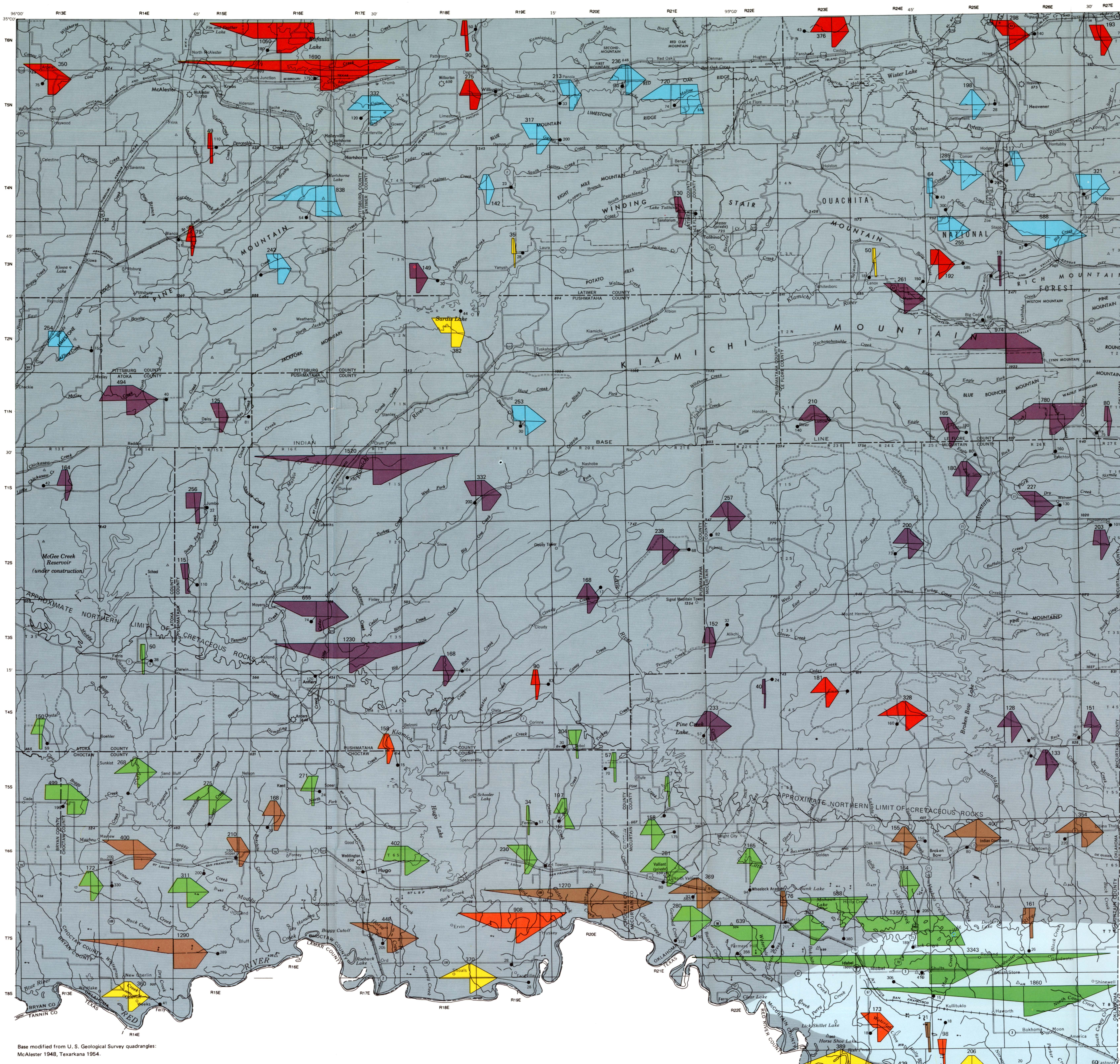


Base modified from U. S. Geological Survey quadrangles: McAlester 1948, Texarkana 1954.

