

**KANSAS GEOLOGICAL SURVEY**  
**OPEN-FILE REPORT 87-9**

Geology Field Trip Guide  
Hutchinson Salt Deposits  
April 4, 1987

Kansas Academy of Science, 119th Annual Meeting

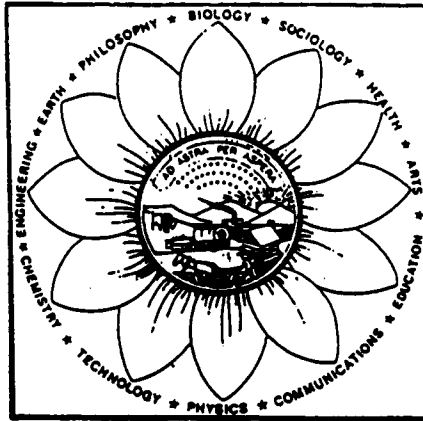
by

L.H. Skelton

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**KANSAS GEOLOGICAL SURVEY**  
1930 Constant Avenue  
University of Kansas  
Lawrence, KS 66047



# KANSAS ACADEMY OF SCIENCE

WICHITA, KANSAS • APRIL 3, 1987  
119th Annual Meeting

GEOLOGY FIELD TRIP GUIDE  
HUTCHINSON SALT DEPOSITS

APRIL 4, 1987

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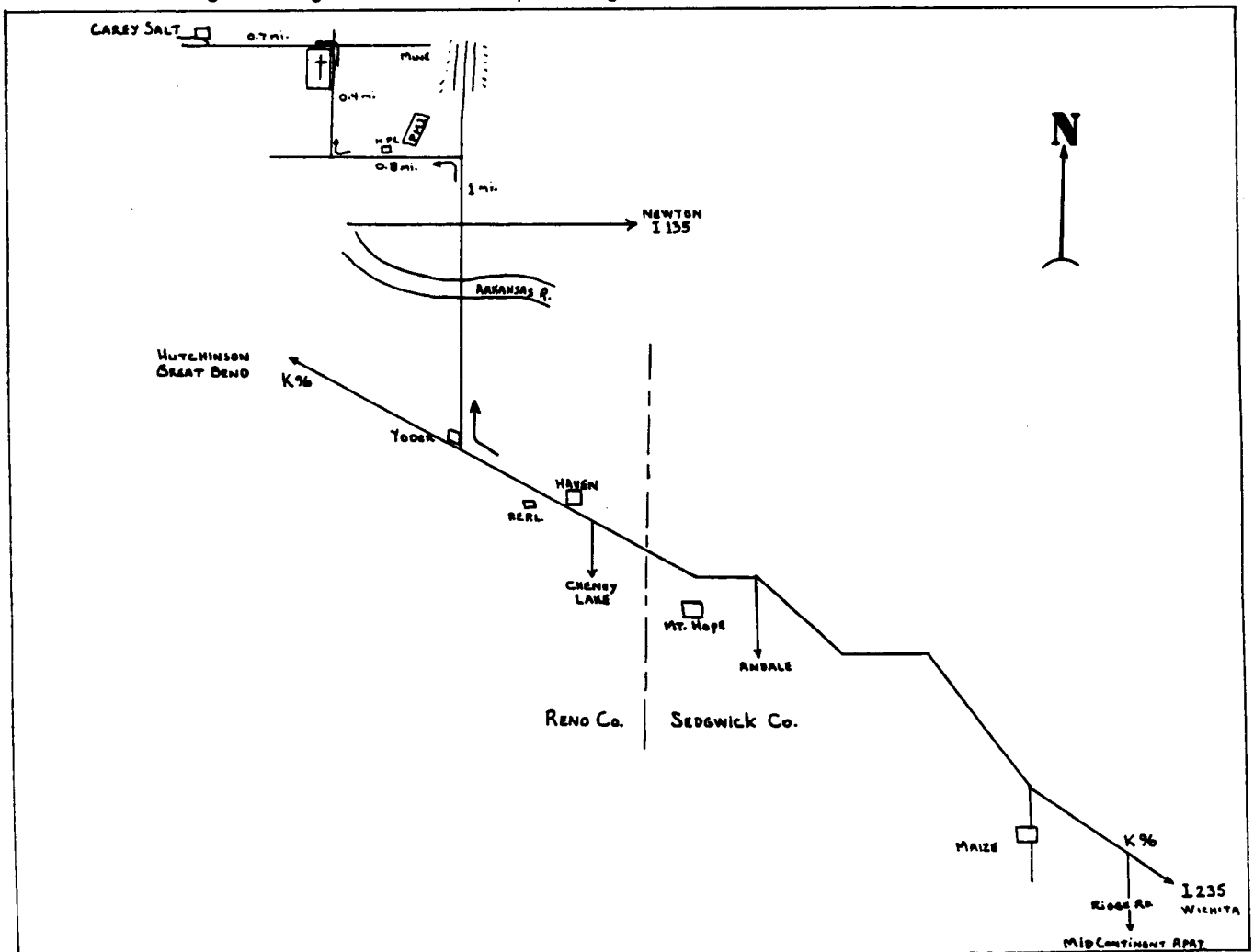
#### ACKNOWLEDGEMENTS

