CAN ROSETTA NOBLE GAS AND ISOTOPIC MEASUREMENTS CONTRIBUTE TO UNDERSTANDING THE ORIGIN AND EVOLUTION OF VENUS' ATMOSPHERE? K. E. Mandt[1], A. Luspay-Kuti[2], O. Mousis[3], S. Fuselier[2,4]. [1]Johns Hopkins University Applied Physics Laboratory, Laurel, MD, [2]Southwest Research Institute, Space Science & Engineering, San Antonio, TX 78228, [4]Department of Physics and Astronomy, Univsersity of Texas at San Antonio, San Antonio, TX.

Introduction: Comparative planetology of the atmospheric evolution of the terrestrial planets is essential for understanding how life formed and continues to thrive on Earth, but not on present-day Venus or Mars. Extensive studies have been conducted for Earth [e.g. 1] and an entire mission has been devoted to evaluating the history of the Martian atmosphere [2]. This leaves the evolution of Venus as the least understood [3].

Studying the atmospheric history of Venus can determine: (1) the origin of volatiles on Venus compared to Earth and Mars; (2) the total initial abundance of volatiles, in particular of water; and (3) the outgassing history of Venus. The VEXAG goals include the above objectives and outline the need for measurements of stable isotope ratios, D/H, $^{12}C/^{13}C$, $^{14}N/^{15}N$, $^{16}O/^{17}O$, $^{16}O/^{18}O$ and $^{34}S/^{32}S$, as well as the relative abundances and isotope ratios of the noble gases.

Sources of volatiles: Atmospheric evolution studies require some information about contributing sources of initial isotopic abundances. Solar values, representative of the bulk abundance of the protosolar nebula (PSN), have been investigated in depth [4]. However, meteoritic studies show that the isotopic abundances of the PSN were not homogenous [4]. Furthermore, observations of D/H in comets remain puzzling [5]. This suggests that the isotopic and noble gas abundances of the terrestrial plantets is likely to result from a complex mix of gas absorbed directly from the PSN and volatiles contributed by impact of planetesimals and comets formed at varying discances from the Sun.

Comet measurements remain limited. Ground-based observations have provided D/H in water and HCN, $^{12}C/^{13}C$ in C_2, CN and HCN, $^{14}N/^{15}N$ in HCN and NH_3 and $^{16}O/^{18}O$ in water for several comets [see 6 and refs. therein]. No noble gas measurements in comets were available prior to the Rosetta mission. Since arrival at the comet 67P/Churyumov-Gerasimenko (67P), a Jupiter family comet, the Rosetta mission has reported precise measurements of D/H $^{16}O/^{17}O$ and $^{16}O/^{18}O$ in water [5], $^{12}C/^{13}C$ and $^{16}O/^{18}O$ in CO_2 [7], $^{12}C/^{13}C$ in C_2H_4, C_2H_5 and CO [8], $^{29}Si/^{28}Si$ [8] and $^{30}Si/^{28}Si$ the relative abundance of the Argon [9] and Xenon isotopologues [10]. Further analysis of the Rosetta data continues, and more stable isotope ratios and noble gas abundances are expected in the coming years.

Relevance to Venus: New observations of noble gas abundances and stable isotope ratios from comets provide important information on potential sources of volatiles for Venus. They can first be used to refine models of atmospheric evolution based on the limited measurements available for the atmosphere of Venus [e.g. 11]. However, given the limitation of these measurements, they can also contribute to models that could be used to project measurements for future missions, as we did for *New Horizons* prior to the arrival at Pluto [11].

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