

# Unconventional Seismic Studies at a Coal Mine Fire Before and After Reclamation Efforts<sup>1</sup>

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**Abstract:** In the 1980s, the state of Colorado Division of Reclamation and Mine Safety developed the statewide Mine Fire Program to observe and evaluate ~36 actively burning underground coal mine fires in CO. Reclamation of these sites, in particular the South Canyon East coal seam fire site near Glenwood Springs, CO is a logistically difficult objective, as the burning coal seams are steeply dipping (~50°) beds along the Grand Hogback monocline. Temperature measurements from vents at the site range between ~100° and > 300° F at the surface, leading to potential for wildfires. We designed a monitoring program to evaluate risk in effort to prevent such hazards by continuously monitoring and evaluating these sites through new quantitative methods. Seismic approaches can be used in a wide variety of geotechnical applications, but the exact needs of any specific project or site require the adaptation and customization of multiple methodologies. With a bit of creativity, however, a diverse array of applications can be realized. Here we present an example of innovative use of seismic data in anthropogenic environments. In a pilot study, we deployed a passive seismometer overnight at this very active coal seam fire near Glenwood Springs, CO. In addition to migrating elk, the instrument recorded intermittent, repeating impulsive events and distinct, unfamiliar long-period signals. We hypothesize that these signals are spalling of roof material or propagation of roof-subsidence fractures and air intake or slow flexure of the roof material, respectively. To test these hypotheses and to assess the utility of passive seismic monitoring of abandoned coal mine fires, a small array of six instruments was deployed for a one-month background monitoring period and additionally recorded data during site reclamation efforts. We will discuss the monitoring results before any reclamation efforts took place and the seismic results during and after attempts to extinguish the subsurface coal seam fire.

**Additional Key Words:** seismic monitoring, site characterization, construction design inputs, geohazards, coalmine, abandoned mine.

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3. Work reported here was conducted near Glenwood Springs, CO; 39.533415N - 107.415357W.