

# Modeling Background Radiation in our Environment Using Geochemical Data

Kara Marsac<sup>1\*</sup>, Pamela Burnley<sup>1</sup>, Elisabeth Hausrath<sup>1</sup>, Russell Malchow<sup>1,2</sup>, Dan Haber<sup>1</sup> and Chris Adcock<sup>1</sup>

National Security Technologies LLC  
Vision • Service • Partnership



1-UNLV, Las Vegas, NV, USA  
•National Security Technologies,  
Las Vegas, NV, USA  
\*marsac@unlv.nevada.edu  
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## Radiation in the Environment

-Is the arrow pointing to an extension of the radiation plume or an effect of geology?  
-When it's your home this distinction becomes important  
-Currently to differentiate there must be an aerial gamma ray survey of the area before the disaster occurred

Figure 1a: NNSA aerial gamma ray survey of Fukushima Daichi<sup>(8)</sup>

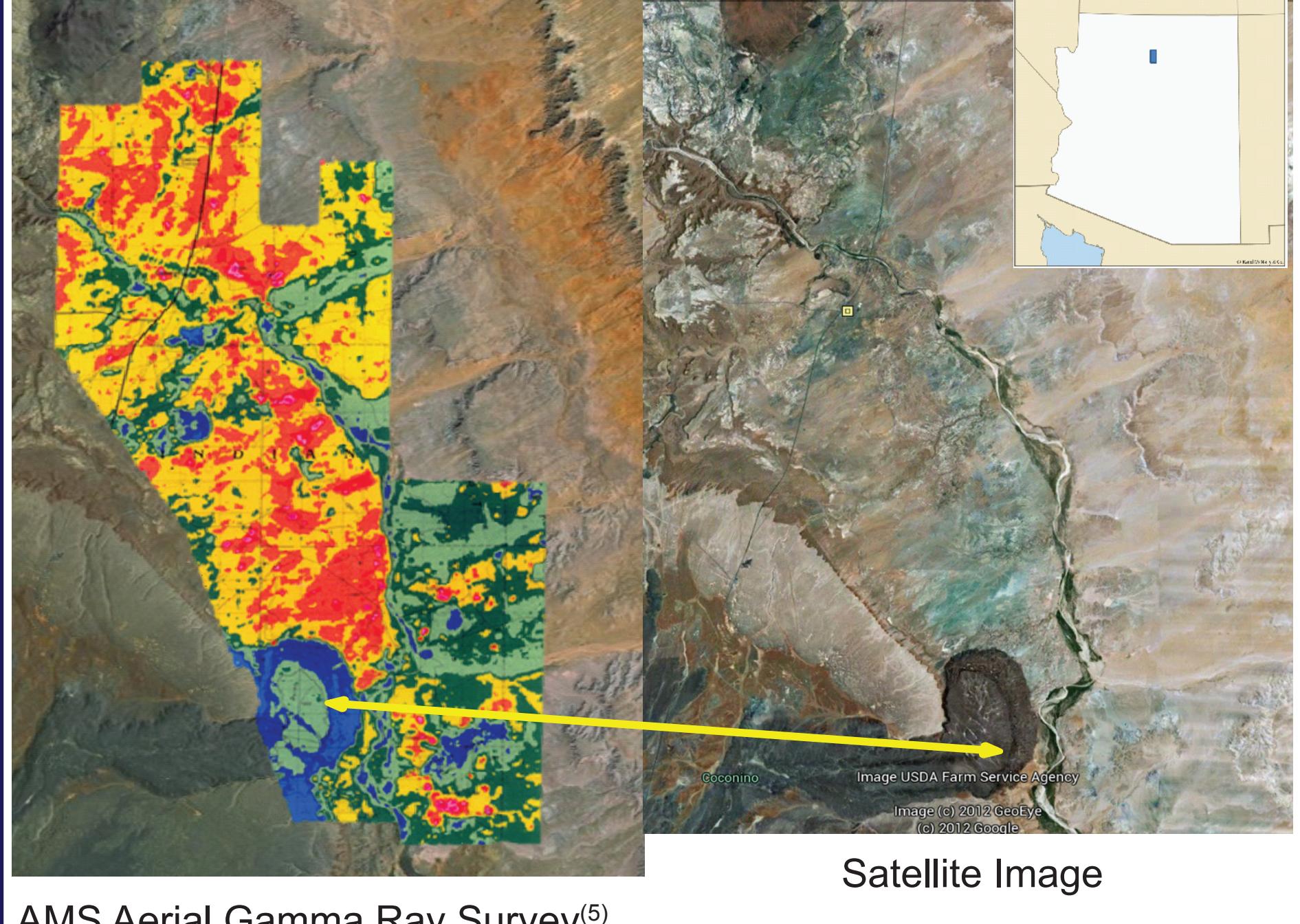
-Radiation occurs naturally in bedrock and soil  
-Gamma rays are released from the decay of the radioactive isotopes K, U, and Th  
-Gamma rays observed at the surface come from the first 30 cm of rock and soil  
-Energy of gamma rays is specific to each isotope, allowing identification



