'Software glasses' clarify view of lunar thorium

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Using a novel approach to data analysis, a sharper pair of “software glasses,” scientists at Los Alamos National Laboratory are taking a closer look at spectroscopic Moon images to better understand how that body was formed. By perfecting their view of a naturally occurring radioactive element, thorium, Moon researchers can now distinguish details of lunar features that were just “blobs” in the earlier imagery.

David Lawrence, acting director of the Los Alamos Center for Space Science and Exploration, explained “Lunar thorium abundances are a key indicator of various lunar geologic processes. By measuring the global distribution of thorium abundances, we gain insight into how the Moon was formed and how it has changed over time. In particular, data from NASA’s Lunar Prospector have revolutionized our understanding of the Moon from what were initially thought to be relatively simple global processes to much more asymmetric, complicated processes.”

On July 31, 1999, NASA's Lunar Prospector spacecraft was deliberately crashed into a permanently shadowed crater near the Moon's south pole, in the hope that as the grand finale to its mission, it might throw up a dust cloud and reveal water ice. Traces of water were not found, but the various types of data gathered during the full mission are still revealing its intellectual treasure.

The Los Alamos team used an analysis technique called spatial deconvolution to reverse the image, blurring that is, part of the Los Alamos gamma ray spectrometer data gathered during the mission. This

is the first time that global deconvolution analyses have been used on orbital planetary gamma-ray data.

“We find that we have improved the sharpness of the image by a factor of 1-1/2 to 2 compared to the original image. With the improved data, we have been able to better understand a number of thorium features on the Moon that were previously too blurry to make out very well, such as the Aristarchus Crater and Plateau,” said Lawrence.

“With the old thorium data, we only saw a single blob covering the whole area. But with the improved analysis we are able to distinguish some mountains from the plateau in the thorium abundances. This information is important in trying to sort out the geology of this complicated region,” he added.

Thorium is interesting to scientists because the Moon developed in a complex fashion, interrupted by frequent catastrophic impacts that spread subsurface rocks rich in thorium across the surface. Thorium is one of the elements in a substance called KREEP, the acronym for potassium (symbol "K"), rare Earth elements and phosphorous, and its presence flags these impacts of geologic melt materials in a measurable fashion. Thorium emits gamma rays -- a high-energy form of light -- of a distinct energy.

“Because thorium is a tracer for KREEP-rich material, these data provide fundamental information regarding the locations and importance of geologic formations that are rich in KREEP-bearing materials,” Lawrence said. “The location and abundance of these materials provide information that help us to understand processes that created the Moon and how it has changed over time.”

Lawrence will present his team’s research at the 38th Lunar and Planetary Science Conference at South Shore Harbour Resort &

Conference Center in League City, Texas. The paper also is the subject of the cover of the February 16, 2007, journal *Geophysical Research Letters*, Volume 34, Number 3.

Source: Los Alamos National Laboratory