Abstract

This study is dedicated to evaluating the potential for a novel pathway of abiotic synthesis of phosphine (PH_3) from phosphorus trioxide (P_4O_6) by a photocatalytic mechanism on aerosols. The mechanism might explain the recent possible detection of phosphine on Venus. This scenario has recently been suggested theoretically by our team based on an analogy with methane production form carbon dioxide on acidic photochemically-active surfaces of materials, which may account for a possible source of methane on Mars. Methane, just like phosphine, was suggested as an indicator of life on terrestrial planets, including Mars. The theoretical testing of photochemical phosphine generation suggests that even if this gas is present in the atmosphere of Venus it cannot be considered as an indicator of life until the suggested mechanism is excluded theoretically, or by experimental results, or direct evidence of life on Venus. This thesis will be followed by preparation of sophisticated experiments and intensive laboratory research addressing this. Furthermore, the role of nitrous oxide as another false positive biosignature was evaluated in this study. The presence of nitrous oxide can also be explained by processes other than biological, particularly on early planets. This study specifically demonstrates the synthesis of nitrous oxide by unexpected plasmochemistry taking place during a simulated hypervelocity atmospheric entry asteroid impact event. In order to evaluate the production, sinks and stability of both biosignature gasses, a 1D Lagrangian planetary atmosphere model (ARGO) was used. For assessing the potential of the newly introduced reaction mechanisms, models of the Venus and early Earth atmospheres in ARGO code and modified STAND chemical network were created and verified. Results of both models have been discussed in terms of detection limits of both gasses. The modifications needed in ARGO in order to achieve better precision were identified and discussed. As the result of this theoretical study, proposition for a new experiment was formulated.