This field trip of the 119th Annual Meeting of the Kansas Academy of Science is to the Carey Salt Division of Processed Minerals, Incorporated at Hutchinson, Kansas. The academy is grateful to Carey officials and employees, especially Mr. Lawrence Schulte, Vice-President and Director of Manufacturing and Mr. Max Liby, Mine Manager, for their time and efforts in making this trip possible. Appreciation is also expressed to Dr. Robert F. Walters, Walters Drilling Company, Wichita, Kansas and to Dr. W. Lynn Watney, Kansas Geological Survey, Lawrence, Kansas for their assistance in preparing this guide and addressing the field trip participants.

Road log from Intersection of State Highway 96 and Interstate 235 west to Carey Salt Mine, Hutchinson, Kansas.

START:	Distance from previous point	Cumulative mileage
0. I 235-K 96 intersection	0	0
1. Go west on K 96 and cross Arkansas River	0.3	0.3
2. Note sandpits to south of K 96	2.0	2.3
3. Sandpits on north side of K 96	0.9	3.2
4. Cross "Old Indian Boundary"	1.3	4.5
5. Turnoff to Maize, Kansas - Maize named by vote of 9 of the town's 14 residents when Kansas was considered a "corn state" like Iowa	1.5	6.0
6. End of dual lane highway going west	0.8	6.8
7. Turnoff to Andale, Kansas. Named for Mr. Anderson and Mr. Dale.	10.8	17.6
8. Turnoff to Mount Hope, Kansas - a name borrowed from Michigan	2.0	19.6
9. Railroad overpass	1.6	21.2
10. Sedgwick-Reno County line	0.5	21.7
11. Turnoff to Cheney Reservoir	4.2	25.9
12. Haven, Kansas	0.9	26.8
13. Panhandle Eastern Pipeline Company compressor/pump station on south side of road.	1.4	28.2
CAUTION! FOR NEXT 10-12 MILES BE CAREFUL OF HORSE DRAWN VEHICLES -- SLOW TRAFFIC!		
14. Pass Laurel Cemetery on north side of road	2.0	30.2
15. Yoder, Kansas. Note signs to State Fairground and Cosmosphere just before turnoff. Yoder is named for Ely M. Yoder, its first postmaster who donated land for the railroad station on condition that the town be named for him. Turn right (north) at Yoder	1.6	31.8
16. Yoder Mennonite Church on right	1.2	33.0
17. Cross Arkansas River	2.1	35.1
18. Notice Pretty Prairie Santa Fe Railroad Depot in field at left. The building was moved		

