ABOUT HEATH·VENTURA

Ventura Earth Sciences provides litigation support, environmental forensics, and expert witness testimony for the legal community in the area of environmental litigation. Mr. Gregory Smith, President of Ventura Earth Sciences was involved early in the testing and development of interpretative techniques for stable isotope analysis, beginning in the late 1990s. At that time, Mr. Smith worked with researchers at Argonne National Laboratory applying interpretation of bulk isotope analysis to sites involving groundwater investigations and remediation.

As methodologies and analytical techniques and methodologies, and equipment improved, compound specific isotope analysis (CSIA) was developed, with Mr. Smith using this powerful tools to interpret the effectiveness of a variety of remediation techniques including steam injection, electrical resistance heating, groundwater pump and treat, and in situ chemical oxidation. Mr. Smith continued to expand the use of CSIA and he has used this analytical technique at various locations around the world as summarized below:

- **England:** differentiated 3 groundwater plumes by comparing fractionation patterns where previously one plume was interpreted to be present.
- **Japan:** At an active automotive parts manufacturer, prior to the use of CSIA, it was believed that the released trichloroethene was stable and not undergoing natural degradation. As a result, the overly conservative groundwater treatment remedy called for both source treatment and hydraulic capture and treatment at the fence-line. Using CSIA, Mr. Smith demonstrated that natural biodegradation was occurring and resulted in concentration reductions in groundwater. As a result the fence-line hydraulic containment and capture component of the remediation could be eliminated, saving significant treatment costs. CSIA was further used to interpret the effectiveness of steam injection treatment.
- **Australia:** A former automotive parts manufacturer had experienced releases of trichloroethene to groundwater at two locations on its property that were interpreted to have impacted offsite groundwater. The client's impacted groundwater was undergoing in situ chemical oxidation, involving multiple treatments that had limited effectiveness. CSIA demonstrated that the oxidation was having limited effect since it was not directed at both the on and offsite sources, with the offsite sources being previously undetected. Natural degradation was controlling offsite migration allowing for a risk-based closure of remediation operations.
- **Spain:** An active manufacturing facility had experienced releases of trichloroethene to soil and groundwater at two locations at the plant site. The two locations were inaccessible due to active production that could not be shut down. Enhanced biodegradation was employed to address the sources, but the monitoring program was having difficulty determining effectiveness. CSIA was used to evaluate the biodegradation treatment that showed that degradation was occurring, but was limited by geochemical conditions in groundwater. Three

additional sources of groundwater pollution were also discovered as part of the study, identifying another limiting condition.

- **Brazil:** An active manufacturer in the process of shutting down operations needed to understand the effectiveness of a permanganate groundwater treatment. The oxidation treatment was combined with natural degradation to manage the offsite impacts. CSIA was used to identify degradation mechanisms, determining where the treatment was effective and where it was not. Two additional areas on site where identified to expand the permanganate treatment to improve overall effectiveness.
- **Indiana:** Groundwater at a former manufacturing plant was undergoing in situ thermal treatment using the electro thermal – dynamic stripping process (ET-DSP®). CSIA was used as part of an overall study to determine the changes in groundwater chemistry during in situ heating and whether this affected the concentration reduction mechanisms.
- **Illinois:** At a former electronics manufacturer, testing of the use of bulk isotopes to evaluate the effects of in situ thermal treatment. The testing was successful in differentiating evaporation and biodegradation of trichloroethene, allowing for the phased shutdown of treatment reducing costs.
- **Illinois:** A former manufacturing plant was being re-purposed. As part of the process, groundwater contamination from the use of 1,1,1-trichloroethane was discovered, with the extent determined. The remedial solution that was applied was electrical resistance heating. Remediation progress was tracked using CSIA to determine at what point degradation processes were more effective than vaporization. When this occurred, active heating was discontinued and natural degradation could continue as the remediation process, reducing costs by approximately 25%.
- **Pennsylvania:** At a Superfund site consisting of an industrial park with multiple releases of various chlorinated solvents the client was interested in determining whether the sources could be differentiated. Unfortunately, the previous consultant sampled the monitoring wells for ^{13}C, only. Full characterization required ^{37}Cl and ^{2}H which the client was unwilling to pay. A qualified interpretation was performed, but the various sources could not be completely differentiated using ^{13}C alone.
- **Missouri:** An electronics manufacturer, located in an area of light industry and residences, had experienced releases of trichloroethene to groundwater in fractured bedrock. The wells were sampled for ^{13}C, ^{37}Cl, and $^{87}Sr/^{86}Sr$. The ^{13}C and ^{37}Cl data was used to differentiate groundwater plumes so as to optimally locate wells for the treatment system. The strontium isotope data was less helpful as a result of the preponderance of strontium in the carbonate bedrock aquifer.
- **South Carolina:** Two manufacturing plants located across the street from one another had experienced releases of trichloroethene to groundwater in a fractured bedrock. The isotope data was used to evaluate mixing from the two sources to define the extent of migration and hence responsibility for clean-up.