ABSTRACT

Mining-induced surface subsidence is the earth's response to a change in structural equilibrium in its geologic setting. Flooding of salt mines causes another equilibrium change because, after flooding, fluid pressures within the mine act on all surfaces of the mine rooms. Dissolution (if the mine is flooded with raw water) also changes the dimensions of the pillars which emulates another episode of mining. Consequently, flooding a salt mine changes the surface-subsidence rates, both in the short term while the mine is flooding and in the long term when the abandoned mine and shafts are filled with brine.

A method is presented for estimating the effects of flooding on subsidence rates. Estimated reductions in subsidence rates are compared to actual reductions in subsidence rates after the flooding of the Jefferson Island, Belle Isle, Weeks Island, and Retsof salt mines. Surface-subsidence measurements made after the flooding indicate that the rates have stabilized within the range estimated by the described method.

INTRODUCTION

In wide underground mines, the pillars within the mined areas bear most of the weight of the overlying material, necessitating that the vertical stress in the pillars is larger than the initial premining magnitude. An increase in vertical stress within pillars is accompanied by elastic shortening of the pillars. If the overlying materials are competent (do not collapse or flow into the openings) and the pillars do not creep, this elastic shortening would be the maximum total subsidence on the surface and it would occur very soon after mining.

In a rock salt mine, however, pillars creep and continually become shorter (and wider). This underground shortening of the pillars is reflected as an ongoing surface subsidence even long after mining is suspended. Additionally, the roof and floor salt may also creep (expand) into the room; however, for mines in salt domes, this is a much smaller contributor to the surface subsidence than the pillar shortening. As described in detail in the next section, the creep rate for pillars depends on its stress state, so changes in the stress state within pillars (e.g., by flooding) cause changes in the pillar-shortening rate and the associated surface-subsidence rate.

RELATIONSHIP BETWEEN SURFACE-SUBSIDENCE RATE AND UNDERGROUND MINE PILLARS

A simplifying assumption in this paper is that surface subsidence is directly and totally a consequence of the superposition of pillar shortening. This is a conservative assumption for two reasons. First, any creep law developed based on the assumption using measured subsidence information will predict pillar creep rates that are *higher* than actual. Therefore, predictions of future subsidence rates will also be higher than might occur. Second, if the roof and floor are expanding into the room (and only a portion of the surface subsidence is attributable to pillar