- |   |     |      |
|---|-----|------|
| here a few years ago from the town of Pretty Prairie, about 16½ miles southwest   | 0.7 | 35.8 |
| 19. Passing through the Stroud Oil Field. The Stroud Oil Field produces oil from the Simpson Group of Ordovician age. Discovered in 1958, 51,390 barrels of oil were produced through 1985. | 1.5 | 37.3 |
| 20. Intersection with U. S. Highway 50. Stop, then proceed straight ahead (north)   | 0.9 | 38.2 |
| 21. Continue north to intersection with G Street. Do not cross over the overpass. Turn left (west) on G Street (See big PMI sign).  | 1.0 | 39.2 |
| 22. From turn, continue west on G Street 0.8 miles to Halstead Street. Kaneb pipeline terminal on right.  | 0.8 | 40.0 |
| 23. Turn right (north) on Halstead. Travel north 0.4 miles past Fairlawn Cemetery to Carey Blvd. at end of cemetery   | 0.4 | 40.4 |
| 24. Turn left (west) on Carey Blvd. and proceed 0.7 miles to Carey Salt office...first building on right. Park in parking lot.  | 0.7 | 41.1 |



## History and General Geology of the Hutchinson Salt

The state of Kansas has been a major American salt producer for many years and ranked fifth nationally in 1986 with total production (excluding brine) of 1,675,000 tons valued at \$71,713,000.00 (USBM, 1987). Since 1880, approximately 79,110,000 tons of salt valued at \$1,147,000,000.00 have been extracted in the state. Mudge, (p. 32) in the First Annual Report on the Geology of Kansas in a lengthy description of salt, salt springs and marshes noted that "...there is an abundance of that article within the State, sufficient, if well developed, to supply the whole valley of the Mississippi, even were its population ten fold greater than at present." Salt production began in the 1860's when the first commercial salt was extracted from salt marshes in Cloud, Jewell and Republic Counties and from shallow brine wells in Miami County. (Schoewe, p. 437). Kansas did not become an important salt producer until the Hutchinson salt was discovered while drilling for oil or gas in 1887. The first salt discovered in Hutchinson, Kansas was on September 27, 1887 (Schoewe, 1958) at a depth of around 450 feet. Two salt companies were organized in Hutchinson and began operations in 1901; these were the Hutchinson Salt Company and the Carey Salt Company. (Haworth, p. 74). Initially, salt was recovered by solution mining. Underground mining in the Carey Mine began in 1923.

Some idea of the importance of the underground salt mine to the community is given by this quotation from the 1949 Field Trip Guidebook of the Kansas Geological Society. (Walters, 1980, p. 9).

"On July 6, 1922, ground was broken for the shaft of The Carey Rock Salt Mine at Hutchinson. On June 23, 1923, construction had been completed and The Carey Rock Salt Mine was dedicated by Governor Jonathan M. Davis. On the same day President Warren Harding visited this city; following his speech, officials in the presidential party went to The Carey Mines for the dedication ceremony. Governor Davis touched the button which started the hoist upward with the first load of salt."

The Carey mine is a room and pillar mine. Originally the mine had a six-foot ceiling and rooms 50 feet by 300 feet separated by 20-foot walls. Portions of the older mined out space close to the shaft are being utilized for record storage by Underground Vault & Storage, Inc. after the ceiling has been raised to nine feet. Present workings have 50-foot square pillars with 50 feet between pillars, and a nine-foot ceiling. This mining method leaves 25 percent of the salt pillars with no shoring required. (Walters, 1980, p. 9).

The Hutchinson Salt is the commercially mined salt in Kansas and has, for practical consideration, almost infinite reserves. It covers some 37,066 square miles (96,000 KM<sup>2</sup>) and fills a volume of roughly 1,100 cubic miles (4,600 KM<sup>3</sup>) in the subsurface portion of the Permian-age Wellington Formation. (Watney, et al). To appreciate that volume, imagine a single halite crystal 10.33 miles on an edge and weighing 13 trillion tons---or a salt wall two miles wide and 1,000 feet high around the 1,150 mile perimeter of Kansas!

The Hutchinson Salt is comprised primarily of halite layers separated by shale partings or beds. Jones, who analyzed a complete core (286 feet) of the salt from a location south of Hutchinson, reported the following composition: halite, 82%; shale, 11%; carbonates (magnesite or dolomite), 4%; and anhydrite, 3%. (Walters, 1980, p. 1).

Salt has many uses: from human consumption as table salt to chemical feedstock to road salt. Approximately 52% of the rock salt mined in the U. S. is used by state and local governments as road salt to melt ice. Another 15% is used as chemical feedstock. Primary chemicals produced from salt are chlorine, caustic soda and soda ash. Other major users include livestock feed dealers, meat packers and tanners, the petroleum industry and water softener industry. When salt brine is added to rock salt and evaporative salt, the chemical industry consumes some 53% of annual U. S. salt production. Virtually all road salt is in the form of rock salt. (Morse, 1984).

