Geo-pollution phenomena by PCE and the geo-pollution mechanism in Shimousa upland, middle-upper Pleistocene, northern Boso Peninsula, central Japan

Osamu KAZAOKA1, Yutaka SAKAI2, Takefumi NANJYO3, Takashi KUSUDA2, Hisashi NIREI3-4
1: Research Institute of Environmental Geology, Chiba
2: Former member of Research Institute of Environmental Geology, Chiba
3: Environmental protection branch of Inzai City Government
4: IUGS-GEM

Introduction

Many springs are distributed in “Yatsuda”, small alluvial valley, in Shimousa upland, northern Boso Peninsula. There is an old well made during the Heian period in Urabe district in Inzai city, northern Shimousa upland. Citizen use groundwater for life in the Urabe district since the Heian period. Perchloroethylene (PCE) was detected in a private well. City government surveyed PCE concentration on 29 private wells around the polluted well. PCE was detected from 3 wells. City government, prefectural government and RIEGC started in collaboration to elucidate the mechanism of the geo-pollution and treatment the groundwater pollution.

Mechanism of the geo-pollution

It is important to elucidate the mechanism of the geo-pollution for the effective treatment of groundwater. This joint team determined the geo-pollution mechanism based on Nirei (1989), Nirei et al (1993) and Satoh & Nirei (1989) (Akita et al., 2001; Kazaoka et al., 2001; Murakoshi et al., 2008). Depths of screens and groundwater qualities of 11 private wells were investigated around the polluted wells. These investigations show that 4 aquifers, 20m, 30m, 40m and 60m in depth have been used for private wells, and the aquifer in 20m in depth has been polluted by PCE. Polluted wells were distributed in line. A factory used PCE locates on the line. Then ground air concentrations of PCE were measured in 0.85m depth on each 4m square by a detector tube in the factory. Hot spots over 200 ppm gas of PCE were found in the factory.

Continuous drilling cores were obtained at 7 points around the polluted area. Strata pollutions about VOCs were measured on each core sample. The geo-pollution site is composed of 8 aquifers and 8 aquicludes from the surface to 60m in depth. Observation wells of each aquifer were drilled at each site. The mechanism of the geo-pollution is as follows: On geo-pollution source, the factory, from the 1st aquifer to the 4th aquifer were polluted with highly concentrated PCE. PCE groundwater pollution plume migrated into the 3rd aquifer, which was used mainly for drinking water wells, and into the 4th aquifer. The highly polluted strata were removed and filled with cement by Soil Replacement Technology. Polluted groundwater in the 3rd aquifer and the 4th aquifer has been pumped up. Groundwater pollution plume of the 2nd aquifer has migrated little because of slow groundwater flow after the removal of main geo-pollution source. The concentrations of PCE have decreased naturally.

Reference: