TRAVERSE PLANNING FOR DESERT RESEARCH AND TECHNOLOGY STUDIES (DRATS) 2010 ACTIVITIES: STRATEGIC GUIDANCE FROM PHOTOGEOLOGIC MAPPING. J. A. Skinner, Jr. and C. M. Fortezzo, Astrogeology Science Center, U. S. Geological Survey, 2255 North Gemini Drive, Flagstaff, AZ 86001 (jskinner@usgs.gov).

Introduction: The Desert Research and Technology Studies (DRATS) group conducted simulated planetary traverse activities in the San Francisco Volcanic Field, northern Arizona, from August 26 to September 17, 2010. DRATS 2010 focused on simultaneous operation and scientific support of 2 rovers, each manned by an astronaut-commander and an experienced field geologist. Two "tactical" back room teams, one for each rover, operated independently from one another during actual traverse operations. A "strategic" back room team was tasked with synthesizing the full range of daily crew observation and propagating logistical and scientific recommendations to the crew. Scientists working within the back rooms were equipped with a range of data sets in order to assist with testing geologic hypotheses over the course of the "mission" and guiding crew members to the locations of highest scientific return.

As part of a collaborative effort with NASA/JSC/DRATS, the U.S. Geological Survey Astrogeology Science Center assisted DRATS 2010 activities by providing data sets and derivative cartographic products for use in designing rover traverses. Herein, we summarize these efforts with particular attention to the construction and use of project-specific photogeologic maps. We also provide lessons learned for continuing collaborations between NASA/JSC and USGS.

Photogeologic Mapping: The primary support task was the construction of a 1:24,000 scale photogeologic map of the DRATS 2010 traverse envelope and immediate environments. This region was ~600 km^2 and extended from Black Point Lava Flow (the location of MMCC) to Colton Crater (the science target for traverses). The primary base map was a grayscale GeoEye image (0.5 m/px resolution), supplemented with USGS-derived GeoEye-based topographic products (1.5 m/px resolution) and National Agriculture Imaging Program (NAIP) stretched color images (1.0 m/px). The digital mapping scale was 1:8000 (25% of "publication" scale) and vertex spacing was set to 80 meters.

We identified 14 discrete geologic units within the traverse envelope and grouped these units based on their interpreted similarities.

- *Surficial units* – Talus, channel, dissected, and plains units interpreted as lateral gradations of variably toned materials that form and occur in topographically subdued surfaces;
- *Volcanic units* – Younger cone, younger flow, block field, older cone, and older flow units interpreted as complexly overlapping materials that form cones, irregularly-shaped mountains, clusters of topographically subdued hillocks, and smooth to rugged materials with lobate downslope margins;
- *Basement units* – Grey-toned (mottled), red-toned (platy), red-toned (layered), light-toned (slabby), and light-toned (layered) units interpreted as nearly horizontal rocks that underpin all other units.

We intended our photogeologic mapping efforts to help establish observational baselines and metrics in order to assess (1) the range of scientific questions that are required to guide surface exploration, (2) the strategies for pre-traverse regional mapping and data set integration, (3) the fundamental hierarchy of field-based geologic observations required to maximize fulfillment of science objectives, (4) the methods to optimize the integrity of crew-based scientific deductions, and (5) the means to minimize the discrepancies between remote- and field-based geologic assessments.

Strategic Locations: The photogeologic map provided a context for tabulating potential field-based observations and for establishing priority levels of observations relative to one another. Map-based geologic questions that required specific observations included:

- Do surface and marginal flow morphologies indicate temporal uniqueness or contrasting chemistry?
- Are different styles of volcanism documented?
- Can rock benches and scarps located within the interiors of some volcanic cones provide information about eruption characteristics?
- Are "basement units" geologically unique and laterally continuous?
- Is there evidence for regional tectonic activity?

We used these and other questions in tandem with the photogeologic map to identify field locations that had a high likelihood of providing information critical to testing and/or clarifying the broad-scope understanding of geologic units and their formational history. We summarized specific observations (ranked and plotted on the map) for use as a checklist to ensure that all outstanding geologic questions might be answered. To that end, some observations were considered mutually exclusive, in that detailed observation at one recommended site might diminish the utility of other similar sites. Thirteen "critical observations" were incorporated into 62 discrete areas within the region of interest for potential intersection with traverse plans.

Lessons Learned: Terrestrial geologic field campaigns are being increasingly designed in conjunction with a range of remote data sets, which not only increases efficiency and but also provides an opportunity to directly test remote-based observations. The cost of manned and unmanned missions to planetary surfaces requires use of critical data products to establish a context for observation. Without these, mission observations are made in a vacuum and are susceptible to inefficiencies. The use of regional-scale photogeologic map for use in DRATS 2010 traverse planning provided a framework for ranking rover- and crew-based observations. The map allowed crew members to become familiarized with what terrains they would face over the course of a day's activities and to develop hypotheses about how certain units may (or may not) be related to equivalently mapped outcrops (J. Bleacher, *pers. comm.*).