The geology and depositional environment of the Hutchinson salt are best summarized by the following abstracts and illustrations prepared by Robert F. Walters and W. Lynn Watney.

- Haworth, E., 1902, Annual Bulletin of the Mineral Resources of Kansas for 1900 and 1901: University Geological Survey of Kansas, 78 p.
- Morse, D. E., 1984, Salt in U. S. Dept of Interior, Minerals Yearbook, vol. 1, 1984, p. 763-774.
- Mudge, B. F., 1866, First annual report on the geology of Kansas: Kansas Geological Survey, Lawrence, 56 p.
- Schoewe, W. H., 1958, The geography of Kansas in Transactions of the Kansas Academy of Science, v. 61, no. 4, p. 437-440.
- U. S. Bureau of Mines, 1987, The mineral industry of Kansas in 1986: Mineral Industry Surveys, 2 p.
- Walters, R. F., 1978, Land subsidence in Central Kansas related to salt dissolution: Kansas Geol. Survey Bull. 214, 82 p.
- Walters, R. F., 1980, Solution and collapse features in the salt near Hutchinson, Kansas: Guidebook, 14th Annual Meeting Geological Society of America, South-central Section, Wichita, Kansas.
- Watney, W. L., Berg, J. A., and Paul, S. E., In preparation, Origin and distribution of the Hutchinson Salt (Lower Leonardian) in Kansas in Permian Rocks of the Midcontinent: S.E.P.M. special publication.

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CAREY UNDERGROUND SALT MINE

Approximate Ctr. of SE/4 - Sec. 16, T. 23S, R. 5W  
Reno County, Kansas

Elevation, ground 1515 ft

CONSTRUCTION OF SHAFT

0 to 58.7 ft	Caisson section. Ring seal at base
58.7 to 126 ft	Concrete shell section 18 inches thick Water ring and sump at base
126 to 156 ft	Shale backfill
156 to 440 ft	Concrete backfill
440 to 558 ft	Timber section
558 to 575 ft	Concrete backfill
575 to 645.5 ft	Open shaft

LITHOLOGY

0 to 8 ft	Soil
8 to 60 ft	Sand and gravel - water-bearing
60 to 126 ft	Shale red with slabs of blue shale. BEDROCK 60 ft Water at 75 ft, 89 ft and 95 ft in shale and at 115-ft in 8-inch gypsum layer
126 to 156 ft	Soft red shale
156 to 267 ft	Shale, red, soft with blue streaks
267 to 325 ft	Shale, hard, gray or red
325 to 364 ft	Shale, gray or blue, firm
364 to 397 ft	Shale, gray, extra hard
397 to 486 ft	SALT. Streaks of shale. TOP SALT 397 ft.
486 to 494 ft	Shale and salt
494 to 520 ft	Salt
520 to 532 ft	Salt and shale
532 to 558 ft	Salt
558 to 569 ft	Shale
569 to 645.5 ft	SALT. Bottom of mining seam. BASE SALT 700 ft (Est.)

