Development of an on-site measurement method for oil-contaminated soil core samples by nuclear magnetic resonance

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【Outline】

Non-destructive on-site measurement methods for contaminated soil cores are needed to quickly evaluate the degree of contamination. To meet this need, we applied proton nuclear magnetic resonance (NMR) relaxometry to oil-contaminated soil cores and successfully detected the contaminated core portions and quantified the heavy oil component in the cores.

【Details】

We measured the NMR transverse relaxation of soil core samples from an oil-contaminated site using a low-field NMR system (Fig. 1). The proton transverse relaxation time and initial signal amplitude were plotted for each sample (Fig. 2). Through calibration, the signal amplitude for clean and oil-contaminated samples can be converted into the water volume fraction and oil weight fraction, respectively. Data points for the oil-contaminated core portions are clearly distinguished from those for the clean portions (Fig. 2). This is a consequence of the simple and robust physics that the relaxation time of viscous heavy oil molecules is shorter than that of the less viscous water molecules.

Nakashima et al. (2011) Water Air & Soil Pollution, 214, 681-698.

This study was financially supported by the Ministry of the Environment, Government of Japan.

【Application of research results】

The system shown in Fig. 1 is portable, and this method is useful for the non-destructive, quick, on-site measurement of cores before the time-consuming, destructive measurements in laboratories far from the site.

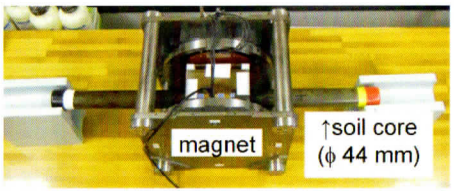

Fig. 1: NMR apparatus with a soil core. About 4 minutes were needed to measure each core portion.

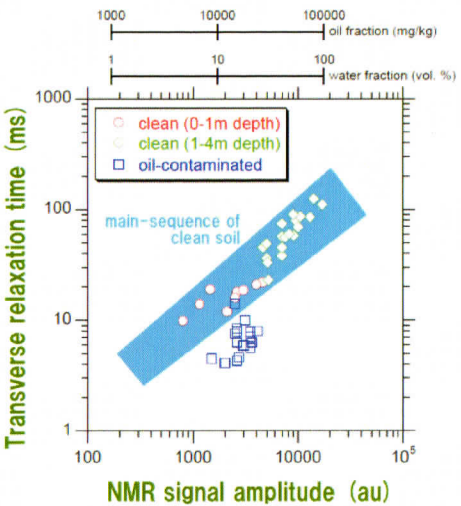

Fig. 2: Plot of 44 NMR data points. The clean sample data points are divided into two groups on the basis of the sampling depth.

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