EXPLORATION TARGETS FOR A MISSION CONCEPT WITH MULTIPLE VENUS GLIDERS: J. A. Cutts[1], D. C. Nunes[1], K. L. Mitchell[1], D. A. Senske[1, M], M. T. Pauken, L. H. Matthies[1] and P. Tokumaru[2], [1]Jet Propulsion Laboratory, California Institute of Technology, MS 321-550, 4800 Oak Grove Drive, Pasadena, CA 91109, James.A.Cutts@jpl.nasa.gov, [2] AeroVironment Inc., 181 W. Huntington Drive, Monrovia, CA 91016.

The Venus Guided Aerosonde is a glider that is deployed from an aerostat (balloon) at an altitude of approximately 55 km. The aerosonde descends rapidly to the surface to minimize heating and when the range to the surface permits high quality visual and near infrared observations, the vehicle enters a shallow glide phase of the mission. In this phase it relays scientific data on the surface to the aerostat at Mb/sec rates. Approximately 5 aerosondes can be deployed from one aerostat platform and several targets have been selected to permit the broadest possible attacks on the science. The concept is derived from the Venus Aerobot Multisonde Mission Concept [1] which became a Discovery proposal in the late 1990s. Progress in guidance and thermal control permits much more precise targeting to surface feastures (<2 km) and greater operating lifetimes in the lower atmosphere (up to 1 hr).

Session: This topic is intended for for the session "Within the Atmosphere" because this is where the instrument platform is located. However, the science involves measurements of both the surface and atmosphere and addresses all three VEXAG goals.

Targets: The selection of targets is based on an assumed traverse length of 25 km, a mean altitude of observation of 2 km and an uncertainty in targeting of 2 km based on the most recent study which incorporates state of the practice guidance techniques. Separate deployment platforms would be needed for the northern and southern hemispheres. Deployments up to 65º latitude are practical with a solar powered mission.

Target T1: Xi Wang Mu Tessera (32.8º S, 60.9º E). Target includes thermal emissivity anomaly, tesserae structure and geologic contact between the tesserae and plains (see Fig 1).

Target T2: Idunn Mons (46.0º S, 214.5º E). Potential active volcano candidate.

Target T3: Maxwell Montes (65.2º N, 3.3º E). Focus on impact on atmospheric circulation and traverse radar bright zone and measure possible non=basaltic crust.

Target T4: Kallistus Fluctus (51.1º S, 21.5º E). Area of erosive lava emplacement forming a channel.

Target T5: Ovda Fluctus Lat (6.1º S, 95.5º E). One of two lava flows that may be high viscosity lavas.

Target T6: *Mahuea Tholus* (37.5º S, 164.7º E). Potentially high viscosity lavas; geologic contact between plains units.

Science Goals: A mission with five gliders addresses all three science goals identified by VEXAG although with different levels of completeness. Six of the investigations identified by VEXAG can be implemented from the platform if it is appropriately equipped.

Measure circulation in situ from 55 km to the surface at a range of latitudes and times of day (I.B.1): Estimation of wind velocity will result from the guidance and navigation required to reach surface targets. The latitude and longitudinal diversity of targets ensures that the investigation objectives can be met.

Characterize small scale vertical motions in order to characterize role of convection and waves (I.B.3): These measurements will be most sensitive near the surface where the vehicle is on a gliding trajectory. In this range it will also sense the effects of topography on circulation particularly with respect to Target T3.

High resolution imaging and topography (II.A.1): This top priority investigation is required in order to learn the sequence of events in Venusian history. This includes assessing any evolution in volcanic and tectonic styles and analyzing any evidence of significant past horizontal displacement.

Investigation of contemporary rates of volcanic activity (II.A.4): This is achieved by flying directly over the active volcano candidate Idunn Mons and observing outgassing *in situ*. Sulfur dioxide sensors already qualified for operating at Venus surface temperatures have been developed by the Glenn research Center.

Compositional information at regional scales for large-scale picture of geochemical processes (II.B.2): Measurements of composition at locations where the crust may be more compositionally evolved (e.g., Maxwell Montes) would invoke the presence of water during crustal recycling.

Formation in different climate environment (III.A.2): As imaging observations from the Mars rover on the surface have demonstrated, ultra high resolution imaging preferably at centimeter scale or better will be needed to resolve morphological features indicative of formation in past climates such as fluvial bed forms of deposition or erosion. Rounded boulders viewed from a slowly moving aerosonde could provide definitive evidence of such conditions preserved from early in the history of the planet.

