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Delineation of a Coal Burn Edge with Seismic Refraction

Karen D. Sontag

Paul J. Wolfe

Wright State University - Main Campus, paul.wolfe@wright.edu

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coal seam structure or the formation velocities. The ambiguity in interpretation might be resolved if multiple receiver locations were available.

Tomographic Interpretation of Crosshole Data C1.5

Sven Ivansson, National Defence Research Institute, Sweden

As a first step in the analysis of registrations from a crosshole experiment, it is suitable to use a tomographic approach for estimation of seismic P velocities. The crosshole area is thereby divided into a number of rectangular cells, in each of which the P velocity is assumed constant. The raypaths, one for each shot/receiver pair, are assumed to be straight (see, however, below). It is now possible to write a system of equations for estimation of the unknown cell velocities. From the registrations only measured first-arrival traveltimes are used. Having noted some drawbacks with an earlier proposed iterative algorithm we used least-squares theory for the solution.

It is, however, important to realize that different sources of error get into action in the above process. First of all, errors are present in the measured traveltimes. These give rise to so called statistical errors in the velocity estimates but their impact is quite easily assessed using standard statistical theory. Closely linked to this is the question of uniqueness of the estimates; it may happen that unbiased estimators of some cell velocities do not exist. Another cause of error is the assumption of straight raypaths. (According to Fermat's principle the raypaths will in fact be curved.) By synthetic examples it is shown that severe distortions due to this assumption can occur. Methods to "turn the picture right" are discussed.

As an example, actual field data from the Kråkemåla experiment conducted in late 1981 in southern Sweden are used in the discussion.

Seismic Crosshole Techniques for Mapping Ore Bodies C1.6

Matts Gustavsson, Hans Israelson, Sven Ivansson, Per Morén, and Jörgen Pihl, National Defence Research Institute, Sweden

Seismic techniques have so far been only sparsely employed by the mining industry for ore prospecting. There is a growing interest in geophysical techniques for ore prospecting which allow depth penetration of 1 km or more. The known bodies usually dip, however, very steeply and for direct mapping the standard seismic reflection method probably should be modified substantially. This paper presents an application of the seismic crosshole method which is well suited for mapping steeply dipping structures, provided suitable boreholes or galleries are available.

The application here describes an attempt to detect a steeply dipping magnetite ore at the Research mine in Kiruna, Sweden. Geophone recordings of some 50 microexplosions in slim boreholes were collected with recording distances up to 165 m. A tomographic mapping of the P velocity across an area of 50×165 m, intersecting with the magnetite layer, shows good agreement with geological and geophysical observations in the galleries of the mine as well as E -module determination of drilled core samples.

Delineation of a Coal Burn Edge with Seismic Refraction C1.7

Karen D. Sontag and Paul J. Wolfe, Wright State University

Coal seams in many areas of western United States have ignited and burned for considerable distances underground. Burning reduces the coal reserves and alters the overburden to highly fractured clinker. The boundary between the coal and the clinker needs to be defined for determination of reserves and for planning seismic petroleum exploration in these areas.

A seismic refraction method was tested that may possess advantages over previous techniques for locating the burned zone edge. Field tests were conducted at Kerr-McGee Coal Corp.'s open pit Clovis Point mine near Gillette, Wyoming. Explosive sources were detonated in shot holes in the pit floor. Geophone lines were laid on the surface beyond the edge of the pit. The lines crossed from an area of known coal to an area of clinker.

Delays in arrival times were found to correlate with the expected beginning of the clinker zone. Waves passing through the clinker also exhibit a significant attenuation. A magnetic survey conducted along the seismic lines showed anomalies in the regions where seismic data indicated the burn edge. On the basis of these results, this technique shows potential for locating burn edges where other methods do not work well and where it may be less expensive than extensive drilling.

Some Problems Concerning the Inversion of Observed In-Seam Seismic Dispersive Data C1.8

Th. Krey, consultant to Prakla-Seismos, West Germany

In the last few years, in-seam seismics resulted in an improved extraction of dispersion curves from observed data. These dispersion curves can either be inverted to obtain information on the distribution of coal and rock in the direction normal to the seam or to obtain information on the variation of seam thickness along the raypath. Both kinds of inversion may contribute to a more effective evaluation of transmission surveys.