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# ABSOLUTE SPECIFIC ACTIVITIES OF DEPOSITED RADIONUCLIDES IN DUST AND SOIL SAMPLES, NELLIS DUNES RECREATIONAL AREA (NDRA)



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## ABSTRACT

Dust and soil surfaces contain terrestrial radionuclides that occur naturally in the earth's crust. However, the level of activity differs by soil type, particle size and geographic location. Some radionuclides are more abundant in one soil type but less concentrated in others. This research paper looked at the radioactivity levels of dust and soil samples based on particle size. The samples were measured in vial sample holders using HPGe Germanium detector for a period of five days each. Background radiation was counted for same amount of period and subtracted to eliminate any counting statistical errors. The results showed that there is no significant correlation between particle size and radioactivity concentration levels. However, the amount of activity found in the samples depends on the type of radionuclide abundant in that sample. Potassium-40 has the highest activity level in all samples whereas Cs-137 has the lowest amount. This may be due to the fact that Cesium-137 is not a naturally occurring radionuclide. The small amounts of activity present due to fallout from atmospheric weapons tests conducted at nearby test site. However, these activity levels are so low there are no health risks to be concerned with.

## INTRODUCTION

The purpose of this research project is to continue the ongoing analysis and characterization of soil and dust samples, collected at collected at Nellis Dunes Recreation Area (NDRA), located about 15 miles North-East of Las Vegas, in terms of their mineral, chemical and radionuclide content by different research groups.

This project will measure dust samples using a gamma detector to determine their absolute radioactivity. The results will be compared to national standards in terms of radioactivity levels. If the activity levels found in these samples are found to be above national standards by a higher percentage, then this would cause an alarm. However, it is not expected to see the results of this research surpass the national standard levels.

Determining the radioactivity level of the samples will be more valuable if the relative activities can be correlated with sample size and texture. For example, arsenic concentrations are found to be slightly higher in dust samples than in soil samples since the dust samples have a finer texture (Soukup et al, 2009). This study will apply a similar approach and compare the radionuclide concentrations in dust samples to that of soil. The absolute activities of dust samples of various sizes will be a valuable evaluation of how sample particle size affects concentration levels.

## LITERATURE REVIEW

This project is a continuation of previous and recent studies on the mineralogical, chemical and radionuclide characteristics of soil and dust samples from Nellis Dunes Recreational Area (NDRA). The area is a 36 km square open landscape used for Off-Road Vehicle Driving (ORV) and managed by the Bureau of Land Management. It is located about 15 miles North East of Las Vegas. As the only recognized area that is legally accessible for off-road vehicle driving, it has become a regular destination for people of Southern Nevada interested in using it for recreational purposes.

Since air quality has become a major priority for the residence of Southern Nevada, the control and prevention of air pollutants such as dust is a top priority for local officials. Dust emission, according to a recent study, is a major source of air pollution that can lead to serious health problems such as asthma, dementia, and even in serious cases cancer. The presence of some dry lakes surrounding the city and the sand dunes at NDRA provide an opportunity for dust emission to occur either naturally or by human activities. This creation of dust particles in air is a major concern because particular matter in the form of dust particles can enter the lung parenchyma causing significant cardiovascular and respiratory damages, such as lung cancer (Ali S. Kamal et al, 2011), (Fattore et al, 2011).

It has been elucidated that particle size and texture are important factors in the elemental and chemical composition of the soil, as well as the degree of health effects due to exposure. A study conducted by researchers show a correlation between particle size and particular matter composition. Higher elemental concentrations were found in PM<sub>2.5</sub> (Osormas-Vegas et al 2011). The Environmental Protection Agency (EPA) describes PM<sub>2.5</sub> as particular matter that

is 2.5 micrometers in diameter and smaller. It is determined that acute cardiovascular changes, such as increase heart rate, can be caused by ambient PM<sub>2.5</sub> exposure (Kamal et al, 2011). The different constituents of air pollution were compared and it was found that PM<sub>2.5</sub> "had the highest health impact on the 24,000 inhabitants of the two small towns" surveyed under the study (Fattore et al, 2011). Particular matter emission causes about a total mortality of 8 out of 177 in a year, whereas other pollutants such as ozone and nitrogen dioxide only cause 3 mortalities. (Fattore et al, 2011).

## METHODOLOGY

Four different dust samples are used in this experiment. The different dust samples have been characterized based on size and type of surface soil. The samples were collected based on a mapping design created to better utilize appropriate scientific methods. About 17 different mapping areas were created and labeled numerically based on sample type. Sand and sand-affected areas are labeled from 1.1 to 1.5 depending on the degree of rock fragments, surface crust and amount of vegetation. Silt/clay areas are labeled 2.1 to 2.3, rock-covered areas are labeled from 3.1 to 3.5 and finally drainage areas are labeled 4.1 to 4.3 (McLaurin et al, in review).

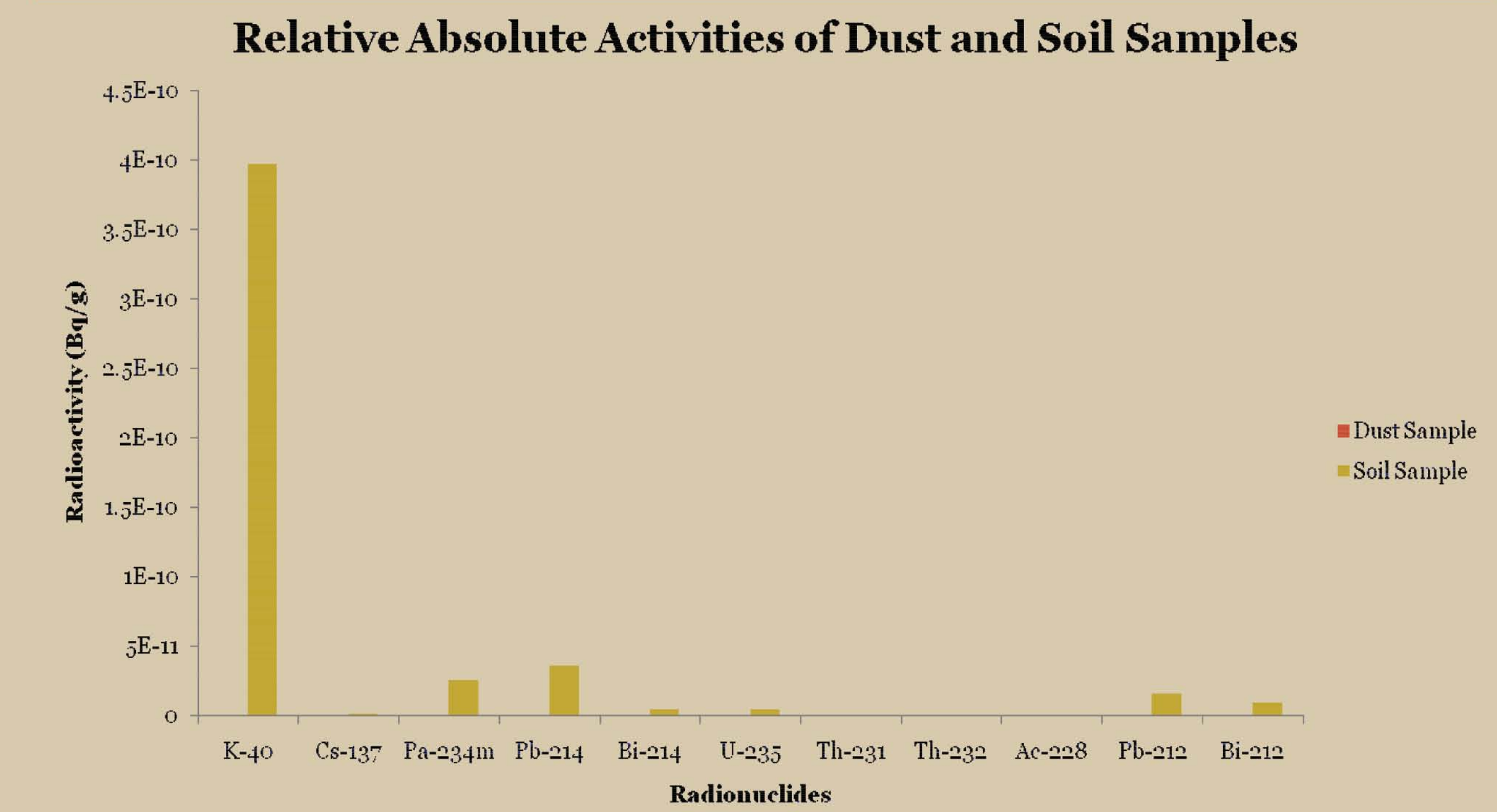
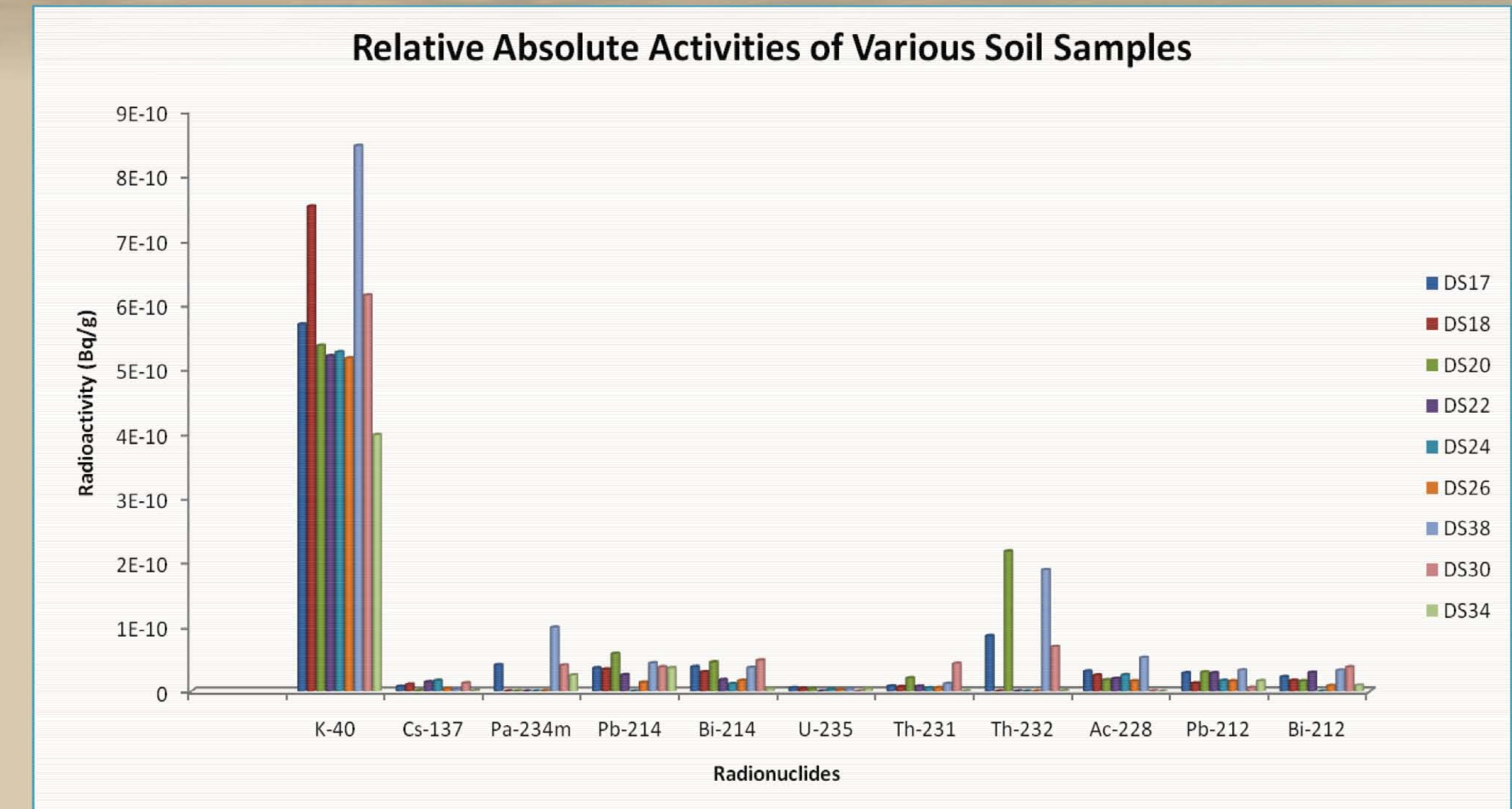
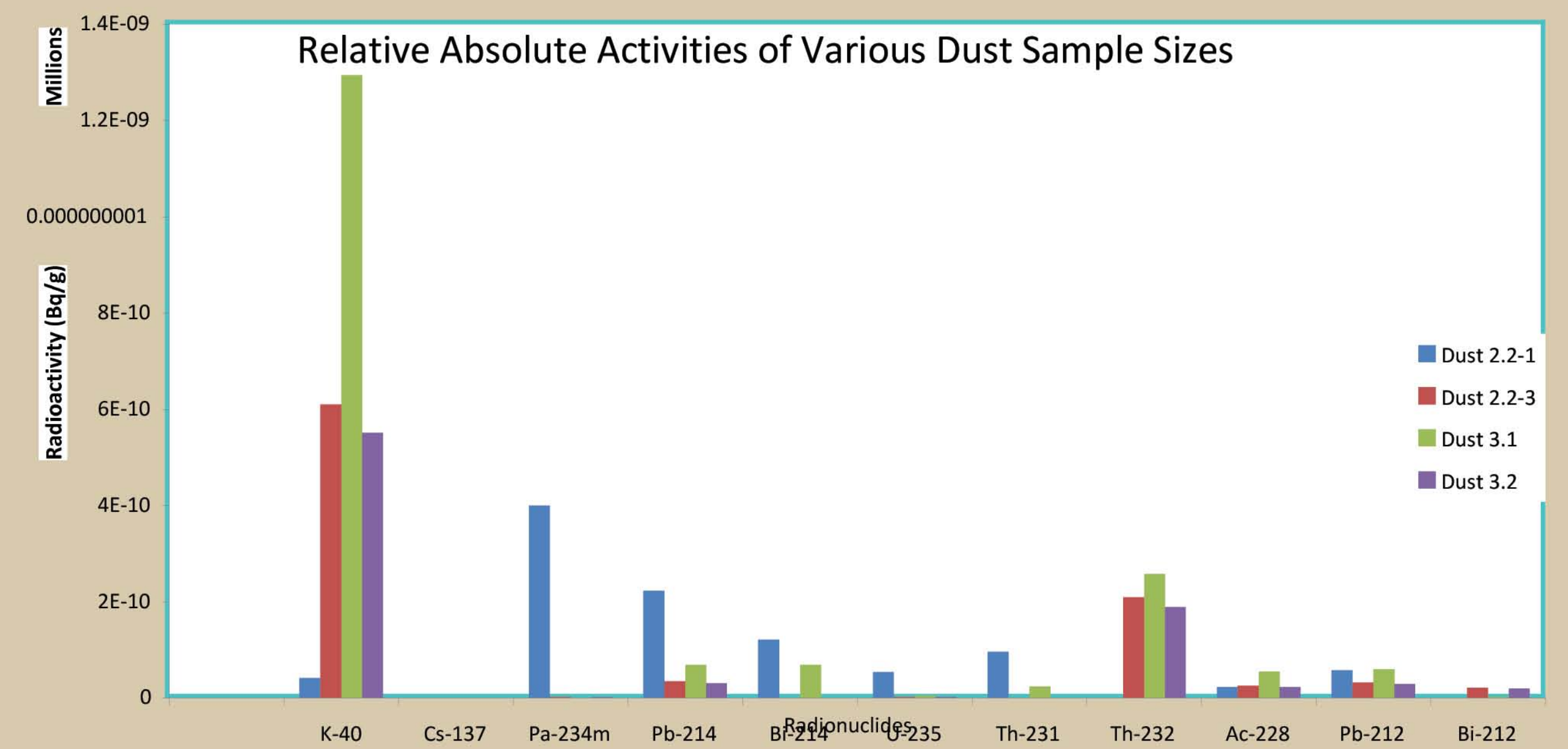
The samples in this survey are categorized from site 2.2-3, 3.2, 2.2-1, and 3.1. The dusts collected in this area were in the silt/clay areas and the rock-covered areas. The samples were finely crushed to get rid of large particles. The samples were then individually carefully weighed and placed in vial sample holders. Each of the individual samples was measured for five consecutive days. Background was also assayed for five consecutive days to clear any form of background activity from the results.

