

# **KANSAS GEOLOGICAL SURVEY OPEN-FILE REPORT 73-3**

REPORT ON THE MINE-SHAFT CAVE-IN, KANAPOLIS, KANSAS

by

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# Report on the Mine-Shaft Cave-in, Kanapolis, Kansas

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The site of a mine-shaft cave-in on the east edge of Kanapolis, Kansas, was visited on March 18, and 28, 1972, to determine the possible conditions and extent of the collapse. Discussions of the conditions and events existing prior to our observations were made with Mr. Howard Lucus, mine inspector with the U.S. Bureau of Mines, Mr. Norman W. Biegler, geologist with the Kansas State Board of Health, and Mr. W. Holms, plant superintendent with Acme Brick Co., the owner of the property where the cave-in occurred.

Original depth of the main operating shaft (shaft #1) was 790 feet with an estimated shaft size of 9 x 17 feet. An average thickness of approximately nine feet of salt was worked in the mine, with a maximum of 11 feet reported in several locations. The mine was operated for a number of years by the Crystal Salt Company, but was sold to the Morton Salt Company in 1941. In 1947, operations in the mine were terminated because of failing cribbing at about the 126 foot level and in 1949 the main shaft (shaft #1) and the air shaft (shaft #2) were plugged. According to reports, only the upper 126 feet of the main shaft was plugged. Apparently a large piece or pieces of concrete that were shoved into the opening <sup>y</sup> lodged in the shaft in the area of the failed cribbing at 126 feet. The hole was subsequently backfilled from that point to the surface.

Aquifers at 28 and 143 feet below the ground surface contributed water to the original shaft. A sandstone aquifer (probably at the contact between the Cretaceous Kiowa Formation and the underlying Permian shales) at the 143 feet depth was estimated to contribute 2000 gallons per day to the shaft. A flow of 25 to 30 gallons per minute entered the shaft from the Pleistocene terrace

deposits (Grand Island Formation) at approximately the 28 foot level.

Water entering the shaft during mining operations was caught in collecting rings placed at several locations in the shaft, the lowest of which was 320 feet below the ground surface.

Based on the figures of 25 gallons per minute for 3 years (from the time the mine ceased operation in 1947 until the upper aquifer was shut off by plugging the <sup>shaft</sup> ~~exit~~ in 1949) and 2000 gallons per day for 25 years (1947-1972) from the Kiowa Formation, the amount of water in the mine would be approximately 8 million cubic feet.

On January 12, 1972, the fill material in the shaft fell to the bottom of the shaft. (The plug and some of the fill material may have fallen to the shaft bottom in November, 1971.) Mr. Holms lowered a long string with a brick tied to it down the shaft opening. The string slackened at approximately 700 feet. This probably indicated the top of the fill at that time. Pieces of brick dropped in the opening indicated a long distance to the water level in the shaft at that time.

Material around the shaft started slumping into the shaft opening and continued to enlarge to a size of 129 feet (in north-south direction) and 95 feet (in east-west direction) (measured 3-29-72). Based on 18 soundings the top of the material in the opening is approximately 60 feet below ground level. It is believed that the depth to the level where outward collapse from the original shaft size occurred is approximately 150 feet. Based on the present sizes of the collapse area it is estimated that approximately 400 to 500 thousand cubic feet of material caved into the shaft.

Size of the shaft opening would accommodate approximately 110 thousand cubic feet of material from the bottom of the shaft to the level 60 feet below ground level. This would mean that approximately 300 to 400 thousand cubic feet (11 to 14 thousand yards) of material was transported into the mine.

A 1941 map of the Crystal Mine and the connecting Royal Mine to the north was obtained from the U.S. Bureau of Mines who had previously obtained the old mine map from the Morton Salt Company. The map shows mining by the room-and-pillar method, <sup>with</sup> a ~~slat~~ removal ratio of between 70 and 75 percent. Based on the 70 percent salt removed figure it is estimated that there are 6.3 million square feet of mined area in the two mines. Assuming a 10 foot ceiling <sup>h</sup> height, the volume of the mine would be approximately 63 million cubic feet. We estimate from this that the water level in the mine is less than 1.5 feet deep as the calculated amount of water entering the mine was about 8 million cubic feet.

Allowing for substantial error in the amount of water entering the mine, the mine should not be filled with water.

#### Analysis

It appears that collapse of fill material and rock and soil surrounding the mine shaft occurred due to the original improper filling of the main shaft to the Crystal Mine. After 22 to 23 years time the timbers supporting the large concrete block at about 126 feet below the top of the shaft apparently <sup>a</sup> gave away, allowing the block and the overlying fill material to fall to the bottom of the shaft opening in November. The resulting shock that occurred

when the material hit the bottom of the shaft resulted in the "sonic boom" effect felt by some citizens in Kan<sup>o</sup>polis. Had the mine and shaft been filled with water as reported by the Bureau of Mines, water would necessarily have gushed out at the surface. This did not occur. Further, has there been water in the shaft, the hydraulic piston effect would have somewhat buffered the shock of the falling material.

The remainder of the material originally used to fill the shaft finally fell to the bottom on January 12, 1972. Subsequent slumping of the material occurred that resulted in a large opening, and after approximately 300 thousand cubic feet of material had entered the mine itself the mine opening bridged off and no more material entered the mine, and then the shaft filled with the slumping material.

Shortly after the major slumping occurred near the surface, the shaft started to fill with water as determined by numerous observations of the crater following the opening of the shaft. Apparently the slumped material sealed off the openings at the mine level sufficiently so that water started accumulating in the shaft and continued to rise until the local water table in the area was reached. The water table in late March was approximately 23 feet below the ground surface.

Depth to the collapse material in the shaft is approximately 60 feet as determined by soundings. If no additional washing of material into the underground mined areas occurs, the surface crater at the old shaft should not enlarge in diameter more than perhaps 50 additional feet. At the present time the caving of the sidewalks appears to be stabilized.

#### Conclusions and Recommendations

1. Unless there is subsequent washing of material into the underground mine openings that would result in further subsidence in the shaft, the area

should be reasonably stable.

2. Slumping along the walls could result in enlargement of the hole up to 50 additional feet in diameter.

3. Filling of the present surface depression will require approximately 400 to 500 thousand cubic feet (15 to 19 thousand yards) (Wilson, April 5, 1972, says 24,000<sup>cube yards</sup>) of material.

4. Less than two feet of water is probably present in the mine. However, there has been no direct confirmation of this. The collapse material probably has partially sealed the shaft so that only very small amounts of water are being contributed to the mine from the shaft.

5. The area of the interconnected Crystal and Royal Mines is approximately nine million square feet, with approximately 25 to 30 percent of the area comprising the mine pillars. Future work might include theoretical studies of the rock mechanics of the pillars to determine if possible collapse or flowage of the salt might occur. Because part of the town of Kanapolis is located over portions of the two mines, such a study might predict potentially hazardous conditions in the town.