Preliminary Analysis of Tinto Vallis and Palos Crater; A Proposal for CRISM Targeting. A. Annex[1] B. Grigsby[2], D. Turney[3], J. R. Zimbelman[4] and J. W. Rice, Jr[5], [1]MONS, Saint Anne's-Belfield School, 2132 Ivy Road Charlottesville, VA 22903, andrew.annex@gmail.com, [2]Arizona State University, Mars Space Flight Facility, Tempe, AZ, [3]Johns Hopkins Applied Physics Laboratory, Laurel, MD. [4]CEPS/NASM MRC 315, Smithsonian Institution, Washington, DC 20560-0315, jrz@ceps.nasm.edu. [5]Lunar and Planetary Laboratory, 1629 E. University Blvd.,University of Arizona, Tucson, AZ 85721-0092, jrice@lpl.arizona.edu

Introduction: Although Mars may appear to be a dry dusty rock, with the advance tools from the Mars Odyssey and the Mars Reconnaissance Orbiter missions our view of Mars has changed. Within the last ten years significant discoveries of water related features and deposits have been discovered all across the surface of Mars. So many in fact that only a small number of all the possible water related features of Mars have been studied thoroughly by advanced instruments such as CRISM and HiRISE. Tinto Vallis and its accompanying The Palos impact crater is an example of such a water related feature. As a part of a independent study at the high school Saint Anne's-Belfield School (Charlottesville VA), MONS (Mars Outreach for North Carolina students), MESDT (Mars Exploration Student Data Teams), and D Turney at Johns Hopkins Applied Physics Laboratory, we initiated a advanced study of Tinto Vallis and of Palos based upon a hypothesis of James R. Zimbelman at the Smithsonian Institution. With the support of B. Grigsby from MESDT and D. Turney from APL, we have applied for a CRISM targeting of a ROI (region of interest) in the Tinto Vallis/Palos region that is to be determined as of now. As of this time, the CRISM science team has agreed with the points that will be outlined in this abstract and that the region was selected as a candidate for observation. The ROI will be target by CRISM most likely in the fall of 2009. This independent study serves as an opportunity to make a significant contribution to the overall geologic history of Mars. Although the Tinto Vallis/Palos region of Mars only covers a small area of the entire surface, it is important for scientists to have as much detail as possible of all the water related features of Mars in order to form a more complete understanding of Mars's wet past.

Figure 1: Tinto Vallis and Palos, THEMIS Day IR mosaic

General Dimensions and Locations: Tinto Vallis and Palos are located in Tyrrhena Terra, directly north of Tyrrhena Patera at approximately 111.3°E, -4°N (Palos is at 110.8°E, -2.7°N). Tinto Vallis appears to originate at an un-named area of chaotic terrain that is 15.5km in diameter. The width of the Valley ranges between 2km and 5km with a length of 180km. Tinto Vallis has a slope of approximately -3.36 meters per kilometer. The second drainage inflow channel that merges with Tinto Vallis in the south-west corner of Palos is 30km long and 6km wide. Palos itself is 55km in diameter and its base is about 800 meters below the surrounding terrain. Palos is also relatively flat with a general slope downhill towards the north and north east sides of the crater between 1.7 meters per kilometer and 5.5 meters per kilometers.

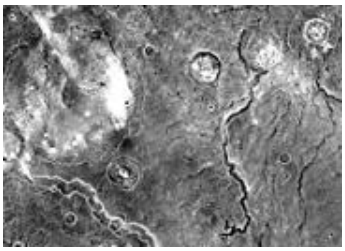

Figure 2:THEMIS night IR mosaic, Palos on left, two smaller systems to the right.

Hypothesis: Palos Crater was proposed as a possible landing site for the MER mission [1]. Palos appears to have been a lake/playa, which breached and drained on the north side of the crater [1, 2, 3, and 4]. Tinto Vallis along with a separate drainage system are the most likely source for the water and sediments that could have collected within Palos. This relationship is the most commonly used indicator of a former lake within a crater [5]. The area surrounding Palos has many other fluvial formations including two smaller systems 50 kilometers to the east of smaller craters with smaller drainage channels flowing into them (see figure 2). To the west of Palos there are also scores of other drainage systems, fluvial formations, chaotic terrain, and rampart craters. These fluvial formations and drainage systems all appear flow into Isidis Planitia. Tinto Vallis is

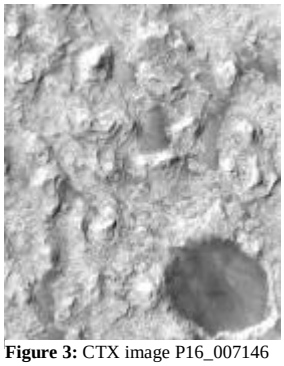

Figure 3: CTX image P16_007146 _1752_XN_04S248W, Possible layer features

very well preserved, with very little apparent erosion of the walls or cliff-edges of its v-shaped morphology. Zimbelman indicated that Tinto Vallis was an underground channel that caved-in. This Hypothesis is supported by irregularities in one section of Tinto Vallis ~40km from the entrance into Palos (see figure 1) [1]. Tinto Vallis flows into Palos at an intersection with the for mentioned drainage system, which appears to have flowed into Palos before Tinto Vallis did. On the floor

