A(U238)/A(U234**)** OF SOIL SAMPLES RESULTS FROM CRATER **A** IN **KHIAM** AND ACTIVITY RATIO **f** = A(U238)/A(U235**).**

Location : Jallahieh soil : Khiam	U238 ($Bqkg^{-1}$)	U235 ($Bqkg^{-1}$)	U234 $Bqkg^{-1}$	**A(U238)/A(U234)**	**f= A(U238)/A(U235)**
At the surface 0 meter	176±7	8	160±12	1.11±0.10	22.0
-1m: bellow surface	435±19	20	396±30	1.10±0.11	21.75
-2m :bellow surface	**527±22**	24	488±37	1.08±0.11	21.95
-2m close to a metal piece	650±27	30	603±42	1.08±0.11	21.66
-3m bellow surface	**238±10**	11	187±13	**1.30±0.15**	**21.63**

It can be seen that all the activities ratios **A(U238)/A(U234)** obtained from UNEP measurements of the samples taken from crater **A** show the values to conform with natural uranium within experimental errors, where this ratio is equal to 1.0. This result is also in agreement with our alpha measurements for the samples GL and JJ shown in Table II , excepting the sample taken by UNEP at 3 meters depth, which is equal to **1.30** indicating the presence of depleted Uranium. This result contradicts the uranium natural mass ratio of the isotopes U-235 and U-238 of 0.713 for that sample given in **Table IVA**. This anomalous value (1.30) is in agreement with our measurement of a sample taken from the control artificial crater KO-J.G.C (see section3-1 above) at a depth of 3 meters and obtained by alpha–spectroscopy method as it is given in table VII below. A possible clarification of such contradiction in UNEP results and ours will be offered below within the context of our measurements.

9-The Path to Harwell Laboratories:

In the waves of confusion about the presence of Uranium depleted or enriched, and the large uncertainty in the measurements, I have decided to take my samples to Harwell Laboratory and to perform my measurements there, where Busby's measurements have been conducted. This institution is scientific par excellence. I met the staff of the experts in the mass-spectroscopy and alpha- spectroscopy measurements techniques and discussed with them the problem regarding the dispute about the finding of enriched uranium found in the measurements of the Lebanese soils in their Laboratory.

9-1 Procedure

First the samples were screened at Dr. Chris Busby's laboratory in Wales in Britain using beta and alpha radiation activity. Those samples which showed high values of beta radio activities were selected and I took them then to Harwell Laboratory to be studied by mass- and alpha spectroscopy methods.

Based on the information of measurements stated by UNEP in their reports, I found out that Harwell uses the same procedures of measurements in mass-spectroscopy as it is done at Spiez Laboratory used by UNEP. Thus comparison of data obtained from both laboratories for a given sample can be made and will help eliminate the confusion about the presence or non-presence of DU or EU in Lebanon. Also, contrary to other teams, I will use the artificial ditch I have dug at 5-6 meters away from crater A(see text above) as a control, which will help to clarify all those contradictions about the DU affair. For our measurements, I requested at Harwell that each of my samples must be measured 10 times (10 runs) in order to arrive at better statistics and to obtain results with higher confidence. Harwell staff was very co-operative and responded very professionally to my request.

What motivated me to do so is the social impact on the Lebanese society caused by the contradictions in the results obtained in the Khiam samples or other samples claiming the presence of Depleted Uranium, Enriched Uranium or none of both. Also accurate and clear scientific results for my own previous investigations was required. It must be emphasized here that the samples used were taken just after the end

of the conflict and were kept sealed in glass jars so that they were not subject to any weathering effects such as moistening.

9-2- Measurements:

9-2-1- Measurements by mass-spectroscopy using ICP-MS.

