SEARCHING FOR THE MISSING MARTIAN ORGANICS WITH THE MARS PHOENIX SCOUT MISSION. D. Archer, Jr. and P. Smith, Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721, darcher@lpl.arizona.edu.

Introduction: When data from the Viking life experiments indicated a lifeless Mars, mission scientists were disappointed but not necessarily surprised. What was surprising was that the Viking GC/MS failed to detect *any organics whatsoever* even at the few parts per billion (ppb) level. Every year, about 2.4 x 10^8 grams of organic carbon, mostly in the form of kerogen, are delivered to Mars by meteorites [1]. Benner et al. calculate that even if this material is mixed to a depth of 1 km, there should be organics present in the martian regolith on the 500 ppb level.

The fact that Viking detected no organic material was attributed to the presence of powerful oxidants in the martian regolith created by UV radiation. Results of the other life experiments supported this theory. However, new theories question the conclusion that Viking's negative results indicate that there are no organics on the surface of Mars. This new theory and accompanying data indicates the possibility of surface organics in a form undetectable to the Viking GC/MS. These new ideas have lead to renewed enthusiasm in the search for organics in the Martian regolith.

A new look: Benner et al. [1] postulate that, under oxidizing conditions, martian organics would not be completely destroyed, but would instead be reduced to more stable organics (under martian conditions) such as benzenecarboxylate or oxalate. The Viking GC/MS, which pyrolized samples at a maximum temperature of 500ºC would have had difficulty detecting these substances, even if they were present in the regolith.

Navarro-González et al. [2] report that in the Atacama desert, one of the most arid regions on earth, the Viking life detection experiments would only have found organic molecules at trace levels, and would have completely failed to find benzene, though it is present in the soil. So if benzene is a decay product of martian organics, it could be in the soil and still have escaped detection. This data was obtained by pyrolosis of the sample at 500ºC, in order to simulate the Viking experiment. When the samples were pyrolized at 750ºC, the levels of organics (including benzene) were above the published Viking detection limits [3].

Phoenix and TEGA: The Thermal and Evolved Gas Analyzer (TEGA) that will fly aboard the 2007 Mars Phoenix Scout Mission will be able to detect organic molecules at a sensitivity of a few parts per billion (similar to Viking); however, the ovens in TEGA have a maximum temperature of ~1000ºC [4], which should be high enough to reveal the presence of benzenecarboxylates if they exist in the martian regolith at predicted levels. We expect that Phoenix will find organics, present in the form of decay products of more complex molecules.

Contamination issues and solutions: The sensitivity and the small sample size (.038mL [4]) of the TEGA oven makes it prone to possible contamination by terrestrial organics. Precautions will be taken to minimize the chance of contamination, but technological and cost constraints require that the most sure way of guarding against contamination is in the sample method and interpretation of results.

Phoenix will be equipped with a robotic arm capable of reaching 1 meter from the lander and able to dig a 1 meter deep trench in the martian regolith (conditions permitting). If organic concentration increases with trench depth, indicating less oxidation with depth and therefore a lower rate of organic destruction, we can be fairly certain that we are seeing martian organics and not terrestrial contamination.

Also, the landing site is far enough poleward that Phoenix will land on ground that is covered during northern winter with ~1 meter of carbon dioxide ice. The condensation of CO_2 out of the atmosphere could also bring airborne organics down with it. When the seasonal ice melts, these organics would then be concentrated in a thin layer that may be more resistant to oxidative destruction. If samples taken at different trench depths show a banded pattern of organic concentration, this would also indicate a positive response that contamination cannot mimic.

Perhaps the greatest difficulty will be interpreting what a given organic signature means. As the oxidizing environment will reduce almost all organic molecules to simple decay products, determining whether or not detected organics are of meteoritic origin or were produced on Mars will be very hard. Determining whether or not the organics are of biogenic origin will be even more difficult. The detection of organics by Phoenix would be a first step in this direction.

References: [1] Benner S.A. et al. (2000) *PNAS, 97,* 2425-2430. [2] Navarro-González et al. (2003) *Science, 302,* 1018-1021. [3] Biemann K et al. (1977) *JGR, 30,* 4641-4648. [4] Boynton W.V. et al. (2001) *JGR, 106,* 17, 683-17, 698.