

715 HORIZON DRIVE  
SUITE 340  
GRAND JUNCTION, CO 81506  
USA  
VOICE 970.242.4220  
www.agapito.com

CHICAGO OFFICE  
630.792.1520

GOLDEN OFFICE  
303.271.3750

April 18, 2007

226-20

Mr. Laine Adair  
General Manager  
UtahAmerican Energy, Inc.  
794 North C Canyon Road  
Price, UT 84501

Re: **GENWAL Crandall Canyon Mine Main West South Barrier Mining  
Evaluation**

Dear Laine,

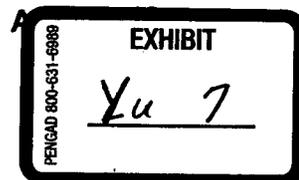
Agapito Associates, Inc. (AAI) has completed the geotechnical analysis of GENWAL Resources, Inc.'s (GENWAL) plan for room-and-pillar mining in the Crandall Canyon Mine Main West south barrier. AAI recommended the use of pillars on 80-ft by 92-ft<sup>1</sup> centers for retreat mining in both the north and south Main West barriers based on an earlier analysis documented in our July 20, 2007, report.<sup>2</sup> The design proved successful on development in the north barrier panel under maximum cover reaching 2,200 ft deep.

The panel was successfully retreated to crosscut (XC) 138 under approximately 2,100 ft of cover when poor roof conditions motivated moving the face outby and skipping pulling pillars between XCs 135 and 138. The retreat was re-initiated by pulling the two pillars between XCs 134 and 135 in early March 2007. A large bump occurred at this point resulting in heavy damage to the entries located between XCs 133 and 139. The remaining north panel was abandoned in favor of mining the south barrier.

AAI engineers Michael Hardy and Leo Gilbride visited the bump location on March 16, 2007, under the escort of Mr. Gary Peacock, GENWAL Mine Manager and Mr. Laine Adair, General Manager, UtahAmerican Energy, Inc. GENWAL commissioned AAI to refine the pillar design for the south barrier based on the response of the north panel pillars. AAI was able to analyze the stress and convergence conditions at the time of the bump and modify the pillar design accordingly to control the potential for similar events in the south barrier. The results of the analysis and recommendations for south barrier mining are summarized in the following letter.

<sup>1</sup> Pillar geometry stated in terms of center dimensions; entries typically mined 17 ft wide.

<sup>2</sup> Agapito Associates, Inc. (2006), "DRAFT—GENWAL Crandall Canyon Mine Main West Barrier Pillar Mining Evaluation," prepared for Andalex Resources, Inc.



## ANALYSIS

Ground conditions were simulated using the calibrated NIOSH LAMODEL<sup>3</sup> displacement discontinuity model used in the preceding study.<sup>2</sup> The complete model area is illustrated in Figure 1. Simulated conditions at the time of the bump are shown in Figures 2, 3, and 4. Figure 2 describes the vertical stress distribution in the pillars leading up to the bump. Figures 3 and 4 show the corresponding degrees of coal yielding and roof-to-floor convergence. The figures incidentally show retreat mining in the south barrier, although this did not exist at the time of the bump. The two retreats were simulated in the same model for convenience, which is possible because the two areas are geomechanically isolated from one another in the model.

At the time of the bump, the cave was reported to be lagging inby XC 138. Also, the new start-up cave was minimally developed above the two pillars pulled between XCs 134 and 135. These lagging caves were simulated in the model by limiting load transfer through the gob, which causes higher abutment loads to be transmitted to surrounding pillars. The lagging caves can be recognized in Figure 1 by the white colored gob areas.

Model results show that high stresses were placed on the pillars from three contributing sources: (1) abutment loads from the main cave (inby XC 138), (2) abutment loads from the start-up cave (between XCs 134 and 135), and, to a lesser extent, (3) abutment loads from longwall Panel 12. Peak stresses were concentrated on the pillars located between the two caves (between XCs 135 and 138). Figure 3 shows significant yielding in these pillars indicative of overloading. Modeling suggests that the start-up cave contributed on the order of 5,000 psi additional stress to some parts of the surrounding pillars. This, coupled with the other abutment loads, is believed to have created a high stress region that allowed a localized bump in the pillars somewhere between XCs 134 and 135 to propagate to pillars over a much wider area.

