Compound specific isotope analysis (CSIA) as a tool to monitor *in situ* transformation of hexachlorocyclohexane (HCH)in soil, sediment and surface water

YAQING LIU†, PUNEET KOHLI\*, LANGPING WU†, IVONNE NIJENHUIS†, RUP LAL\*, HANS-HERMANN RICHNOW†.

†Department of Isotope Biogeochemistry, Helmholtz Centre for Environmental Research-UFZ, Permoserstraße 15, 04318 Leipzig, Germany

\*Department of Zoology, University of Delhi, 110021,Delhi, India

In India, technical hexachlorocyclohexane (HCH) was extensively used from the 1960s until 1997. During this period, around one million tons was produced. Subsequently, Lindane (γ-HCH, the only HCH isomer with insecticidal properties) replaced technical HCH in agricultural and pharmaceutical formulations. According to national statistics, approximately 56,000 to 84,000 tons of HCH waste could have been generated which caused heavy contamination. One Lindane manufacturing chemical plant, situated 25 km north-east of Lucknow, which has been engaged in Lindane production since 1997, was selected to survey HCH contamination in soil, sediments and surface waters.

We investigate the Lucknow field site for HCH residues in the vicinity of a former dump site and the Lindane production plant in order to analyse the HCH residues in soil, sediments and surface water. Compound-specific carbon stable isotope analysis was applied as a tool to investigate the transformation of HCH. The concentrations and carbon stable isotope composition of HCH isomers as well as enantiomer fraction of α-HCH were investigated as indicators for transformation processes.

We conducted three sampling campaigns during 2014 and 2015. For the evaluation of HCH transformation, soil, sediment and water samples were collected in the farmland near the dumpsite as well as muck samples from a dumpsite which was used as representative for original production. HCH isomers could be detected in all theevaluated samples. The concentration of single isomer detected in the soil, sediment and water samples were up to 1.65g/kg, 3.1g/kg and 0.39mg/L, respectively. α-HCH was the dominant isomer. The carbon stable isotope composition of HCH isomers from muck samples were compared with those in the soil and sediment samples. The enrichment in 13C isotope composition compared to muck (Δ=δ13Csample-δ13Cmuck) up to 3.6‰ suggested transformation of HCHs by biodegradation. Comparing sampling campaigns, in the same sampling zone, significant variation of carbon isotope value can be observed suggesting that inhomogeneity of the distribution also affected the biotransformation of HCH.

As a further indicator for biodegradation the enantiomeric fractionation of α-HCH was monitored in soil samples. No significant shift was observed in the enantiomer fraction (EF) of α-HCH serving as a second line of evidence for biodegradation.

Therefore, for further evaluation of the contribution of biotic and abiotic transformation of HCHs,additional approaches are needed, such as multi-dimensional CSIA (2D-CSIA, 3D-CSIA) or microbial and molecular biological investigations.