Figure 2: AMS Helicopter with gamma ray detectors attached

-Measures radioactive isotopes in the environment  
-Fly areas with 200-400 m spacing  
-Low flying  
-NaI Scintillation detectors  
-Collect gamma rays from:  
-Cosmic sources  
-Equipment  
-Radionuclides in atmosphere  
-K, U, Th in rock and soil  
-Human sources

## Radiation and Geology



AMS Aerial Gamma Ray Survey<sup>(5)</sup>

Satellite Image

Figure 3: On the left is an aerial gamma ray survey of our modeling area in north central Arizona near Cameron, on the right is a satellite image of the same area. Much of the field area is on the Navajo reservation and has been historically mined for uranium. The effect of the basaltic lava flow on the background radiation (yellow arrow) is clearly visible.

## Collecting Existing Geochemical Data

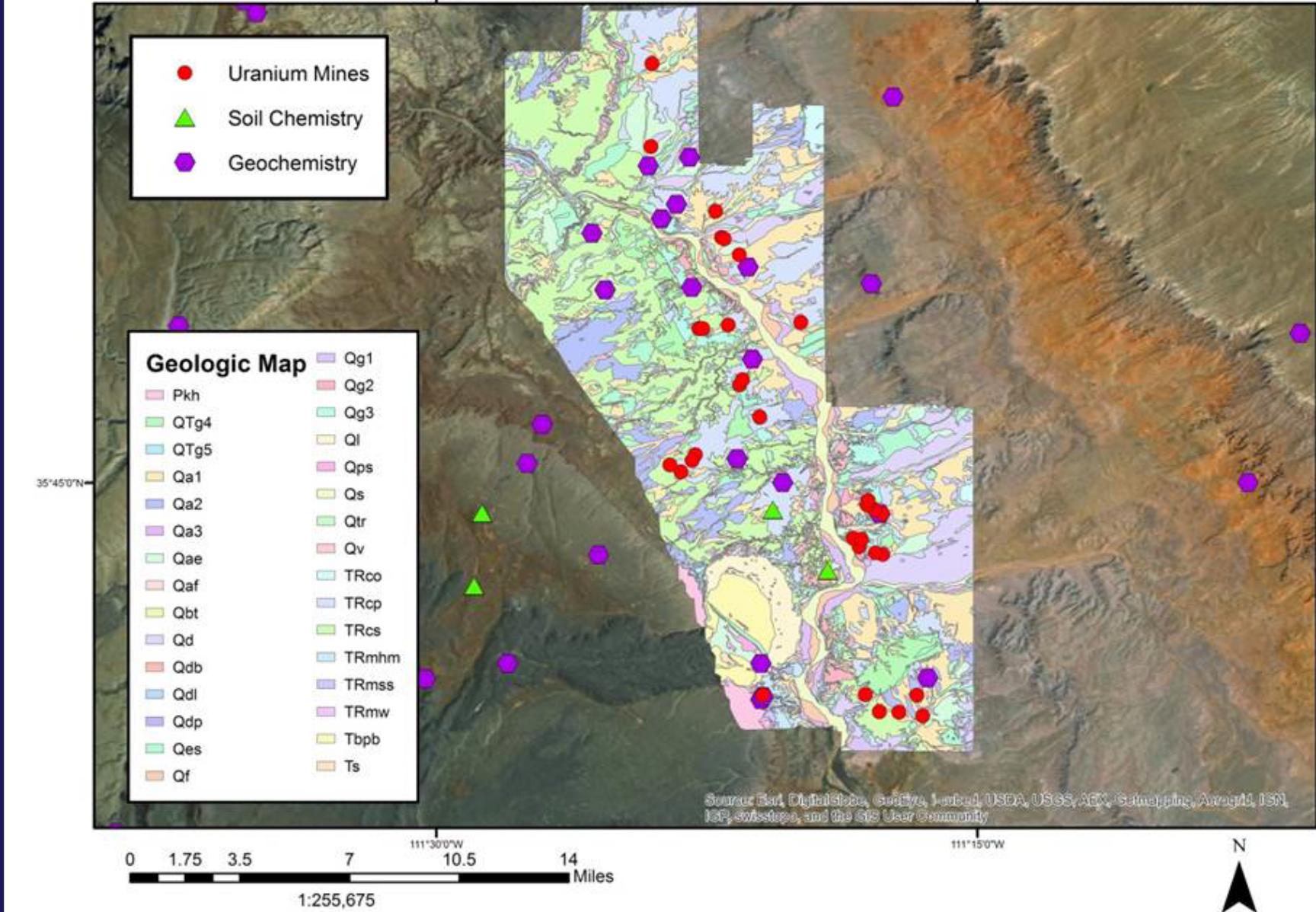


