

Letter of Interest subsurface research immediately appropriate at Homestake February, 2006

Title:

Ecosystem Biogeochemistry Transitioning from Near-Surface to Deep Earth Ecosystems

Investigator: TJ Phelps, TC Onstott, SM Piffner, R.Colwell, TC Hazen, S Bang, J Wang, B

Collaborators: many from local and distant institutions, multidisciplinary

Science Goals: Develop an understanding of the transitioning of near-surface (terrestrially charged) ecosystem biogeochemistries to deeper ecosystems of unknown relationships to the surface with respect to time, depth, energy conduction and biomass exchange. Of particular emphasis will be relationships between viable biomass, metabolic signatures, remnant signatures of previous life and preservation of macromolecules.

Research objectives: Using multiple screened zones in up- and down-gradient portions of each water bearing unit we intend to decipher relationships between biogeochemistries and that unit's relationship to surface ecosystems. Among the shallower transitions will be a shift from oxygenated waters fueled by recent photosynthate as it transitions with depth to anaerobic fluids fueled by fermentation endproducts. Deeper formations will evidence greater impacts by inorganic electron acceptors (e.g., sulfate, iron) and still deeper ecosystems will evidence older waters of considerable saline and perhaps fueled by deep hydrogen sources. The wells and screened zones will be those established for monitoring, engineering, site characterization as well as those from TC Onstott's project on the impact on subsurface microbial activities on the properties of subsurface formations. Other research objectives include mechanisms of macromolecule preservation, energy conservation and transfer between formation units and waters, altered energy flow paths and energy sources, responses to stress and adaptation, organismal transport or niche expansion, fluid transport and communication, relationships between existent viable biomass and remnant signatures of previous life.

Methods: Access screen zones from other projects, site characterization, and engineering design. Conduct recon trips along major routes for spot sampling as well as into less used portions of the mine and drifts.

Integration with E&O: Easy early Access to entice long term R&D interest. Ideal for NSF-REU programs and good mechanisms to introduce new investigators to subsurface work for their expansion into other more detailed focused R&D. Immediate access to surface and near surface with soon access to moderate depths followed by stepwise access to deeper depths and deeper screened zones is ideal for student training for decades. Will also include group trips into less utilized portions of the facility under intense safety and scrutiny.

Infrastructure Requirements and Impact on Other Users: Builds on all early characterization efforts but detracts from none. Intermittent use of individual screen zones is for hours per month.

Will utilize wells and screen zones for monitoring and characterization. Will also entail group trips into less utilized portions of the facility under intense safety and scrutiny. As facility develops we will expand access to deeper more developed facilities. Will require access to elevators, drifts, stopes, screen zones, lab space, gassing stations, glove bags, multi-level packing systems for wells, long distance groundwater pumping facilities, several Kw of power availability and perhaps outyear demand for small drilling/coring operations.

Readiness for Deployment of the Technology: All is ready and prepared.

Readiness of Effort and Funding: Proposals could be readied to coincide within months of site availability.

Budget: Minimal work at 150k/y up to 500k/y for up to 10 yrs

ES&H Issues: Fits readily within site umbrella with minor modifications and will increase complexity as the facility advances in depth and scope..