# Noninvasive characterization of biogeochemical hotspots using induced polarization imaging

H. M. WAINWRIGHT[1*], A. FLORES-OROZCO[2], M. BÜCKER[23], B. DAFFLON[1], J. CHEN[1], S. S. HUBBARD[1] AND K. H. WILLIAMS[1]

[1]Lawrence Berkeley National Laboratory, 1 Cyclotron Road, Berkeley, CA, USA, hmwainwright@lbl.gov (*correspondance).

[2]Vienna University of Technology, Gusshausstrasse 27-29, E120-3, 1040-Vienna, Austria.

[3]Steinmann Institute, University of Bonn, Mechenheimer Allee 176, Bonn, Germany.

Naturally reduced zones (NRZs) have been found under many floodplains and are considered to be biogeochemical hotspots, distinguished by elevated organic matter content, reduced mineral precipitates, distinct microbial activities, and elevated contaminant concentrations (e.g. uranium) [1] [2]. Identifying the location of NRZs within floodplain sediments is challenging, since conventional wellbore data are spatially limited and the distribution of NRZs is often heterogeneous. In this study, we developed an innovative methodology for probabilistic mapping of NRZs using induced polarization (IP) imaging data and lithological logs. Measurements were collected at the Department of Energy (DOE) field site near Rifle, Colorado (USA). Inversion of surface time-domain-induced polarization (TDIP) measurements yielded 3D images of electrical resistivity and polarization properties of subsurface sediments [3]. Comparison of complex resistivity images to co-located wellbore data found NRZs to exhibit a distinct distribution of resistivity and polarization. To estimate the spatial distribution of NRZs, we developed a Bayesian hierarchical model to integrate TDIP and wellbore datasets in a probabilistic manner. Validation results showed the approach to be successful in delineating spatially heterogeneous interfaces and NRZs and thus provide a minimally invasive means for parameterizing a hydro-biogeochemical model at the dimensions of a floodplain (here 5-hectares). In the Rifle floodplain, the NRZs were primarily associated with fine-grained sediments and clustered primarily along the active river margin, suggesting both depositional and hydrological controls on the location of such biogeochemical hotspots.

[1] Campbell KM, et al. (2012) *Applied Geochemistry* **27**(**8**):1499-1511; [2] Qafoku NP et al. (2014) *Applied Geochemistry*, **42**, 77-85; [3] Flores Orozco A et al. (2011), *Journal of Geophysical Research* **116**, G03001.