The soil and water samples were processed at Harwell and prepared for measurement of the Uranium Isotopes U-235 and U-238.These measurements were performed 10 times for each sample by the ICP-MS instrument in order to obtain accurate results. In **Table (VIA)** we present the data of the appropriate soil samples, which include: the soil sample of the Khiam crater **A,** the soil sample from crater B, and the soil sample from the artificial ditch as control for crater **A**. The table shows also measurements of samples taken from Dardara field in Khiam area, which show natural uranium

Table VI A : MEASURED SEVRAL SOIL SAMPLES BY MASS-SPECROSCOPY AT HARWELL LABORATORY Factor f indicates the Activity ratio As(U-238)/As(U-235), which should be compared with 21.7 for natural uranium as calculated in section 6-1 in the text

LOCATION						
(KO-..)and (EF…) are our codes and Harwell codes respectively	U-238 ($mgkg^{-1}$)	U-238 specific activity ($Bqkg^{-1}$)	U235 ($mgkg^{-1}$)	U235 Specific activity ($Bqkg^{-1}$)	%U-235	f =As(U-238)/As(U-235)
Jallahieh crater A						
Soil Sample						
KO-7A (EF6874)	43.2	536	0.314	25.12	0.721±0.009	21.44±0.31
KO-J.G.C. (EF6871) Control ditch	18.5	229.4	0.134	10.72	0.719±0.004	21.40±0.12
Jallahieh ,Crater B						
Soil Sample						
KO-3A(EF6873)	2.01	25	0.0144	1.152	0.711±0.040	21.70±1.20
Almarj Crater						
Soil Sample						
KO-1A (EF6872)	0.816	10.12	0.00578	0.462	0.703±0.036	21.90±1.13
KO-MC (IF3671) CONTROLE	1.343	17	0.00988	0.8	0.730±0.025	20.80±0.70
Dardara Crater						
Soil Sample						
KO-8A (EF6875)	4.36	54	0.0313	2.5	0.713±0.022	21.33±0.66
KO-DC (IF3669) CONTROLE	5.23	65	0.0378	3.0	0.714±0.013	21.66±0.40

Table VI B; The **water sample** obtained from crater **B**. KO-3WHC is control water sample obtained from the water supply pipe in Khiam town.

	U-235(µg L^{-1})	U-238(µg L^{-1})	%U-235	Remarks
Jallahieh ,Crater B				
Water Samples				
KO3WH (EF6877)	**0.0456**	**7.11**	**0.637±0.005**	**Depleted**
KO-3WHC (EF6876) : CONTROLE	**0.00344**	**0.527**	**0.648±0.015**	**Depleted**

Table VIB shows our measurements of the water samples from the water residing in the bottom of crater B and which has flown from supply water pipe into the crater due to the explosion, and a control water sample from the repaired water supply pipe for Khiam town. It must be said here that the repairing of the pipe did not include the cleaning of the extended remaining pipe. **Table VIB** shows the content of the specific masses of the uranium isotopes U-235 and U-238 in (**µgL^{-1}**) for water samples and their isotope ratio U-235/U238.
All values of these ratios obtained from soil samples indicate the content of natural uranium within experimental errors as indicated in **Table IV** and **Table VIA.** It can be seen that the ratios of our measurements and those of UNEP are in good agreement with the value 0.725% of natural uranium within the experimental errors for the same samples, but the ratios obtained from the water sample of crater **B** and the pipe water show the existence of DU as presented in **Table VIB,** while the ratio measured by UNEP for the water sample obtained from the seeped water in the bottom of crater A show natural uranium. Another difference is in the uranium U238 content in both cases, where our value is 7.11(**µgL^{-1}**) while UNEP's one was 5.3 (**µgL^{-1}**) .

As a double check and for comparison with UNEP data I have transformed the isotopic mass of U-238 and U-235 in our measurements into **specific activities** from which the activity ratio factor **f** of these isotopes was calculated. This is shown in **Table VIA** .Values for **f** obtained for soil samples indicate the agreement with the natural uranium value of 21.7 and agree very well with UNEP results as can be seen in **Table V** and Table **VIA.**

The soil sample taken from the surrounding of crater **B**, which has replaced a destroyed house by the missile explosion and which was about 22 meters away from crater **A**, showed natural uranium behavior**.** The source water we have measured and used by the town of Khiam has low level specific activity but the water obtained from the crater B has about 14 times higher specific isotopic mass than in the source water. But the presence of DU in the crater water, as we mentioned above, can be due to the contaminated dissolved soil caused by the missile materials in the water. The fact that the source water was also contaminated is due to the contamination of the inner space of the remaining pipe during the explosion. Our measurements of the soil sample obtained from Dardara field are also in good agreement with UNEP results.

