Foreword

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Our nearest ‘planetary’ neighbor, the Moon, is at the same time very familiar and very mysterious. We see the Moon regularly. We watch its phases change. We can see the basins and craters on the moon with our naked eyes. Yet the Moon coyly hides her far side, hiding it from our gaze. While photographic space missions have allowed us to view the far side, and analyze its surface properties, we still have not been able to land there nor measure its far side gravitational field because the Moon is locked in synchronous rotation with one side facing the Earth. The problem is simply one of communication. To obtain data from the far side, whether to support a landed mission or a far side gravity mission, one must communicate over the horizon. This is difficult on a body with no significant atmosphere nor ionosphere.

Japan’s Kaguya mission was designed to overcome this problem. The mission consisted of three spacecraft. The mother craft carried two sub-satellites Okina and Ouna which were released into elliptical orbits permitting information gathered on the far side to be relayed to the Earth and allowing the far side gravitational field to be precisely measured for the first time. The gravity measurements were accompanied by cameras and imagers, magnetometers, gamma and X-ray spectrometers, laser and radar rangefinders, plasma spectrometers and radio and plasma wave receivers. This very comprehensive payload remained in orbit for 18 months obtaining exciting new information about the Moon and adding to our understanding of the Earth’s coy companion.

This collection of articles describes the Kaguya mission, its instruments and scientific investigations and shows some of the early measurements obtained. It begins with an overview of the mission by its lead scientist M. Kato and the project team. This is followed by a discussion of the high definition television system on board Kaguya that both served to make

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the Moon more accessible to the public but also returned very useful scientific imagery. A very important measurement of bodies such as the Moon is the characterization of its reflectance spectrum. This tells us the mineral composition of the surface. The next two articles describe how the multiband imager was used to obtain the absolute reflectance of the surface and how it was calibrated. As discussed above, obtaining an accurate gravitational field was a high priority for Kaguya. The next two articles describe the ground tests, the differential VLBI measurements and the gravity measurements that enabled this objective to be met. The following article shows how Kaguya saw beneath the lunar surface with its radar sounder to uncover the buried structure of the Moon. This is followed by an article on the gamma ray spectrometer that enables the elemental composition of the crust of the Moon to be determined. The following two articles describe the mapping of lunar magnetic anomalies by the magnetometers on Kaguya and the great lengths taken to ensure magnetic cleanliness. This investigation responds to one of the early surprises of the Apollo program, that the lunar crust is magnetized. The next two articles discuss the measurements of the Moon's plasma environment. The Moon does have a weak atmosphere and ionosphere and is surrounded by a magnetized plasma, usually of solar origin but occasionally coming from the Earth. While the cold plasma of the ionosphere is not sufficiently dense to support radio communications around the Moon, it is still of great scientific interest. The volume closes with a discussion of the data processing at the Kaguya Operation and Analysis Center.

The success of a space mission such as Kaguya depends on the hard work, and assistance of many very dedicated individuals. Even assembling a description of this effort such as done herein requires the contribution of many individuals. The greatest contribution comes from the authors who took the myriad documents and charts that such missions produce and distilled from them these highly readable papers. The editors benefited from the advice of an excellent set of referees who carefully read each paper and provided positive feedback to the authors that improved the papers. These referees included, S. Asmar, S. Barabash, D. Brain, P.J. Chi, D. Domingue, M.C. De Sanctis, W.M. Farrell, E. Formalont, D.A. Gurnett, J. Halekas, D.J. Lawrence, J.-Y. Li, A. Nathues, T.B. McCord, S. Mottola, N. Murphy, C. Pieters, T. Prettyman, H. Rucker, R. Simpson, D.E. Smith, T. Stubbs, W.T. Thompson, P. Zarka, M. Zuber.

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