IAA Study Group Status Report

Responsible Commission: 1

Study Number and Title: ***1.10 Terrestrial Analogue Comparison of Terrestrial and Planetary Geology***

Short Study Description (repeat from Study Group Proposal):
The cosmic study will investigate the synergy and commonality of studying geology on Earth and on another planet.
Terrestrial analogues are places on Earth that approximate, in some respect, the geological, environmental and putative biological conditions on a particular planetary body, either at the present-day or sometime in the past. Analogue studies are driven by the need to understand processes on Earth in order to interpret and ground truth data sent back from Mars and other planetary bodies by unmanned orbiters and rovers.
Human exploration and testing of Analogue campaigns can assist in the design and validation of technologies and systems to ensure full operability and functionality once deployed at the surface of Mars. Integrated analogue campaigns allow to test exploration strategies and operations planning to maximize the achievement of the mission objectives (e.g. scientific return or production of O2) and to ensure inter-operability between the different elements of the mission.

One of the main goals is to investigate existing laboratory and university capacities and solicit interest, from developing countries and space emerging countries. A particular focus will be made to offer affordable access to space exploration in Latin America and Africa in using the IAA network.

The cosmic study will engage selected international experts to suggest a global space planetology sciences education and public outreach (EPO) model that: (1) strengthens Latin America's and Africa's future space exploration workforce; and (2) promotes science, technology, engineering, and mathematics (STEM) education and public engagement to communicate the benefits of space for understanding our planet and living in Latin America and Africa; and (3) underlining the importance for involving countries, organizations and individuals who can provide new contributions to the Robotic and Human Exploration endeavor.

A review of on-going study Terrestrial Analogues will be duly taken into account and will represent the starting point of this activity. Interfaces with the Virtual Reality/Telepresence study group (1.12) will also be opened.

Progress in past six months:

Surface processes on Earth & Mars

Currently, space-faring nations with an interest in Mars exploration tend to cluster in the northern hemisphere, mainly in Europe and North America, which necessarily restricts perspectives and accessibility to field areas where ground truth research for terrestrial analogs may be conducted. Thus there is major potential contribution that earth science and planetary science communities in currently non-space-faring nations can make to advance the progress of Mars studies, through the provision of infrastructure and in-country support for Earth-Mars analog field work, as well as drawing on deep field experience in areas little visited by outsiders to facilitate process analyses. In the case of Mars, with emphasis on African and Latin American venues, I'm thinking specifically of the arid zones of North Africa (e.g., Sahel and Sahara zones), East Africa (e.g., Afar) and Southern Africa (e.g, Namibia), as well as the high deserts of the South American Cordilliera (e.g., Andes Alitplano), and the Mexican and Central American volcanic belts. These venues all offer a variety of environments that correspond almost directly with Martian volcanic and erosional analogs, including cryospheric analogs in the Altoplano for instance, and their study could shed much light on the character and dynamics of a variety of Mars surface processes. Clearly, the arid regions of the Middle East, South Asia, and Australia, as well as the Circum Pacific Ring of Fire, the Arctic and Antarctic, all offer Earth-Mars analogs, as well. The comprehensive study of the full geographic range of such features and process, including the target areas for this study, Africa and Latin America, will undoubtedly bear fruit, move the field forward, and provide opportunities to bring indigenous earth-science researchers from these target areas more in touch with contemporary Mars research, and with planetary science, in general.

Fluvial & deltaic deposits on Earth and Mars

Studies of Earth analog terrains relating to a variety of styles of fluvial erosion, mainstream topography, basin shape, and drainage network ramification on Mars have been, and will likely be fruitful. More broadly, such studies address the fluvial transport environment, deltaic depositional environments at channel and valley network outflows, the groundwater environment especially regarding groundwater sapping processes, as well as the interaction between impact (pre-existing and subsequent) features and resulting impact basin Sedimentology. The latter, particularly, has figured prominently in recent landing site proposals for past and future surface missions.