Thus our results indicate that no DU, excepting in the crater **B** water, or EU are present in our measured soils and agree very well with UNEP ratios results. These results obtained from both laboratories offer an excellent scientific prove and assurance of the absence of depleted or enriched uranium in the investigated soil samples excepting the water one from crater **B**. Our measurements of the soil samples taken from the ground of the artificial ditch and the measurements of the soil sample taken and measured by UNEP from the ground of crater **A**, both at the same depth of 3 meters, **gave the same specific isotopic masses for U-235 and U-238 as indicated in Table IV and Table VIA**. This might hint at homogeneous distribution of uranium in the ground of that area. But the measurement of specific activity and specific uranium isotopic mass at a depth of 2 meters in crater **A** gave **twice** specific activity and specific isotope mass value as that value taken at 3 meters depth in both, the artificial one and the crater A, indicating contamination of crater A by radio active natural uranium introduced by the missiles. This contamination is also justified by the measurement taken by UNEP for a soil sample, which was in contact with a missile metal piece, where the uranium specific isotopic mass was 52.4 mgkg^{-1}, as shown in **Table V**. This is 2.73 times as the value found at 3 meters depth in crater **A** and in the control ditch. This important finding will be discussed below.

9-2-2- Measurements by alpha-spectroscopy

To extend the confidence in our results of measurements, we applied in addition the alpha-spectroscopy method at Harwell. The samples were digested in acids. After co-precipitation of nuclides of interest with iron hydroxides, ion-exchange chromatography was used to further purify and separate the uranium, which was then electroplated into stainless-steel discs. Measurements of alpha emissions of the Uranium isotopes U-238, U-235 and U-234 were carried out by alpha-spectroscopy.

The ratio of the isotopes U-238 and U-234 was calculated and listed in **Table (VII**) for each sample. It is seen that the values of the ratios (U-238/U-234) for the corresponding samples are close to **one** agreeing with the value for natural uranium within the experimental errors. The specific activity in thesoil sample from crater **A** of the isotope U-238 is in excellent agreement with that obtained by mass-spectroscopy indicated in **Table VIA(see code KO-7A (EF6874))**. It agrees also with UNEP value at -2m depth in crater **A**.(**see Table V**)

Table VII: Results for the determination of Uranium in soil by Alpha-Spectroscopy method: Sample KO-J-G-C was taken at 3 meters depth in the **control ditch**.

Samples Codes+location	Lab. Ref.	U-238 (Bq kg^{-1})	U-235 (Bq kg^{-1})	U-234 (Bq kg^{-1})	Ratio: (U-238/ U-234)
KO-7A, Crater A	EF 6874	(560 ± 30)*	19 ± 2	(510 ± 30)*	1.10±0.12
KO3A, Crater B	EF 6873	38 ± 4	< 3	42 ± 4	0.90±0.20
KO-J-G-C: Control	EF 6871	(300 ± 20)*	13 ± 2	(235 ± 15)*	**1.30±0.20**
KO1A,Al-marj Crater	EF 6872	30 ± 3	< 2	25 ± 3	1.20±0.25
KO8A, Dardara	EF 6875	77 ± 6	4.4 ± 1.1	78 ± 6	1.00±0.16
KOJ.G.C; is an artificial ditch as control					

1. **. Uncertainties are quoted at 2SD based on expanded uncertainty**
2. *: specific activity obtained in crater **A** at depth 2 meters is 2 times higher as the one obtained in the control ditch and in crater Aboth at 3m depth.

The value of **1.30** for the soil sample (code KO-J.G.C.) was obtained from the control artificial ditch at 3m depth. This value(1.30) was obtained also from UNEP measurements of soil sample obtained at 3m depth in the neighboring crater **A,** where we have used the ratio of the specific activities of the isotopes **U-238** and **U-234 .(**see **Table V** and Table **VII** above).

This value of 1.30 could be interpreted as an indication of the presence of DU in both the artificial ditch and the missile crater **A**, which contradicts the results of the obtained mass ratios of the isotopes U-235 and U-238 obtained in our own measurements by mass spectroscopy as well as by UNEP.

10-Clarification of the contradictions:

10-1- The case of the results obtained by the British team.

