"III Congreso Latinoamericano de Astrobiología (2021)"
Revista Mexicana de Astronomía y Astrofísica Serie de Conferencias (RMxAC), **55**, 94–94 (2023)

https://doi.org/10.22201/ia.14052059p.2023.55.30

NITROUS OXIDE (N_2O) CONCENTRATION AS A POSSIBLE SIGN OF LIFE IN EXOPLANETS

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A biosignature is any substance, group of substances, or phenomenon that provides evidence of life (Schwieterman et al. 2018). Nitrous oxide (N_2O) has been suggested as a biosignature for N_2-O_2 dominated atmospheres as the biosphere is the main source of N_2O on modern Earth. However, in the Proterozoic, N_2O production processes were different from the present ones because of the ocean's euxinia (Buick 2007). M dwarfs stars are the most abundant (∼ 70%) and long-lived stars in our Galaxy and are amongst the main targets to search potentially habitable planets (Shields et al. 2016). Our goal is to assess the potential of N_2O as a biosignature by calculating its concentration in atmospheres belonging to potentially habitable planets from M dwarf-stars systems, and emulating theoretically Proterozoic conditions.

We calculated the N_2O abundance for atmospheres with different concentrations of O_2, CO_2 and CH_4 for planets around the Sun and the M dwarfs, AD Leo and GJ 876 by using a 1-D photochemical model. We inferred the N_2O fluxes from the emissions of ecosystems with low primary production (Table 1). We related each flux with the Proteobacteria biomass by estimating the Proteobacteria fraction relative to the global prokaryotic biomass according to Bar-On et al. (2018) with the N_2O flux emitted by the those ecosystems. We used the *phylum* Proteobacteria because this taxa was originated ∼2.8 to 1.6 Ga ago (Ludwing & Klenk 2001).

Our results show higher concentrations of N_2O in atmospheres with higher O_2 because this molecule shields N_2O from the UV (Fig. 1). For a given N_2O flux, N_2O concentrations were higher in planets from M dwarf systems, compared to planets around Sun like stars (Fig. 1), which implies that N_2O is potentially detectable on planets around M dwarfs. Besides, the biomass responsible for the N_2O flux on each simulated planet is close to the Proteobacteria biomass on present Earth.

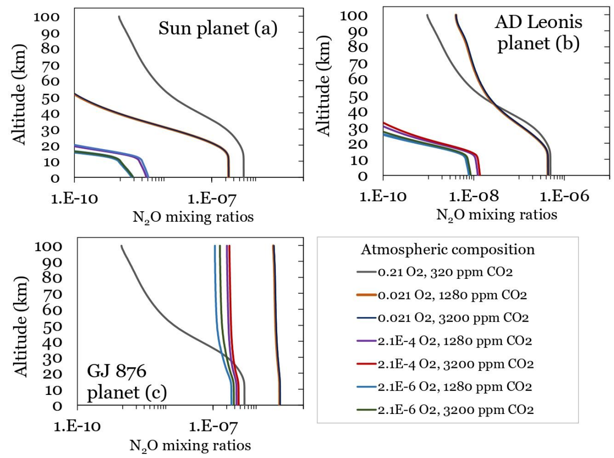

Fig. 1. N_2O mixing rations to atmospheres of planets circling the Sun (a), AD Leo (b) and GJ 876 (c), compared to Earth's present atmospheric level.

TABLE 1

TOTAL BIOMASS OF THE *PHYLUM* PROTEOBACTERIA

N_2O flux (cm^{-2} s^{-1})	Biomass (gC)
2.45×10^9	1.51×10^{16}
8.85×10^8	7.54×10^{15}
2.80×10^8	8.14×10^{15}
3.35×10^9	6.39×10^{15}
1.16×10^8	8.70×10^{15}

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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.2023.55.30