

Redox Probe QC Development

During the course of the T-Rex project, the method for continuously measuring the redox potential of the soil has been developed, and many pitfalls have been discovered and addressed.

By the end of the project, a robust QC (Quality Control) for the redox probe was developed to be used during the construction of the probe and the operation of it.

The following figure shows the timeline with the major implementations in the QC for the construction of the redox probe and use of the method:



Figure 1. Timeline of the most significant QC implementations for the correct measurement of the continuous redox potential in the soil.

The following aspects approached in the QC are listed below:

Construction of the probe

Pt purity

A certified Pt purity of 99.99% has to be used for the construction of the working electrode in the probe

Pt isolation

The cable connecting the Pt working electrode and the voltmeter cannot be in contact with the formation. This cable can be made of Al or Cu in its conducting part, and if groundwater ever touches it, the Al or Cu will be a part of the redox reactions measured by the Pt electrode, obtaining a very unstable reading and no valid voltage difference. The latest of the QC is to make totally sure that no groundwater can ever be in contact with the conducting material of the cable. In this way, the Pt is the only metal in the system Reference electrode-voltmeter-Pt working electrode that is in direct (galvanic) contact with the formation being measured.

Performing redox measurements

Before a survey

Calibration

A 225mV calibration solution is used to measure the potential between the Pt electrode and the reference electrode. Since this value is temperature dependent, both the temperature of the calibration solution and the reference electrode will be noted.

Reference electrode quality and fitness

A high quality reference electrode of the type with porous frit and not with a tissue salt bridge should be used. It should also give the possibility to change the electrolyte solution. The reference electrode is inspected visually and electrochemically (calibration) to check whether the 3M AgCl electrolyte solution must be changed.

Pt isolation

Same QC method as during the construction of the probe.

While measuring

Dual-redox

Two diametrically opposed Pt working electrodes are built in the probe to ensure that both give similar redox plots. In case the plots differ, a Pt isolation test after measuring, when back at the surface, will reveal whether there has been cable exposure, or whether the difference between the two plots is due to formation heterogeneity.

Soil temperature monitoring

Since the redox potential at the reference electrode is temperature dependent, a temperature probe is inserted in the soil next to the location of the reference electrode, in order to record any changes in temperature while drilling. This temperature monitoring has not shown to affect the redox readings.

Between points in a survey

Calibration

A 225mV calibration solution is used to measure the potential between the Pt electrode and the reference electrode. Since this value is temperature dependent, both the temperature of the calibration solution and the reference electrode will be noted.

Pt isolation

Same QC method as during the construction of the probe.

Pt electrode cleaning and inspection

Incrustations or depositions