The presence of water and methane at polar regions searched by Spectral Profiler data onboard Kaguya

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Abstract:

The presence of volatile elements including water ice on the surface atlunar polar regions has been widely investigated by recent observations. Clarifying their origin could be directly connected to transportation mechanism of life related materials to Earth-Moon system, and a finding of large amount of water ice could be a valuable resource in the context of future utilization of the Moon. However, most of the reports which supported presence of water ice remained room for consideration of their presence because of indirect evidence and/or low S/N data.In this study, extensive survey of water or other volatile species was conducted using Spectral Profiler (SP) data on board KAGUYA[1], which observed visible to near infrared with having high signal to noise ratio. We searched absorption features attributed to presence of water and other volatile elements at the high S/N range of 1100nm to 1500nmat polar regions higherthan 80 degrees. As a result, we identified the clear absorption features of three volatile phaseswhich are water frost, water gas, and methane ice for the first time in one reflectance spectra among about ten million spectral data sets.The discovered data distributed higher than 80 degrees at both polar regions and the absorption data could be well identified without data processing such as smoothing and/or data stacking.

Especially, we found prominent profiles in and around Nobile crater where is classified as a permanent shadowed region (PSR). Furthermore, presence of considerable amount of solid methane, which identified by the prominent features at 1150nm, supports the idea that illuminated material might be originated from comet.

The water contents were inferred from maximum depth of the absorption feature at 1500 nm compared with the experimental data[2]and water content for all the discovered profiles is estimated to be about two weight percent in average

We speculated such large amount of water could be existed on the surface (and/or shallow depth of subsurface) at wide area of the polar regions. Existence of mixture of water ice and gas phase indicates sublimation and/or condensation process occurred at the observation area. Especially it is noted the regions at where we found water ice are involved in non-PSR. Recently, space agencies such as NASA and JAXA are actively planning to explore the polar region of the Moon because of its usability as lunar base and possible existence of volatile elements. Our new findings of presence of water at the non-PSR region should motivate to proceed direct sample return mission(s) in the future.

References

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