The samples were measured using a Canberra Model GR3519 high-purity germanium gamma detector with a relative efficiency of 35%. Energy calibration was done using a certified soil reference standard in vial sample holder geometry. The calibration was done with reference to ANSI Standard N42.14-1999.

The mean activities of the various radionuclides were expressed in picocuries per samples and the specific activities were analyzed in Bq/g. The results were then analyzed using bar charts to differentiate the activity levels of the varying samples sizes and textures

## RESULTS

The results indicate no correlation between sample size and radioactivity level. With the activity levels of the different sample sizes graphed on a bar chart, it shows differentiation in activity levels varies more with the type of radionuclide than seen in size variance. For example Potassium-40 activities are slightly higher in all samples analyzed than other radionuclides such as Cs-137. The radioisotope Pa-234m has high concentrations in Dust 2.2-1 whereas the activity levels in Dust 3.1 are high in Potassium-40. The activity levels of Potassium-40 are higher in soil samples than dust samples. All other radionuclides have very low activity levels in dust compared to soil samples. The relative activity levels of the soil samples are random and do not correlate with the size of the particles. The differentiation in activity levels is more related to type of radionuclide than sample size in both dust and soil samples. However, due to the low activity levels found in these samples, there is little concern for significant health risks.



## CONCLUSIONS

From the analyses of the results, it can be concluded that there is a slight difference in activity levels of dust or soil samples of various sizes. However, the level of activity concentrated in one sample does not correlate with the particle size of the sample but rather the radionuclide content of the sample. Potassium-40 has the highest amount of activity in all samples. The activity levels of all the dust or soil samples are so minimal they are considered low-risk in terms of health effects. Further research in the spatial and temporal radioactivity levels of the dust or soil samples will serve as a gauging tool to safeguard potential risk factors.

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