Dr. Busby's team reported results indicating enriched Uranium in the Khiam crater **A**. Our results of the soil samples taken from craters **A** and **B** (crater **B** was at a distance of about 22 meters from crater **A**),and from which Busby obtained his samples, showed content of natural uranium in contradiction with Busby's findings. The percentage value of enrichment obtained by Dr. Busby at Harwell Laboratory was given as 0.920±0.20. The fact that Busby's results were obtained by only one run measurement of the sample might produce an erroneous value due to experimental failure. This happened in one of our measurement within the 10 times runs for one sample , where a percentage ratio value was 0.78% , whereas the other nine runs

gave natural uranium values within the same sample. This can be seen also in **Table A, where measurements of the same soil sample of crater A gave different values as 25 and 34 mgkg^{-1}** for U-238.

That was the merit of performing 10 trials measurement for each sample in order to achieve better accuracy and avoid accidental errors.. Therefore, Busby's results of enriched uranium based on one time measurement of the soil sample obtained from that crater must be still justified. The absence of any fission element in that sample indicates that uranium could not have come from a nuclear reactor waste until measurements are taken and showing fissions by-products or, as we mentioned above, the contaminant is a mixture of natural uranium (NU) and EU.

10-2- The case of anomalous results showing the presence of DU in crater A and the control ditch KO- J.G.C.

The mass ratios of the isotopes U-235 and U-238 obtained by mass-spectroscopy measurements for the samples obtained from the control ditch **KO-J.G.C** and crater **A** agree very well, showing no presence of DU as indicated in **Table (IV)** and **Table (VI)**. At the other hand, the specific activity ratio U-238/U-234 obtained in our Alpha-measurements for the control ditch and UNEP specific activity measurements for the crater **A** gave a value of 1.30 (see tables **V** and **VII**) for samples taken at a depth of 3 meters for both samples, as we mentioned above, indicating DU content in the soils. It is noticed here that at that depth the specific activity values for the isotopes U-238 and U-234 taken by our alpha measurements in the ditch are very close to UNEP values in crater A both at depth 3m..

The contradiction in the ratio value of 1.30 can be explained by the behavior of the uranium isotopes in their environment. During the digging of the artificial control ditch and at a depth of 3 meters, the soil samples we have taken was very moist. The same thing happens when crater **A** was emptied by UNEP. At 3 meters depth in crater A the soil started to appear more natural and similar to the control ditch soil. Also water started to leak out in that crater and a moist sample and water sample were taken by UNEP for investigation. The result from both samples showed natural uranium in using the mass ratio U-235/U-238. But using the specific activity ratio for U-238 and U-234 showed DU.

Thus, the uranium environment in the sample contained water and this will affect the results. This was not the case in the other dry samples. This can be explained as follows:

In water, U-238 and U-234 can not be found in secular equilibrium owing to geochemical processes **(Ref.7).** As a decay product, U-234 resides in the immediate vicinity of the parents U-238, Th-234 and Pa-234m. The energy released from the decays is thought to weaken the structure in the immediate vicinity of the isotope U-234, thus increasing its mobility relative to the primordial U-238. Also solubility of Th-234, the producer of U-234, can affect the ratio results. Thus the mobility of U-234 decreases its presence in the vicinity of U-238 and therefore increases the value of the ratio U-238/U234, as was the case in our alpha measurements and the UNEP specific activity measurements of U-234 and U-238. This clarifies the contradictions in our and UNEP measurements.

REMARK: One expert in UNEP team at the press conference, given by the Lebanese Council for Scientific Research in Beirut, claimed that the recoil of U-234 atom caused by the alpha emission could play that role. This can not be justified, because this did not happen in the dry samples of the same soil we have measured. Also this effect can not occur due to the binding force of U-234 in the crystal and its heavy mass. We face this kind of recoil in Gamma Mossbauer Spectroscopy, where lighter atoms are used.

11- Conclusion:

We have undertaken investigation on the presence of depleted or enriched uranium in soil and dust samples taken from several bombarded areas in Lebanon by the Israelis during the July\ August conflict in the year 2006.

From the above measurements and discussions we conclude that the samples, obtained from the measured craters in South Lebanon and dust samples obtained from South Beirut, do not contain depleted uranium within the precision of our measuring instruments of the Gamma- Alpha- and Mass- Spectroscopy Techniques. However the contaminated **water sample** obtained from a water half filling a crater(crater B) caused by the bombardment of a house in Khiam, showed presence of DU in that crater based on the mass ratio of U-235/U-238 .