Figures 2, 3, and 4 show stress, yielding, and convergence levels in the same sized pillars (80-ft by 92-ft<sup>1</sup>) in the south barrier for ordinary retreat conditions, where no pillars are skipped. The figures show that high-stress conditions attenuate quickly away from the face and that protected conditions exist as close as one crosscut outby the face.

Figures 5, 6, and 7 illustrate the benefit of increasing pillar size from 80-ft by 92-ft<sup>1</sup> to 80-ft by 129-ft<sup>1</sup>. The added 37 ft length, approximately equivalent to an extra full cut, increases the size and strength of the pillars' confined cores, which helps to isolate bumps to the face and reduce the risk of larger bumps overrunning crews in outby locations. For conservatism, a lagging cave was also assumed in the south panel. Plans are to slab the south barrier to a depth of about 40 ft. The wider span is expected to improve caving conditions compared to the north panel and reduced concentrated loads at the face.

The south barrier will be mined to about 97 ft wide (rib-to-rib) after slabbing. The slabbed barrier will be subject to side abutment loads from gob on both sides, resulting in elevated stress levels through the core. Model results indicate that the barrier will yield to a

---

<sup>3</sup> Heasley, K.A. (1998), *Numerical Modeling of Coal Mines with a Laminated Displacement-Discontinuity Code*, Ph.D. Thesis, Colorado School of Mines, 187 p.

Mr. Laine Adair

April 18, 2007

Page 3

depth of about 20 ft along the ribs, but that the core will remain competent. This is likely to result in some bumping in the gob, but is not considered to pose unusual risk to crews working at the face.

## RECOMMENDATIONS

Based on the evidence from the Main West north barrier retreat and results of numerical modeling, we recommend mining with 80-ft by 129-ft<sup>1</sup> pillars, or similar, in the south barrier. This size of pillar is expected to provide a reliable level of protection against problematic bumping for retreat mining under cover reaching 2,200 ft. Pillars should be robbed as completely as is safe to promote good caving. Slabbing the south-side barrier is expected to benefit caving. Skipping pillars should be avoided in the south barrier, particularly under the deepest cover.

Please contact me to discuss these results, at your convenience, or if you have any questions.

