

# QUARTERLY REVIEW

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## Anatomy Of A Cave-In<sup>1</sup>

by RICHARD VAN HORN

U. S. Geological Survey, Denver, Colo.  
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In October 1966, a plumber kneeling at the bottom of an 11-foot deep trench in northeastern Salt Lake City, Utah, was suddenly buried by 3 feet of muddy wet soil.

The probable causes of this terrifying accident are related to man's disruption of the natural arrangement of the geologic strata.

Although it is not possible to construct buildings without disrupting the natural

arrangement, certain clues can point out dangerous situations so that suitable safety precautions can be taken.

During the course of mapping the geology of Salt Lake City, I have noticed at several places disruptions similar to the one at the cave-in site. The purpose of this study was to determine what went wrong at the cave-in site and see if any clues could be found that might be used to provide warning of potentially dangerous conditions at other excavations.

The day after the near-fatal cave-in, I made a brief examination of the site and talked to the men who had rescued the trapped plumber.

Prior to construction activity, the soils at the cave-in locality consisted of a thin covering of clayey to bouldery silt. This material had been washed out of the nearby mountain canyons by streams and deposited on high ancient Lake Bonneville shoreline sediments consisting of silt, sand, and gravel.

The ground surface sloped moderately steeply westward. When the area was subdivided for urban development, the debris from the cut for a street was used to fill the lower area west of the street. The fill consisted of a slightly compacted mixture of stream and lake deposits and its placement was not con-

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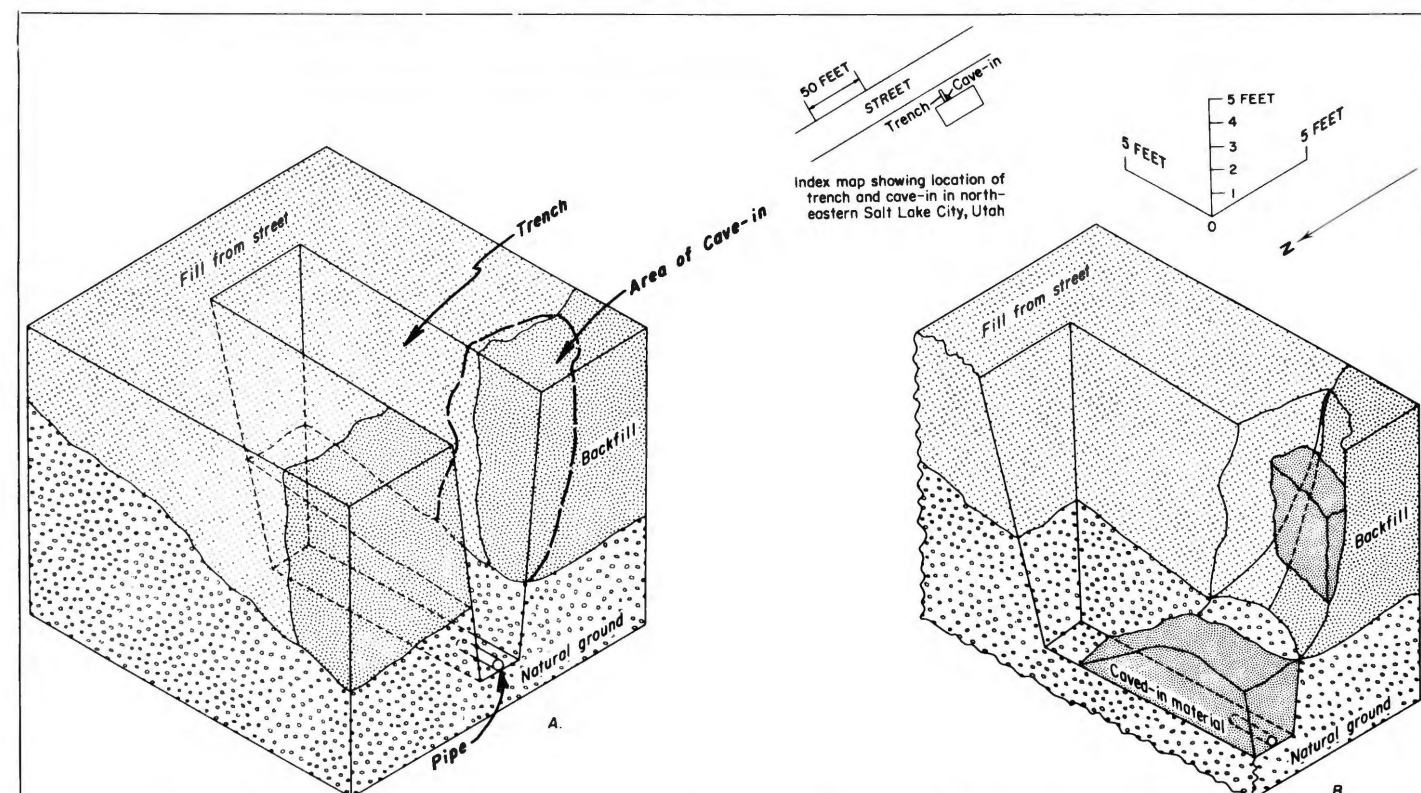


