PROGRESS IN THE DEVELOPMENT OF CHEMIN-V, A DEFINITIVE MINERALOGY INSTRUMENT FOR LANDED SCIENCE ON VENUS. D. F. Blake[1], P. Sarrazin[2], T. F. Bristow[1], A. H. Treiman[3], K. Zacny[4], and S. Morrison[5]. [1]NASA Ames Research Center, Moffett Field, CA USA 94035-1000 (david.blake@nasa.gov), [2]SETI Institute, 189 N. Bernardo Ave. suite 200, Mountain View, CA USA, 94043, [3]Lunar and Planetary Institute, 3600 Bay Area Blvd., Houston, TX, USA 77058-1113, [4]Honeybee Robotics, 398 W. Washington Blvd., suite 200, Pasadena, CA USA 91103. [5]Carnegie Institution for Science, 5241 Broad Branch Rd NW, Wash, DC USA 20005.

Introduction: Science objectives of a Venus Lander [1] include: 1). Determine the elemental composition of surface rocks, and 2). Identify mineral phases to address atmosphere and surface evolution along with surface mineralogy. These objectives must be met within 1-2 hours.

Mineralogical Analysis using X-ray Diffraction and X-ray Fluorescence (XRD/XRF): X-ray Diffraction is the only *in-situ* technique able to definitively identify, quantify and determine the elemental composition of minerals present in planetary regolith. XRD was employed in robotic planetary exploration for the first time on the Mars Science Laboratory (MSL) *Curiosity* rover [2]. Descriptions of the samples analyzed by CheMin as well as publications related to the analyses can be downloaded from the CheMin database: https://odr.io/Chemin.

CheMin-V is the product of a decade of post-CheMin technology development, yielding increased data acquisition speed, a 50% reduction in instrument mass and volume, improved pattern resolution and a considerable improvement in XRF performance, allowing quantitative chemical analysis of elements Z> 10. With sample delivery from HoneyBee Robotic's PlanetVac [3], CheMin-V can return quantitative mineralogical results in ~15 minutes and can analyze up to four separate samples, leaving margin for sample delivery and data transmission. XRD/XRF analyses of drilled and powdered samples on Venus by CheMin-V will yield:

- Identification of all minerals present >1 wt. %.
- Quantification of all minerals present >3 wt. %, including structure states and cation occupancies.
- Abundance of all major elements present in each mineral (H and above) from their refined lattice parameters, for minerals present at >5 wt.%.
- Valence states of all major elements, including speciation of multivalent species such as Fe for minerals present at >3 wt% (from their empirical formulas).
- The quantity and elemental composition of X-ray amorphous material, if present.

There are no other spacecraft instruments currently in NASA's planetary science inventory that can claim even one of these capabilities.

Development of CheMin-V to TRL-6+. A next-generation CheMin-V instrument called "XTRA," coupled with a PlanetVac Sample Handling System (SHS) is being developed to TRL-6 as part of a NASA DALI grant for lunar applications. The entire system will be tested to TRL-6 by early next year. Figure 1 shows a 3-D model of the instrument and Figure 2 shows a conceptual design of the SHS.

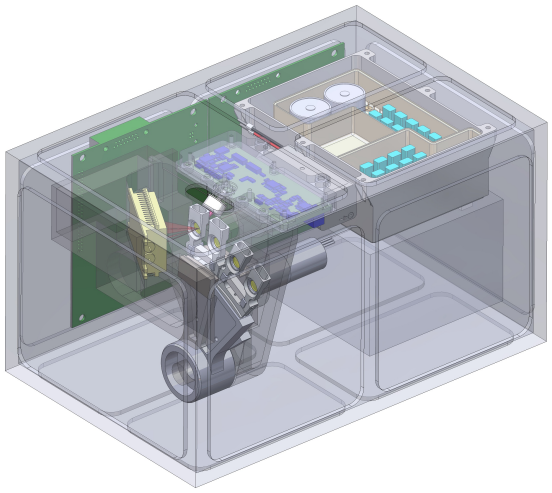

Fig. 1: 3D model of the XTRA instrument showing the refined design of the geometry and sample handling system. Dimensions: 290 X 190 X 162 mm.

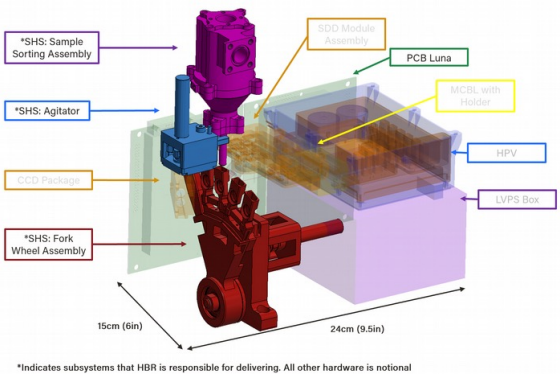

Fig. 2: Preliminary design of a TRL-4 sample handling system (SHS). Note that the transparent components are notional instrument components laid out in a potential orientation.

References: [1] GOI VEXAG final report, 07/01/19. [2] Blake, D.F., et al. (2012), Space Sci. Rev. **170**:341-399, DOI 10.1007/s11214-012-9905-1. [3] Zacny, K. et al. (2017), IEEE Aerospace Conference, Big Sky MT, 2017.