Sincerely,

**Signature**

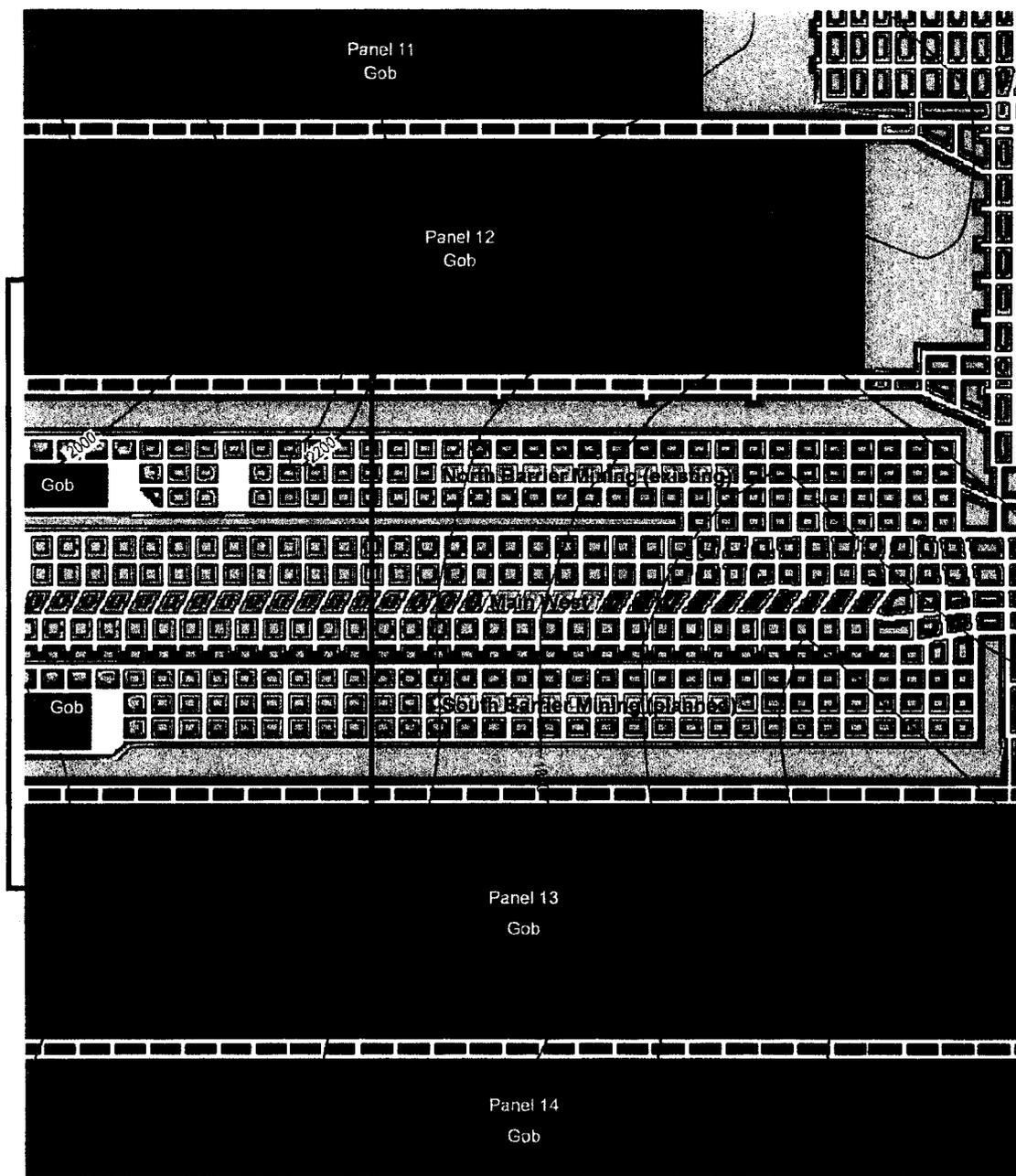
Leo Gilbride

Principal

[gilbride@agapito.com](mailto:gilbride@agapito.com)