## SALT: HUTCHINSON AREA

by

Robert F. Walters

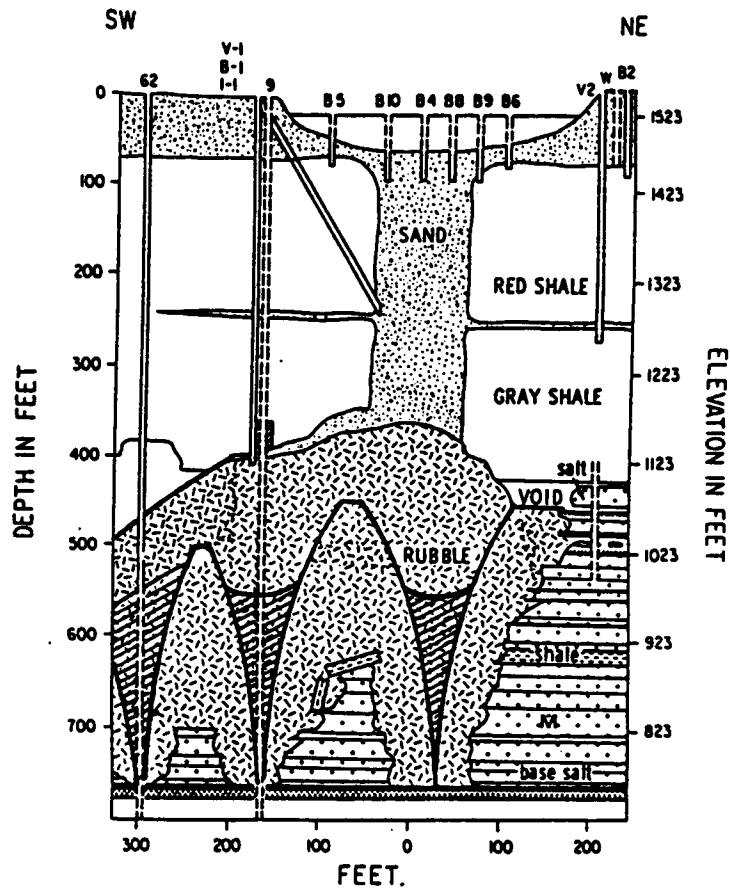
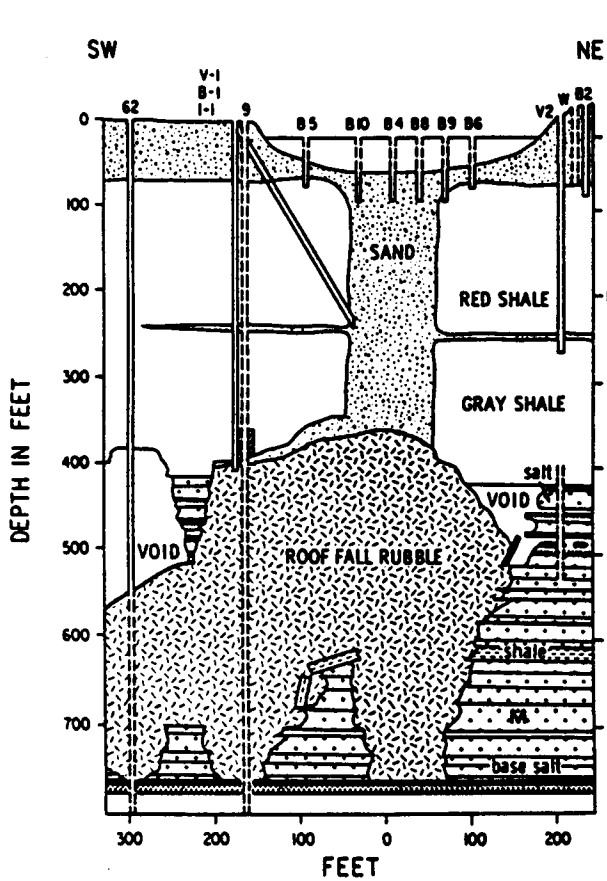
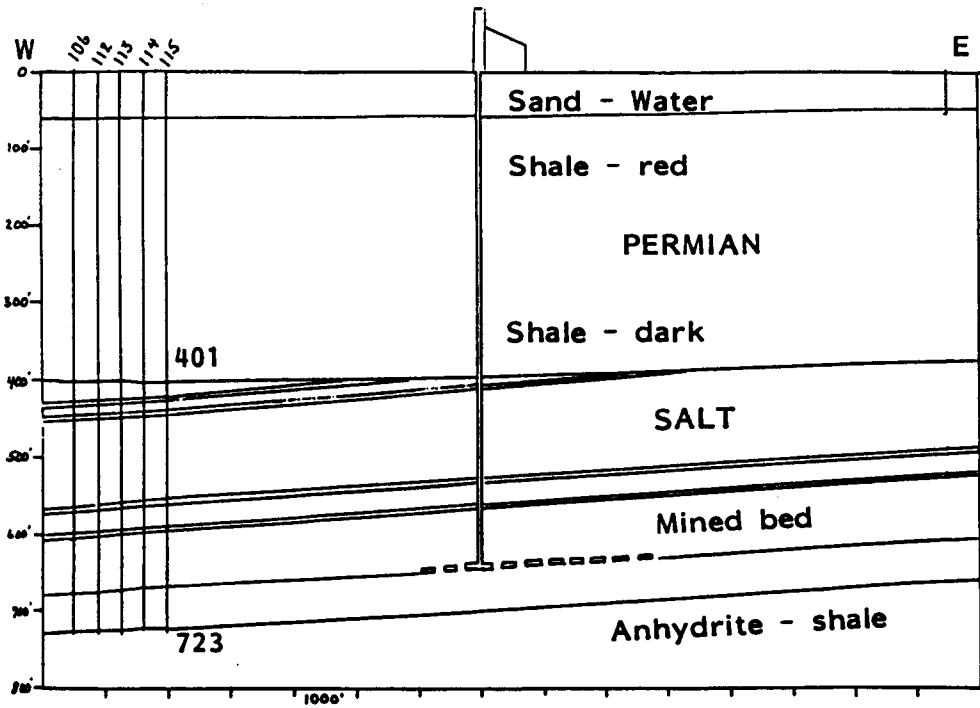
Salt has been produced continuously since 1888 at Hutchinson, "The Salt City". The Carey Underground Salt Mine in the SE/4 of Section 16-T-23S-R5W, was opened in 1923. The mine is developed in a single salt bed near the base of the salt section, originally with a six-foot ceiling from 639 feet to 645 feet shaft depth, now with 9 foot ceilings. Room and pillar mining removes 75% of this salt bed leaving 25% in pillars. The rooms, pillars, and ceilings are stable. The mined out space is leased to Underground Vault and Storage Company, Inc. for secure record storage in a constant temperature and humidity environment.

