PRELIMINARY LUNAR MAPS OF U, K, AND TH BY THE KPLO GAMMA-RAY SPECTROMETER K. J. Kim[1,2], S. Y. Kim[1,2], I.-S. Hong[1], J. H. Park[1], Y. Choi[1], Y. K. Kim[3], K. S. Park[3], K. B. Lee[4] and the KGRS Team, [1]Korea Institute of Geoscience and Mineral Resources, Daejeon, 34132, [1]Republic of Korea, Resource Engineering, [2]University of Science and Technology, Daejeon, Republic of Korea, [3]Nucare(Inc), Osong, Republic of Korea, and [4]Korea Research Institute of Standards and Science, Daejeon, Republic of Korea

Introduction: The KPLO arrived in lunar orbit at an altitude of 100±20 km on December 27, 2022[1]. The KPLO orbiter is carring six scientific instrurments, including a gamma-ray spectrometer (KPLO Gamma-Ray Spectrometer, KGRS). The science goals of KGRS are associated with investigations of both lunar geology and lunar resources down to a half-meter depth of the lunar surface. The KGRS has successfully collected its data since its arrival in the KPLO's lunar orbit. Up to date, natural radioactive elemental maps have been produced by the KGRS. Various formats of elemental radioactive maps have been published over the years by the lunar missions such as Apollo 15/16 (1971/72) [2], Lunar Prospector (1998) [3], Kaguya (2007)[4], Chandrayann-1 (2008) [5], and Chang'E 1 & 2 (2007 & 2010) [6,7]. The natural radioactive elemental maps of U, Th, and K are investestgated from these missions. All missions generated Thorium map, and they are well compare to each other although gamma-ray sensors are different. The Kaguya team generated a global Urainum map and the result of uarium distri-ubution on the Moon is quite similar to that of KGRS. Checking through the radioactive elemental maps could be the first step of lunar gamma-ray spectroscopy for the KGRS performace. Any production of other possible elemental aboundance map will be investigated after the current work is completed.

KGRS instrument: The KPLO Gamma-Ray Spectrometer (KGRS) is a 6.3 kg, compact, low-weight instrument for the elemental analysis of lunar surface materials within a gamma-ray energy range from ~30 keV to 12 MeV. The major components of KGRS consist of a primary $LaBr_3$ gamma-ray detector with an anti-coincidence counting module of 5% boron-loaded plastic scintillator to reduce both gamma-ray background from the spacecraft and housing materials, and cosmic ray background. The KGRS collects its data every 10 sec with a 100 % duty cycle.

The main sensor of KGRS is made of $LaBr_3$ which has intrinsic gamma-ray backgound of ^{138}La and ^{227}Ac radioisotopes. During the curise period gamma-ray backround in deep space obtained. This gives a merit of checking the self-activity of $LaBr_3$ without any background interference in a laboratory environment. The gamma-ray background on the Moon by facing to deep space is expected to be different from deep space because the lunar environment has gamma-ray background level could be higher interacting made by the solar wind and surface of the Moon. Obtaining both gamma-ray background from deep space and on lunar orbit provide a better understanding in backgound sources in KGRS data processing.

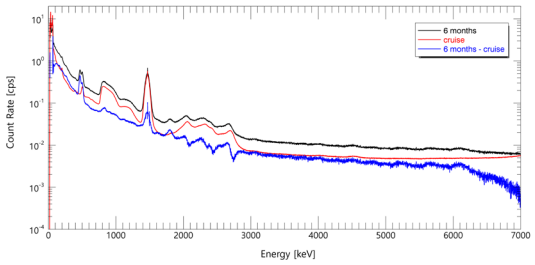

Figure 1. Gamma-ray spectra by the KGRS from Jan. 1 ~ Jun. 30, 2023

Method: For the gamma-ray spectrum analysis with the first 6-month data, a six-month summed dataset is generated with energy calibration steps. Then a 5-degree summed dataset was produced. The summed data set is processed to generate a corrected summed dataset through correction steps for GCR, altitude, solar event, and background. To generate the radioactive elemental maps of U, Th, and K, a peak analysis for the gamma-ray peaks at 609 keV, 1461, and 2615 KeV was performed respectively.

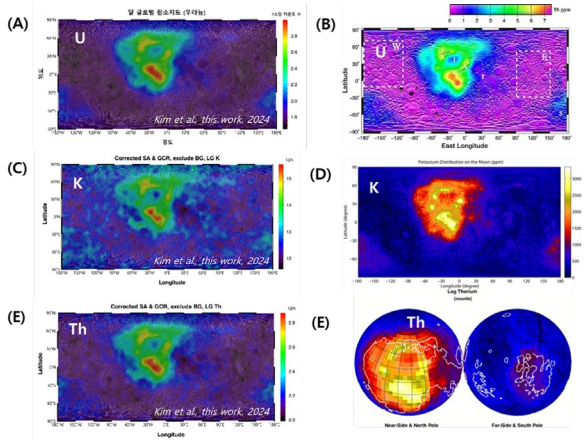

Figure 2. U, K, Th maps by KGRS are compared with Kaguya (B), Chang'e-2 (D), and Lunar Prospector (E).

The preliminary maps of U, Th, and K maps from the KGRS are gamma-ray counting maps. The abso-

lute abundance maps for of these elements are under progress at this time. The Figure 2 shows the U, K, Th maps by KGRS are similarly compared to those from the previous missions' GRS data of Kaguya [8], Chang'e-2 [9] and Lunar Prospector [10]. The natural radioactive maps can be used for lunar geology as well as aspects of lunar resources for future applications.

Discussion: The nominal mission period of 1 year has ened on December 31, 2023. The first half of the extended mission period will continue at the current lunar orbit with an altitude at 100±20 km. Additional data accumulation by KGRS during 2024 will provide addition elemental maps that require higher counting statistics for a reliable peak analysis. In the near future, the natural radioactive elemental maps of U, K, and Th will be published, and the data will be publicly released in 2024.

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