LG/smvf:klg

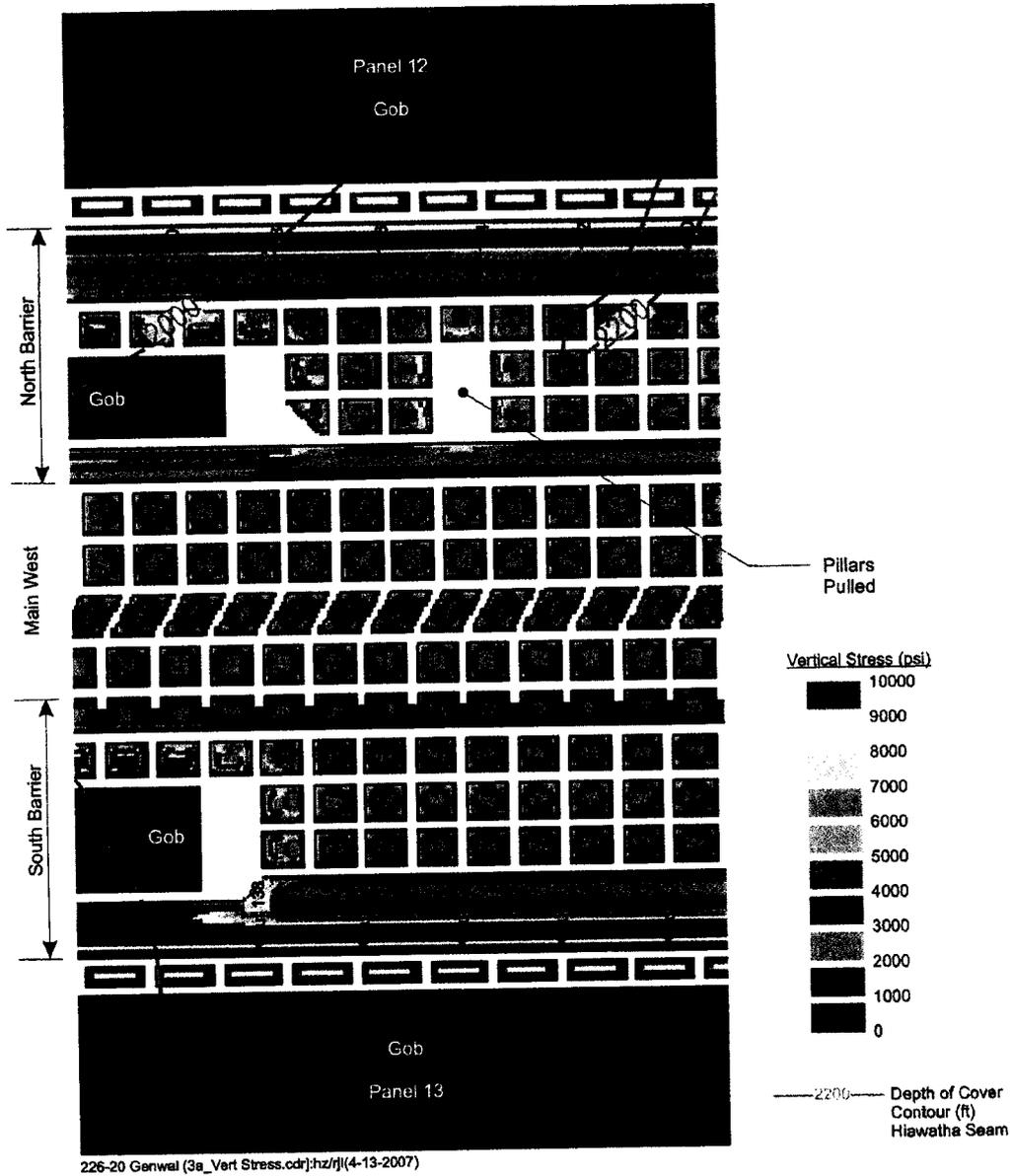
Attachments(7): Figures 1-7



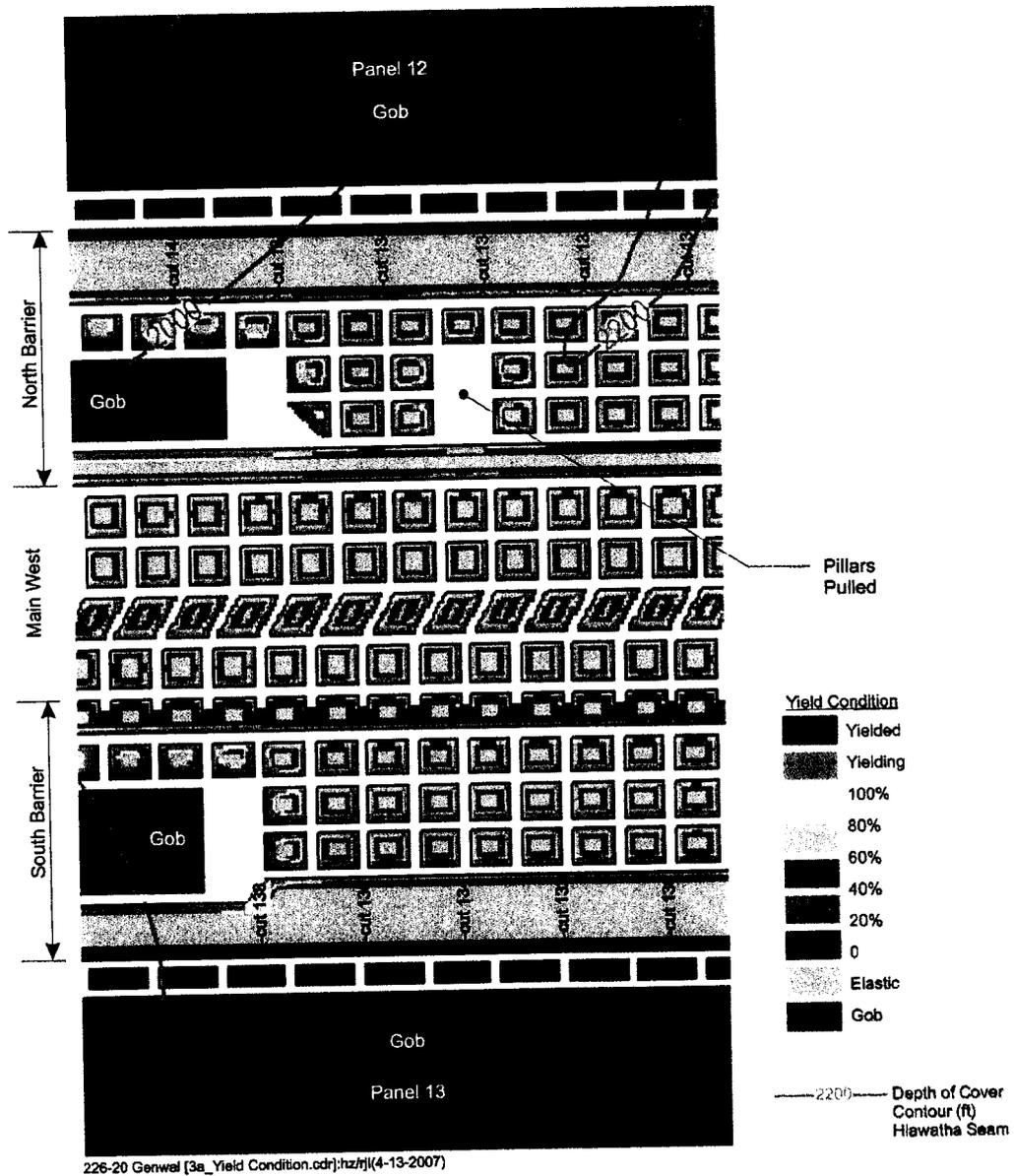
226-20 Genwal [3a\_Yield Condition\_Overallw Detail];h:zrj(4-13-2007)

