COMPARISON OF PLAINS VOLCANISM IN THE TEMPE TERRA REGION OF MARS TO THE EASTERN SNAKE RIVER PLAINS, IDAHO WITH IMPLICATIONS FOR GEOCHEMICAL CONSTRAINTS. S. L. Weren[1], S. E. H. Sakimoto[2], S. S. Hughes[3], and T. K. P. Gregg[4] [1]Franklin and Marshall College Department of Geoscience, PO Box 3003, Lancaster, PA 17604, serena.weren@fandm.edu, [2]GEST at the Geodynamics Branch, Code 921, NASA Goddard Space Flight Center, Greenbelt, MD 20771, sakimoto@geodynamics.gsfc.nasa.gov, [3]Dept. of Geosciences, Idaho State Univ., Box 8072, Pocatello, ID 83209, hughscot@isu.edu, Dept. of Geological Sciences, The Univ. at Buffalo, SUNY, 876 Natural Science Complex, Buffalo, NY 14260.

Introduction: The Eastern Snake River Plains (ESRP) in Idaho have long been considered a terrestrial analog for the plains volcanism like that evident in Syria Planum and Tempe Terra, Mars. Both the ESRP and Tempe Terra are sediment-blanketed volcanic fields in areas with significant extensional faulting. Similar volcanic features can be observed throughout both study areas using field analysis and DEMs of the ESRP and the Mars Global Surveyor (MGS) data from Mars. These features include flow fields, low shields, shields with steep summits, and fissure eruptions. A few other volcanic features, such as cinder cones, which suggest variable compositions, volatile interactions, and multiple volcanic events can be seen in both areas [2]. The eruptions in both the ESRP and Tempe Terra generally originate from the fissures creating elongate, multi-vent shields as well as isolated or aligned single vent shields [1, 3]. Many of these show evidence of radial flow patterns from summit craters as well as lava tube fed flows. The volcanoes of Tempe Terra display some of the global latitudinal parameter trends of small volcanoes on Mars [2]. Some of these trends may be explained by the variation of volatile content and compositional variation across Mars [2]. However, within Tempe Terra no significant local latitudinal trends can be seen in edifice attributes and not all variations are explained by global trends. This study builds upon previous studies of the Tempe Terra region and the ESRP [eg. 2] in order to develop a more detailed representation of features and topographic data. Using these data we attempt to help constrain the composition and eruptive style of the Tempe Terra volcanoes by correlating them with the similar and quantified ESRP variations.

Data and Analysis: *Eastern Snake River Plains*. The ESRP provides a unique area to study because of the multiple emplacement styles of basalt lava, including flood basalts, shields, and fissures eruptions [4]. For both the Eastern Snake River Plains and Tempe Terra we conduct topographic parameter analysis for the features using an IDL-based program called *Gridview* [6]. The grids for the ESRP are derived from 30 meter USGS DEMs. We use *Gridview* to measure volcano edifice diameter, height, area, volume, flank slope, and crater dimensions. For the ESRP, the *Gridview* data are combined with field profiles, observations, and geochemical analysis to develop a better understanding of the evolution of volcanism in the area. Olivine Tholeiite shield volcanoes comprise the majority of features in both the ESRP [4]. They display a large range of profiles from low shields with indistinct summits to shields with steep summits and collapse craters [4]. Terrestrial shields are an average of 5-25 kilometers in diameter and have average flank slopes of less than 5 degrees. The data points for ESRP volcanoes cluster on the graph of the edifice volume to the diameter ratio plotted against the average flank slope (Fig. 2). Many of the shields have steep summits, which often indicate a change in eruptive style resulting from changes in the viscosity of the magma. These changes in composition or explosivity are consistent with a geochemical comparison of lava from the flank and summit area [6]. The slope of the shield's summit area is an average of 5.5 times the average flank slope, and can be as much as 19 times steeper. The shields that have steeper

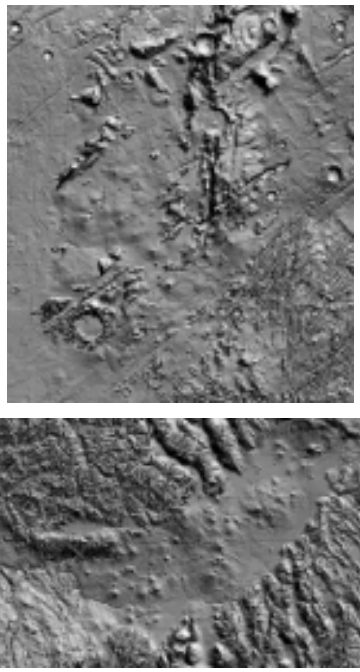


Figure 1: Shaded relief MOLA image a region of Tempe Terra Mars (top). Shade relief USGS DEM image of the Eastern Snake River Plains. Idaho (bottom).

