The novel application of an oxygen sensitive fluorescent indicator to investigate biodegradation processes at a plume fringe in porous media

WEI E. HUANG[1*] , DAVID N. LERNER[1], COLIN C. SMITH[1], CHUNMIAO ZHENG [2] AND SASCHA OSWALD [1]

[1]Groundwater Protection and Restoration Group, Department of Civil & Structural Engineering, University of Sheffield, United Kingdom

[2] Department of Geological Sciences, University of Alabama, AL, United States

* Corresponding author, E-mail: w.huang@sheffield.ac.uk

ABSTRACT: A novel combination of a non-invasive imaging method with an oxygen sensitive fluorescent indicator was developed to investigate the biodegradation processes occurring at the fringe of a solute plume. In conditions where the supply of electron acceptors is limited, biodegradation may be expected to be focused at the plume fringe and transverse dispersion will play a very important role. The method permitted investigation of the mixing process of dissolved oxygen with a plume in a two dimensional porous media at laboratory scale. A small transparent porous matrix (160 mm length, 130 mm width and 3 mm thickness) was made up of quartz plates and quartz sand (212-300 micrometers). Potassium acetate was used as a substrate and was continuously injected into the matrix to form a plume. Ruthenium (Π)-dichlorotris(1,10-phenanthroline) ($Ru(phen)_3$-Cl_2), a water soluble fluorescent dye which can be quenched by dissolved oxygen, was used as an indicator of dissolved oxygen concentration in the porous matrix. Under UV light (450 nm), $Ru(phen)_3^{2+}$ can be excited and emits fluorescence (590-600 nm). The intensity of the fluorescence is dependent on the ambient concentration of oxygen. The oxygen distribution within the matrix was interpreted from images recorded by a CCD camera. The laboratory experiments show that at the core of the plume, oxygen was exhausted at the fringe, it was supplied only by transverse mixing. Physical and biological parameters were evaluated by non-reactive transport and batch experiments. Based on these parameters, MT3D/RT3D successfully simulated oxygen distributions in a two-dimensional porous matrix. Experimental results suggest that in this study biodegradation follows a double Monod model rather than an instantaneous model. This method provides a novel approach to investigate details of behavior of solute transport and biodegradation in porous media.

Key words porous media; imaging, ultra violet light; fluorescent dye; transport; CCD camera; quenching, oxygen, double Monod, biodegradation, ruthenium complex

Ree Geochemistry Of Lignites In The Lincang Germanium Deposit, Western Yunnan Procince, China

HUAWEN QI AND RUIZHONG HU

Institute of geochemistry , C. A. S ., Guiyang 550002, P. R. China (qihuawen@sohu.com)

Introduction

The Lincang germanium deposit is located in Lincang county, western Yunnan Province. There are three coal-beraing cycles (N_{1b}^2 N_{1b}^4 and N_{1b}^6) in the basin. Germanium mainly occurs in the lignite of the first coal cycle (N_{1b}^2), which is close to the basement granites. REE geochemistry of lignites and its relation with germanium mineralization was discussed.

Results and discuss

Results indicate that Ge-rich lignites contain (3.862°´2522.906)×10^{-6} Ge °ΔREE varies from 5.070×10^{-6} to 148.225×10^{-6} while non-germanium lignites contain less than 0.781×10^{-6} Ge and °ΔREE varies from 32.186×10^{-6} to 46.803×10^{-6}. Both the Ge-rich ligintes and non-germanium lignites have distinct negative Eu anomaly and weak positive Ce anomaly. The American shale-normalized REE patterns of Non-germanium lignite and Ge-poor lignite are plain similar to the basemental granites. But Ge-rich lignites' NAS-normalized REE patterns are variable, HREE concentrated with the increasement of germanium. Their NAS-normalized REE patterns are similar to siliceous rocks which formed under hydrothermal environment.

Conclusion

The germanium content of non-germanium lignite is very low indicate that under ordinary sedimentary environment the abnormal enrichment of germanium in lignite is not controlled by the continental source materials or the coal-forming plants. The distribution of Ge-rich lignite is consistent with siliceous rocks siliceous rocks contain 78.374×10^{-6} germanium in average their REE and trace element compositional feature are similar suggest most germanium in lignite was mainly brought by hydrothermal water.

References

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