-----2200----- Depth of Cover Contour (ft)  
Hiawatha Seam

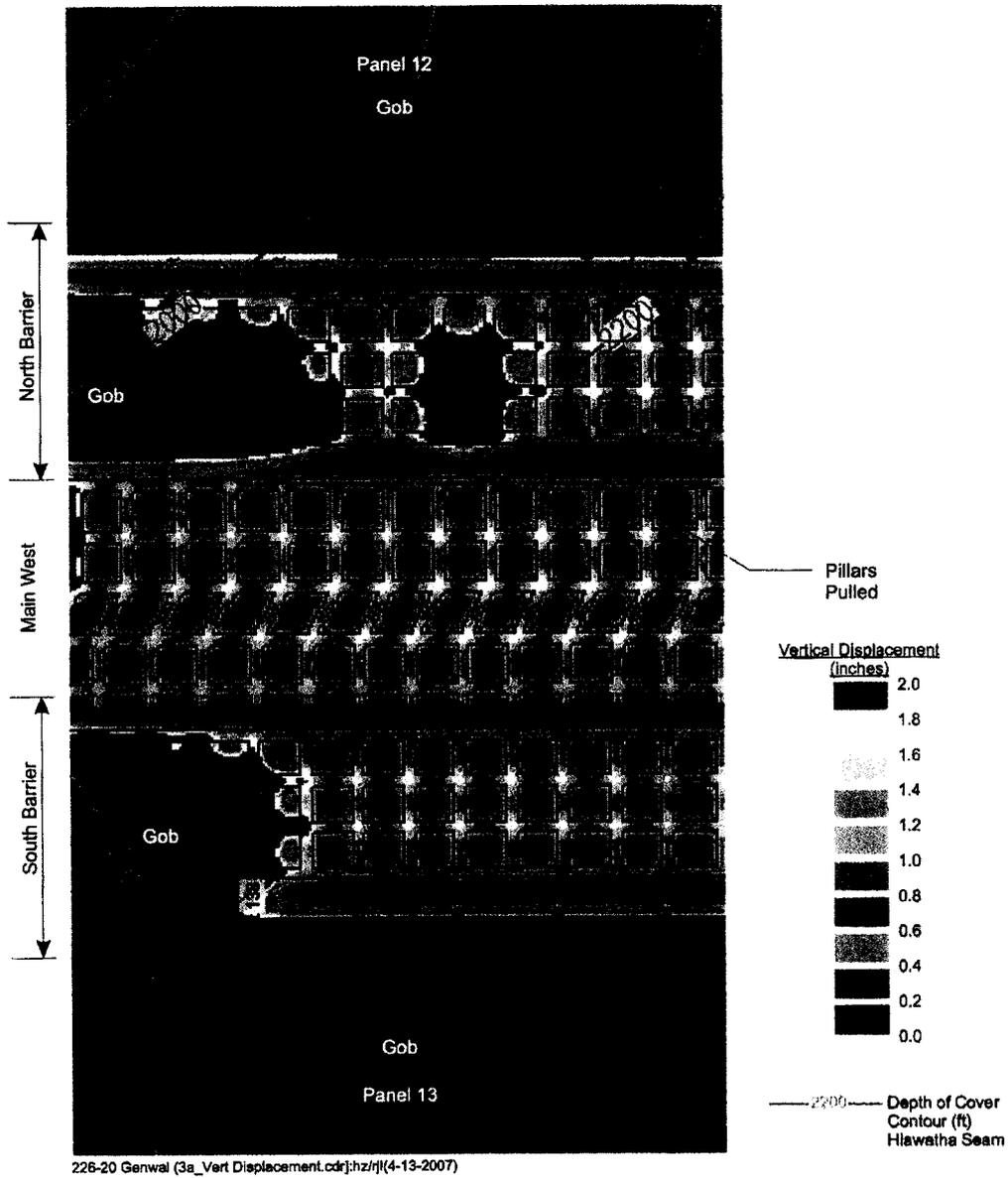
Figure 1. Geometry of LAMODEL Model



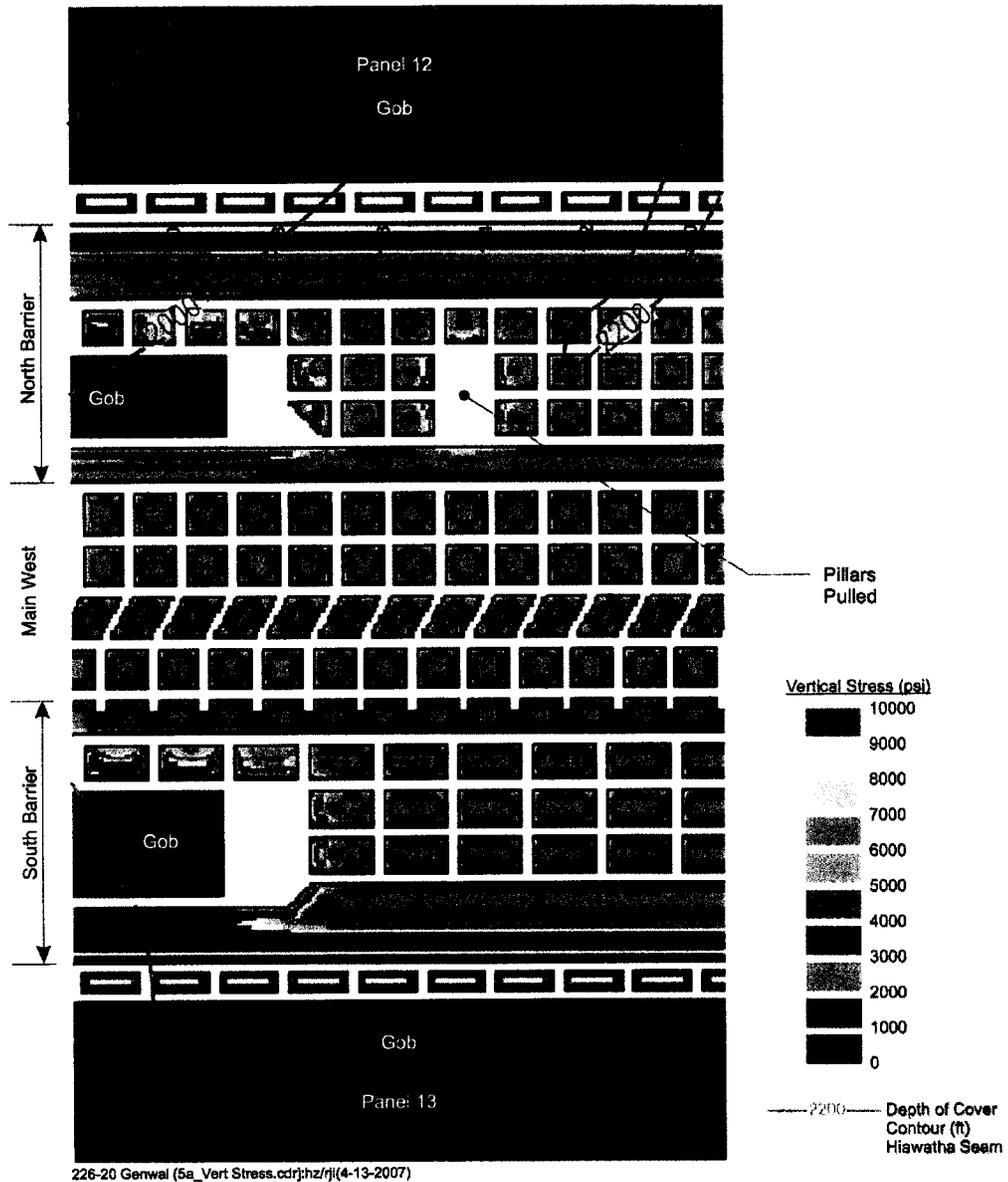
**Figure 2. Modeled Vertical Stress—Existing Mining in the North Barrier and Optional Mining with 80-ft by 92-ft Pillars in the South Barrier**



