

Novel iron-reducing bacterium isolated from Oak Ridge TN

MADHAVI PARIKH^{1*}, CHU-CHING LIN¹,
YANPING WANG¹, ALICE DOHNALKOVA²,
RAVI KUKKADAPU², MARK BOWDEN², TAMAR BARKAY¹
AND NATHAN YEE¹

¹Rutgers University, New Brunswick, NJ, USA

²Pacific Northwest National Laboratory, Richland, WA, USA
(*correspondence: madhavi@eden.rutgers.edu)

Dissimilatory iron reduction enables prokaryotes that respire ferric iron to thrive in subsurface geologic environments. Previous studies have shown that microorganisms with such respiratory capabilities play an important role in iron mineral formation, sediment diagenesis, carbon cycling, and contaminant bioremediation. In this study, we report the isolation of a novel spore-forming, strictly anaerobic, iron-reducing bacterium from groundwater sediments in Oak Ridge, Tennessee.

Enrichment cultures were established with sediments collected from the DOE's Field Research Center in Oak Ridge, TN. An oligotrophic medium was constructed to simulate *in situ* groundwater chemistry as revealed by on-site monitoring wells, using acetate (10mM) as the electron donor and ferrihydrite (30mM) as electron acceptor. After a pure culture was obtained, the genomic DNA was extracted and the 16S rRNA gene was PCR amplified. Growth experiments were conducted to evaluate the ability of this organism to respire alternate electron acceptors, including solid phase Fe (III) oxides, oxygen, fumarate, nitrate, and sulfate. The cultures were sampled at periodic intervals and the cells were examined using TEM and SEM. Mineral transformation products were analyzed using XRD, and Mössbauer spectroscopy.

Enrichment cultures resulted in the isolation of a pure culture of a spore-forming bacterium designated as FRC-RU4. Its 16s rRNA gene sequence (1509 bp) has the most similarity to that of the *Veillonellaceae* family at relatively low level (91% identity), thus may represent a new genus among this family. When grown on ferrihydrite and goethite, the formation of secondary mineral products were observed. Electron microscopy, Mössbauer Spectroscopy, and X-ray diffraction analysis revealed FRC-RU4 induces the formation of nano-particulate goethite and magnetite when grown on ferrihydrite. Biogenic magnetite crystals produced by FRC-RU4 are relatively large particulate (>50nm) compared to the magnetite particles formed by iron reducing *Gammaproteobacteria* such as *Shewanella* and *Geobacter*.

Did evaporites record the boron isotopic composition of seawater?

G. PARIS*, J. GAILLARDET AND P. LOUVAT

¹Géochimie-Cosmochimie, Institut de Physique du Globe de Paris, Université Paris Diderot, 4 place Jussieu, 75252 Paris Cedex 05, France (*correspondence: paris@ipgp.fr)

The secular variations of seawater chemical composition have been investigated through different media among which fluid inclusions in marine evaporites [1]. Boron is an element with a residence time of 10-20 My in seawater [2], longer than the mixing time of the ocean. The boron isotopic composition of seawater ($\delta^{11}\text{B}_{\text{sw}}$) is thus homogeneous in the modern ocean. Until then, the variations of the $\delta^{11}\text{B}_{\text{sw}}$ values have been mainly explored using numerical models based on the modern boron cycle. Such model suggests that the $\delta^{11}\text{B}_{\text{sw}}$ signal is likely to have changed by 2‰ in the last 20 Ma. In this presentation, we explore the boron isotopic composition of Cenozoic evaporites. Boron isotopes are extracted from salts after dissolution in pure water and analyzed on MC-ICPMS Neptune with a d-DIHEN (direct injection) system [4]. Total external reproducibility including chemical extraction process is better than 0.3‰ (2 σ). Strontium isotopes are also analyzed to investigate the origin of the brine.

The $\delta^{11}\text{B}$ values reveal a relative homogeneity for each epoch despite variability likely due to the chemical evolution of the brine during its evaporation. The brine is interpreted as being originally seawater. It is possible to define a seawater component for each studied epoch. Our results suggest that $\delta^{11}\text{B}_{\text{sw}}$ has significantly changed along the last 40 Ma, in agreement with other parameters of the oceanic chemical composition. The $\delta^{11}\text{B}_{\text{sw}}$ change amplitude appears to be stronger than suggested by models. Boron isotopic composition of ancient carbonates is broadly used as a seawater paleo-pH proxy and is therefore used to constrain pCO₂ in ancient times. Using boron isotopes for paleo-pH reconstruction following the paleo-pH equation [2] relies on the knowledge of $\delta^{11}\text{B}_{\text{sw}}$. Constraining the evolution of $\delta^{11}\text{B}_{\text{sw}}$ is a prerequisite for more reliable determination of seawater paleo-pH.

[1] Horita, Zimmerman & Holland (2002) *Geochim. Cosmochim. Acta* (66) 3733-3756 [2] Lemarchand, Léwin, Gaillardet & Allègre, (2000) *Chem. Geol.* (190) 123-140 [3] Hemming & Hanson (1992) *Geochim. Cosmochim. Acta* (56) 537-543 [4] Louvat, Bouchez and Paris (in press.) *Geostandard and Geoanalytical Research*