THORIUM IN THE LUNAR CENTRAL HIGHLANDS. Maria I. Etchegaray-Ramirez, Eldon L. Haines, and Albert E. Metzger, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109.

Results presented previously for thorium as regional values (1) and two degree color maps (2) have shown that the surface composition of the lunar central highlands across the Apollo 16 ground track is not uniform, at least for the KREEP component. The Th concentrations have shown a continuous decrease from west to east with a broad minimum between 15ºE and 30ºE before rising into the eastern maria. Application of the gamma-ray deconvolution technique which restores most of the contrast lost to instrument broadening (3), has revealed more of the local variation within these highlands.

The primary region modeled, which we call the Descartes Region, extends from 16ºW to 34ºE, using data from 2ºW to 30ºE. This is the first Apollo 16 region for which deconvolution has been attempted, partly because the extreme narrowness of the data track suggested an uncertain outcome. The data field is shown in Fig. 1 as ppm Th on the 2º x 2º unit base used for the modeling. Because of the high density of the data, typical 1σ values are 0.2 ppm or less.

In order to obtain better results for that portion of the central highlands beyond the data field in the west, a second region centering on Ptolemy has been modeled. The Ptolemy Region modeled extends from 22ºW to 10ºE, using data from 18ºW to 6ºE.

Figure 2 shows the best combined model of the two regions obtained to date. This model is expected to be a member of the set of statistically acceptable fits which will be presented with the final results. It consists of 12 constructs and a flat which surrounds the constructs. The latter represents the average influence on the instrument of the entire area outside the constructs. The constructs have a predominantly north-south orientation due to the narrowness of the data field. The concentrations of those common to both regions modeled are in good agreement. Construct concentrations are averages weighted by the varying response of the instrument as a function of distance. At distances of 2º and 4º from the nadir, the contributions are about 60% and 25% respectively, of that directly below. A better fit is obtained for the model shown in Fig. 2 than for models which confine constructs to the data track and thereby ignore contributions beyond it.

The comparatively low Th in the constructs containing the Descartes Crater (14º-18ºE) and the Kant Plateau (18º-22ºE) are a feature of every model of the Descartes Region. The low in the construct at 6º-10ºE is of less significance but has been found in all the best models thus far. Descartes and Kant combined into one construct give an acceptable fit with an intermediate Th value, typically 0.3-0.5 ppm. The 2º x 2º pixel containing the Apollo 16 landing site provides a better model fit if included in the Descartes construct rather than Andel, but is acceptable in either.

The undeconvolved regional values of Th in the central highlands (1) are, upon deconvolution, seen with better spatial resolution and sharper

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contrast. The Kant Plateau value of 0.7 ppm is typical of limb and farside highland values, and to date has only been seen on the nearside in the highlands east of Mare Smythii. As such it provides independent confirmation of the x-ray results reported by Andre and El-Baz (4) that, with respect to the portion of the central highlands surveyed to date, this is a singular region in its similarity to farside and limb terra composition. Hawke and co-workers (5) have recently reported mixing model calculations which indicate compositional differences between the regions of Descartes and Andel. This is very marked in these new Th results. By the same token however, the variation in Th over the central highland ground track is such as to be inconsistent with the observation by Hawke et al. (5) of a relatively constant KREEP component over the entire area.

The highest concentrations in the central highlands are at the western edge. Retention of the rising trend towards the west following deconvolution shows that it is not simply due to instrumental broadening from regions further to the west but to significant concentrations of Fra Mauro type basalts in the highlands themselves. Ptolemy itself offers no contrast to the trend of increasing Th from about 10°E to 6°W, showing that no material of contrasting Th composition has covered the basin floor since its formation. A small region at Davy (Fig. 2) appears to be enhanced relative to its surroundings.

A low Th value for Theophilus and its ejecta blanket is a reasonable expectation in view of the highland nature of this region and its proximity to the apparently anorthositic Kant Plateau. Instead, it rises to a value typical of mare basalts to the east. The visual asymmetry of the Theophilus ejecta blanket is also seen in the Th distribution. This observation is also consistent with the orbital x-ray data which finds Theophilus ejecta to be more mafic than surface material of the Kant Plateau as well as a gradual transition between them (4).

Given the successful deconvolution of Th in the central highlands, we plan to submit Fe to a similar analysis. Note however, that recent undeconvolved regional values obtained both by Davis (6) and ourselves (7) already show more typically highland concentrations of Fe for the Descartes catalogue region (which includes the Kant Plateau) than for the Andel or Theophilus catalogue regions.

This work was supported under NASA contract NAS 7-100 at the Jet Propulsion Laboratory, California Institute of Technology and is JPL Planetary Program #326-81-65.

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Fig. 1. Observed the Th data field for the Descartes Region, the values being concentrations in ppm on a 2° scale.

Fig. 2. Deconvolved distribution of Th in the central highlands. Constructs east of 10°E were modeled as part of the Descartes Region, west of 10°E as part of the Ptolemy Region. Values are ppm Th.