Scale 1:250,000

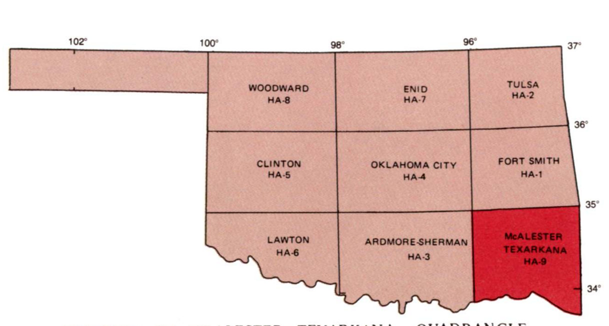
5 0 5 10 15 20 Statute Miles

5 0 5 10 15 20 25 30 Kilometers

DATUM: MEAN SEA LEVEL

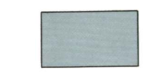
Figure 6: Map Showing Chemical Quality of Ground Water.

Chemical quality data compiled by D. L. Bergman and M. V. Marcher, U. S. Geological Survey, 1971.



LOCATION OF MC ALESTER—TEXARKANA QUADRANGLE

EXPLANATION



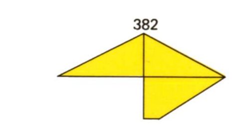
Chemical quality good to fair

Good-quality water contains less than 500 mg/1 dissolved solids. Fair-quality water contains between 500 and 1,000 mg/1 dissolved solids. In a few local areas, dissolved solids may exceed 1,000 mg/1.

Chemical quality poor

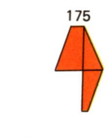
Poor-quality water contains more than 1,000 mg/1 dissolved solids, mainly sodium chloride. In this area, water in units overlying the Antlers Formation is of good to fair quality; water from the Antlers Formations contains as much as 6,240 mg/1 chloride. The dissolved-mineral concentration depends on the depth of a well and its location. Water from the lower part of the formation anywhere in the outlined area probably exceeds the recommended limit for chloride. Water from the upper part of the formation near the northern boundary of the outlined area may not greatly exceed the recommended limit for chloride, but farther south it probably is too highly mineralized for most uses.

GEOLOGIC SOURCES OF WATER



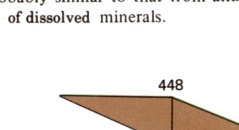
Water from alluvium

Water from alluvium along the Red River is of the calcium-magnesium bicarbonate type. Hardness is the most troublesome characteristic, and water from most parts of the aquifer is hard or very hard. Sulfate and chloride concentrations are low and the dissolved-solids concentration is usually less than 500 mg/1. The number of samples from alluvium along other streams in the area are too few to define the chemical characteristics of the water



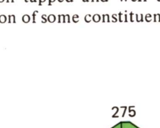
Water from terrace deposits

The number of samples from terrace deposits are too few to define the chemical characteristics of the water. However, water from terrace deposits is probably similar to that from alluvium but may have a lower concentration of dissolved minerals.



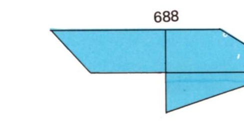
Water from undifferentiated rocks of Cretaceous age

Water from undifferentiated rocks of Cretaceous age is generally of the sodium-potassium bicarbonate type and is hard or very hard. The chemical quality differs considerably from place to place, depending on the geologic formation tapped and well depth. Consequently, in local areas, the concentration of some constituents may exceed the recommended limits.



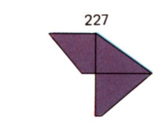
Water from the Antlers Formation

Water from the Antlers Formation differs from place to place, but in most of the area it is of the calcium-magnesium and sodium-potassium bicarbonate type and is generally hard or very hard. Sulfate, chloride, and dissolved-solids concentrations are generally low. In southeastern McCurtain County, water from the Antlers Formation is of the sodium chloride type, with a chloride concentration as much as 6,240 mg/1 and a dissolved-solids concentration as much as 11,000 mg/1, making it unusable for most purposes.



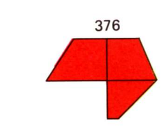
Water from the Atoka Formation and from rocks of Morrowan and Atokan (?) age

Water from the Atoka Formation and rocks of Morrowan and and Atokan (?) age is commonly a combination of the calcium-magnesium and sodium-potassium bicarbonate types and is hard or very hard. The water is low in chloride and sulfate, but dissolved solids may exceed the recommended limit locally.



Water from the Stanley Group

Water from the Stanley Group is either of the calcium-magnesium carbonate type or the sodium-potassium bicarbonate type and is commonly moderately hard to hard. The chloride and sulfate concentrations are low in nearly all the area, and dissolved solids exceed the recommended limit only locally.



