Produced water chemistry, treatment models, and use in algal biofuel production and carbon capture and sequestration; or, How produced water is like Champagne

ENID J. SULLIVAN[1]*, RAJESH PAWAR[2]
AND PHIL STAUFFER[2]

[1]Los Alamos National Laboratory, Chemical Diagnostics and Engineering Group, MS J964, P. O. Box 1663, Los Alamos, NM, 87545 (*correspondence: ejs@lanl.gov)
[2]Los Alamos National Laboratory, Computational Earth Sciences Group , MS T003, P. O. Box 1663, Los Alamos, NM, 87545 (rajesh@lanl.gov, stauffer@lanl.gov)

Water produced from oil and gas operations, or from geochemically similar formations, can be an appealing supplement to water-intensive energy production processes such as algal biomass growth and solar thermal generation that occur in high-solar-flux regions that are typically arid. Water produced during geologic sequestration is a similarly high-volume stream that can be treated to supplement carbon capture and energy generation processes that coexist with sequestration. Water volumes produced during geologic sequestration are predicted to reach about 7 MGD over 50 years, under certain scenarios [1]. The geochemistry of such waters varies from moderate salinities and low total dissolved solids, to high salinity and/or high organic carbon content. We are developing a treatment process selection model that will be a component of CO2-PENS, which incorporates primary (TDS, TSS) and secondary (metals, dissolved gases, and organic constituents) geochemical characteristics of produced water. We are basing process selection on operating saline-water treatment plants including reverse osmosis and thermal desalination types. The model will enable selection of treatments that are cost effective and address specific end-use needs carbon capture and co-production of energy. The model can be extended to identify specific treatment needs and costs for algae cultivation and subsequent coproducts such as animal feeds.

[1] Stauffer, Viswanathan, Pawar & Guthrie (2009) *Environ. Sci. Technol.* **43**(3), 565–570.

Deep-mantle-derived noble gases in metamorphic microdiamonds from the Kokchetav massif, Kazakhstan

H. SUMINO[1]* AND L.F. DOBRZHINETSKAYA[2]

[1]Geochemical Laboratory, Graduate School of Science, University of Tokyo, Tokyo 113-0033, Japan (*correspondence: sumino@eqchem.s.u-tokyo.ac.jp)
[2]Department of Earth Sciences, University of California at Riverside, Riverside, CA 92521, USA (larissa@ucr.edu)

Metamorphic diamonds from the Kokchetav massif in northern Kazakhstan are considered to have crystallized from C–O–H fluid during ultra-high-pressure metamorphism of metasedimentary rocks subducted to 190-280 km depth [1]. Noble gas isotopes offer great potential to constrain the origin of diamond-forming media. Previous studies have revealed that secondary processes during the diamond residence in the host rock drastically modified the original noble gas signature of the diamonds [2]. Nanometric solid/fluid inclusions in the microdiamonds, which represent the former diamond-forming fluid [1], are potential candidates to preserve the noble gas trapped during the diamond crystallization. We carried out noble-gas analyses of the Kokchetav microdiamonds applying two gas extraction techniques: *in vacuo* crushing and stepwise heating. The latter selectively extracts noble gases from inclusions with less noble gas extraction from the diamond lattice.

Most ^{3}He was extracted by diamond crushing what indicates that ^{3}He occurs within inclusions trapped during diamond formation. The estimate of the inclusion-hosted ^{3}He/^{4}He of $(3.3–6.5)\times10^{-5}$ is significantly higher than that of the MORB-source mantle (1.1×10^{-5}), but close to the highest value observed in OIBs (ca. 7×10^{-5} [3]) containing primordial noble gases derived from deep mantle. Neon isotope ratios obtained using stepwise heating also indicate the presence of a plume-like component. However, the several-orders-of-magnitude-smaller amount of crush-released Ne than that of the stepwise heating suggests the plume-like Ne is hosted by the diamond lattice and/or the solid inclusions. Results show that plume-like primordial noble gases were involved in the Kokchetav microdiamond formation, suggesting interaction of the subduceted continental slab with a fragment of the very deep mantle. The latter was probably transported to the mantle wedge of the subduction channel from the deep lower mantle source through large-scale mantle convection.

[1] Dobrzhinetskaya *et al.* (2006) *EPSL* **243**, 85–93. [2] Verchovsky *et al.* (1993) *EPSL* **120**, 87–102. [3] Stuart *et al.* (2003) *Nature* **424**, 57–59.