The Alpha spectroscopy method, with its better precision, seems to give better and more reliable results than the Gamma method. Alpha method, based on the measured samples and the comparison with measured depleted uranium from contaminated military exercise fields, gives the confidence to state that the soils and the dusts I have investigated do not contain depleted uranium within the range of our statistical errors. But as it was proven in our testing, Alpha-spectroscopy method can not be used in wet soil samples due to the behavior of the U-234 and Th-234 isotopes in wet medium. It was shown in our experiment that Mass-Spectroscopy is the more reliable technique to be used in measuring DU.

From UNEP measurements the uranium content at a depth of 3 meters in Khiam crater **A** was 19.2 **mg.kg^{-1}** for the isotope U-238 , while at 2 meters depth was 42.50 mg.kg^{-1},which is 2.2 times as at 3 meters depth. In our mass-spectroscopy measurements, we obtained 18.5 **mg.kg^{-1}** for the isotope U-238 at 3 meters depth in the control ditch, while our result from the crater **A** at about 2 meters depth was **43.2 mg.kg^{-1}**, which is 2.3 times as the control ditch value. This is in agreement with UNEP results, where a value of **42.5 mg.kg^{-1}** was obtained.. That means that crater **A** was contaminated with natural uranium. Thus the case of the Khiam samples results, which showed high radio activity measured by us and UNEP in the crater area, leads us to believe that:

11-1- The Natural Uranium

The Israelis might have used weapons equipped with high radio active industrial natural uranium in their missiles in this location. This is based on the fact that the specific activity in the soil taken at 2 meters depth in the crater **A** was twice as high as the one obtained from the sample taken at the point of 3 meter depth in that crater and in the control ditch, which indicates that new uranium was introduced to this location by the missiles. This fact is supported in addition by UNEP measurements at 2 meters depth in the crater of a sample which was in contact with a missile metal piece, where uranium specific mass of the isotope U-238 was 52.4 mg/kg , indicating contamination by uranium carried by the missile metal piece.

Also measurements by UNEP at a distance 70 meter away from crater **A** showed a value of 27.2 mg/kg, which is higher level than normal values we have obtained in Khiam region. Thus this contamination is not confined to the localized crater hole. I would like to emphasize here that my samples were collected just after the end of the bombardment and were not distorted by any refill as it is the case in UNEP investigations in the crater **A** (the impact hole) and its surroundings. Our results in term of U-238 content in the crater **A** gave a value of 43.2 mg/kg which is the same value of 42.5 mg/kg measured by UNEP at 2 meters depth(see tables **IVA,IVB, VIA**). UNEP also measured a water sample from crater **A** at a depth of 3 meters and found 5.3 **µg/L** of U-238 as compared with our value of 7.11 **µg/L** obtained from a water sample we have taken from crater B, which was not refilled, and was about 22 meters distance from crater **A** (See Table **VIB** above). Also our value was about 14 times higher than the control water sample taken from the supply pipe near the crater and this is a much higher value than natural uranium content in normal water. Thus the increase in natural uranium must have come from the missiles causing these two craters. It is also the missile metal piece which has contaminated the soil as indicated by UNEP's own measurements, and not the other way.

11-2-United Nations Environment Program UNEP Measurements: Quo vadis?

In its report, UNEP stated on page **165** that:
"*The team also visited sites rumored to have been attacked with DU-containing weapons, including a site on Khiam. Samples were analyzed by a leading Swiss governmental laboratory in field of radiation. The results show no evidence of the use of weapons containing DU, natural uranium or any other uranium isotope composition*"(Ref.5)
Well, the evidence is strongly proven in our above given results, where excess of natural uranium in crater **A** and beside it the possible existence of DU in crater **B** in the Khiam site was found. The above statement also says: "***Samples were analyzed by a leading Swiss governmental laboratory in field of radiation."*** Fine, but how much independent and objective is Spiez Laboratory Institution? Does it belong to Swiss Military or not? Is it connected to NATO? Why did not a Lebanese independent research scientist accompany UNEP during their measurements in Spiez Laboratory Institution for example? What is secret about it doing so?
Also UNEP stated that:
"**The dose rates measured during the excavation of the hole never exceeded 250 (nSv/hour**".
But our measurements showed much higher dose in the order of **726 nSv/hour** as indicated by our detector shown above. In some cases the doses were **850 nSv/hour** as I stated to the press. This value is also consistent with the Laboratory analysis obtained from the mass spectroscopy results at Harwell. UNEP might be right in measuring low doses but at what location and what kind of the soil was measured in the **impact hole**, as they called it?.
The reason that our results values agree with UNEP ones is because UNEP took samples, which were smeared with traces of the explosion effects as I witnessed it, which means contaminated soil.
Thus one can not completely exclude the use of missiles equipped with DU or dirty bombs by Israel.
Mr. Achim Steiner, Executive Director of UNEP, wrote in the UNEP final report on that war on Lebanon:
"***I hope it is a measure of comfort for the local population that no evidence of the use of depleted or natural uranium-containing weapons was found. However, the large numbers of cluster bombs, which lie unexploded throughout much of southern Lebanon, do constitute a sever impediment to post-conflict recovery".***
Such statement in regard the uranium radiation does not meet the actual problem. The above results do not **comfort the local population**, where much higher radio activity of uranium than normal does exist. Yes, the last part of the statement does conform with the brutal use of cluster bombs by Israel. So many children and young men have already been killed by such bombs.