Water from undifferentiated rocks of Paleozoic age

Water from undifferentiated rocks of Paleozoic age is either sodium-potassium bicarbonate, calcium-magnesium bicarbonate, or a combination of the two types. Typically, the water is moderately hard to hard. Except in a few local areas, chloride, sulfate, and dissolved solids are low.

● 32

WELL

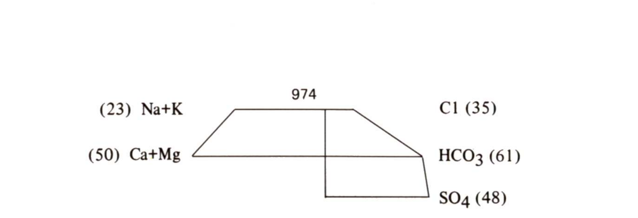
Number is well depth, in feet.

SPRING

WATER-QUALITY DIAGRAMS

Diagrams which show the general chemical character of ground water are based on analyses of water samples from wells or springs at the indicated points. Ionic concentrations in milliequivalents per liter are plotted for sodium plus potassium (Na+K), calcium plus magnesium (Ca+Mg), chloride (C1), bicarbonate (HCO_3), and sulfate (SO_4). Anions are plotted to the right of the center line and cations to the left. The area of the diagram is an indication of the dissolved-solids content — larger areas indicate greater dissolved-solids content. Variations in shape of the diagram reflect variations in chemical character. Numbers with diagrams are dissolved-solids content.

Numbers in parentheses beside ions in the diagram below are factors that can be used to convert the ionic concentration from milliequivalents per liter to milligrams per liter. For example, use the scale to read the value of milliequivalents per liter of a particular ion, and multiply the value by the number beside the ion. The resulting number for C1, HCO_3, or SO_4 ions is the concentration in milligrams per liter, and the resulting number for Na + K is the concentration as Na. The resulting number for Ca + Mg is the hardness as $CaCO_3$.



CHEMICAL QUALITY OF GROUND WATER

To provide data on the chemical quality of ground water in the McAlester-Texarkana Quadrangle, water samples from 113 wells and 4 springs (fig. 6) were collected and analyzed by the U.S. Geological Survey. Laboratory determinations were made for hardness and for concentrations of calcium and magnesium, chloride, bicarbonate, sulfate, nitrate, and dissolved solids. Sodium and potassium, as sodium, was calculated by difference

All ground water contains minerals dissolved mainly from soil and rocks. High concentrations of dissolved minerals may restrict use of water for many purposes. Drinking-water standards established by the U.S. Public Health Service (1962) state that the following chemical substances should not be present in a water supply in excess of listed concentrations, if in the judgment of the reporting agency and certifying authority, other suitable supplies are or can be made available:

Constituent	Maximum concentrations recommended (milligrams per liter)
Sulfate	250
Chloride	250
Nitrate	45
Dissolved solids	500

Various minerals, notably gypsum, in rock are the major source of sulfate in ground water. In combination with calcium, sulfate may cause hard scale in boilers, water heaters, and pipes. A laxative effect may result when sulfate is in combination with magnesium, and sulfate in excessive amounts gives water an unpleasant taste.

Chloride is derived from some minerals, from ancient sea brines trapped in the rocks, and from human, animal, and industrial wastes. Chloride in small amounts has little effect on the usability of water for most purposes, but in concentrations of several hundred milligrams per liter it gives water a salty taste. Small to moderate amounts of chloride have been reported to increase the corrosive characteristics of water.

Nitrate is derived from human and animal wastes and from nitrates in the soil; fertilizer is a source of nitrate. Concentrations greater than 45 mg/1 (milligrams per liter) may cause methemoglobinemia ("blue baby") in infants, and therefore waters with high nitrate content should not be used for infant feeding or by expectant mothers (U.S. Public Health Service, 1962, p. 48).

Dissolved solids consist principally of dissolved-mineral constituents but may include organic material that may be present after a measured quantity of water has been evaporated. Large amounts of dissolved solids limit the use of water for many purposes.

Hard water is objectionable because of its scale-forming properties and because it makes large amounts of soap necessary. The U.S. Geological Survey (Dufor and Becker, 1962, p. 27) classifies water having a hardness less than 60 mg/1 as soft; 60 to 120 mg/1, moderately hard; 121 to 180 mg/1, hard; and more than 180 mg/1, very hard.