Summary Recommendations: Despite advances in the use of photogeologic maps for the strategic design of mission traverses, certain deficiencies remain. We make the following recommendations based on lessons learned from DRATS 2010 activities:

- Review maps and their constructional bases with both crew and back room scientists in order to allow for a fuller understanding of geologic context;
- Construct more detailed, large-scale maps for high-priority EVA locations, so that the fidelity of the linework translates more appropriately to field-based observation;
- Incorporate intuitive symbology for the depiction of relevant landforms, tectonic features, and erosional fabrics;
- Clarify the geologic relevance of "plains" related materials (interpreted as admixtures of erosional detritus) so that they can be more appropriately ranked for priority;
- Make map and base information available to crew members so that they can more succinctly address changing geologic hypotheses;
- Track evolving geologic hypotheses within the "strategic" back room and systematically use recommended observations as a check list.

References: [1] Eppler, D. et al. (this volume). [2] Ming, D. et al., (this volume). [3] Horz, F. et al. (this volume). [4] Tanaka, K. L. et al. (2009) NASA/CP-2010-216680.

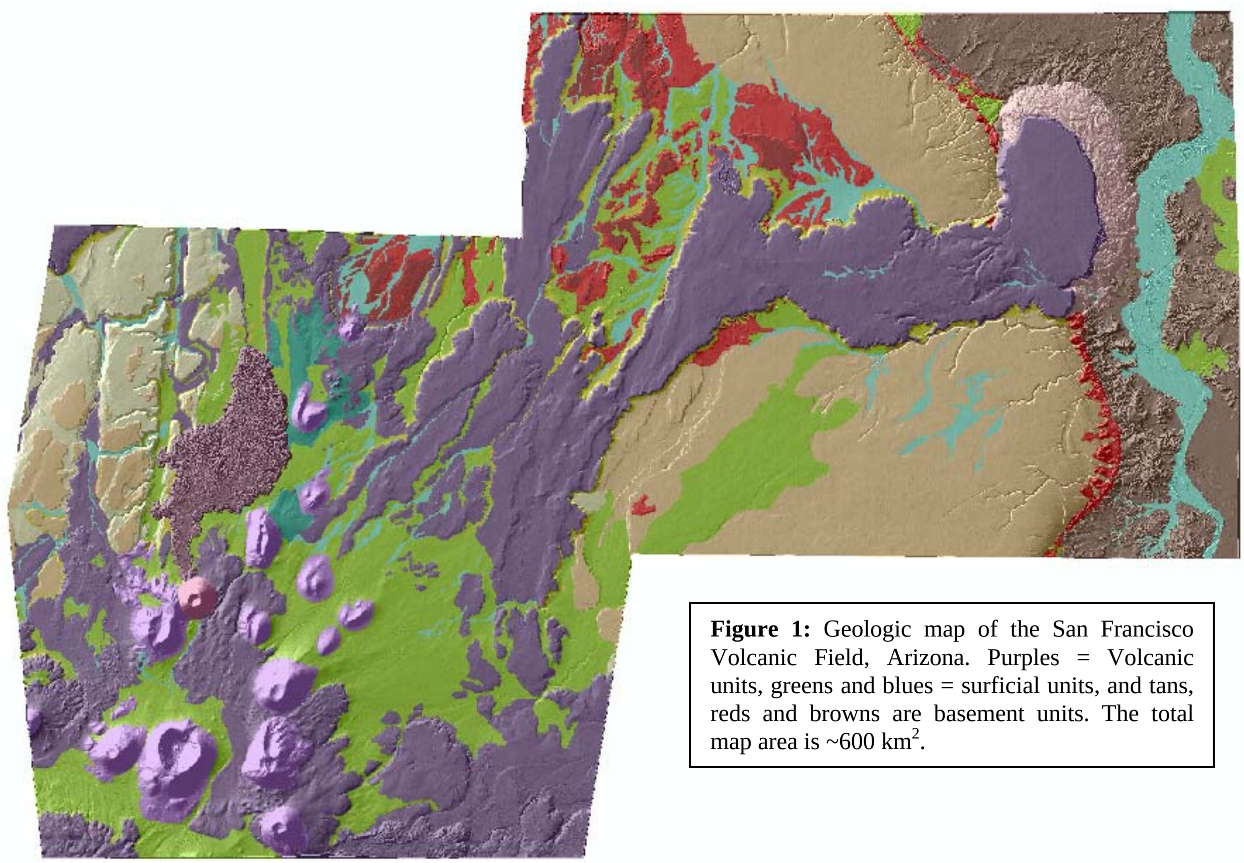

Figure 1: Geologic map of the San Francisco Volcanic Field, Arizona. Purples = Volcanic units, greens and blues = surficial units, and tans, reds and browns are basement units. The total map area is ~600 km^2.