Salinity and Uranium Distribution and Fate in the Upper Arkansas River Corridor

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PROBLEM:

- Saline Arkansas River water flows from southeast Colorado into southwest Kansas.
- The river water is high in dissolved uranium and has contaminated groundwater in the High Plains aquifer.
- The groundwater is used for drinking water, as well as for stock, irrigation, and industry.
- The river is now essentially a closed basin, so salinity and uranium concentrations continue to accumulate.

QUESTIONS:

- What are the current concentration distributions and controls on the fate of the salinity and uranium?

• SOURCE OF SALINITY AND URANIUM IN RIVER

Main natural source: Weathering of marine Cretaceous shales containing gypsum and sulfides in Colorado.

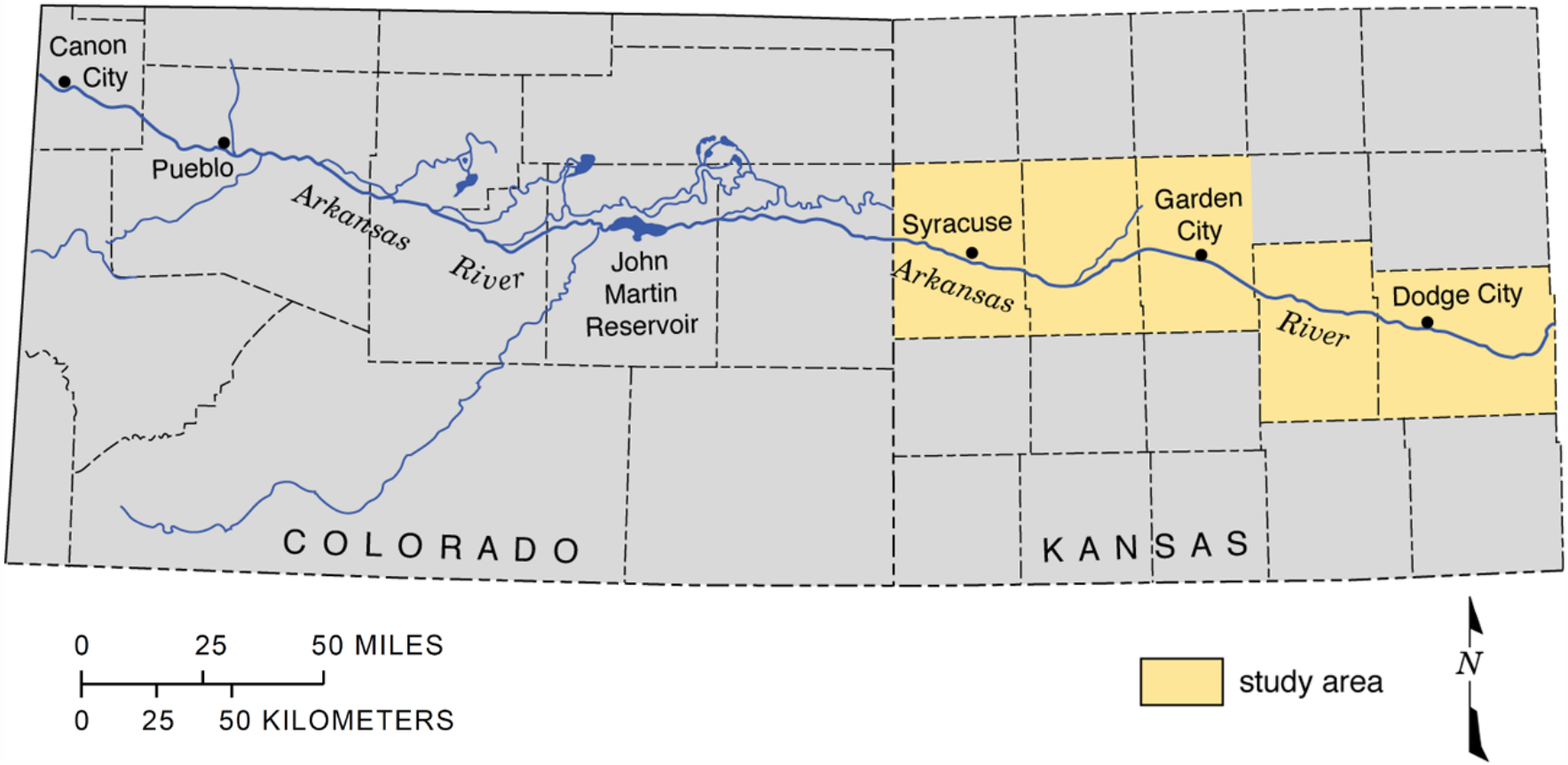
Human sources: Insignificant.

