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# Volcanism and Astrobiology: Life on Earth and Beyond

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# Volcanism and Astrobiology: Life on Earth and Beyond

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Any attempt to investigate the origin and evolution of life on Earth or elsewhere must include consideration of the link between life and its changing planetary environment. Life is subjected to a variety of environmental perturbations during its tenure on a planetary surface, some of which are long-lived (*e.g.*, long-term climate change), some short-lived (*e.g.*, asteroid and comet impact events). One pervasive influence on life has been volcanism. Given that volcanism is one of the primary mechanisms that generate geochemical disequilibria and fluid migration at a planet's surface or in its near subsurface, volcanism and life are inextricably linked.

In this special issue, we have compiled a collection of papers presented at a session on Volcanism and Life at the Astrobiology Science Conference in 2010. These works focus on recent advances in studies of the interaction of volcanism and life.

Volcanism provides a source of geochemical energy, and the heat it generates circulates a wide range of elements and compounds. It is not surprising that volcanically active regions were likely locations where prebiotic reactions may have led to the emergence of life. Papers in this issue explore the link between volcanism and the origin of life.

The potential of volcanic pumice as a substrate for prebiotic reactions is explored by Brasier *et al.* (2011), who discuss a novel hypothesis for an origin of life that makes use of the remarkable properties of this material.

Chemicals produced in geothermal regions not only have the potential to drive early abiotic reactions but also provide redox couples for life. A paper by Reigstad *et al.* (2011) explores thermal springs in Svalbard, High Arctic, and the microbial diversity of bacteria and archaea in that environment that are sustained by chemolithotrophic energy sources. A paper by Hellevang *et al.* (2011) explores the biological implications of abiotic hydrogen production in the deep subsurface and the factors that control hydrogen production. Some volcanic environments are cold, yet the weathering of volcanic rocks releases iron that can sustain a variety of chemolithotrophs, which include iron oxidizers. Cockell *et al.* (2011) describe perennially low-temperature biofilms that contain iron-oxidizing bacteria that inhabit the volcanic terrains of Iceland.

Volcanic environments provide habitable conditions from micrometer to planetary scales. By investigating the factors that control habitability at different scales in volcanic environments, insights are gained into the physical and chemical factors that control the distribution of organisms on Earth and the potential for volcanic environments to harbor life elsewhere. Cousins and Crawford (2011) review what is known about volcano-ice environments as potential locations for life on Mars, and Northup *et al.* (2011) investigate life in volcanic lava tubes and what their biosignatures might tell us with regard to the search for life on other planetary bodies. Bagshaw *et al.* (2011) describe laboratory and field data on those factors that control the habitability of the interior of volcanic glass.

Many volcanic environments provide ideal locations for the preservation of life. Hydrothermal processes and the fact that some volcanic glasses provide nutrients for life make volcanic substrates ideal candidates for the search for ancient life in the terrestrial rock record and possibly on Mars. Preston *et al.* (2011) explore the use of infrared spectroscopy to find biosignatures of life in basaltic glass. Evidence for fossil endoliths in basaltic glass in the North Atlantic Ocean are described by Cavalazzi *et al.* (2011), while Ivarsson *et al.* (2011) present evidence for fungi preserved in lithified volcaniclastic material from Gran Canaria.

Collectively, these papers show that studies in extremophile microbiology, microbial paleobiology, life detection, and the origin of life intersect with the remarkable and diverse conditions found in Earth's volcanic environments. Volcanic terrains are promising locations within which to search for answers as to life's origins and to investigate the reasons for its tenacity on Earth and, potentially, beyond.

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