Thus our above results do not confirm Mr. Steiner nor UNEP statements regarding the no use of uranium in the Israeli weapons. Our results offer the scientific prove on the use of dirty natural uranium by the Israelis.
In a press release, (Ref.8,) UNEP stated**:**
"The excavation of the bomb impact hole,(crater A), clearly showed that the ground was composed of soils and material that were placed there before the bomb attack occurred."

This is imagination and not scientific statement and it is blurring the truth and irresponsible conclusion**. I do not believe that Gabriel, the Angel, did com from heaven and put that high level of radiation there**.
I have interviewed many citizens in the town of Khiam, young and old people and owners of land, who are very familiar with the area of that location. All stated that no outside materials was brought or introduced into that area and all the samples I have taken from that area were comparable in their nature with the samples of the control ditch I have dug in that place and other samples from different locations. If UNEP's above statement is true, why then the measured samples taken by UNEP at a distance of 70 meters away from that crater(impact hole) gave a value of 27.2 mg/kg, which is relatively high and is half the amount(

see table IVA) measured in the sample taken close to the missile metal piece? Why should the sample stack to the missile metal piece have higher radiation than the soil taken from crater which showed high activity as was shown by UNEP and us/ Does not this indicate contamination of the soil by missiles explosions?
Also Lebanon does not possess nuclear facilities for uranium processing to be delivered to that area!!!? Thus UNEP statements do not stand the scientific results presented in this report (I mean our report).

The results obtained from three methodologies for the measurements in Khiam craters and Dardara field show consistent outcome of the measurements stated above.
I can make the following remarks regarding the confusions of some contradictions. Any disagreement is subject to the following reasons:

11-2-Instrumental and procedural.

In order to obtain believable results, high precision instrumentation and procedures must be followed. Our results obtained from the above mentioned methodologies are very consistent with very reasonable accuracy, due to the high resolution of the measuring instruments. Experimental failure can occur as it is seen in duplicate measurements, where results came out to be different as is the case in the Green Audit measurements for a soil sample from crater **A** as indicated in **Table A**

11-3-The choice of samples:

The choice of appropriate samples collection is very crucial in this case. The sample must be well localized in the crater ground. From the measurements by gamma-spectroscopy, I have found for example that enrichment in one sample, taken from the disputed Khiam crater, was 0.72%, a normal natural enrichment, while the enrichment obtained from sample **B** taken from the same crater, was 0.60±0.12, which indicates possible content of DU. This shows inhomogeneous distribution of radio active elements in the crater soil. But both samples have high specific activity more than normal as discussed above. This problem was clarified by the better mass-spectroscopy method.

11-4- The merging of DU in the environment

The more important cause of any discrepancy in the results is the amount of uranium delivered by the missile explosion to the location soil of the crater, because it is this amount which will determine the specific activity of the samples as well as the quantity of the DU mass. Such amount will play a crucial roll in the precision of the measurements, since for small contaminating amount, it will be very difficult to measure small activity and mass of Depleted Uranium in such a small increase without a large margin in uncertainty in the achieved values of the measurements of enrichment or depletion. This depends also on the methodologies used in this case.

12- The continuity of investigation:

Because the total health effect of uranium on humans is still not completely well known yet, a thorough survey of the whole problem of the health effect on the Lebanese citizens is still needed.
The author is planning to form a task force from Lebanese and overseas experts to conduct further research in that direction regarding health effects and medical problems.

