Omics and Geochemistry: the ENIGMA 100-Well Survey

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At the Department of Energy’s Oak Ridge field site, over 20 years of historical and published data for more than 800 groundwater wells is available in a computer queryable database. In this study, we conducted a survey of 99 groundwater well clusters in order to (1) characterize key microbial populations at geochemically distinct locations, and (2) identify associations between environmental gradients and microbial communities. To optimize geochemical diversity, wells were selected using k-medians clustering to group 818 wells into 100 clusters by 14 geochemically similar measurements. At each well, in situ groundwater measurements were recorded and unfiltered and filtered groundwater samples were collected for both geochemical measurements and analysis of microbial communities. Nucleic acids were collected by filtering water through a 10.0µm pre-filter and 0.2µm-membrane filter and then extracted using a Modified Miller method. Evaluation of divergence of microbial communities across all the wells indicates the microbial communities are fairly distinct. Comparison of microbial communities within each well shows taxa are not as divergent compared to across all wells. Metadata correlations of all the wells show many of the geochemical parameters are independent of each other. To evaluate potential microbial-geochemical associations, a random forest classification system was used and trained on the OTU abundances to predict continuous values for each geochemical parameter. Results indicate that with careful design and a large dataset, the groundwater microbial community structure can be used to accurately predict the water geochemistry. This project is part of the ENIGMA (Ecosystems and Networks Integrated with Genes and Molecular Assemblies) Scientific Focus Area at LBNL (http://enigma.lbl.gov).