MONITORING ACTIVITY AT AN SUBSURFACE COAL MINE FIRE USING PASSIVE AND ACTIVE SOURCE SEISMIC METHODS

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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. An initial program objective is the development of state of the art methodology for short and long-term monitoring, including rapid response capabilities. Tetra Tech Inc. has been contracted by the state to inventory and monitor each site and develop site-specific integrated methodologies for monitoring these active subsurface fires. For example, 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 (~50º) beds within the Mesa Verde group along the Grand Hogback monocline. Coal seams daylight along the exposed fold for miles, which led to this geologic structure historically becoming the most prolific coal mining region in the state. These coal seams were mined in the early 1900s by taking advantage of the approximate 50° dip by using vertical stopes and gravity to remove coal from the mine face. Temperature measurements from vents at the site range between ~100° and > 300° F at the surface, leading to potential for wildfires. Monitoring programs like this one aim to prevent such hazards by continuously evaluating these sites through new quantitative methods.

Tetra Tech developed a passive (ambient) and active-source seismic experiment to record over a month-long period. Three component and less-expensive vertical sensors were deployed with the seismograph stations to provide two data volumes for comparing post-processed data resolution and monitoring efficiency to develop future mine fire seismic monitoring instrumentation criteria with cost-benefit analysis in mind. A total of 12 stations were deployed in a distributed array in close proximity to the most active surface expression of the fire to record and locate seismicity emitted from the burning mine fire, and to image and map the expanding rubble zone the fire creates in the overburden with an active source survey. Data were collected near the most active surface expression of the fire, which is thought to be the most rapidly changing area within the site.

Results from this experiment will be presented as a function of seismicity over time and will be analyzed to determine if passive/active seismic monitoring is an effective tool for protecting forestlands, citizens, and infrastructure from mine fire hazards in the future