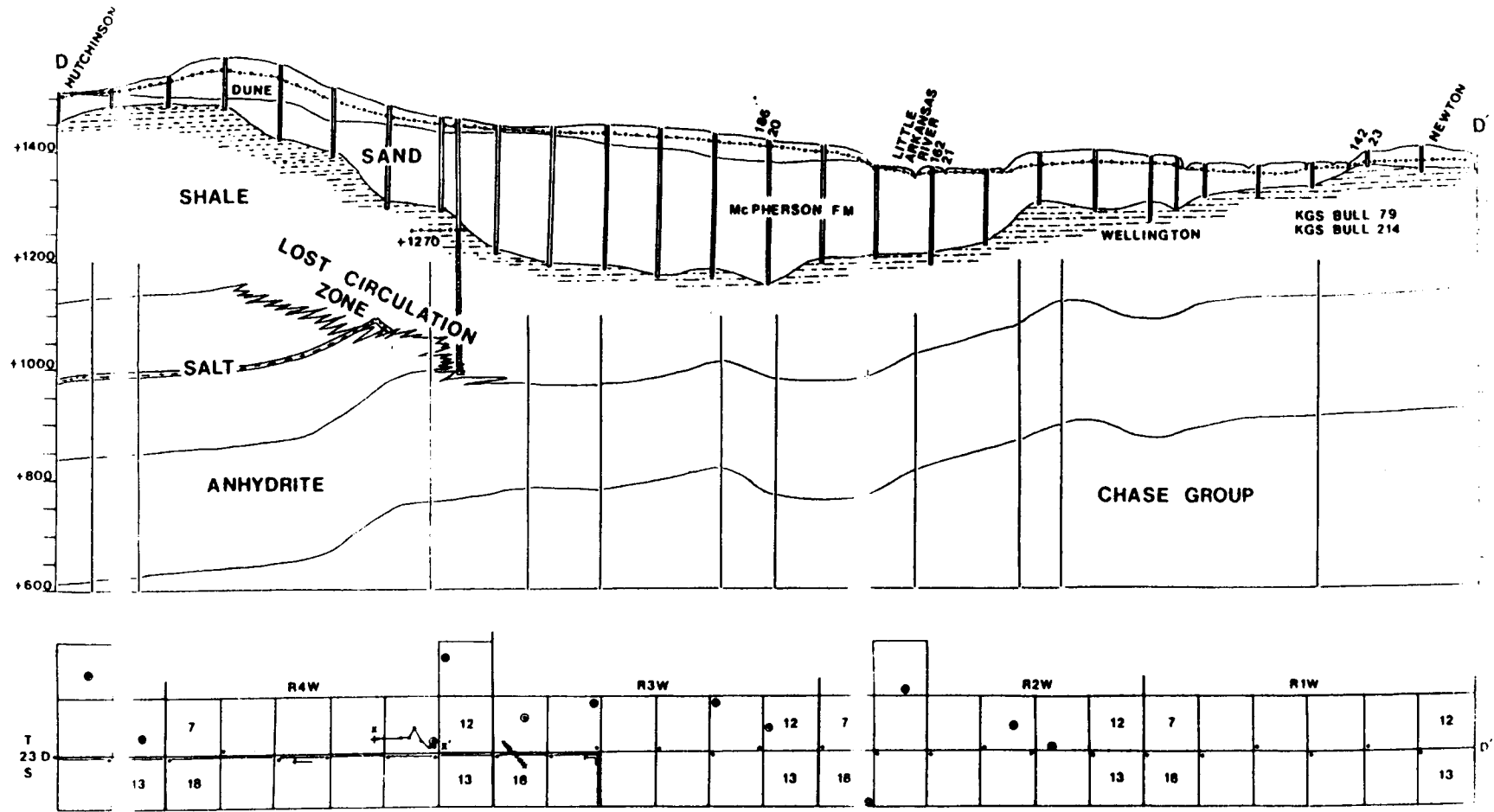
The Carey Solution Brinefield, one mile west in the S/2 of Section 17, in operation since 1904 was placed on full production after a 1925 subsidence in downtown Hutchinson. Additional salt beds are present at the top of the salt section which extends from 400 feet to 725 feet. (See diagram.) Brine is produced by the "forcing" method from individual brine wells in which fresh water is pumped under pressure down the tubing, forcing saturated brine to flow upward in the annular space between tubing and casing. Abundant fresh water is available from the near surface aquifer extending from 20 feet below ground level to 60 feet. No salt brine wells are fractured because of proximity of the brinefield to the underground mine.

