Biogeochemistry of manmade lake nearby industrial city, Riyadh, Saudi Arabia

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Extremophiles are microbes that have the ability to maintain a life cycle in severe environments such as those characterized by high salt (halophiles) and high temperature (hyperthermophiles). A manmade lake (pond) nearby the second industrial city at the south of Riyadh, Saudi Arabia with estimated area of 25 square kilometer and 20 meter depth, which was created accidentally, is characterized as extreme environments whereas TDS reaches around 7700 ppm and the temperature of surrounded area hits 60 °C in summer and goes down -2 °C in winter. The lake has been fed by all type of wastewater ranges from treated wastewater generated from facilities of the industrial city, draining system of rainfall and portable sewage tanks. A discharge channel (stream) somehow connected to the lake from facilitits of industrial city via underneath the highway was bulit recently. This work aimed to measure phyisco-chemical properties, selected heavy metals (Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Cd, Pd) and presenting bacteria along the stream and the lake itself in order to propose a hypothesis regarding biogeochemistry behaviour of indigenous microorganisms.

Practically, nitrates, carbonates and sulfates clearly decreased by 41.5%, 28.5%, 14.0%, respectively, from stream part to lake itself. Similarly, level of Cr, Mn, Fe, Co, Zn, Cd and Pd decreased as sampling have been collected along stream to lake. On the other hand, concentrations of Ni and As increased by 46% and 27 %, respectively while Cu didn't show any significant change. On the bacterial level, microbiological conventional methods produced 62 isolate (38 isolated from lake's samples and 24 isolated from stream's samples) and identified using state-of-art RiboPrinter microbial characterization system, which is based on pattern of DNA bands. *Aeromonas hydrophila* species represented 10% of total isolates from lake's samples while *Klebsiella pneumonia* species found to be 50% of isolates from stream's samples. In such an open complex ecosystem, many variables are accounted to have certain behavior like chemistry of elements and geological structure of the area. Moreover, shifts in bacterial species profiles and changes in physcio-chemical between stream and lake can be linked to each other and lead to isolate novel species.

Analysis of fluid inclusions with fs-LA-ICP-MS

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Hydrothermal Cu deposits are one of the most significant type of ore deposits for many metals (e.g. Cu, Zn, W, Mo, Au). Fluids are responsible for the transport and the enrichment of those metals [1]. To learn about the conditions that led to metal enrichment in fluids, we want to investigate the composition of fluid inclusions from ore deposits *in situ* by femtosecond laser ablation inductively coupled plasma mass spectrometry (fs-LA-HR-ICP-MS; using an ElementXR® MS).

For this purpose a new analytical setup is developed by combining a heating freezing stage with our deep UV (λ = 196nm) fs-LA-HR-ICP-MS system. By freezing the fluids, we are aiming to expand the signal length of the ablated fluid inclusion and with that to minimize analytical uncertainties compared to previously applied nanosecond LA-ICP-MS techniques [2].

Preliminary test measurements of a frozen standard solution relative to the NIST610 glass, resulted in an analytical uncertaity of 10% (1σ) for the analyses of e.g. Cu, Zn, Pb, Ag and other trace elements. We also tested our method by the analyses of natural high saline (>20wt% $NaCl_{eq.}$) fluid inclusions in hydrothermal quartz veins from Cornwall, UK and with synthetic fluid inclusions in quartz of different salinities. First results indicate that inclusions of a size between 10μm to 30μm and in a depth up to ~50μm can be analysed with a succes rate of > 60%. ^{23}Na is used for internal standardization. For several isotopes, including ^{44}Ca, ^{66}Zn, ^{95}Mo, ^{85}Rb, ^{133}Cs and ^{208}Pb we achieved signals significantly above the detection limit (3σ of background) for a duration of 20 to 40 seconds.

In future investigations, we want to apply this technique to analyse natural fluid inclusions from different ore deposits and synthetic fluid inclusions from HP/HT experiments.

[1] Heinrich *et al* (2003), *Geochim Cosmochim Ac* **67**, 3473-3496. [2] Pettke *et al* (2012), *Ore Geology Reviews* **44**, 10-38.

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