Quarterly Journal of Engineering Geology, 27, 7–14. 0481-2085/94 $07.00 © 1994 The Geological Society

Three-dimensional ground movements in the vicinity of a mining activated geological fault

K. A. S. Phillips & E. G. Hellewell

2 New Road, Grovesend, Swansea SA4 4WE, UK

Abstract

This paper investigates the circumstances and conditions that lead to the activation of a particular geological fault when longwall panel extraction occurs in the vicinity.

Three-dimensional ground movements were observed at survey stations located across a fault as these were being influenced by active mining. The development of ground movements is defined by recording the subsidence, strain and horizontal displacements of the survey stations. The measured ground movements are compared to the predicted *Subsidence Engineer's Handbook* and in-house Subsidence Prediction Program subsidence and strain profiles, and the visual damage evident along the testline. Conclusions are drawn which suggest that surface geology heavily influences the location and magnitude of sustained surface damage.

Introduction

Lee (1966) and Hellewell (1988) have highlighted the need for further research into abnormal subsidence behaviour, especially the influence of geological faults on the subsidence profile. It was considered necessary to develop a database to determine the conditions which lead to fault activation through the examination of specific cases.

Field observations

In conjunction with the British Coal Corporation, a testline was established in the Derbyshire Coalfield to monitor three-dimensional ground displacements in the vicinity of a geological fault when influenced by active mining. Twenty 1-metre long Fenomarker stations (lettered A to T) were installed in a highway grass verge, in order that any subsequent highway repairs would not interfere with the stations. The station density increased from approximately 30 metres intervals at the extremities of the testline to 5 metres in the suspected region of the fault. Three-dimensional displacements were measured using a Wild T2000/D15/GRE3 Total Station. Error analysis indicates the three-dimensional coordinates of each of the stations could be determined to within ± 3.1 mm.

Station A was considered the base station and was assumed to be located in stable ground outside the zone of influence of the mining. A series of reference object sightings was established from the base station, thus allowing fixed reference bearing to be obtained. The surveys commenced in August 1987 and continued at approximately monthly intervals until the face ceased production in December 1988. A number of subsequent surveys were conducted at less frequent intervals to monitor any residual movements.

Previous mining

Six coal seams had been extracted in the vicinity of the fault, with the earliest recorded mining activity occurring around 1832. No evidence of any fault movement was recorded before the 1950s. This may be explained by the limited records prior to this date, combined with the agricultural use at the surface, making fault movement difficult to detect. In 1985, workings in the vicinity caused the fault to be activated, resulting in a significant step feature in the highway. Road repairs and erosional agencies effectively concealed this damage, which is thought to have been located between stations M and N.

Current mining

The panel under investigation worked a 2.2 metre thick coal seam at a depth of approximately 405 metres, which dips about 11° towards the east. The depth of cover decreased as the face advanced. The panel proceeded in a northwesterly direction and worked parallel to and below the previously activated fault, which lies to the northeast, as illustrated in Fig. 1.

The geological fault and geology

The testline is underlain by approximately 1 metre of unconsolidated deposits, which rest upon sandstone of