Search for evidence of hydrous minerals (III.A.3): Although definitive evidence of such minerals can only be obtained from in situ contact observations, infrared spectral signatures acquired from the lowest altitudes may be able to provide indications of spectral heterogenity at a small scale.

Table 1: Relationship between selected targets and Goals, Objectives and Investigation

	Goals, Objectives & Investigations addressed by Aerosonde						
Goal	**I**		**II**			**III**	
Objective	**B**		**A**		**B**	**A**	
Investigation	1	3	1	4	2	2	3
Key Instruments							
High res imaging			●			●	●
Chemical sensor				●			
Spectral mapper			●		●	●	●
Temp/pressure	●	●					
Tracking	●	●	●	●	●	●	●
Target/Description							
T1: Xi Wang Mu Tessera (-32.8S, 60.9E)	●	○	○	●	●	●	●
T2: Idunn Mons (-46.0S, 214.5E)	●	○	●	●		●	●
T3: Maxwell Montes (65.2N, 3.3E)	●	●	○	●	●	●	●
T4: Kallistus Fluctus (-51.1S, 21.5E)	●	○	○	●		●	●
T5: Ovda Fluctus (-6.1S, 95.5E)	●	○	○	●		●	●
T6: Mahuea Tholus (-37.7S, 164.7E)	●	○	○	●		●	●

Discussion: In Table 1, the Key Instruments box indicates with solid circles the instruments that are needed to address each of the six investigations. The lower part of the table, the Target Description box, indicates how well observations of each target address each of the six investigations. A solid circle indicates that this is done well, an open circle indicates that there is a question of feasibility and no circle indicates not applicable.

In addition to the specific science objectives many of the targets, but not all, are relevant to a future landed mission by characterizing both the science merit and the safety of potential landing sites.

Surface Visibility: Here, we have relied on Moroz's classical analysis of the visibility of the Venus surface from a descending probe [3]

Key Trades: Key trades that we hope to explore in the splinter sessions are between an aerosonde platform with a larger lift factor that executes a slow traverse at near constant altitude or a steeply diving vehicle that carries out a longer traverse but with varying surface resolutions.

Mission Duration: As with any mission to the low er atmosphere of Venus, the thermal environment limits its lifetime. Generally the smaller and more slender the probe, the shorter the lifetime. The tradeoff is for the probe to spend 15 minutes in its data taking phase before it hits the surface.

Risk Management: Because of the uncertainties in descent speed and heat transfer during descent, there will be considerable uncertainties in mission lifetime. The risk management plan must ensure that Level 1 science objectives are achieved in a period when there is 95% confidence that the platform is still operating.

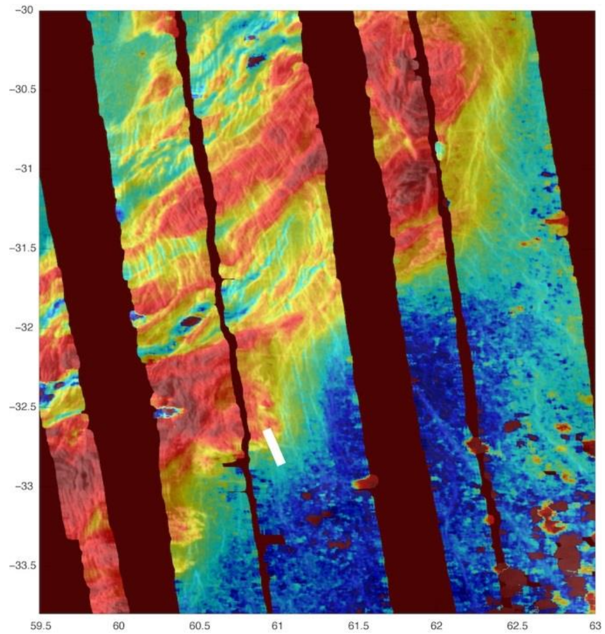

Figure 1. Target T1 section of the stereo-derived DTM of the Xi Wang-Mu Tessera, underlain by the mosaicked F-BIDR. Color represents elevation from -500 m (blue) to 1500 m (dark red); the elevated terrain corresponds to the tessera while the lower terrain corresponds to plains. Mottled appearance of plains in DTM is due to the poor quality of stereo-matching for the featureless plains. White line is a 25-km scale bar and illustrates the possible ground-track coverage of a glider over the tessera-plains transition [2].

References: [1] Cutts J. *et al.* (1999) AIAA Balloon Technology Conference 1999. [2] Nunes D. *et al.* (2013) Fall AGU Meeting Dec 2013, Abstract P41D-196. [3] V.I. Moroz (2002) *Planetary and Space Science*, 50, 287–297.

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