Figure 1. Block diagram of the trench showing its relation to the soil units. The plumber was found face down near the short section of pipe in the bottom of the trench.

(A) Indicates structure before cave-in occurred.

(B) Indicates structure after the cave-in, with the north trench wall removed from view.

— — — — — Long dashes indicate the break along which the cave-in occurred.

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trolled.

Several years later, an excavation for a house foundation was made in this fill. After the concrete basement walls had been poured, the area outside the walls was backfilled with the excavated soil. Water was then allowed to run over the backfill (according to reports, for an entire week) in order to settle the backfill.

It was at this stage that the plumber excavated an 11-foot deep, 2-foot wide, steep-walled trench from the basement wall eastward toward the street.

Figure 1 is a three-dimensional cut-away drawing showing the relations of the soils and the trench as if seen from inside the house.

Both the fill and the backfill are reddish-brown plastic silt that contain moderate amounts of clay and sand. When wet and squeezed between thumb and forefinger, this material feels very gritty, but also slippery. It has a strong tendency to stick to the fingers and is difficult to wipe off.

If this material is wetted to the consistency of putty and then allowed to dry in the sun, it will set so that it will crumble only after being squeezed with moderate pressure between the fingers.<sup>2</sup>

Examination of the trench after sliding occurred showed that the original westward-sloping ground surface was present in the lower 3 feet of the trench. The soil above this and for 2 or 3 feet east of the foundation wall was newly emplaced backfill. The remainder of the trench was in the old fill from the street.

A zone of high water content, that was mostly in the backfill, nearly coincided with the cave-in boundaries shown in the view of the south trench wall in figure 1.

The caved-in material came from this water-soaked zone and no original ground and very little fill from the street were involved in the cave-in. One small block of backfill did not slide all the way to the bottom of the trench and was held back with a wooden plank while the plumber was being rescued. The large amount of water in the backfill was shown by the 2 inches of water found in the bottom of the air pocket which was formed when the plumber instinctively drew his arm around his head for protection from the falling material.

When the trench walls were examined after the cave-in the newly emplaced backfill walls were darker in color than the adjoining older fill and thus indicated a greater water content. Labora-

## IAG Guidebook At Utah Survey

*Anatomy of the Western Phosphate Field*, 1967 Guidebook of the Intermountain Association of Geologists currently is available at Survey offices for the pre-publication price of \$12.50.

The new publication is a guide to geological occurrence, exploration methods, mining engineering, recovery technology, water resources, minor elements and rare earths.

Along with other information, the book includes a composite bibliography to western mineral resources and 28 authoritative papers by authors from the USGS, the U.S. Bureau of Mines and from industry.

The road log of the field trip also is available at Survey offices for \$1 a copy. Because the supply is limited, immediate orders are suggested.

tory tests showed that the backfill contained 16 percent water whereas the old fill only had 5 percent water.

These relations suggest that the water used for puddling the newly emplaced backfill played an important part in causing the cave-in. The newly emplaced backfill had many small openings into which the water ran. The older fill from the street-cut and the original ground had already settled and only a small amount of water could get into them.

The excess water in the backfill had two detrimental effects: it added much weight to the loosely packed backfill, and, it had a buoyant effect on the soil particles. These two factors finally overcame the frictional forces that tended to keep the soil bank in place, and the newly emplaced backfill slid into the trench.

The treachery of uncompacted and unconsolidated materials is well exemplified by the cave-in accident of October 1966. The geologic examination of the cave-in strongly suggests that excavation into recently backfilled and puddled areas should be avoided where possible.