Substantial libraries of earth image data exist for Latin American and African regions, even where surface access is difficult (e.g., Afar, Dafu, Dem. Rep. Congo volcanoes) for political or logistical reasons. The most important systematic database, among several, is the archive of Advanced Spaceborne Thermal Emission and Reflection (ASTER) imaging radiometer data: VNIR (15m/pixel; 0.5-.9um), VNIR (30m/pixel; 1-2.5um, 6 channels), and TIR (90m/pixel, 8-12um, 5 channels), now approaching 3 million 60x60km frames, having been collecting data worldwide since year 2000, including a global digital elevation data base (GDEM) at 30m/pixel and 8-12m vertical resolution. Another specialty archive, the ASTER Volcano Archive (available online at http://ava.jpl.nasa.gov) provides full spatial resolution image granules as geo-located jpg and kmz files, compatible with Google Earth™ for the over 1545+ volcanoes on the Smithsonian GVP Holocene list (148,032 image granules, as of 02 Nov). Clearly, a fertile opportunity exists for utilizing local African and Latin American technical ground expertise in the interpretation of ASTER and other (e.g., LANDSAT) mission data of Earth analogs in the context of comparison to existing Mars orbital data (e.g., Viking, Themis, Mars Express, etc.). Comparisons between MOLA and GDEM for fluvial (and other systems), may be especially revealing.

Aqueously altered volcanic terrains and regolith

Latin American and African volcanoes offer myriad possibilities for the study of the progressive erosion, degradation, and renewal of a variety of volcanic landforms, ranging from well-expressed, perfectly conical stratovolcanoes, to well-eroded collapse calderas, in a variety of climatic zones, and often with clear chronological sequences among volcanoes in a particular co-located group. Local expertise on formation processes, on eruption histories, and on erosional processes would materially aid in the interpretation by planetary geologists of Martian features, especially for putative pyroclastic blankets on Mars, which remain an outstanding issue, both for basic process volcanology, but for interpretation of styles and effects of volcanic activity on the Martian atmosphere and environment.

Terrestrial volcanoes and Martian volcanic edifices

On the Earth, sub-aerial volcanic processes produce characteristic landforms in all terrestrial climate zones. They tend to occur in belts, mainly at plate boundaries, with a few notable oceanic (e.g., Hawaiian Islands), and continental (e.g., San Francisco Volcanic Field, Arizona, USA; Columbia and Snake River volcanic plains, Pacific Northwest, USA; Deccan Traps, India), exceptions that occur within plate interiors. While not as massive or as topographically high as their planetary counterparts (e.g., Martian volcanoes) terrestrial volcanoes provide some of the most spectacular and graceful landforms on the Earth’s surface (e.g., Mount Fujiyama, Japan; Mt. Kilamanjaro, Kenya). Because Mars does not exhibit plate tectonics, volcanic features there tend to manifest most prominently as central vent structures of prodigious volume (e.g., Olympus Mons and other Tharsis Volcanos; Elysium Volcanics), with accumulated loads that cause crustal flexure and tectonic fracturing. The opportunity for comparing and contrasting terrestrial analogs with Martian counterparts can help inform such comparisons, especially as we are able to contrast scale, topography, and activity lifetimes, as well as tectonic environments, and the presence or lack of volatiles in the eruption process.

Website Study Information up to date? (Study Group Membership, Study Plan and Schedule):

I will send out a reminder to respond to IAA. Below is the full member list with member contact updates:

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Issues requiring resolution? (recommend approach):

None

Product Deliveries on Schedule? (If modified explain rationale):

Yes. Delivery and Publication by end 2015

Study Team Member Changes:

Victoria Hipkin and Igor Mitrofanov have different contact information.

I have added all members contact information as some of them have changed email, etc. I will follow through and make sure members respond to your request to confirm membership as well.

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Status Report Date: September 1, 2014

Study Team Membership Changes

-See above:

Effectivity Date: September 1, 2014

Discontinue:

None