13-Acknowledgement

The author would like to thank the Green Line Organization in Lebanon for its cooperation in achieving the first part in the stages **I** and **II** of this project. My thanks go to the Director of the Radiometric Seminar at Regensburg University for the use of the gamma spectroscopy equipment. Also my thanks go to Dr. Andreas Musilek and Dr. Max Bichler at the Atomic Institute of the Austrian Universities for the

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14- A Closing Prologue to the Consciousness of Mankind.

14-1-("Menchlisch, All zu Menchlisch" said Nietsche) : The Barbarism of Wars?

Based on the above results and behavior of Israel in its wars and attacks using very so destructive weapons on Lebanon as I have witnessed it and as seen in some of the photos presented in this report, and the use of 4 millions cluster bombs with such brutality and un-humane behavior, one can not, as I mentioned above, completely exclude the use of missiles equipped with DU or dirty bombs by Israel.

.14- 2-Morality and Duty of Institutions

14-2-1 The Duty of Sciences

I can not help it but to deviate from scientific numbers and values into the more humane statements concerning the crimes of the wars. Science and Humanism can not be separated due to our striving into the high values of the human existence. Thus few thoughts should be dedicated to the moral duty of the press and the scientific communities in Lebanon and abroad regarding the use of Uranium by Israel and by other powers in wars on Lebanon and on other nations.
In the last few decades and so, several wars have been conducted against humanity, where dirty weapons, such as depleted uranium, have been used. The effect of such crime on the health and the impact on the

social life of the people, who were subject to such attacks, was catastrophic in countries like Yugoslavia, Afghanistan and Iraq. The case in Lebanon is still pending for further studies and investigation on the biological and health levels.

1-At a press conference, arranged in Beirut by the Lebanese Council for Scientific Research to give conclusions about the presence of radiation problem caused by the Israeli missiles and buster bombers in Lebanon and in the presence of the representatives of UNEP, WHO,IAEA and the Arab Atomic Energy Agency, one could hear and smell the monopoly of the politics interfering in the destiny of the people's health.

2-The director of the Arab Atomic Energy Commission stated: "No one has the right to give any statement or measurements about radio activity outside the official and governmental institutions. Not any one who carry Geiger Mueller Counter has the right to declare the presence of radio active materials" How nice?? We ask the speaker: Is he the only qualified person to do research in that matter? Must the qualified Lebanese scientists remain mute? What a hypocrisy?

3-At that conference UNEP representatives offered results of the measurements on the smear samples using mass-spectroscopy but **did not** offer any analysis of the soil samples they have taken in the second visit?

4-The WHO representative stated: " There is no need to say much about the subject, since the results by UNEP do not show presence of DU. There is not enough research done on the effect of DU on the people's health?". Thanks!!

All gave statements indicating the absence of harmful radiations in the missiles craters. It was a nice well orchestrated press conference covered with a political cloak.

It seems to me that the barbarism of some big powers has no respect to God's Human Creatures. They are simply destroying the beauty of life and making other people, such as in Iraq's Gulf Wars, a testing ground for their dirty weapons and killing. All Mankind should stand up and raise the voice of morality and justice for all.

14-2-2-and the Press

Thus it is the moral duty of the press and the media to enlighten the public in a scientific approach about the health effect of the use of Uranium on the population of Lebanon. The press and other media must adder to the principles of creating awareness among the population about the danger of nuclear radiation be it artificial or natural radiation.

Governmental scientific or non scientific institutions should not prevent the press or the scientists, from enlightening the Lebanese people in a humane manner about the possible presence of Uranium in Lebanon caused by Israeli wars against that country, so that preventive actions can be taken. I believe that any action against enlightenment or trying to bluer the truth about the use of DU or dirty weapons against the population is a crime toward the Lebanese people and other societies. The above statements of UNEP and others I have cited above are irresponsible and unjustified.

13-2-3 HUMANE MANNER MEANS:

Some television media, like **Al-Jazeera,** have reported on enriched uranium found by Dr. Busby, and presented the case in such a drumming manner which has created an unjustified psychological fear among the Lebanese population without considering the absolute truth in the scientific results of Enriched Uranium measurements in their reporting. This was also an irresponsible behavior

Lebanon: 20-6-2007Mohammed Ali Kobeissi.

Wer sich immer strebend bemueht, den werden Wir eloesen :(Ghoette in Faust)