Figure 4: USGS Geologic map<sup>(1)</sup> of the study area. Red points are uranium mines, blue points are soil chemistry data points, and purple points are bedrock geochemical data points collected from national databases such as the USGS, IEDA, and GeoROC; uranium mining companies such as DIR Exploration; and scientific literature.

## Rock Unit Geochemistry

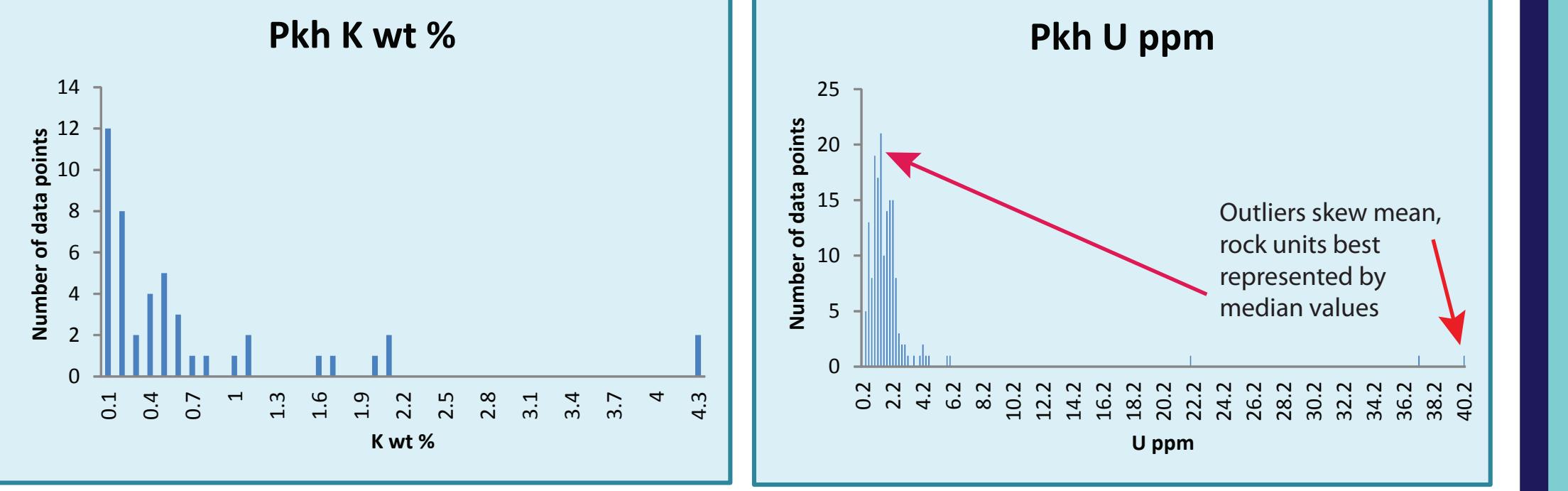


Figure 5: Example geochemical data for Pkh (limestone, Harrisburg Member, Kaibab Fm), includes histograms and statistics of U, K, Th value. For units with multiple data points the median value was chosen to represent the unit.

Pkh	K (wt %)	U (ppm)	Th (ppm)
mean	0.6525	185.26	6.5386
Standard deviation	0.9459	1670.2507	5.2315
range	4.1938	16599.7	13.1
median	0.37	1.45	6.52
mode	0.04	1.9	N/A

Pkh

K (wt %)

U (ppm)

Th (ppm)

mean

Standard deviation

range

median

mode

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0.04

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