# Microbial metabolic diversity in deep sedimentary rocks of a foreland basin, Taiwan

LI-HUNG LIN[1], PEI-LING WANG[2], HON-TSEN YU[1], TING-WEN CHENG[1], SHENG-RONG SONG[3] AND CHIEN-YING WANG[4]

[1]Institute of Zoology, National Taiwan University, Taipei, Taiwan (lhlin@ntu.edu.tw)
[2]Institute of Oceanography, National Taiwan University, Taipei, Taiwan
[3]Department of Geosciences, National Taiwan University, Taipei, Taiwan
[4]Department of Earth Sciences and Institute of Geophysics, National Central University, Taiwan

Terrestrial subsurface microbial niches have been greatly extended to various enviroments that were previously thought barren of any life form. These ecosystems, including deep sedimentary aquifers, petroleum reservoirs, and igneous intrusions, are characterized by compartment of fracture network where the water activity and substrate flux are greater than those in rock matrix. The groundwater transport, however, is extremely slow, limiting the substrate influx derived from surface photosynthesis and exhchange between different reservoirs. Microbial populations are potentially self-sustainable, relying upon geologically-produced substrates. Contrary to those in stable continental crust, microbial communities and channel for substrate transport are frequently disrupted in active tectonic environments (such as subduction zone) and remain poorly constrained.

The Taiwan Chelunpu Drilling Project has provided an unprecedented opportunity to reveal the terrestrial subsurface microbial ecosystem that may have experienced constant disturbance by the arc-continent collision since 5 Ma. The drilling penetrated through the Pleistocene-Pliocene sedimentary rocks to a depth of 2000m below land surface (mbls). Two major fracture zones with ~100 m thickness were encountered at depths of ~1100 and ~1750 mbls, respectively. Among 25 samples retrieved from the rock formations or within the fracture zones along the depth profile, 15 were ground to powders, inoculated to media designed for fermenter, iron reducer, sulphate reducer and methanogen, and incubated at temperatures ranging from 30 to 70$^{o}$C. Mesophilic and thermophilic fermenters and organotrophic sulphate reducers were ubiquitously present in most samples, whereas iron reducers and methanogens appeared only at the samples from the upper (400-700 mbls) and lower portions (1800-1900 mbls) of the drilled cores. The presence of metabolisms is not correlated with lithology, depth, temperature and fracture.

# Carbon dioxide sequestration through enhanced weathering of chrysotile mine tailings and subsequent microbial precipitation of magnesium carbonates

I. POWER AND G. SOUTHAM

Department of Earth Sciences, The University of Western Ontario, London, Ontario, Canada, N6A 5B7 (ipower@uwo.ca)

Magnesium silicate minerals naturally weather and release magnesium ions, which may participate in carbon dioxide sequestration through the precipitation of carbonate minerals (Goff and Lackner, 1998). However, this dissolution-precipitation reaction is kinetically slow under ambient surface conditions. Column leaching experiments were developed to evaluate the use of acid generating substances in dissolving chrysotile mine tailings, collected from Clinton Creek, YT. The addition of elemental sulphur or sulphide-rich mine tailings in conjunction with acidophilic sulphur or iron oxidizing bacteria, respectively, enhanced the release of magnesium by up to twenty five times over control systems. Biological columns were shown to significantly increase the rate of dissolution by accelerating the oxidation of these acid generating substances. It was also demonstrated that chrysotile tailings are efficient in neutralizing acidic leachates, which resulted in the precipitation of the associated metals (iron, copper, zinc) within the columns.

Ferris et al. (1994) demonstrated that oxygenic photosynthetic bacteria can catalyze the formation of magnesium carbonate minerals, thereby consuming carbon dioxide. Cyanobacteria, added to a collection of magnesium-rich waters, raised the pH resulting in the oversaturation of magnesium carbonate and subsequent precipitation of carbonate minerals.

These results suggest that magnesium-rich mine tailings may be utilized as carbon sinks by accelerating dissolution through the addition of acid generating substances coupled with microbially catalyzed precipitation of carbonate minerals.

## References

Goff F. and Lackner K.S., (1998), *Environ. Geosci*. **5**:89-101.
Ferris F.G., Wiese R.G. and Fyfe W.S., (1994), *Geomicrobiol*. **12**:1-13.