Not so hot and not so salty microbes and their role in oil recovery and corrosion

MICHAEL J. MCINERNEY[1]

[1]Department of Microbiology and Plant Biology, University of Oklahoma, Norman, OK 73019 USA; mcinerney@ou.edu

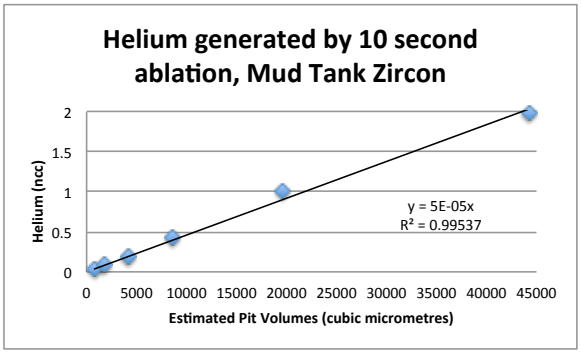
Diversifying the global energy portfolio with carbon-free or carbon-neutral fuels is critically needed. However, fossil fuels will likely be the dominant energy source for several decades. Significant amounts of oil remain entrapped in oil reservoirs, many of which are not too hot (30 to 50ºC), but are salty (salinities ranging from 2 to 19%). We conducted a test of a microbial plugging process in a hypersaline oil reservoir (14-19% salinity; 35ºC). The injection of molasses and nitrate stimulated in situ microbial growth and metabolism, which blocked a major water channel and corrected interwell permeability heterogeneities. The efficacy of biosurfactant-mediated oil recovery was tested in a control field trial. Two wells received an inoculum of biosurfactant-producing *Bacillus* species and 67 cubic meters of nutrients (glucose, sodium nitrate, and trace metals); two wells received just nutrients; and one well received only formation water. The lipopeptide biosurfactant was detected only in the produced fluids from the inoculated wells. A year later, the two wells that received an inoculum were treated with the same two strains and 670 cubic meters instead of 67 cubic meters of nutrients. The lipopeptide biosurfactant concentration was about 20 mg/L and about 330 barrels of additional oil were recovered. Most probable number analysis showed that heterotrophic, thiosulfate-reducing bacteria related to *Anaerobaculum* species were the most numerous sulfide producers in a corroding oil production facility (marine salinity; 55ºC). Enrichments containing *Anaerobaculum* species caused significant corrosion of metal coupons when yeast extract and thiosulfate were present. Our work shows that microbial permeability profile modification and in situ biosurfactant production are possible. Fermentative thiosulfate users are important mediators of corrosion in some oil production facilities

RESOChron: ELA-ICP-He-MS instrument for *in situ* U-Th-Pb-He geothermochronology

BRENT IA MCINNES[1], NOREEN J EVANS[1], MIKE SHELLEY[2], BRAD MCDONALD[1], DAVID GIBBS[3], ASHLEY NORRIS[4], ED ROBERTS[3], CLIFF GABAY[4] AND DES PATTERSON[5]

[1]AuScope GeoHistory Facilty, John de Laeter Centre for Isotope Research, Applied Geology, Curtin University, Perth WA Australia; b.mcinnes@curtin.edu.au
[2]Laurin Technic Pty Ltd., Canberra ACT, Australia
[3]Australian Scientific Instruments Pty Ltd, Canberra ACT
[4]Resonetics Ltd, Nashua NH, USA
[5]Patterson Instruments Ltd, USA

The development of an *in situ* microanalytical instrument capable of rapid automated U-Th-Sm-Pb-He isotope analysis of multiple grains will permit a more detailed interrogation of the time-temperature history of apatite, zircon, rutile, titanite and other accessory phases. Previous work[1-3] has demonstrated the technical feasibility of this approach, while this project advances the field via the development of a prototype system that integrates four existing commercial components: (i) a helium mass spectrometry module based on the Alphachron™ design, (ii) an ICP-MS module (Agilent 7700), (iii) an excimer laser ablation module based on the *RESOlution* design, and (iv) swappable ultra-high vacuum and flow-through analytical cells designed by Laurin Technic.



Initial *in vacuo* laser ablation testing on a large Mud Tank zircon indicate that: (i) the DL for radiogenic ^{4}He, is exceeded when ablation volumes are >780 μm^3 corresponding to a 10 μm deep ablation pit with 5μm radius; (ii) U-Th-Pb-He mapping/profiling is feasible with this new approach.

[1] Boyce J. W. *et al*., 2006, GCA 70, 3031–3039; [2] Boyce J. W. *et al*., 2009, G-cubed 10. doi:10.1029/2009GC002497; [3] Vermeesch, P. *et al*., 2012, GCA 79, 140-147.

DOI:10.1180/minmag.2013.077.5.13