"III Congreso Latinoamericano de Astrobiología (2021)"
Revista Mexicana de Astronomía y Astrofísica Serie de Conferencias (RMxAC), **55**, 114–114 (2023)

https://doi.org/10.22201/ia.14052059p.2023.55.50

III Latin American Congress of Astrobiology (3CLA)(Virtual-Modality, August 3-6, 2021)
Editors: Leticia Carigi, Sandra I. Ramírez Jiménez, Miguel Chávez Dagostino, and Millarca Valenzuela - DOI: https://doi.org/10.22201/ia.14052059p.2023.55.50

ASTROBIOLOGICAL IMPLICATIONS OF THE FORMATION OF PHOSPHORUS COMPOUNDS FROM LASER ABLATION SIMULATING VOLCANIC LIGHTNING

J. I. Mateos López[1], J. de la Rosa[1], P. Molina Sevilla[1], and R. Navarro González

In the Laboratorio de Qumica de Plasmas y Estudios Planetarios, the fall of volcanic lightning was simulated by laser ablation on a Hawaiian basalt in an atmosphere of the present Earth. We aim to search oxidized phosphorus molecules not detected by ionic chromatography. However, the result show that atmosphere and volcanic lightning do play an important role in the formation of oxidized compounds of carbon, nitrogen and sulfur, and most likely phosphorus.

Phosphorus has played an important role in the origin and evolution of life (Butusov et al. 2013). Although present in the Earth's crust (0.1 %), much of the minerals it forms are insoluble in water, therefore, are not bioavailable. This fact has made us wonder how inorganic phosphorus gave way to a phosphorus present in biochemical processes. One hypothesis is that the electrical discharges associated with volcanic eruptions could provide the necessary environment to favor the process for availability to primitive organisms (Glindemann et al. 1999). Given this premise, igneous rocks of basaltic type that come from past volcanic activity on Earth and similarly on Mars could give us information about possible mechanisms of the formation and active evolution in the universe (Colangeli et al. 2001).

Our experimental procedure consisted of 4 stages:
(a) Preparation of a gas mixture that simulated the Earth's atmosphere: A Praxair brand dry air tank was used. The gas was passed through a stainless steel pipe to a mixer which controls the flow of gas to a manifold where the reactor is filled.
(b) Assembly of the basalt into a glass reactor: The volcanic lightning strike simulation system consists of a Pyrex brand glass reactor. Inside this reactor, the basalt was placed, the reactor is closed and connected to the manifold to first generate a vacuum and then filling it with dry air.
(c) Simulation of volcanic lightning strikes on basalt: A Surelite Model II-10 Continuum Nd-YAG brand solid state laser was used. The plasma struck the surface of the Hawaiian basalt. It radiated onto one face, ensuring there was always contact.
(d) The powder sample was analyzed by ion chromatography

[1]Instituto de Ciencias Nucleares, Universidad Nacional Autónoma de México, Apartado Postal 70–543, 04510 Del. Coyoacán, México, D.F (jose.mateos@correo.nucleares.unam.mx).

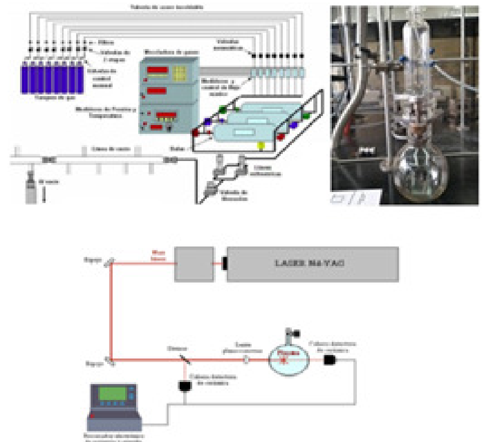

Fig. 1. (a) Diagram of the manifold. (b) Image of basalt inside the reactor. (c) Laser scheme.

Concentration (mg/L)

F^-	CO_3^{2-}	Cl^-	Br^-	$NO_3{}^-$	PO_4^{3-}	$SO4^{2-}$
LD	30.1	0.6	LD	31.4	LD	8.4

Results showed that the atmosphere plays an important role in the formation of oxidized compounds and that the presence of water is not necessary for the formation of this type of specie, the concentration of phosphorus in Hawaiian basalt is so low (0.226%) compared to other basalts that it is possible that the production of the oxidized species has not been detected, so it will be necessary to look for new ones, and determine if their production by this route is possible.

REFERENCES

Butusov, M., & Jernelöv. A. 2013, Phosphorus: an element that could have been called Lucifer
Glindemann, D., Graaf, R., & Schwartz, A. 2000, OLEB, 551, 561
Colangeli, L., Sears, D. W. G., & Seiferlin, K. 2004, JGRE, 109, E07S01