Sewage Waste Implicated as a Predominant Microbial Carbon Source Mediating Arsenic Release in Bangladesh Aquifers through PLFA $\Delta^{14}C$, Sterol Fecal Biomarkers and Cl/Br Ratios

WHALEY-MARTIN, K.J.*[1], MAILLOUX, B.[2], VAN GEEN, A.[3] BOSTICK, B.[3], , AHMED, K. M.[4], CHOUDHURY, I.[4] SLATER, G.F.[1]

[1]School of Geography and Earth Sciences, McMaster University, ON, Canada (corresponding: martikjw@mcmaster.ca, gslater@mcmaster.ca)

[2] Environmental Sciences Department, Barnard College, NY, NY 10027, (bmaillou@barnard.edu, rfs2129@barnard.edu, ck2491@barnard.edu)

[3] Lamont-Doherty Earth Observatory, Columbia University, Palisides, NY 10964 (avangeen@ldeo.columbia.edu, avangeen@ldeo.columbia.edu)

[4] Department of Geology, University of Dhaka, Dhaka 1000, Bangladesh 10964 (kazimatin@yahoo.com, imtiaz_choudhury@yahoo.com)

Novel approaches are necessary to address the debate concerning the nature of carbon sources indigenous bacteria use to mediate As groundwater contamination across Bangladesh. Aquifer depth profiles of two As contaminated sites of the Araihazar Upazila, Bangladesh, (sediment and groundwater collected from 2013-2015) were constructed using $\Delta^{14}C$ analysis of the *in situ* sedimentary microbial communites (PLFA) and carbon pools (DIC, DOC and SOC) with complimentary measures of sewage contamination (sterol fecal biomarkers and $Cl/Br_{(aq)}$ ratios) and $[As_{(aq)}]$.

At both sites (<30m), $\Delta^{14}C_{PLFA}$ (-60 ± 20‰) indicated utilization of a dissolved carbon pool of comparable age to DIC rather than sedimentary carbon sources ($\Delta^{14}C_{DIC}$ = +24 ± 30‰; $\Delta^{14}C_{DOC}$ = -230 ± 100‰; $\Delta^{14}C_{SOC}$ = -630 ± 50‰). Concentrations of the fecal biomarker (coprostanol) (<LOD to 1.33ng/g) increased with depth. In high arsenic zones (<30m), sewage contamination indexes found were >0.7 and highly correlated with As concentrations at both sites (R=0.718; 0.938). Cl/Br ratios at shallow depths ranging from 990-1870 (indicative of sewage wastewater) correlated with As (R=0.88; 0.55). At greater depths (>50m) groundwater was low in As and Cl/Br ratios had background values for recharge water (240 to 337). These results suggest As release is occurring in aquifers contaminated with sewage-derived waste water which when present is a plausible predominant dissolved microbial carbon source.