In 1978 ground subsidence occurred around wells 50 and 57. Both are part of a coalesced cavern system of nine wells which developed too great a roof span causing roof sagging, shale bedding separations, and ultimately surface subsidence. Research core drilling programs have been conducted around both holes and also around well 56 where no measurable subsidence occurred. These programs were conducted by the Solution Mining Research Institute, the U. S. Bureau of Mines, and the Carey Salt Division of PMI.

One mile farther west, salt is mined in the W/2 of Sec. 19 by Cargill using pairs or systems of wells connected underground by fracturing. Fresh water is pumped down one well and brine returned to the surface from an adjacent brine well. The objective is to create horizontal caverns in the lower salt beds leaving upper salt beds in place as a roof, thus minimizing or eliminating subsidence. The old mined out area just south of the Cargill buildings was the site of a sudden and spectacular subsidence in 1974 which left the main line tracks of the Missouri-Pacific Railroad suspended in mid air. North of the Cargill buildings and affecting the dock on the north side, subsidence occurred in 1952 when the plant was then operated by the Barton Salt Company. Slow subsidence continued for many years requiring re-surfacing and filling of the dock loading area. Subsidence was still continuing in October 1978 when it was investigated by a research drilling program.

Yet farther west, in Section 22-T23S-R6W, where the salt is encountered from approximately 500 to 800 feet, caverns dissolved in the salt are used for storage of liquified petroleum gases, principally propane and butane by CITGO and other companies.





Cross section from Hutchinson, Ks. to Newton, Ks. showing solution front of Hutchinson Salt.  
 (from Walters, 1980)

ORIGIN AND DISTRIBUTION OF THE HUTCHINSON SALT (LOWER LEONARDIAN)  
IN KANSAS

Watney, W. Lynn, Berg, James A.\*, and Paul, Shirley

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The Hutchinson Salt Member of the Lower Leonardian Wellington Formation covers some 96,000 Km<sup>2</sup> in the subsurface of Kansas, roughly occupying a volume of 4600 Km<sup>3</sup>. This salt deposit is an important economic resource. It is a source of chlorides found in groundwater and a major cause numerous natural and manmade sink holes. Stratigraphic changes adversely affect seismic and gravity surveys.

