Volcanically Driven Hydrothermal Systems on Post-Noachian Mars: Hotspots of Habitability on a Changing Planet

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Detailed View of Terrestrial Volcanic Hydrothermal System

- System driven by heat from magmatic chamber.
- Increased thermal gradient heats ground water and may contain magmatic sourced waters.
- Dissolution of mafic minerals would create silica saturated fluids.
- Deposition of silica, sulfates, travertines and oxides occur nears vents and hot springs.
Proposed Sites of Hydrothermal Systems on Mars

Lava-Rock interaction to create rootless cones. South of Elysium HiRISE PSP_002622_1820

Apollinaris Mons

Home Plate, Gusev Crater. Squyres et al 2007
Syrtis Major Volcanic Complex

Nili Fossae

Isidis Basin

Nili Patera

Syrtis Major
Nili Patera Caldera

400 m elevation

30km

Syrtis Major

Nili Fossae

Isidis Basin
High Silica Detection

30 km

10 km
Nili Patera Cone
Light-toned Deposits
Calibrated CRISM Spectra
Ratioed Spectra

Position and shape of 2.21 µm are consistent with Si-OH.
Spectral Reproduction with Super resolution CRISM

Super resolution ~10m/pixel

CRISM 18m/pixel

Super Resolution
Nili Patera Volcanic Cone

CTX-CRISM Composite on CTX Stereo DEM 5x
Nili Patera Volcanic Cone

CTX-CRISM Composite on CTX Stereo DEM 5x
Fan Deposit
South Deposit
Review of Nili Patera Hydrothermal System Model

- Complex Syrtis Major caldera indicated several eruptive episodes. Hiesinger and Head 2004
- Dacite bearing flow in Nili Patera would require magmatic differentiation and a long lived system. Christensen et al. 2005
- Silica is deposited on the flank of the cone, in nearby mounds and in a field of deposits on the dacitic flows.
Habitability of Volcanic Hydrothermal Systems on Mars

- Hydrothermal Systems would provide high water, energy and habitability for duration of magmatic body.
- Volcanic hot spring environments may provide habitable pathway between deep hydrosphere / possible deep biosphere and the surface.
- Systems would deposit silica sinter, an ideal substance for preserving biosignatures. Farmer and Des Marais 1999