Some mineralization may be due to contamination by saline water, particularly in extreme southern McCurtain and Choctaw Counties. Such contamination may be caused by poorly plugged or improperly cased oil-test wells, or artesian wells may be drilled into salt-water zones.

Some mineralization of ground water in parts of Pittsburg, Latimer, and Le Flore Counties may be due to its having been in contact with buried coal beds. Water from abandoned coal pits and waste piles also may be a source of local ground-water contamination. However, the effect of mineralized water from these sources probably is small because rocks in the coal fields are mainly shales, which generally have a very low permeability.

REFERENCES

Dufor, C. N., and Becker, Edith, 1964, Public water supplies of the 100 largest cities in the United States, 1962: U.S. Geological Survey Water-Supply Paper 1812, 364 p.

U.S. Public Health Service, 1962, Drinking water standards, 1962: U.S. Public Health Service Publication 956, 61 p.

Summary of chemical analyses of water from Red River alluvium

	Concentrations (in milligrams per liter): Maximum	Upper quartile[1]	Median	Lower quartile[2]	Minimum	Number of analyses
Hardness	613	390	308	173	13	10
Sulfate	60	45	16	11	8.2	10
Chloride	20	18	7	5.2	3.4	10
Nitrate	48	7.3	1.6	.0	.0	10
Dissolved solids	1,070	429	365	206	4.7	10

Summary of chemical analyses of water from the Atoka Formation and from rocks of Morrowan and Atokan (?) age

	Concentrations (in milligrams per liter): Maximum	Upper quartile[1]	Median	Lower quartile[2]	Minimum	Number of analyses
Hardness	480	188	121	67	34	16
Sulfate	264	32	15	6.2	2.0	16
Chloride	136	64	16	9.0	4.0	16
Nitrate	40	1.9	.1	.0	.0	16
Dissolved solids	838	327	254	206	64	16

Summary of chemical analyses of water from undifferentiated rocks of Cretaceous age

	Concentrations (in milligrams per liter): Maximum	Upper quartile[1]	Median	Lower quartile[2]	Minimum	Number of analyses
Hardness	686	328	124	32	5	17
Sulfate	778	61	35	9	2.9	16
Chloride	845	196	40	8	4	17
Nitrate	56	2.5	1.0	.2	.0	17
Dissolved solids	1,900	1,710	448	168	76	17

Summary of chemical analyses of water from the Stanley Group

	Concentrations (in milligrams per liter): Maximum	Upper quartile[1]	Median	Lower quartile[2]	Minimum	Number of analyses
Hardness	475	159	108	48	2	30
Sulfate	346	26	11	7.8	1.4	30
Chloride	615	26	9.0	4.6	1.6	30
Nitrate	51	3.2	.1	.0	.0	30
Dissolved solids	1,520	259	200	150	19	30

Summary of chemical analyses of water from the Antlers Formation

	Concentrations (in milligrams per liter): Maximum	Upper quartile[1]	Median	Lower quartile[2]	Minimum	Number of analyses
Hardness	1,926	200	127	69	16	40
Sulfate	471	47	20	8.7	2.0	40
Chloride	6,240	114	16	8.0	2.6	40
Nitrate	72	5.0	.4	.0	.0	40
Dissolved solids	11,100	511	273	156	34	40

Summary of chemical analyses of water from undifferentiated rocks of Paleozoic age

	Concentrations (in milligrams per liter): Maximum	Upper quartile[1]	Median	Lower quartile[2]	Minimum	Number of analyses
Hardness	300	218	63	50	16	14
Sulfate	139	34	24	12	5.8	14
Chloride	590	84	9.6	4.0	2.8	14
Nitrate	3.3	.6	.1	.0	.0	14
Dissolved solids	1,690	376	246	90	4.9	14

[1] Upper quartile — 25 percent of the samples had a content greater than the value shown and 75 percent had less.
[2] Lower quartile — 25 percent of the samples has a content less than the value shown and 75 percent had more.

RECONNAISSANCE OF THE WATER RESOURCES OF THE MC ALESTER AND TEXARKANA QUADRANGLES, SOUTHEASTERN OKLAHOMA

By

Melvin V. Marcher and DeRoy L. Bergman

U. S. Geological Survey

1983