VENERA 9, 10, AND 13 LANDING SITES AS SEEN BY MAGELLAN. A.T. Basilevsky, Vernadsky Institute, Russian Academy of Science, 117975 Moscow; C.M. Weitz, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, 91109.

Introduction: This study is part of a joint analysis of geochemical and TV in situ observations of Venera/Vega landers and the Magellan imagery of the landing sites. A major difference in the observation scale as well as uncertainty of the lander's position within each landing circle (R=150 km) make the analysis difficult but not hopeless and initial results of analysis for the Venera 8 site have been very useful [1]. A photogeologic study of Magellan imagery for the Venera 8 site has shown the presence of a pancake volcanic dome which we believe to be evidence for the presence of geochemically evolved non-basaltic material at this site [1]. These results are in agreement with the relatively high contents of K, U, and Th measured by the Venera 8 gamma ray spectrometer at this landing site [2].

Description: Venera 9 landed on the northeastern slope of Beta Regio rise. The landing circle is centered at 31.01 N, 291.64 E [3]. This slope of Beta Rise, like other ones, is composed of patches of tessera and plain-like terrain embaying the tessera. Within the landing site the plain-like terrain dominates while tessera occupies less than 10% of the area. The plain-like terrain here is mostly fractured with an EW trending linear zone. No wind streaks are seen within the site. The Venera 9 spacecraft landed on a steep (30 degree) slope covered with plate-like decimeter-size rock fragments with soil in between [4]. The gamma ray spectrometer measured low contents of K, U, and Th typical for tholeiitic basalts [2].

Venera 10 landed at the lowland near the southeastern edge of Beta Regio rise. The landing circle is centered at 15.42 N, 291.51 E [3]. The geology of this area is determined by the presence of large massifs of tesserae and mottled plain which embays the tesserae. The center of the landing site is on the plain about 30 km from the tessera. The plain occupies 60-65% of the site area, while tessera occupies the remaining 35-40%. Adjacent to the southern boundary of the landing site is a 60-km diameter gently sloped volcano with lava flows emanating radially from it. A few wind streaks inferring a west to northwest direction are seen behind some small volcanic domes. TV panorama of the site show a small area of plain covered with soil in local lows between the outcrops of bedded rocks at local highs. The outcrops are spaced a few meters from eachother and stand 10 to 15 cm above the soil-covered lows. This implies that the soil thickness in the lows is not more than about 0.5 m [4]. Gamma ray spectroscopy measurements of K, U, and Th are very close to those measurements taken at the Venera 9 landing site [2].

Venera 13 landed at Navka Planitia east of Phoebe Regio rise. The landing circle is centered at 7.55 S, 303.69 E [3]. The landing site is dominated by radar-dark plain transected by a NW-SE trending fracture belt. The southeastern portion of the site is affected by part of a 200-km corona-like feature. Northeast-southwest trending subtle wind streaks can be seen behind some topographic obstacles, in some cases inferring a southwest downwind direction. Just outside the landing site circle are three pancake volcanic domes and a steep-sloped volcano. TV panoramas of the site show a landscape similar to that seen at the Venera 10 site: plain with soil in local lows and bedded rock outcrops at local highs [5]. X-ray fluorescent spectroscopy indicates a composition close to subalkaline (4% K) basalt [2].

Discussion: The Venera 9 site is dominated by plain-like terrain, most likely formed by vast eruptions of low viscosity basaltic lavas. No features that would indicate the presence of geochemically evolved lavas can be seen at this site. This is in good agreement to the tholeitic composition of the surface material as measured by the lander. Absence of wind streaks combined with the fact that the analyzed material is representative of on-slope talus implies that the material is locally derived.

The Venera 10 site contains two major terrains: plain (60-65%) and tessera (35-40%). Features that may have formed by the eruption of evolved lavas cannot be found. Because the TV panorama shows that the landing occurred on the plain, the tholeitic composition of the surface material represents the composition of the plain (assuming no aeolian supply of tessera material).
The Venera 13 site is a radar-dark plain whose morphology suggests a high-K basaltic surface material. The high MgO and low silica content of this material does not imply highly evolved material [7]. A possible chemical analog for the Venera 13 material can be found in the Quaternary volcanics of the Sunda and Banda arcs, Indonesia [6]. They are leucitic basalts which belong to a specific mafic group. The whole volcanic association of the Sunda and Banda arcs is compositionally very broad from tholeiitic to dacitic and rhyolitic volcanics. A model for their origin implies three sources of the melt: 1) peridotitic mantle, 2) crustal material, 3) unusual K-enriched mantle [8]. The latter is the inferred source for rocks of that specific mafic group which is the chemical analog of Venera 13 material.

It is not clear what the relationship is between the high-K basalts of the Venera 13 site and the surrounding volcanic assemblages, which includes the above-mentioned pancakes and steep-sloped volcano. They may compose a complex assemblage of Venera 13 basalts and other volcanics including the pancakes and steep-sloped volcano.

At these three sites and also at the Venera 14 site, TV panoramas showed outcrops and/or fragments of bedded rocks. Before the Magellan mission, the most plausible explanation for the origin of these bedded, low cohesive, basaltic composition rocks was that they were lithified ash beds formed by sedimentation rather than explosive volcanism [9]. Now that Magellan imagery has shown evidence for aeolian activity, it may be that these layers represent aeolian deposits. Because we do not see mantles of this bedded material on Magellan imagery, it could imply that they are deposits thin enough for the radar to penetrate through them. Another possibility is that the rocks are not lithified deposits but instead some peculiarly textured lavas, perhaps similar to the quenched bedded subaqual pillow lavas found on Earth. Small scale layering has recently been found in basaltic lavas of Surtsey Island, Iceland, and this layering is interpreted to be a function of local vent geometry and magma volatile distribution [10].

Conclusion: Analysis of the Magellan data for the Venera 9, 10, and 13 landing sites, as well as previous analysis for the Venera 8 site, has shown that the Magellan-observed landform morphology correlates extremely well with the surface composition as measured by the landers. Steep-sloped volcanic edifices, including pancake domes, are strong evidence for the presence of evolved melts. Unfortunately, no conclusive results on the composition of tessera which is abundant within the Venera 10 site were obtained. Magellan observations show that lava flows are the predominant component of plain-forming material. Therefore, the bedded rocks seen in the TV panoramas could be either 1) thin layers of tuffs, 2) lithified aeolian sediments from various sources, or 3) lavas with peculiar texture.