Apollo landing sites 16 and 17: Spectral mapping and crater statistics reevaluated B. Bultel[1], R. Metayer[1], S.C. Werner[1] Centre for Earth Evolution and Dynamics, University Oslo, Norway, benjamin.bultel@geo.uio.no

Introduction:

The approach of dating the surface of the Moon by linking crater densities and isotopic ages of lunar samples (Apollo and Luna missions) started in the 1970s [1, 2] and these studies proposed lunar cratering rates as well as chronology models [3,4].

In order to make the link between isotopic ages of samples and the crater densities observed, it is necessary to define homogeneous geological units corresponding to this sample.

The observed crater size frequency distribution (CSFD) on given surface unit are fit with different crater production functions that have been suggested. These are used to calibrate the crater density measurement, which resulted in different lunar chronology models. For instance, it is still not clear if during the last 3 Gy, the crater production function should be stable or decreasing [5]. The definition of a crater production function is therefore crucial for the definition of Lunar cratering chronology. Indeed, the shape of the crater production function must be determined over a large diameter range and over large homogeneous units.

We suggest here to compile data from crater counting on Apollo and Luna landing sites for the diameter range between 200 meters and 1 km on redefined units via a spectro-imagery study. This work leads to CSFD that give different fits with known crater production function compare to previous studies [i.e. 6].

In the present study, we used multiple spectro-imagery dataset to define homogeneous spectral unit as counting area to date the surface of Apollo landing sites.

Data and Method:

We used here data from Kaguya Spectral Mapper as well as Multispectral Imager map from [7] and Moon Mineralogical Mapper data (M3) to define homogeneous spectral units on Apollo landing sites 16 and 17. On these units we performed crater counting to determined ages with CraterStats [8] and counts were done using CraterTools [9] on Kaguya Television Camera data.

Preliminary Results:

We present here preliminary result for two Apollo landing site (16 and 17).

The results for the Apollo 16 landing site:

The different units determined by spectroscopic study are given in Figure 1. Their estimated ages are given in Table 1. The age of the landing site found in this study is 3.9 Gy, which is consistent with the ages given in previous studies [e.g., 6].

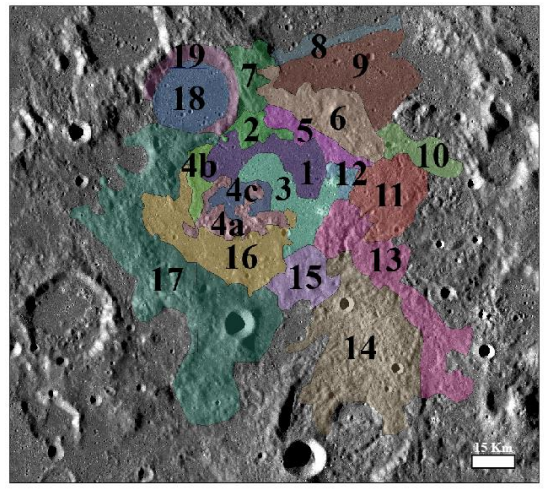

Figure 1: Spectral units determined with Moon Mineralogical Mapper data (M3) at Apollo 16

Table 1: Estimated ages at Apollo 16 site for units derived from M3 data

Unit Number	Estimated ages (Gy)
1	3.8-3.9
2	3.9-4.1
3	3.8-3.9
4a	3.9-4.1
5	3.8-4.0
6	3.8-4.1
7	3.8-4.1
8	3.9-4.1
9	3.8-3.9
11	3.9-4.1
13	3.7-4.0
14	3.7-3.9
15	3.9-4.0
16	3.7-3.9
17	3.8-4.0
18	3.7-4.0

The results for the Apollo 17 landing site:

Only the Taurus-Littrow valley is concerned in this study of Apollo 17 landing site. The complete Mare region is not studied here. The landing site is in a valley enclosed between the North, the East and the South

Massifs (Figure 2). A cluster of secondary impact, probably from Tycho crater is visible on the valley floors. From South Hill, one landslide putatively triggered by the Tycho crater ejecta is visible. From both the Kaguya Multispectral data and M3 data, the Massifs are enriched in plagioclase, while the valley is enriched in olivine and can be divided in 3 spectral units (East, Center and West here) and the cluster appears enriched in clinopyroxene while the landslide is composed of a mixing of clinopyroxene and plagioclase. The ages determined in our study are given in the Table 2.

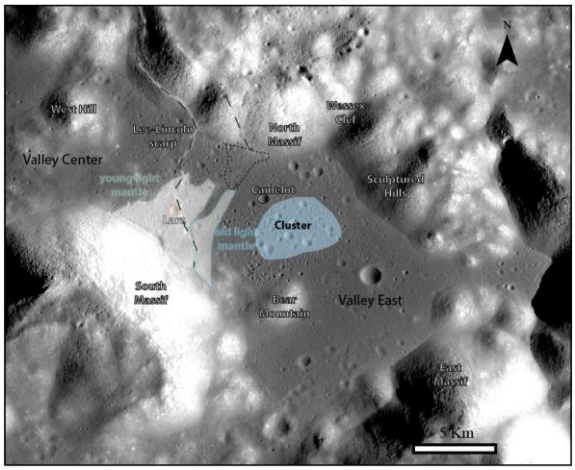

Figure 2: Portion of the Geological map at Apollo 17

Table 2: Estimated ages for Apollo 17 site

Unit Name	Estimated ages
Valleys	1.41 ±0.28 Gy (East) 0.476 ±0.15 Gy (Center) 3.4 ±0.1 Gy (West)
Landslides (old and light mantle)	360 ±180 My (with a resurfacing at 34.4 ±2.9 My ?)

Discussion:

Previous studies report similar ages for Apollo 16 landing site [6]. The difference of ages found for Apollo 17 landing site in this study and previous ones [6] could be due to the exclusion of the "cluster" unit as described by [10]. The details of our study on Apollo 16 and 17 landing sites will be presented. The size frequency distribution for craters with diameters between 200 meters to 1 kilometer will be discussed since they differ from previous studies due to redefined units.

We will also present a comparison of the ages obtained on units determined by spectroscopic investigation with those obtained on units determined by the morphology observed. These preliminary results confirm that our method of determination of units for counting based on spectro-imagery data can be applied on other Apollo and Luna landing sites.

References:

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