# ORP Controlled Facultative Anaerobic Nitrate and Nitrite Reduction in a Groundwater Mesocosm

*Ned Murphy[1]

1. Central Planet Repair, LLC

Nitrate functions as an essential nutrient for plants and as a terminal electron acceptor compound for facultative anaerobic bacteria. Nitrate is also a contaminant of surface water and groundwater. This study was conducted to identify the conditions that initiate Nitrate and Nitrite Reduction by Facultative Anaerobic Bacteria in groundwater without a significant organic carbon loading from either natural or anthropogenic sources.

Inhibition of Nitrate Reduction by very low concentrations of Dissolved Oxygen under these conditions has been observed during in-situ bioremediation projects conducted by the author. Experience at remediation sites shows that the Facultative Anaerobes will enter an inhibited state under low oxygen conditions prior to initiating Nitrate Reduction. This is due to the bacteria selecting the greater metabolic efficiency of using Oxygen as the electron acceptor even if Nitrate is present in significantly greater abundance.

The specific conditions where nitrate reduction initiates is the “Nitrate Gate” which is a relationship of Dissolved Oxygen vs Oxidation Reduction Potential. The location of the “Nitrate Gate” in various biogeochemical conditions is being investigated using a purpose built groundwater mesocosm that is a closed system with specific control of the Dissolved Oxygen and Oxidation Reduction Potential in synthetic groundwater. The biogeochemical zonation present in the mesocosm thus allows for evaluation of transitions in the reduction of nitrogen oxides in response to the developed conditions.

The facultative anaerobic use of nitrogen oxides as electron acceptors is dependent upon the dissolved oxygen and dissolved organic carbon concentrations in the aqueous system. Facultative anaerobic systems can reduce the nitrogen oxides from nitrate to nitrite to nitric oxide and nitrous oxide.

Management of nitrogen oxides in natural and wastewater systems is gaining attention as a method for limiting the emissions of these gases to the atmosphere. Identifying boundaries of the the biogeochemical transformations is important for managing the fate and transport of these compounds.

Keywords: Mesocosm, Nitrate, Biogeochemistry