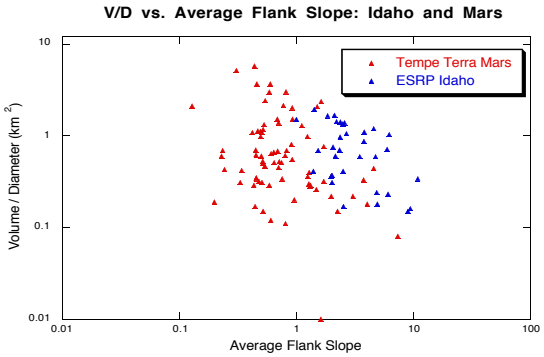
summit slopes have coarse diktytaxitic textures and large plagioclase grains at the summit. The shields without the steep summit areas have smaller plagioclase grains and a sub-ophitic texture. The fissure eruptions have a relatively similar diversity to the shields and mainly differ in the diameter and crater dimensions. The shape of a fissure volcano is often elongated in both diameter and crater length in one direction, and the crater depth is often deeper than the average shield. It is also important to mention the presence of cinder cones, tuff cones, spatter cones, and rhyolitic domes in the ESRP because we find evidence for their existence in Tempe Terra as well.

Tempe Terra. Tempe Terra, an area once crossed with fissures, has now been significantly resurfaced into a gently sloping volcanic plain crossed with mostly buried fissures. From Viking, Mars Orbital Camera (MOC), and Thermal Emission Imaging System (THEMIS) images the presence of long flow fields, shields, and fissure eruptions in Tempe Terra can be seen. To analyze the volcanic features of Tempe Terra we use grids created from the Mars Orbital Laser Altimeter (MOLA) elevation data. In Gridview, we measure the same set of dimensions as we do for the ESRP. A majority of the volcanic features that can be measured in Tempe Terra are shield and fissure volcanoes. The shields of Tempe Terra are an average of 10-60 kilometers in diameter and have an average flank slope less then 2 degrees with a majority less then 1-degree. Like the volcanoes of the ESRP, the Tempe Terra volcanoes also have a distinct cluster on the graph of the volume/diameter ratio to the flank slope (Fig. 2). Some of the shields in Tempe Terra also have slopes that get steeper around their summits. The slope of the shield summit region is an average of 1.5 times the average flank slope. Similarly to the shields, the fissure eruptions have the same topographic characteristics except for the elongated edifice and crater diameter and a deeper crater. Other indicators of compositional or volatile interaction changes are the parasitic cones that erupted on some of the shields. There are also a few volcanic edifices that more closely resemble terrestrial cinder cones than shields. Another significant feature in the Tempe Terra region is Tempe volcano, which is a relatively larger edifice to the east of the main volcanic plain. It represents a more explosive period of volcanism and a possible increase in magma silica content.

Comparisons Between Volcanic Fields. The grids used for analysis have resolution that is approximately the same when scaled to terrestrial or Martian features for easily comparable results. These data show that the Martian shields are significantly broader, lower, and have much shallower average flank slopes then the terrestrial shields. The differences in dimensions are consistent with earlier studies that suggested that Martian shields should be broader and shorter, and have greater volumes than terrestrial shields of similar composition due to the effects lower gravity and atmospheric pressure have on a flow [5]. The lower inclination of the steep Martian summits is also consistent with these conditions. Despite the differences in dimensions, both shield populations have similar volume to diameter ratios (Fig. 2). Many of the same processes that have been found to affect the formation of the range of volcanic features in the ESRP may also have affected the topographically similar volcanoes of Tempe Terra. Analysis of lava from the ESRP suggest increases in degassing or silica content of magma late in the eruption sequence helping to creating the steeper summit areas on the shields. Another possible explanations for the steep summits, as well as other volcanic features, like cinder cones, may be increased volatile interactions.

Add ESRP volcanoes

Conclusions: A more detailed comparison of the dimensions of the ESRP and Tempe Terra volcanoes reveals that the volcanic edifices are very similar in construct. These similarities are in agreement with the affects of lower gravity and atmospheric pressure. A closer look at the composition of ESRP volcanic edifices show a significant range of features suggesting changes in eruptive style and the evolution of magma. These results may be an explanation for the same diversity of features found in the Martian area of Tempe Terra.



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