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Prime Habitable Environment of Mars: Argyre Impact Basin

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The geologic provinces of Mars, as identified through a synthesis of geologic, paleohydro-logic, topographic, geophysical, spectral, and elemental information [1], are windows into its evolution, such as the Hellas-Argyre province (middle to early Mars). The Argyre basin and surroundings, in particular, records long-term water enrichment and heat-energy, likely nutrient-enriched materials, and solar radiation, collectively making Argyre a prime habitable environment for the exploration of possible life [2-4]. The giant impact event tapped into primordial mantle and granite-enriched crustal materials, including rocks enriched in elements which are critical to life (including P,O,N,C,H,S,Ca,Fe; see [Shigenori Maruyama, this conference]), creating a catchment for water and rock materials since its formation about 4.0 Ga [1-3].

A lake was formed directly subsequent to the event, feeding the far-reaching Uzboi Vallis system; other lakes filled the impact-derived local basins as well. The lakes soon froze, and the once lacustrine environment transitioned into glacial and periglacial environments. Through time, liquid water/water-ice waned, though not totally being depleted, as there was subsequent Tharsis superplume-driven, transient hydrological cycling at global scale [3] (including enhanced activities in the basin region).

Long-term water enrichment in and surrounding the Argyre basin includes geologically-recent and possibly present-day periglacial and glacial activity [5,6]. The major topographic variations between the deep catchment basin and nearby Tharsis-superplume plateau may have resulted in enhanced precipitation through time resulting from both endogenic activity (e.g., Tharsis) and exogenic activity (e.g., obliquity).

In addition, the impact produced a complex system of tectonic structures, many of which are thousands of kilometers in length and reach great depths (likely the Moho). Such basement structures served as conduits for the migration of volatiles and heat energy into the basin region from as far away as Tharsis [1-3].

Yet another important habitable-environmental condition is the long-term heat generated by the impact. There even appears to be geologically recent venting along the basin floor as well as reactivation of the impact-generated basement structures. Such an interplay among long-term water enrichment and heat-energy, likely nutrient-enriched materials, and solar radiation collectively point to Argyre basin as a prime habitable environment for exploration of possible life.

References

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