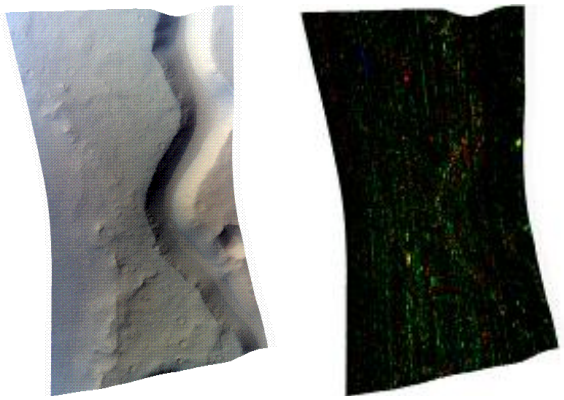

Figure 4:Left: VNIR tinto vallis, CRISM id: HRL0000C0F4
Figure 5: Right: Hydroxylated silicates map of HRL0000C0F4
Credit: NASA/Johns Hopkins University Applied Physics Laboratory

of Palos there appears to be layering features (figure 3). The crater decreases in elevation towards the north east from the south west. The layers are about 20 meters thick based on data from the MOLA instrument. In figure 3, a ghost crater is being revealed by the erosion of the layer above. These layers appear to be composed volcanic ash, most likely from Tyrrhena Patera. The layers may have been eroded enough by Aeolian processes to expose the original base of Palos. This cannot be tested without a high resolution spectral image, such as a CRISM target. Figures four and five are a CRISM target of a section of Tinto Vallis. Unfortunately the hydroxylated silicate map does not appear to show any significant phyllosilicate deposits. The green and red phyllosilicate signatures visible in the image appear to follow along the channel of Tinto Vallis because the summery parameters are sensitive to shaded slopes and strong brightness boundaries. This region of Tyrrhena Terra has a large amount of dust covering the region. This is a factor that has to be considered strongly when picking the ROI because dust cover could hide water related features. This is why during the course of the preliminary study of Tinto Vallis, the focus shifted to the crater Palos and the drainage system that flows into it. Tinto Vallis may have had all of its water bound past eroded by Aeolian processes and covered by dust. Figure 6 is a TES dust map layered over a THEMS daytime mosaic, showing the dust distribution in Palos and in Tinto Vallis. The dust map shows two areas of low dust accumulation within Palos, which make them possible regions for the ROI. Although low in resolution, the TES mineral maps can be used to identify minerals quickly. Figure 7 is a CTX mosaic of Palos with an overlay of a TES mineral map of sheet silicates. The TES mineral map shows a signature of sheet silicates in a section of the drainage inflow channel in the bottom left of the picture. This makes the area a possible ROI for the CRISM target. Little else can be concluded about the separate channel; it may have been a section of Tinto Vallis although it appears to end abruptly only ~20km from the inlet into Palos. It also has three drainage channels that flow into it, indicating that it was formed by water related erosion. The outlet of Palos shows streamlined islands and what appear to be sediment deposits that formed when Palos breached on the north side of the crater.

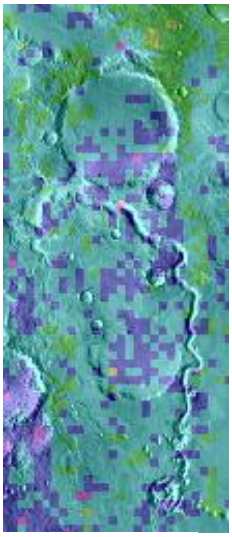

Figure 6: TES dust map of tinto vallis and of palos

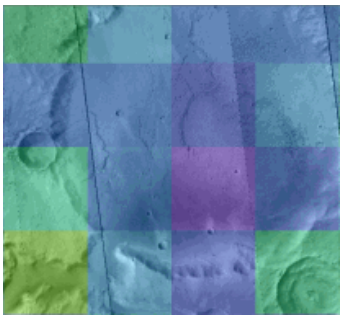

Figure 7: TES mineral map over ctx mosaic: Bandfield, J.L., Global mineral distributions on Mars, J. Geophys Res., 107,

Conclusion: The Tinto Vallis and Palos paleo lake system has several locations that could yield spectrographic evidence for its water-bound geologic history. Gusev crater, the most well studied paleo lake system on Mars, has revealed important evidence of the history of water on Mars. Palos may do the same if high-resolution spectrographic images are taken of it and the surrounding terrain. The CRISM team conquered with the argument for advanced study of Palos and a ROI will be targeted with CRISM. This was the original goal of the study and the final findings will be published after a thorough examination of the data.

References: [1] J. R. Zimbelman, et al (1999). [2] Scott D. H., Dohm J. M. and Rice J.W. (1995) U.S.G.S. Misc. Invest. Series Map I-2461. [3] Rice J. W. and Scott D. H. (1998) Mars Surveyor 2001 Landing Site Workshop, (V. Gulick, Ed.), NASA Ames Res. Center. [4] Zimbelman J. R., Johnston A. K. and Patel A. N. (1999) LPSC XXX, Abs. #1662. [5] Forsyth R.D. and Blackwelder C.R. (1998), J. Geophys. Res., **103**(E13), 31,421-32.