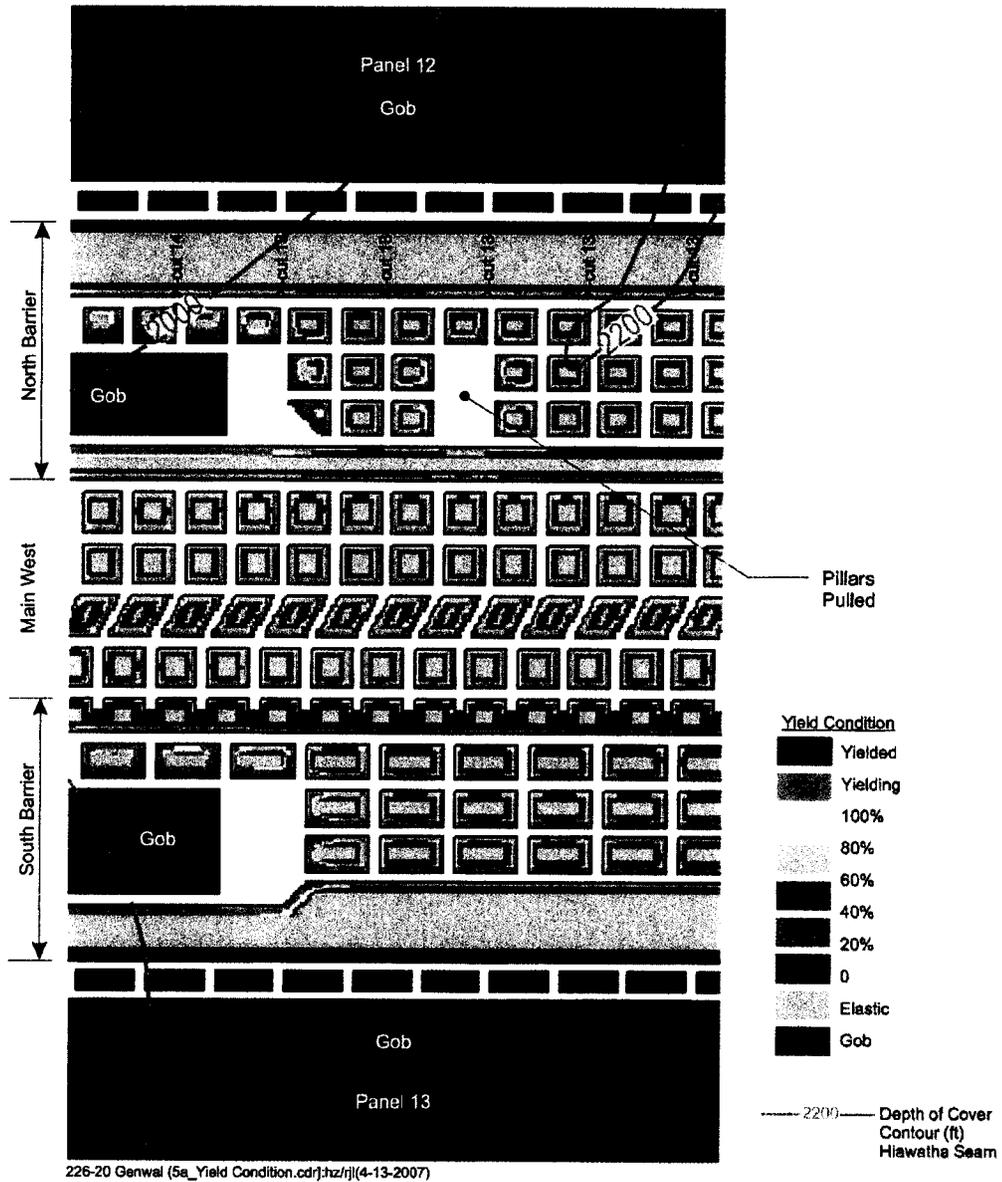
**Figure 3. Modeled Coal Yielding—Existing Mining in the North Barrier and Optional Mining with 80-ft by 92-ft Pillars in the South Barrier**



