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Volcanic Activity Application:

Using In-Situ Inc. MP TROLL 9000™ to Monitor Water Quality Parameters As An Indicator Of Potential Volcanic Unrest

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Project Overview

Water Quality parameters are continuously monitored by the USGS on Lower Separation Creek in the Three Sisters area of central Oregon. A major goal of this project is to obtain a continuous record of the anomalous Cl^- discharge from the area of crustal uplift, allowing an indication of volcanic activity. Chloride is released as a gas (HCl) from degassing magmas and it is anticipated to see an increase in Cl in springs and streams prior to an eruption. Specific parameters monitored include: water depth, pH, temperature, and conductivity.

The Separation Creek probe data is particularly valuable because it provides a full-time record of the Cl^- discharge from the area of uplift that can be compared to the results of continuous geophysical monitoring or to events such as the onset of seismicity. There are no regulatory requirements for this monitoring, although the USGS is tasked with monitoring volcanic unrest by whatever means it deems best.

Equipment / Procedure Overview

Equipment: Two MP TROLL 9000s (15psig, temperature, pH & conductivity), 25ft Quick-Connect cable and Communication cable were used as primary equipment. Additionally, a laptop computer, dye dilution equipment for gauging stream flow and a 6ft section of 2" PVC pipe for a stilling well were used.

Deployment: The 1st probe was deployed in lower Separation Creek inside a plastic pipe that serves as a stilling well and provides protection against damage from floating debris. The 2nd probe installed in a small tributary high in the Separation Creek drainage where a stilling well is not needed. Both probes are hidden and secured in place. The Quick-Connect cable is fastened securely above the high water mark. Sensors (pH and Conductivity) are calibrated at each visit to ensure accuracy of data. Hourly log data is downloaded weekly at the site via laptop.

Downloading Data at a Stilling Well

Details of test methodology

Continuous sensing probes have been in place in lower Separation Creek since 10 Apr 2002 and in a small tributary high in the drainage since 31 July 2002. Each probe stores an hourly log of water depth, pH, temperature, and conductivity. The first step in using this data is to remove the effect of temperature on conductivity by converting to specific conductance. The temperature coefficient of Separation Creek water was determined by laboratory heating experiments.

A major goal of this emplacement is to get a continuous record of the anomalous Cl^- discharge from the area of crustal uplift. To do this, depth must be converted to stream flow, and specific

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conductance to Cl^- concentration. Stream flow has been gauged on several occasions using dye-dilution techniques. These measurements provide a rating curve that allows the water depth determined by the probe to be converted into a discharge.

The decision to measure specific conductance instead of Cl^- was based on the relative stability of the two electrodes and the low levels of Cl^- in the stream. To convert specific conductance to Cl^-, there must be a unique relation between the two parameters over the entire range of stream flow. The linear correlation between the specific conductance as measured by the probe and Cl^- concentration in occasional water samples is encouraging, especially considering that bicarbonate is the main anion responsible for generating conductivity and that Cl^- and $HCO3^-$ are only weakly correlated in the anomalous springs in the drainage. Combining the Cl^--specific conductance relation with the stream rating curve allows the total continuous Cl^- discharge for the drainage to be calculated from the probe record.

Test results

The Separation Creek probe data is particularly valuable because it provides a full-time record of the Cl^- discharge from the area of uplift that can be compared to the results of continuous geophysical monitoring or to events such as the onset of seismicity.

The results from this deployment are ongoing and vary with the onset of volcanic activity. Higher Cl^- discharge from the area of uplift compared to the results of continuous geophysical monitoring in the area can pinpoint events such as the onset of seismicity.

How was the In-Situ equipment helpful in achieving the test objectives?

Small size, memory and ease of data retrieval allow consistent test result collection while remaining unobtrusive to those visiting the wilderness area.

More Information

Information contained in this application note was provided by Shaul Hurwitz, USGS, Menlo Park CA. He may be contacted at shaulh@usgs.gov
This does not constitute endorsement by the U.S. Geological Survey.

"The data collected by the two In-Situ probes in the Three Sisters area of central Oregon is vital to our monitoring volcanic unrest in this area."