Abstract: Remote detection techniques of accidental oil spills under ice are needed to support oil spill response in the Arctic. The various techniques tried so far have not been fully satisfactory. We present preliminary considerations of Earth’s field NMR (EFNMR) from the ice surface for this purpose.

At present, EFNMR from the surface of the Earth, Surface NMR, is used to detect significant volumes of water or organic pollutants at depths roughly comparable to the coil’s horizontal extent. In contrast, oil under fresh Arctic ice is expected to be only few cm thick at a depth of 1-2 m so that a horizontal extent of 5-10 m may have to be examined in order to have sufficient number of protons for NMR detection. Thus, a major component of this project is to perform EFNMR on a sample that is much thinner than its other two dimensions and located at an intermediate depth.

We designed a flat coil that has a uniformly sensitive region at a specific depth for this purpose. This coil is suitable for other shallow geophysical applications, as well.

Another requirement for this project is to suppress the signal from seawater that would otherwise dominate the signal. It is proposed to begin the NMR pulse sequence with an adiabatic fast passage inversion for as many of the protons around the volume of interest and then perform the intended NMR operation at the zero-crossing of the water protons at which point the longitudinal magnetization of the oil will have significantly recovered.

It is planned to identify the oil by its relaxation times that are shorter than those of water. Studies will be performed at Montana State University to characterize the relaxation time behavior of oil and water in crack structures of ice.

No full paper available.