SurVenTIS - Surface of Venus Thermal Imaging System. J. Helbert and N. Müller, Institute for Planetary Research, DLR, Rutherfordstrasse 2, D-12489 Berlin, Germany, joern.helbert@dlr.de.

Introduction: VIRTIS on Venus Express has provided us with the first global mapping of surface types on Venus [1]. While correction algorithms as used for VIRTIS [2] can reduce cloud induced contrast variations, the scattering in the clouds will always result in blurring. This limits the achievable spatial resolution from orbit to about 50km. A balloon or descent probe which would allow taking a thermal imaging system below the main cloud deck would reduce this problem significantly. The technical limitation of such platforms would not allow carrying any instrument like VIRTIS. Therefore we propose SurVenTIS, a miniaturized instrument specifically designed for studying the surface composition of Venus on spatial scales intermediated between orbital and in-situ data. Depending on the mission profile a surveyor of geological interesting regions can be performed as well as investigations on the local heterogeneity in the surface composition and its link to recent volcanism. In combination with other instrumentation the interaction between surface and atmosphere and especially the question of chemical erosion can be addressed. Finally a search for thermal anomalies indicating volcanic activity can be performed with high spatial resolution.

Instrument design: SurVenTIS is a near-IR imager with 6 filters taking advantage of the spectral windows in the atmosphere of Venus. The filters are selected to study albedo variations, oxidation state of the surface and derive compositional information. At least one filter will allow imaging from high altitudes and overlaps with the spectral coverage of VIRTIS on Venus Express.

Table 1: Preliminary set of geological and calibration filter

<table>
<thead>
<tr>
<th>Filter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.02, 1.10 μm</td>
<td>Comparison with VIRTIS and usable from high altitudes</td>
</tr>
<tr>
<td>0.77 μm</td>
<td>Constrain albedo vs. Absorption</td>
</tr>
<tr>
<td>0.65 μm</td>
<td>Fe3+ band, oxidation state of the surface</td>
</tr>
<tr>
<td>1.27 (1.31) μm</td>
<td>&quot;De-clouding&quot; window</td>
</tr>
<tr>
<td>Neutral</td>
<td>&quot;Stereo imaging&quot; – ambient lighting</td>
</tr>
<tr>
<td>Black</td>
<td>Flatfielding and calibration</td>
</tr>
</tbody>
</table>

Currently the use of a high temperature usable MCT detector is envisaged.

The instrument uses a highly integrated frontend electronic (FEE) and an FPGA based instrument controller unit (ICU). The FPGA will provide onboard signal processing for data compression.

SurVenTIS features a simplified and miniaturized instrument concept based on proven technology and use as much as possible off the shelf components. It benefits from extensive heritage in IR technology and camera development at DLR as well as from the heritage for the data analysis directly derived from VIRTIS on Venus Express.

Imaging performance: Based on the performance of the imaging system the spatial resolution would be approx. 50m at 53km altitude and 30m at 40km altitude. However the achievable spatial resolution in the Venusian atmosphere is limited by blurring due to clouds and haze. At a height of 40km a probe would be below the lower cloud deck, however the haze can still affect the spatial resolution. We therefore assume that we can achieve a spatial resolution in the range of a few 100m per pixel – comparable to high resolution Magellan imaging.

The 1.02 and 1.10 μm filter will allow imaging from high altitudes applying cloud removal techniques as developed for VIRTIS on Venus Express using the 1.27 or 1.31 μm filter to assess the optical thickness of the clouds [1, 2].

Assuming a drifting platform the combination of images will allow creating stereo images of the surface. The grey filter will provide neutral color images from lower altitudes. More importantly will to assess the ambient light level and thereby provide information on the properties of the haze below the clouds.
The 0.77 µm filter will provide constraints of albedo versus absorption. The 0.65 µm window will allow to assess the oxidation state of the surface. Both filters have been selected as a compromise between the transmissivity of the atmosphere and the targeted spectral bands. Imaging in this filter is preferably performed while the platform is below the lower cloud deck.

**Regional surveys:** The VIS/Near-IR spectroscopy allows deriving mineralogical information on a regional scale. While the compositional information will be limited compared to in-situ measurements the imaging technique allows assessing compositional heterogeneities on larger spatial scales and correlations between landforms and surface types.

Furthermore using the 1.02 and 1.10 µm filter allows to derive the surface temperature with a high accuracy as shown by VIRTIS on Venus Express [1].

![Figure 2 Detection limit for active volcanism for different spatial resolutions of the imaging system](Figure2.png)

**Figure 2** Detection limit for active volcanism for different spatial resolutions of the imaging system [3]

This measurement allows a detailed search for the thermal signature of active volcanism. SurVenTIS will be able to map lava flows with a significantly smaller surface area as possible currently with VIRTIS from orbit. Depending on the mission profile and the region for the survey SurVenTIS can study in detail the correlation between surface composition, morphology and volcanic activity.

**Decent imager:** On a lander SurVenTIS can be used as a descent imaging system to provide context the in-situ operation. Furthermore the imaging would allow to locate the landing site with high accuracy as shown by the example of the DISR imaging system on Huygens. This would be a huge benefit compared to the “blind” landing as performed by the Venera landers for which the exact landing locations are still unknown.

**Summary:** SurVenTIS will allow to study the surface composition of Venus on spatial scales intermediated between orbital and in-situ data. Depending on the mission profile will do a survey of geological interesting regions or act as a context instrument for a landing platform. SurVenTIS will investigate local heterogeneity in the surface composition and its link to recent volcanism. It will study the interaction between surface and atmosphere and especially address the question of chemical erosion.