Precise determination of the Ca isotopic compositions by thermoionization mass spectromery

H.-W. CHEN[1]*, J.-C. CHEN[1], J.J. SHEN[1], D.-C. LEE[1] AND T. LEE[12]

[1]Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan, ROC (*correspondence: haart@earth.sinica.edu.tw)

[2]Institute of Astronomy and Astrophysics, Academia Sinica, Taipei, Taiwan, ROC

High precision Ca isotopic measurements have been set up using the thermo ionization mass spectrometry (TIMS). With the improved sample loading technique, it is possible to sustain a Ca ion current of 1.5~3nA for more than an hour for high precision Ca isotopic measurements. Using this procedure, typical analytical precision (2σ) for $^{40}Ca/^{44}Ca$, $^{43}Ca/^{44}Ca$, $^{46}Ca/^{44}Ca$, and $^{48}Ca/^{44}Ca$ are 1.6, 0.31, 7.5, and 0.68 epsilon (ε; in parts per 10^4), respectively, after normalizing to $^{42}Ca/^{44}Ca = 0.31221$ [1]. Four separate runs are usually taken for individual sample to ensure the reproducibility of the isotopic measurements, and the analytical uncertainty (2σ) can be further reduced to 0.87, 0.13, 4.6, and 0.42ε for $^{40}Ca/^{44}Ca$, $^{43}Ca/^{44}Ca$, $^{46}Ca/^{44}Ca$, and $^{48}Ca/^{44}Ca$, respectively, if the data of all four runs are combined. With the improved analytical precision, in particular for the less abundant ^{43}Ca and ^{48}Ca, it is possible to re-examine the Ca isotopic heterogeneity in terrestrial and meteoritic materials, and to explore the preserved non-linear stellar nucleosynthetic signatures in meteorites and homogenization process in the early solar system.

[1] Russell *et al*. (1978) *GCA* **42**, 1075-1090.

Interaction of NOM and NZVI: Implication for NZVI's toxicity and reactivity in the environment

JIAWEI CHEN[1,2]*, ZONGMING XIU[2], GREGORY V. LOWRY [3] AND PEDRO J. J. ALVAREZ [2]*

[1]State Key Laboratory of Geological Process and Mineral Resources, China University of Geosciences, Beijing 100083, China (*correspondence:chenjiawei@cugb.edu.cn)

[2]Dept. of Civil & Environmental Engrg., Rice University, Houston, TX 77005, USA

[3]Dept. of Civil & Environmental Engrg., Carnegie Mellon University, Pittsburgh, PA 15213, USA

Nano-scale zero-valent iron (NZVI) particles are increasingly used to remediate aquifers contaminated with hazardous oxidized pollutants such as trichloroethylene (TCE). However, the high reduction potential of NZVI can result in toxicity to indigenous bacteria and hinder their participation in the cleanup process. Here, we report on the mitigation of the bactericidal activity of NZVI towards gram-negative *Escherichia coli* and gram-positive *Bacillus subtilis* in the presence of Suwannee River humic acids (SRHA), which were used as a model for natural organic matter (NOM). *B. subtilis* was more tolerant to NZVI (1 g/L) than *E. coli* in aerobic bicarbonate-buffered medium. SRHA (10 mg/L) significantly mitigated toxicity, and survival rates increased to similar levels observed for controls not exposed to NZVI. TEM images showed that the surface of NZVI and E. coli was surrounded by a visible floccus. This decreased the zeta potential of NZVI from -30 to -45 mV and apparently exerted electrosteric hindrance to minimize direct contact with bacteria, which mitigated toxicity. H_2 production during anaerobic NZVI corrosion was not significantly hindered by SHRA ($p > 0.05$), However, NZVI reactivity towards TCE (20 mg/L), assessed by the first-order dechlorination rate coefficient, decreased by 23% (from 0.0178 ± 0.0007 h^{-1} to 0.0137 ± 0.0004 h^{-1}). These results suggest that the presence of NOM offers a tradeoff for NZVI-based remediation, with higher potential for concurrent or sequential bioremediation at the expense of partially inhibited abiotic reactivity with the target contaminant [1].

This study was sponsored by the USEPA (R833326), the Fundamental Research Funds for the Central Universities (2010ZD14, 2010ZD13), National Program of Control and Treatment of Water Pollution (2009ZX07424-002), Program for New Century Excellent Talents in University (NCET-07-0769), and China Geological Survey (Ke [2011]-01-66-07).

[1] Chen *et al*. (2011) *Water Research* **45**, 1995-2001.