CO VARIATIONS AT AN EASTERN KENTUCKY COAL FIRE

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Coal Fires occur in abandoned coal mines where the coal bed has not been properly shut off from the outside.

Small cracks and crevices can lead to deep fires in the coal bed releasing harmful chemicals, such as the carbon monoxide studied in this experiment, into the air and to nearby communities.
Background

Mark Engle, USGS
Truman Shepherd coal fire is located on the border of Floyd county and Knott county in Eastern Kentucky and was abandoned in the 1970’s

First spotted in 2009 with data taken in 2011 and 2012

Developed in old mine in Upper Elkhorn No. 3 coal

Office of Surface mining first used suppressant foam then attempted to dig back to fire
Starting on October 7th at 12:01 am. Temperature and carbon monoxide data was taken from inside a vent at the Truman Shepherd coal fire.

The goal was to secure appropriate data regarding the relationship between carbon monoxide emission from the vent, temperature, and the time of day.

Variations during the time of day were also closely observed.
Figure 1: Location Diagram (Hower)
Truman Shepherd Coal Fire

Figure 2: Vents (Hower)
Coal Fire Site

Aerial view of site.

Figure 3: Aerial Views (Hower)
PVC Pipe
Shurtape ® AF100 UL-listed foil tape.
3 Lascar EL-USB-TC temperature dataloggers with K-type thermocouples with a range up to 1300°C
Lascar EL-USB-CO datalogger
Dataloggers placed in PVC Pipe (Pre-programmed to begin data collection at 12:01 am on October 7th)

At the site a vent was carefully chose for the Dataloggers

PVC Pipe(with data loggers inside) inserted into vent and kept in place using nearby rocks
Procedure

- Dataloggers set to collect data for 22 days (begun on October 7th and lasting for a 22 day period)
On November 3rd, PVC Pipe and Dataloggers retrieved from site

Data taken back to CAER to be analyzed
Temperature

- Temperature stayed between 29 and 34 degrees Celsius, leaving a lack of variation.
- Previous studies have included ranges between 22 and 41 degrees of Celsius.
- The most significant variation was seen at Lotts Creek where a variation of 100 degrees Celsius within several hours (Hower et al., 2012).
CO emissions varied from 50 ppm on the first day to over 200 ppm the last day of the recording.

Figures 4 and 5 show the daily peaks seen in the CO during the data collection.

As shown in Figure 5, there are three distinct patterns in the data: 200-250 ppm, 140-220 ppm, and a small cluster 50-120 ppm.

Daily increases occur between the hours of 10am and between 8pm and midnight every night.

Similar patterns have been seen at Ruth Mullins and Lotts Creek Mines.
Figure 4: CO(ppm) vs Elapsed Time
CO (ppm) with Regression

CO 5-min avg (ppm) vs. cumulative time (min)
Figure 5: CO(ppm) v time of day

[Graph showing CO concentration over time with peaks and valleys indicating hourly data points]
Additional Research

What else needs to be done

- Longer duration data
  - A possible external battery

- Research other possible factors

- Water quality tests nearby
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Questions?