

# Abiotic Production of O<sub>2</sub> and O<sub>3</sub> on High CO<sub>2</sub> Terrestrial Atmospheres

Antígona Segura  
*Instituto de Ciencias Nucleares*  
*Univesidad Nacional Autónoma de México*  
MEXICO  
[antigona@nucleares.unam.mx](mailto:antigona@nucleares.unam.mx)

Victoria S. Meadows  
*Infrared Processing and Analysis Center*  
*California Institute of Technology*  
USA

James Kasting  
*Department of Geosciences*  
*Pennsylvania State University*  
USA

Martin Cohen  
*Radio Astronomy Laboratory*  
*University of California, Berkeley*  
USA

David Crisp  
*NASA Jet Propulsion Laboratory*  
USA

Previous research has indicated that high amounts of ozone (O<sub>3</sub>) and oxygen (O<sub>2</sub>) may be produced abiotically in atmospheres with high concentrations of CO<sub>2</sub>. The abiotic production of these two gases, which are also characteristic of photosynthetic life processes, could pose a potential “false-positive” for remote-sensing detection of life on planets around other stars. We use a photochemical model that considers hydrogen (H<sub>2</sub>) escape and a detailed hydrogen balance to calculate the O<sub>2</sub> and O<sub>3</sub> formed on planets with 0.2 of CO<sub>2</sub> around the Sun, and 0.02, 0.2 and 2 bars of CO<sub>2</sub> around a young Sun-like star with higher UV radiation. Using the results obtained by the photochemical model we calculated the visible/near-infrared spectra of the simulated atmospheres using a radiative transfer model (SMART\_SPECTRA).

Our simulations show that the O<sub>3</sub> and O<sub>2</sub> concentrations in the simulated planets are extremely small, and unlikely to produce a detectable signature in the spectra of those planets. With a balanced hydrogen budget, and for planets in the habitable zone that possesses abundant liquid water, abiotic formation of O<sub>2</sub> and O<sub>3</sub> does not constitute a possible false positive for life detection in either the visible/near-infrared or mid-infrared wavelength regimes.

We will present the O<sub>3</sub> and O<sub>2</sub> concentrations obtained on our simulations and the planetary spectra that may be observable for instruments like Terrestrial Planet Finder and Darwin.