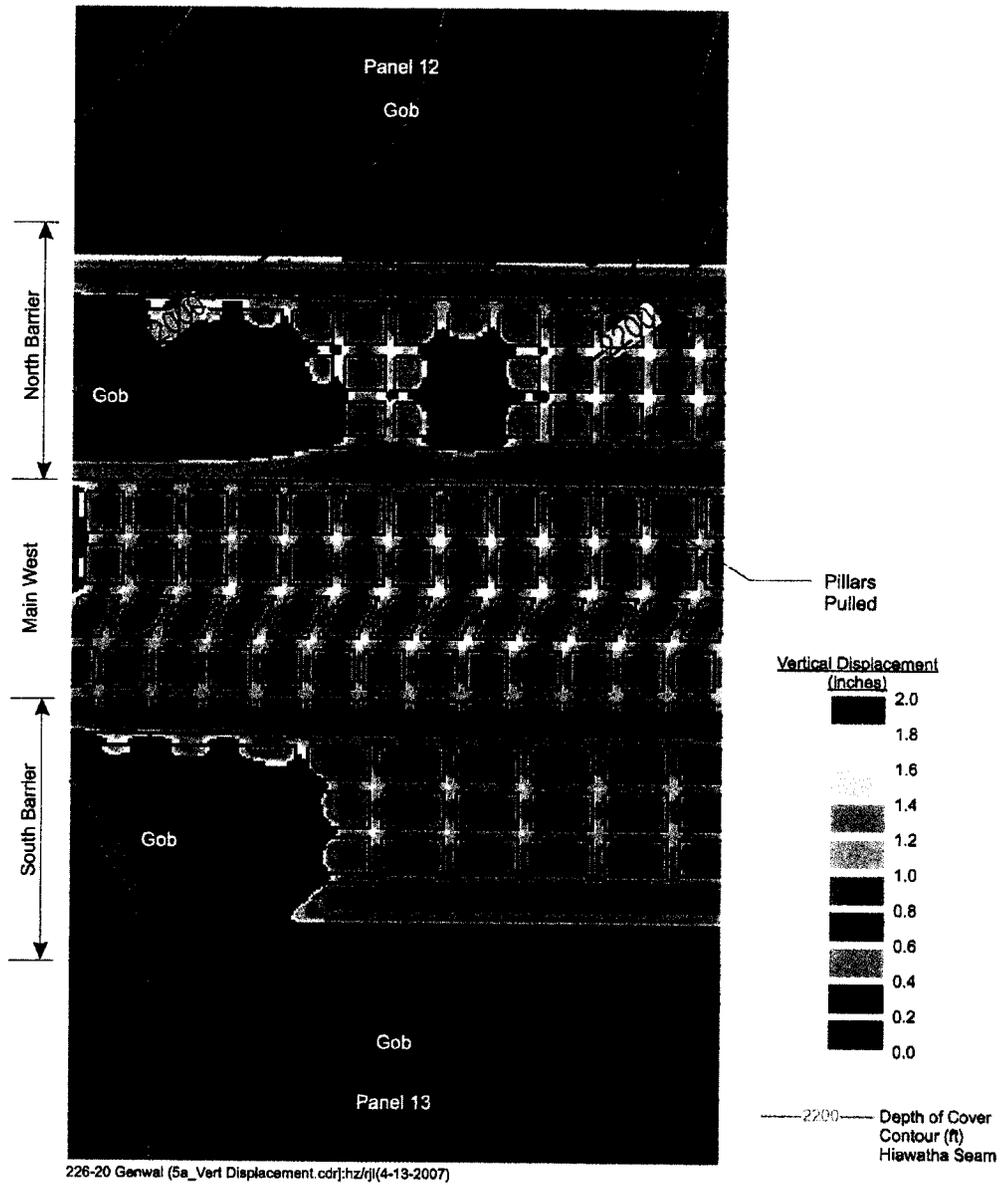
**Figure 4. Modeled Roof-to-Floor Convergence—Existing Mining in the North Barrier and Optional Mining with 80-ft by 92-ft Pillars in the South Barrier**



**Figure 5. Modeled Vertical Stress—Existing Mining in the North Barrier and Optional Mining with 80-ft by 129-ft Pillars in the South Barrier**



**Figure 6. Modeled Coal Yielding—Existing Mining in the North Barrier and Optional Mining with 80-ft by 129-ft Pillars in the South Barrier**



**Figure 7. Modeled Roof-to-Floor Convergence—Existing Mining in the North Barrier and Optional Mining with 80-ft by 129-ft Pillars in the South Barrier**