If avoidance is not possible, and the soil appears dangerously wet or slippery, the sides of the trench should be sloped to a safe angle, or protected by suitable lagging before anyone enters the trench.

The appearance and feel of the soil, as mentioned earlier, may provide a warning of possible danger.

2. Field identification of these materials indicates that each is probably a CL-MH soil in the Unified Soil Classification System used by many engineers.

## KURIE DETAILS STRUCTURE OF THE KANARRA

Structural history of Kanarra anticline, a complex fold extending north-south for 25 miles through Washington County, is described in detail by Andrew Edmunds Kurie in the August, 1966, Bulletin of the Geological Society of America.

Mr. Kurie, geologist with the Utah State Highway Department discusses the sequences of fold and fault episodes which make the Kanarra structure a highly complicated and often puzzling aspect of southwest Utah geology.

Initial folding took place in Laramide time (Late Cretaceous - early Tertiary) with the anticline overturned to the east. Thrusting to the west (Taylor Creek fault) was contemporaneous with the folding and eastward overturning. In places the east-dipping thrust planes also were folded and overturned to the east. After a period of extensive erosion, the Kanarra anticline again was modified in late Tertiary or Recent (?) time by, at least, two episodes of movement along the Hurricane fault which parallels the fold for much of its length.

Despite large size and existence of potential reservoir formations the Kanarra anticline has been little prospected for oil and gas. In the light of Kurie's structural interpretation a number of hitherto unsuspected and untested structural traps appear to exist along the fold.

Reprints of Kurie's paper "Recurrent Structural Disturbance of Colorado Plateau Margin near Zion National Park, Utah," are available for 50¢ from the UGMS.

## IGNIMBRITE STUDIES IN IRON COUNTY

Summer field studies in Iron County's State Line Mining District focused on the ignimbrite sequence and the relation of mineralized fracture zones to these volcanic rocks.

Several mines were mapped and sampled for analysis. The results of the 1967 study will be encompassed in a forthcoming UGMS report.

The State Line Mining District, located 18 miles north of Modena, has produced approximately \$1,000,000 since its discovery in the late 1800s.

## ***In the service of the State of Utah . . .***



The Utah Geological and Mineralogical Survey has functioned as one of the University of Utah's research bureaus since 1949.

As an affiliate of the College of Mines and Mineral Industries, it engages in a program of research and public service devoted to development of earth science and Utah's mineral, energy and water resources.

To fulfill this aim, the Utah Survey:

- Engages in and supports basic geological research;
- Applies geology to resource and engineering problems;
- Undertakes geologic mapping and

the compilation and interpretation of geologic data;

- Provides information to the public through a regular series of publications, open-file reports, maps, correspondence, interviews, and lectures.

The director of the UGMS fills the position of State Geologist.

To dispense the greatest amount of information at the least expenditure of money and duplication of effort, the UGMS cooperates — formally and informally — with many Federal agencies, including the Geological Survey, Bureau of Mines, Bureau of Reclamation, Corps

of Engineers, Forest Service, Soil Conservation Service, and Parks Service.

Survey reports and maps are used by Federal and State agencies involved with state lands construction, highways, water supply, energy resources, industry, and tourism. Such basic resource information is of particular assistance to State and local planning organizations.

Organization of the Survey was authorized by the State Legislature in 1931, but it was not established until 1941, when it became part of the Department of Publicity and Industrial Development. Eight years later, it was placed under University administration.



## WILDERNESS OIL REAL POSSIBILITY

Information released to news media serving the petroleum industry by Shell Oil Company indicates that Shell's No. 1 Dahlgreen Creek Unit test, SE, NE, NW Sec. 9, T. 2 N., R. 14 E., Summit County, penetrated the North Flank Fault at Shallow depth thus proving that the fault is a reverse type, or thrust fault with a south-dipping plane (see *Quarterly Review*, Feb. 1967, p. 1 and Aug. 1967, p. 7).

The well is located 3.5 miles southwest of the Bridger Lake Oil Field, which is being developed by Phillip's Petroleum. It is about one mile south of the projected trace of the North Flank Fault and 4 miles north of the boundary of the proposed High Uintas Wilderness Area.

Spudded on glacial deposits, the well entered Paleozoic limestone of the overthrust sheet at about 445 feet, then drilled limestone (?) for another 270 feet.

