

## GC/C/IRMS as a tool to evaluate the degradation of chlorinated organic compounds in groundwater

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The in-situ remediation techniques by microbial activity are used for reduction of chlorinated organic compounds in polluted groundwater. However, the evaluation of microbial activity for decomposition of chlorinated organic compounds is not clear by only the concentration analysis. So, we focus on the usage of the stable carbon isotope analysis of chlorinated organic compounds such as trichloroethylene (TCE), and its daughter products; cis-dichloroethylene (cis-DCE) and vinyl chloride (VC).

The stable carbon isotope ratio ( $\delta^{13}\text{C}$ ) of these organic compounds were analyzed by a GC (Agilent : 7890A) coupled to an isotope ratio mass spectrometer (SerCon : 20-22) with combustion interface (SerCon : GC-CP) (GC/C/IRMS). The system was equipped with a purge-and-trap concentrator (GL science : AQUA PT 5000J PLUS) connected to the GC. In the  $\delta^{13}\text{C}$  value measurement, the measurement limit was usually 200ng-C, and standard deviation in TCE, cis-DCE and VC were  $\pm 0.08$ ,  $\pm 0.37$ ,  $\pm 0.11$  permil, respectively.

Groundwater samples were collected at polluted site with and without bioremediation treatment.

In samples from without treatment site, even the concentration decreasing were detected, the  $\delta^{13}\text{C}$  values of TCE are almost same as original one. On the other hands,  $\delta^{13}\text{C}$  values of not only TCE but also the daughter products increase with a decrease in concentration of TCE. These results show the usefulness of GC/C/IRMS for distinguishing the reason of concentration reduction by in-situ microbial activity of decomposition of these organic pollutants from physical factors such as dilution, diffusion, and adsorption.

Keywords: GC/C/IRMS, chlorinated organic compounds, biodegradation