USE AND APPLICATION OF Mn OXIDE IRIS SENSORS

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IRIS

Indicator of Reduction In Soils

PVC Tubes painted with an Fe oxide paint

Originally developed by Byron Jenkinson based on his PhD dissertation at Purdue


An extension of previous experimental pedology studies


Making and Applying IRIS Tubes


MC Rabenhorst - US Patent 7,550,297, 2009. Synthetic iron oxides and their use as an indicator of reduction in soils (IRIS). The present invention relates to improved IRIS Fe oxide paint compositions, to the dried (or cured) residue of such paints, and to devices upon which such paint compositions have been applied (IRIS devices) used to assess reducing conditions in soils.


87% of the observation were reduced with respect to Fe if 20% of the paint was removed in a 10 cm section. 100% were reduce if 30% was removed from a 10 cm section.

More work on Fe IRIS


IRIS and Porewater Sulfides

IRIS and Porewater Sulfides

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\begin{align*}
0 & \quad -2 \\
O_2 + 4H^+ + 4e^- & \rightarrow 2H_2O \\
+5 & \quad +3 \\
NO_3^- + 2H^+ + 2e^- & \rightarrow NO_2^- + H_2O \\
+4 & \\
MnO_2 + 4H^+ + 2e^- & \rightarrow Mn^{2+} + 2H_2O \\
+3 & \\
Fe(OH)_3 + 3H^+ + e^- & \rightarrow Fe^{2+} + 3H_2O \\
+6 & \quad -2 \\
SO_4^{2-} + 10H^+ + 8e^- & \rightarrow H_2S + 4H_2O \\
+4 & \quad +4 \\
CO_2 + 8H^+ + 8e^- & \rightarrow CH_4
\end{align*}
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Redox Potential Sequence
The Search for Mn IRIS Sensors


Birnessite reduces at essentially the same redox potential as nitrate making it a potentially great surrogate for denitrification.
Mesocosm experiment at room temperature

Every day for 7 days an Mn IRIS sensor (in this case a film instead of a tube) was removed from the saturated mesocosm.

At the same time we measured denitrification on Day 1, 2, and 3.

loading films
Use ImageJ software (free on-line from NIH).

Set to create a binary image

The software computes the depleted area>

In this case 76% of the saturated zone was removed and 50% of the capillary zone.
Denitrification rates increased over time: Day One: 0.61; Day Two: 3.48; and Day Three: 5.89 ug/kg/h.
Our next step is to see how the Mn IRIS sensors work in the field while measuring denitrification

Science Marches On!!