Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

PPS01-13 Room:201B Time:May 21 17:30-17:45

Planetary Tectonic System (#1) and the Search for Life

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For life to initiate, diversify, and flourish, it requires a continuous nutrient supply, metabolism with continuous reactions to gain energy, and self-duplication. These conditions can be optimally met through a planetary tectonic system (PTS) that is composed of a nutrient-enriched continental landmass, an ocean, tectonic structures such as rift systems that act as conduits for the migration of volatiles and heat energy, and a sunlit planetary surface. This is realized through the evolution of the Earth, particularly in the case of the Cambrian explosion [1; also see Shingenori Maruyama, this conference]. The Cambrian explosion included a dramatic increase in the supply of nutrients and oxygen and resultant organic matter, including macroscopic hard-shelled animals that reached dimensions 1 million times larger than the Precambrian Eukaryotes.

The PTS to explain the Cambrian explosion is as follows [1, also see Shigenori Maruyama, this conference]: (1) the appearance of a landmass of nurtrient-enriched materials resulting from a drop in sea-level related to plate tectonism including subduction of hydrated slabs into the mantle, (2) the global distribution of the nutrient-enriched continental materials into the ocean through wind (aeolian erosion and deposition) and water (e.g., fluvial erosion and transport along river systems); winds, for example, transported fine-grained materials from desert regions to the oceans, feeding the plankton life along the surface of the open oceans, and (3) the interaction among deep-seated basement structures, magma, and continental lakes which collectively yield life-thriving, hydrothermal systems (considered prime habitable environments on Earth and Mars; [1,2]).

The delivery of enormous amounts of nutrients drove the burst of photosynthesis which resulted in an increase of free oxygen in the atmosphere and a rapid increase of organic matter. Knowledge of PTS provides the road map for the search for life beyond Earth [also see Dohm and Maruyama?Planetary tectonic system #2, this conference].

References

[1] Maruyama, S et al., (2013?in press), Geoscience Frontiers 171.

[2] Dohm, J.M., et al. (2011) GSA Special Paper 483, 317?347, doi:10.1130/2011.2483(21).