An extensive subsurface study was conducted using cores, wireline logs, and sample descriptions to re-evaluate the lateral and vertical distribution of halite and associated strata in the Sumner Group, an interval between the Stone Corral Formation and the Chase Group. Correlations were established between basic lithologic types and geophysical wireline log responses. Some 4000 wireline logs were interpreted and maps produced such as interval thickness, iso-halite, and structural elevation using computer methods.

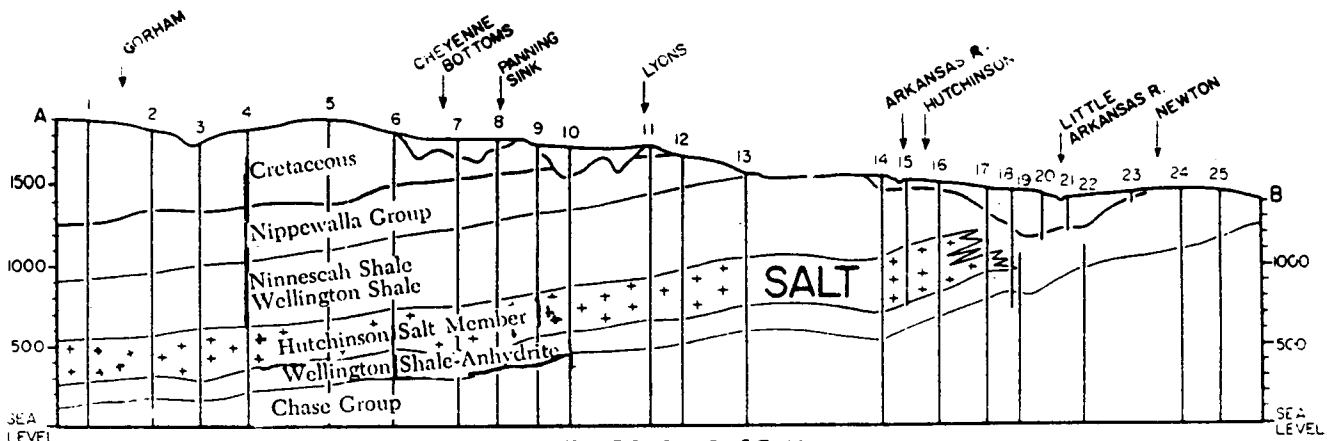
The Hutchinson Salt Member was deposited in a shallow depression that was intermittently open to the south. Halite is thickest and most continuous in the northeastern portion of this basin. Halite deposits progressively offlap and grade into sulfate southwestward into Oklahoma, the site of the waning Anadarko Basin. Thin, but widespread and basinwide anhydrite-shale couplets punctuate the halite successions of shale, occasionally dolomite, anhydrite, bedded and unbedded halite. This series is repetitive according to results of Markov Chain analysis. The abruptly thinning eastern limit of the Hutchinson Salt in Kansas reflects solution of salt near the present land surface. Bromide geochemistry and petrography of the halite indicates that the halite is a primary precipitate from a fluctuating, shallow, marine brine body.

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SYSTEM	SERIES	GROUP FORMATION OR MEMBER	GENERAL CHARACTER OF ROCKS	
PERMIAN	Lower Permian	Stone Corral	Dolomite and Anhydrite	
		Sumner Group	Ninnescah Sh	Red beds consisting of reddish brown shale and siltstone
			"Upper Member"	Dark gray shale
			Hutchinson Salt Member	Salt with interbedded anhydrite, shale, magnesite, and dolomite
	Wellington Formation	"Lower Member"	Anhydrite and gray shale with interbedded dolomite.	
Chase Group		Limestone, dolomite, and gray and variegated shale beds.		

Stratigraphic chart of Sumner Group, Lower Permian, in Kansas.

From Watney, et al., in preparation.



Cross section from NW Sec. 5, T. 13 S, R 15 W. Russell Co., Ks. to N.W. Sec. 16, T. 23 S, R, 2 E., Harvey Co., Ks.

(From Walters, 1978, p. 4)



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