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# 月の中心核の現状理解と展望
# Understanding the Lunar core: past, present and future

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The central core is a major part of a planet and satellite, contributes to the bulk composition of the major elements and plays a role of a dynamo engine. Formation of a core is thought to be a natural sequence of global differentiation in an expected magma ocean of the planet during its formation and evolution. Understanding the core is therefore a key issue in earth and planetary sciences. The moon has a very small iron core or no core, which is a consequence of the small mean density less than 3.5 g/cm$^3$. The fact is strong evidence of the giant impact hypothesis in which the moon forms mainly from the mantle materials of a colliding planetary embryo. Recent global mapping of the lunar surface magnetic field indicates existence of a systematic magnetic field that can be produced by an ancient fluid motions of a liquid core: the lunar core dynamo. Thus, characterizing the lunar core on its size and composition is important for understanding the formation and evolution of the moon. Determination of the core size was the central objective of the former Lunar-A project constructing a seismometer network with hard landing probes named penetrator.

Seismology provides us the most efficient way to reveal the internal structure of the moon like as on the earth. Seismic waves excited by an event can be a light illuminating the interior of the moon. Since the Lunar-A project was canceled, seismic data recorded by the Apollo project are only the data that human beings have ever obtained. In the project, four seismic stations was built from 1969 to 1972 and formed a triangle network with a side of about 1,000 km, and had been operated for five and half years. During the observation period, more than 10,000 seismic events were detected by the network. The data has been used for interpretations on the deep structure of the moon. However, the deeper part of the moon has not been revealed since most of moonquakes are located in the near side of the moon and the span of the seismic network is about 1,000 km at most. Moreover long lasting codas of direct P- and S-waves conceal signs from the core.

Entering 21th century, high performance computing resources are available in many scientific fields. Using such a resource, re-interpretation of the Apollo seismic data has been performed in this decade. Some researches reported a detection of reflection and transmission waves from the core and determined the core size of 300˜400 km which is consistent with the other estimations using geodetic and electromagnetic data. However, after complicated processing of data, the detection is still marginal or questionable. To clear the existence and size of the core of the moon, we must deploy a wider seismic network using seismometers with higher performance. Technologies of Lunar-A type penetrator and broadband seismic sensor able to operate under extreme environment are necessary for a future exploration of the lunar deep interior. At last, I introduce future mission plans using the technologies.

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