Planetary Science from a Next-Gen Suborbital Platform: Sleuthing the Long Sought After Vulcanoid Asteroids. S.A. Stern[1] , D.D. Durda[1], M. Davis[1], and C.B. Olkin[1]. Southwest Research Institute, Suite 300, 1050 Walnut Street, Boulder, CO 80302, astern@swri.edu.

Introduction: We are on the verge of a revolution in scientific access to space. This revolution, fueled by billionaire investors like Richard Branson and Jeff Bezos, is fielding no less than three human flight suborbital systems in the coming 24 months. This new stable of vehicles, originally intended to open up a space tourism market, includes Virgin Galactic's SpacesShip2, Blue Origin's New Shepard, and XCOR's Lynx. Each offers the capability to fly multiple humans to altitudes of 70-140 km on a frequent (daily to weekly) basis for per-seat launch costs of $100K-$200K/launch. The total investment in these systems is now approaching $1B, and test flights of each are set to begin in 2010.

We have been funded to conduct a multi-flight next-gen suborbital series of imaging experiments to search for the Vulcanoids, a long sought after putative population of small asteroids orbiting inside the orbit of Mercury.

Background: Among the few stable dynamical niches that are still largely unexplored is the region interior to Mercury's orbit (i.e., orbits with aphelia <0.25 AU; see Fig. 1), where a population of small, asteroid-like bodies called the Vulcanoids is hypothesized to reside. This reservoir likely contains valuable samples of condensed material from the early inner solar system, of which we have no current information, but which could be spectroscopically studied in the future. It also bears relevance on our understanding and the interpretation of Mercury's cratering record, and thus Mercury's surface chronology.

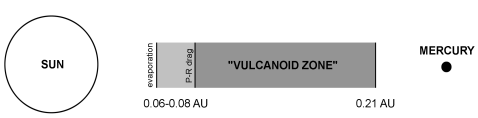

Figure 1. The Vulcanoid zone (VZ) interior to the orbit of the planet Mercury.

Although a modest population of Vulcanoids may exist, they are particularly challenging to detect due to their angular proximity to the Sun and relative faintness compared to the twilight sky. Viewed from Earth, the Vulcanoid Zone (VZ) lies between just 4º (0.08 AU) and 12º (0.21 AU) of the Sun. This means it can only be observed near twilight (with difficulty, we note) or with spacecraft coronagraphs that block the disk of the Sun. High sky brightness, short observation windows before sunrise or just after sunset, and atmospheric haze and turbulence are among the daunting challenges faced by ground-based observers searching for objects near the Sun at twilight. Consequently, only a few visible-wavelength ground-based searches for Vulcanoids have been conducted.

Experiment: We will conduct a large area search for Vulcanoids using our SWUIS imager developed for Space Shuttle and high altitude F-18 flights. We will conduct our Vulcanoid search experiment at altitudes of 100-140 km near twilight so that the Vulcanoid region is seen above a dark Earth with the Sun below the depressed horizon. In this way we will eliminate the scattered light problems that have dogged all ground-based Vulcanoid searchers.

The Vulcanoid search is an extension of the same observing strategy we followed for our NASA-funded investigation at high altitudes in the F/A-18B aircraft. The limitations that have plagued past ground-based visible-wavelength searches for Vulcanoids can be greatly alleviated by reducing or removing the various observing problems (clouds, variable hazes, turbulence, scattered light, high airmass, etc.) associated with the atmosphere. From above the Earth's atmosphere, in deeper twilight than is *ever* possible from the ground for objects so close to the Sun, we will be able to detect Vulcanoids down to at least magnitude V = 12.5, corresponding to p_v = 0.14 (i.e., Mercury-like) objects only 8 km across at the outer boundary of the Vulcanoid zone. Covering ~100 square degrees to limiting magnitude V=12.5-14.0, this effort will result in the most comprehensive, constraining Vulcanoids search yet conducted.