ENDOGENOUS LUNAR VOLATILES  Co-leads: F. M. McCubbin1 & Y. Liu2; Contributors: J. J. Barnes1, J. W. Boyce1, J. M. D. Day1, S. M. Elardo4, H. Hui2, T. Magna6, P. Ni3, R. Tartèse3, and K. E. Vander Kaaden3, 1NASA Johnson Space Center, Mailcode XI2, 2101 NASA Parkway, Houston, Texas 77058, USA 2Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91109, USA. 3Geosciences Research Division, Scripps Institution of Oceanography, La Jolla, CA 92030-0444, USA 4Geophysical Laboratory, Carnegie Institution of Washington, 5251 Broad Branch Rd. NW Washington DC 20015 5State Key Laboratory for Ore Deposit Research, School of Earth Sciences and Engineering, Nanjing University, Nanjing 210023, China 6Czech Geological Survey, Klařov 3, CZ-118 21 Prague 1, Czech Republic 7Department of Earth and Environmental Sciences, University of Michigan, Ann Arbor, MI 48109 8School of Earth and Environmental Sciences, University of Manchester, Manchester, UK 9Jacobs, NASA Johnson Space Center, Mailcode XI, 2101 NASA Parkway, Houston TX 77058, USA (email: francis.m.mccubbin@nasa.gov).

Introduction: At the time of publication of New Views of the Moon [1], it was thought that the Moon was bone dry with less than about 1 ppb H2O. However in 2007, initial reports at the 38th Lunar and Planetary Science Conference speculated that H-species were present in both apatites [2] and pyroclastic volcanic lunar glass beads [3]. These early reports were later confirmed through peer-review [4-8], which has motivated many subsequent studies on magmatic volatiles in and on the Moon within the last decade. Some of these studies have cast into question the post-Apollo view/synthesis on the current state of 1) apatite compositions (volatile abundances and isotopic compositions); 2) nominally anhydrous mineral phases (moderately to highly volatile); 3) volatile (moderately to highly volatile) abundances in and isotopic compositions of lunar pyroclastic glass beads; 4) volatile (moderately to highly volatile) abundances in and isotopic compositions of lunar basalts; 5) volatile (moderately to highly volatile) abundances in and isotopic compositions of melt inclusions; and finally 6) experimental constraints on mineral-melt partitioning of moderately to highly volatile elements under lunar conditions. We anticipate that each section will summarize results since 2007 and focus on new results published since the 2015 Am Min review paper on lunar volatiles [9].

The next section will discuss how to use sample abundances of volatiles to understand the source region and potential caveats in estimating source abundances of volatiles. The following section will include our best estimates of volatile abundances and isotopic compositions (where permitted by available data) for each volatile element of interest in a number of important lunar reservoirs, including the crust, mantle, KREEP, and bulk Moon. The final section of the chapter will focus upon future work, outstanding questions, and any insights on the types of samples or experimental studies that will be needed to answer these questions.

Chapter changes since the NVM II 2016 Workshop: In the months following the 2016 NVM II workshop, we were informed by the steering committee that the request to have a stand alone chapter on stable isotopes was denied. Consequently, we have decided to cover the topic of volatile stable isotopes in our chapter and include a synthesis/review of new stable isotope data where relevant. There were no additional major changes to report on the contents of this chapter.