Linking the sulfur and carbon cycle by ultrahigh-resolution characterization of dissolved organic matter

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To capture the prevailing steep and distinct biogeochemical gradients and associated redox processes in porous aquifers, high resolution sampling in the centimeter range is needed. At a tar-oil contaminated sampling aquifer, the installation of a high-resolution multi-level well (HR-MLW) revealed the fringes of the contamination plume to be hot spots of biodegradation via sulfate reduction [1-3].

Our current study at this site links high resolution spatial sampling of groundwater with high resolution molecular characterization of solid phase extracted dissolved organic matter (DOM) by Fourier transform ion cyclotron resonance mass spectrometry (FTICR/MS). This technique benefits from ultrahigh mass accuracy and resolution that enable its unique capacity to unambiguously distinguish between CHO and sulfur organic compounds (CHOS) in highly complex and abundant mixtures of organic compounds like DOM [4-7].

The obtained DOM mass spectra show a remarkable high number of CHOS compounds. The pronounced variance of CHOS compounds observed along the HR-MLW is directly related to the distinct inorganic sulfur species gradients. Therefore, the specific sulfur signature of DOM provides new insights into the linkage of the sulfur and carbon cycle.

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