Surface Volatiles

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Introduction

1. Definition of volatiles
2. Old view of volatiles
3. Significance of volatiles
4. Reservoirs of volatiles

Quantifying Present Day Volatiles

1. Abundance
   - PSRs—LCROSS, LEND/LPNS, LAMP, LOLA, visible images LROC & Kaguya, radar
   - Global—M3/Cassini/EPOXI, LAMP, LOLA, Apollo samples
2. Composition
   - PSRs—LCROSS
   - Global—Apollo samples, M3/Cassini/EPOXI, lab irradiation spectral, exosphere composition
3. Distribution
   - PSRs lateral distribution—LAMP, LOLA, LEND/LPNS, Mini-RF
   - PSRs depth distribution—LEND/LPNS, Mini-RF
   - Global latitudinal distribution—LAMP, M3/EPOXI
   - Global local time distribution—LAMP, M3/EPOXI
   - Other temporal variability
4. Physical Form
   - PSR Radar data
   - PSR LCROSS—ice grains, H2 abundance/timing
   - Global 2.8/3.0 um spectral shape

Volatile System

1. Sources
   - Comets—model impacts and retention; expected flux
   - Meteoroids—model impact and retention; LADEE NMS H2O observations; Apollo sample isotopic analysis
   - Solar wind—Apollo agglutinates isotopic analysis, H budget from Kaguya H+, ARTEMIS H+, Chandrayaan-1 H, IBEX H, LAMP H2; lab studies of ion irradiation of lunar soils/rocks; swirls
   - Outgassing—Aristarchus, He & Ar LADEE NMS data, Schroedinger
2. Redistribution
   - Migration/hopping in exosphere
   - Migration/diffusion through regolith
   - Impact gardening

3. Stability
    - Thermal mapping—Diviner
    - Sublimation stability
    - Adsorption stability
    - Depth to thermally stable zone
    - Orbital evolution effects on thermal stability
4. Loss
    - Sputtering
    - Impact vaporization
    - Photodesorption/dissociation
    - Sublimation/thermal desorption

Outstanding Questions

1. Complete quantification of current contents
2. Age of deposits
3. Replenishing rate
4. Relative importance of sources
5. Accessibility
6. Differences between Moon and Mercury, Asteroids, meteorites