The North Flank Fault was crossed at 815 feet and the drilling passed into formations identified as Tertiary.

Between 2,434 and 2,602 porosity with shows of live oil was encountered in several thin sands. However, a drill-stem test from 2,400 to 2,605 recovered only drilling mud.

Preliminary information from this single well thus indicates that the North Flank Fault is a very shallow thrust which dips to the south beneath the Uinta Mountains at about 15°. The hypothesis that *oil-bearing formations of the Green River Basin may extend southward for many miles beneath the overthrust sheet has become a distinct geologic possibility.*

Shell was last reported drilling below 4,800 feet toward the Dakota Formation oil sands expected at 15,800 feet.

### QUARTERLY REVIEW

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UTAH GEOLOGICAL AND  
MINERALOGICAL SURVEY  
103 Civil Engineering Building  
University of Utah  
Salt Lake City, Utah  
84112

## Diggings...

There have been repeated rumors of a large uranium find in southeastern Utah.

Due to a recent flurry of activity in the Gold Hill Mining District the population of the town of Gold Hill has doubled; the grand total is now 12.

The Intermountain Association of Geologists recently elected Howard R. Ritzma, UGMS petroleum geologist, vice president for 1967-68.

## URANIUM REPORT ISSUED BY AEC

During the first 10 months of 1967, surface drilling for uranium in Utah by private industry totalled 448,000 feet, according to a recent U. S. Atomic Energy Commission report.

The actual total could be somewhat greater, however, as some companies may not have been contacted.

By the end of September, with three months of the year still to be accounted for, industry throughout the United States had completed 7,175,000 feet of surface drilling. The AEC's August estimate was 11,600,000 feet for all of 1967.

Of this total, almost one-half is credited to the third quarter, or summer months. Over half was devoted to development drilling to determine the extent and grade of known deposits, and exploration accounted for the remainder.

## AIME Publication

The American Institute of Mining Engineers (AIME) recently announced publication prices for *Ore Deposits of the United States, 1933-1967*, Graton-Sales, edited by John D. Ridge.

The two-volume edition, a compilation of regional and district papers (several concerning Utah), will be ready for mailing in the first quarter of 1968.

Prices are as follows:

1. Member—\$19.50 (prior to publication), \$21.50 (after publication)
2. Student Member—\$14.50 (before and after publication)
3. Non-Member—\$26.50 (prior to publication), \$31.50 (after publication)

## January Talks Slated By Survey Officials

"Cyprus, A Nation In Conflict" will be pictured for Town Club members Jan. 25 by Dr. Eugene Callaghan, senior geologist and assistant director of the UGMS.

Dr. Callaghan lived and worked in Cyprus for many years, and is well qualified to discuss his subject. Recently, while serving as a consultant for the Cyprus Mining Corporation, he was forced to cut short a visit to the troubled east Mediterranean island. A Turkish invasion appeared imminent, and all Americans were asked to leave.

Dr. Callaghan's lecture was arranged through the U. of U.'s Speakers Bureau-Tours.

"Living with Geologic Hazards" was the topic of an address by Dr. William P. Hewitt, director of the Utah Survey, in the Salt Lake Public Library, Jan. 22.

Dr. Hewitt's talk was one of the Monday Afternoon Lecture Series, sponsored by the University of Utah's Division of Continuing Education in cooperation with the library. All lectures in the series will begin promptly at 1:30 p.m. in the Third Floor Lecture Hall.

The Survey director also is slated to address the Nevada Geological Society in Reno, Nevada, Jan. 26.

Other talks given during the last quarter included:

Hellmut H. Doelling, UGMS economic geologist, "Utah's Uranium Picture, 1967," Intermountain Association of Geologists, Salt Lake City, Utah, Nov. 27, 1967.

Howard R. Ritzma, UGMS petroleum geologist, "Bituminous Sandstone Deposits of Utah," Rocky Mountain Section, American Association of Petroleum Geologists, Casper, Wyoming, Oct. 11, 1967.

....., "Oil-Impregnated Sandstone Deposits of Utah," Rocky Mountain Association of Geologists, Denver, Colorado, Dec. 8, 1967.

....., "Oil-Impregnated Sandstone Deposits of Utah," Tar-Sand Sub-committee and Pressure Maintenance and Secondary Recovery Committee, Interstate Oil Compact Commission, New Orleans, Louisiana, Dec. 11, 1967.