The first observation of Chang'E-2 gamma-ray spectrometer

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Gamma-ray measurement coming from the lunar surface is a powerful method to infer its composition of material in the top several tens of centimeters. While gamma ray lines are remotely measured in orbit, chemical elements can be identified in light of the energies from which they were emitted, and concentrations can be estimated based on their fluxes.

Chang'E-2 spacecraft was launched to the Moon (100 km, circle polar orbit) at 1st, Oct., 2011, with a gamma-ray spectrometer (CE2-GRS) as one of its scientific payloads. CE2-GRS using a large $LaBr_3$ (Ce) crystal as its main detector is expected to provide global elemental maps of the lunar surface (e.g., Th, K; Mg, O, Al, Ca, Si, Fe, Ti). It employs a big cup-shape CsI (Tl) crystal to suppress the Compton effects and reduce the background gamma rays from the spacecraft materials interacted with GCRs. Gamma-rays are recorded as 512 channel-spectrum every 3 seconds in the range of 0.3 to 10 MeV with the energy resolution of ~ 4% fwhm@662 keV.

CE2-GRS has about 4-days background measurements in its cruise period. The spectrum shows higher quality than that from past scintillation detectors for the lunar gamma-ray remote measurement. From the background spectra, self-activity peaks of $LaBr_3$ crystal (from ^{138}La and ^{227}Ac decay chain generation) can be found clearly. Elements (O, K, Mg, Al, and Ti) from the spacecraft body, the fuels, and instruments were also identified. Potassium map (cps, 5°×5°) was obtained using first three-month measurements. Since the higher spatial resolution (~ 150 km × 150 km), the derived map can show the potassium distribution on the Moon clearly.

Absolute calibration will be carried out based on the spatial response function. Comparisons with that of Lunar Prospector, Kaguya, and Chang'E-1 will be investigated to see if the new potassium could indicate some interesting, new science.

A Paleoproterozoic tectonothermal event recorded in Precambrian basement rocks of the Kuluketage uplift, Northeastern Tarim, China

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The Kuruktag uplift is located to the north of the Tarim Block. The Neoarchaean to early Neoproterozoic basement rocks are unconformably overlain by the middle Neoproterozoic to Phanerozoic sedimentary cover. The Precambrian basement rocks also crop out in the Korla region, at the western end of the Kuruktag uplift, whose ages are uncertain because of the paucity of reliable isotopic data. These basement rocks, including gneisses, amphibolites, marbles and schists, were subjected strongly deformed and metamorphosed to amphibolite facies.

Four garnet-bearing schists were collected for zircon U–Pb dating and Hf-isotope analyses. CL images display that most zircon grains occur as relatively dark and rounded crystals and are homogeneous in texture, indicative of metamorphic origin. The samples give four metamorphic zircon ages of 1844Ma, 1847Ma, 1850Ma and 1867Ma, respectively. The metamorphic zircon age of ~1.85 Ga obtained in this study indicate that an important tectonothermal event occurred at the end of the Paleoproterozoic in the Tarim Block. Lu–Hf isotopic analysis on these zircons gives Hf model ages ranging from 2.9 to 3.5Ma, indicating that the late Paleoproterozoic metamorphism and tectonism of the Tarim Block represent an overprint on an Archaean basement. These data imply a Paleoproterozoic orogeny in the northern Tarim.

This episode of Precambrian tectonothermal event is broadly coeval with those seen in many continents around the world such as Baltica, Laurentia, Northern Finland, Northern Fennoscandian Shield, Amazonia, North China and India, etc., which is coincident with the timing of the orogeny associated with the amalgamation of the Columbia super-continent, suggesting that the Tarim Block was the part of this supercontinent.