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# The Pb-Pb chronology of impact melt rock 14310 and new crater size-frequency distribution measurements of the Apollo 14 landing site

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## 1. Introduction

The dating of geological units and events on the Moon is achieved by two inherently different approaches: (1) radiogenic isotope dating of returned lunar samples or meteorites and (2) model age determination using crater size-frequency distributions (CSFDs). Combining the results from both approaches applied to Apollo and Luna landing sites has allowed the development of the lunar cratering chronology, which enables absolute model ages to be derived from CSFDs of unsampled regions on the Moon [e.g., 1]. Since the initial development of the lunar cratering chronology, both age determinations through radiogenic isotope ratios and CSFD dating techniques have advanced, and recent orbital missions have collected new global datasets, allowing us to re-evaluate and update the calibration points for the cratering chronology. Here, we combine both dating techniques to reinvestigate the Apollo 14 landing site.

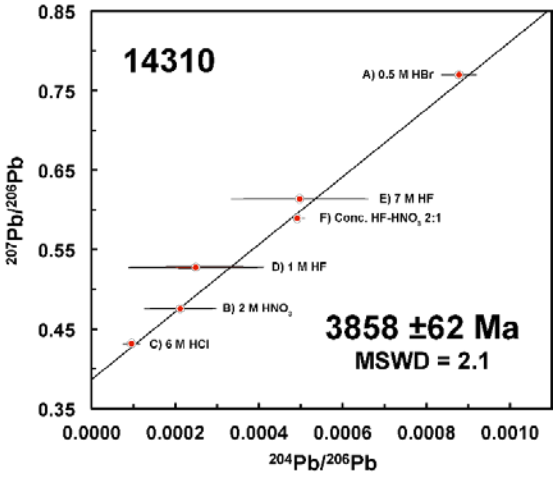


**Figure 1:** Inverse Pb-Pb isochron diagram for a bulk fine-grained fraction of sample 14310.

## 2. Pb-Pb Dating

The pioneering U-Th-Pb studies of sample 14310 performed in the early 1970s yielded dates of ca. 3.8-3.9 Ga [e.g., 2], which were interpreted to represent the crystallization age of this rock. We are carrying out Pb-Pb analyses to complement our multi-system (Sm-Nd, Lu-Hf, Rb-Sr) chronological work on this sample [3], with the aim of testing for concordance among isotope systems and precisely constraining the crystallization age. For our Pb-Pb work, each mineral concentrate was subjected to a 12-step washing and progressive digestion procedure in an attempt to better separate radiogenic, initial, and contaminating Pb components [e.g., 4, 5, 6]. The earlier U-Th-Pb studies [e.g., 2] did not do this, as it would have potentially fractionated these elements. Figure 1 shows our inverse Pb-Pb isochron obtained for a bulk fine-grained fraction (<65 µm) of 14310, which yields a date of 3858 ±62 Ma that is concordant with the Rb-Sr, Sm-Nd, and Lu-Hf dates that we have obtained on the same sample split.

## 3. Apollo 14 Landing Site

The Apollo 14 landing site is situated about 600-800 km south of the Imbrium basin within the Fra Mauro Formation (FMF), which has been interpreted to be Imbrium ejecta [e.g., 7]. The landing site was originally chosen to sample ejecta blocks that were excavated from the very young and nearby Cone crater, and interpreted to unambiguously represent the FMF [7]. Sampling the ca. 30 Ma Cone crater has also provided an important anchor point for young lunar surfaces [e.g., 8]. The presence of old and young surface units make the Apollo 14 landing site especially worthy of reinvestigation, as we can potentially constrain the lunar cratering chronology for both old and young ages.

## 4. CSFD Measurements

The originally reported $N(1)$ value of $3.7 \pm 0.7 \times 10^{-2}$ yielded an estimated age of the FMF of 3.91 ± 0.1 Ga [1]. We used the global Wide Angle Camera (WAC) mosaic (100 m/pixel; incidence angle: 60°) to perform new CSFD measurements on the same counting area and report a $N(1)$ value of $4.23 \times 10^{-2}$, which was fit with the lunar chronology function, yielding an age of 3.94 ± 0.02 Ga, as seen in Figure 2. This result is within the uncertainty of [1] and agrees with recent Imbrium age estimations of 3.91-3.94 Ga [e.g., 9].

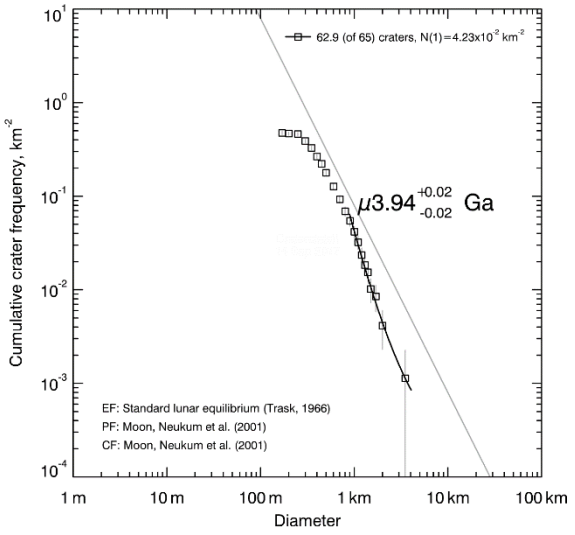


**Figure 2:** Re-counted cumulative CSFD for the original area selected by [1] for Apollo 14.

## 5. Outlook

Our preliminary results indicate that sample 14310 is younger than the Imbrium basin, if we assume the most recent age estimate of 3.91-3.94 Ga [e.g., 9], which we were able to reproduce with our CSFD measurements based on the global WAC mosaic. We are currently performing CSFD measurements based on Near Angle Camera (NAC) data to better constrain the $N(1)$ value of the FMF and will present the results at the meeting. Additionally, we will aim to identify potential source craters of 14310 and discuss possible implications on the lunar cratering chronology. Ultimately, this ongoing study aims to combine both laboratory and remote sensing investigations to reveal new constraints on the age of the Imbrium basin formation event.

## References


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