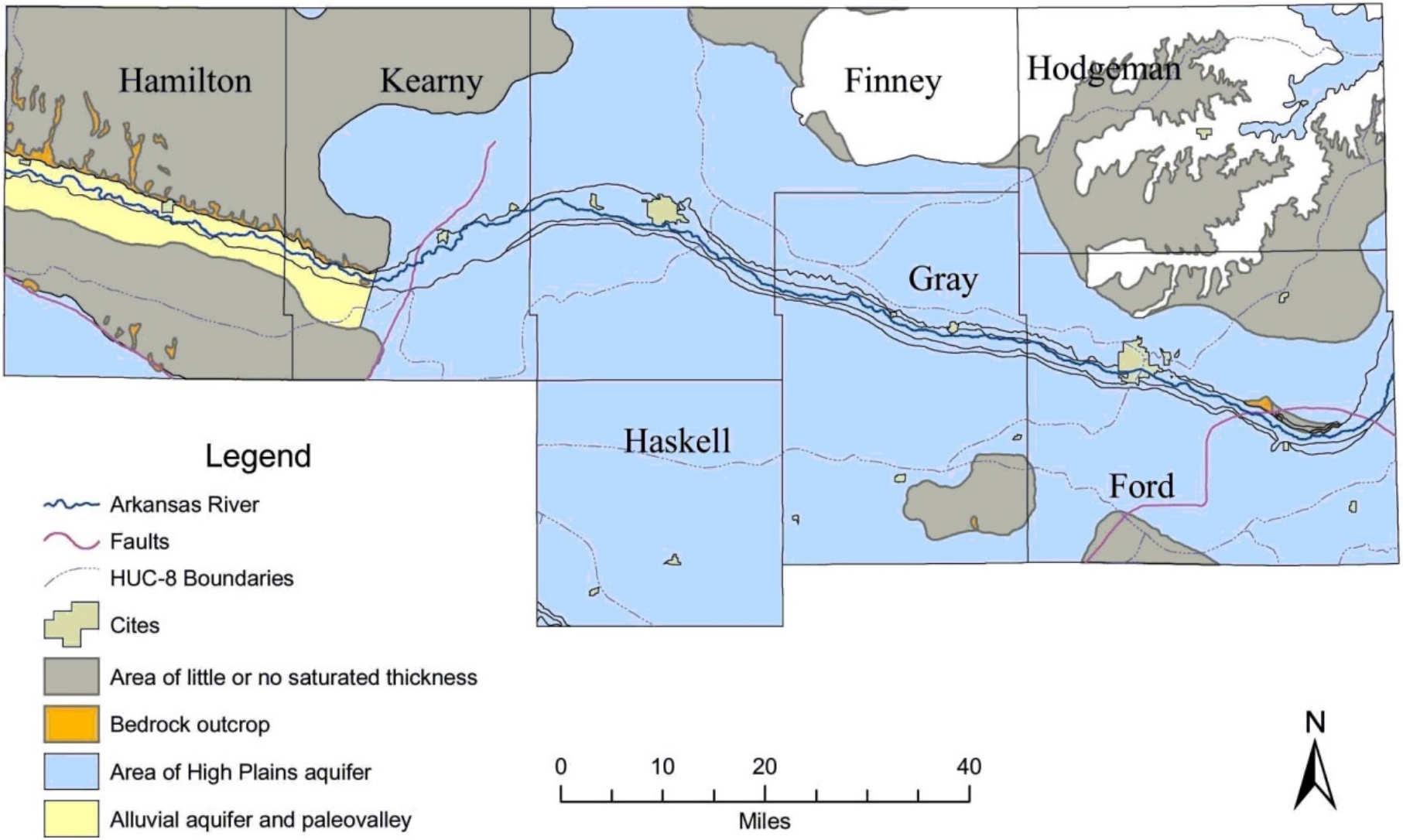
• CAUSE OF HIGH SALINITY AND URANIUM LEVELS

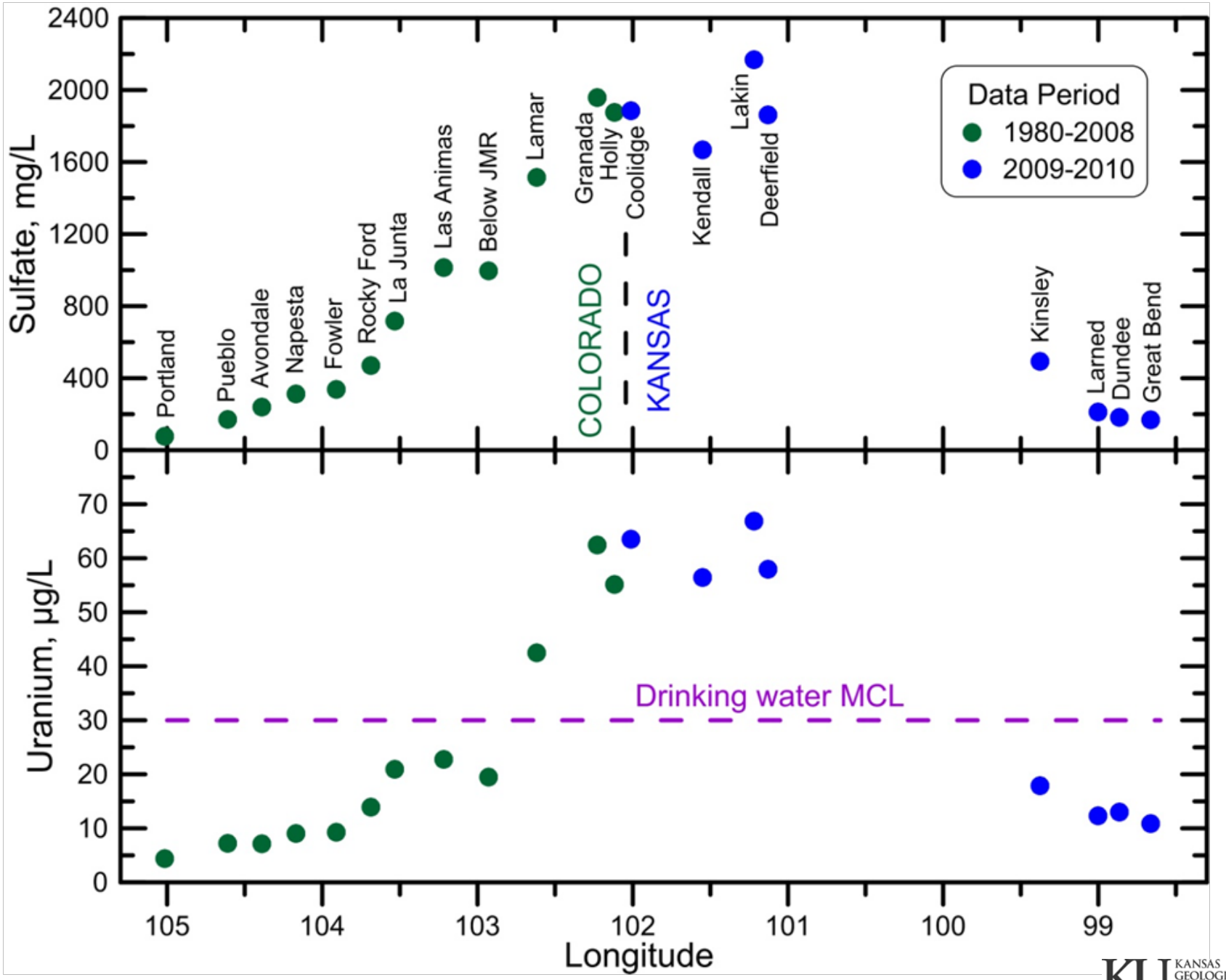
Human: Concentration of dissolved salts by consumption of water by evapotranspiration associated with extensive irrigated agriculture and shallow reservoirs.

Natural: In absence of human activities, salinity and uranium concentration would be 3 to 4 times lower.

Natural Drainage and Canals in the Arkansas River System







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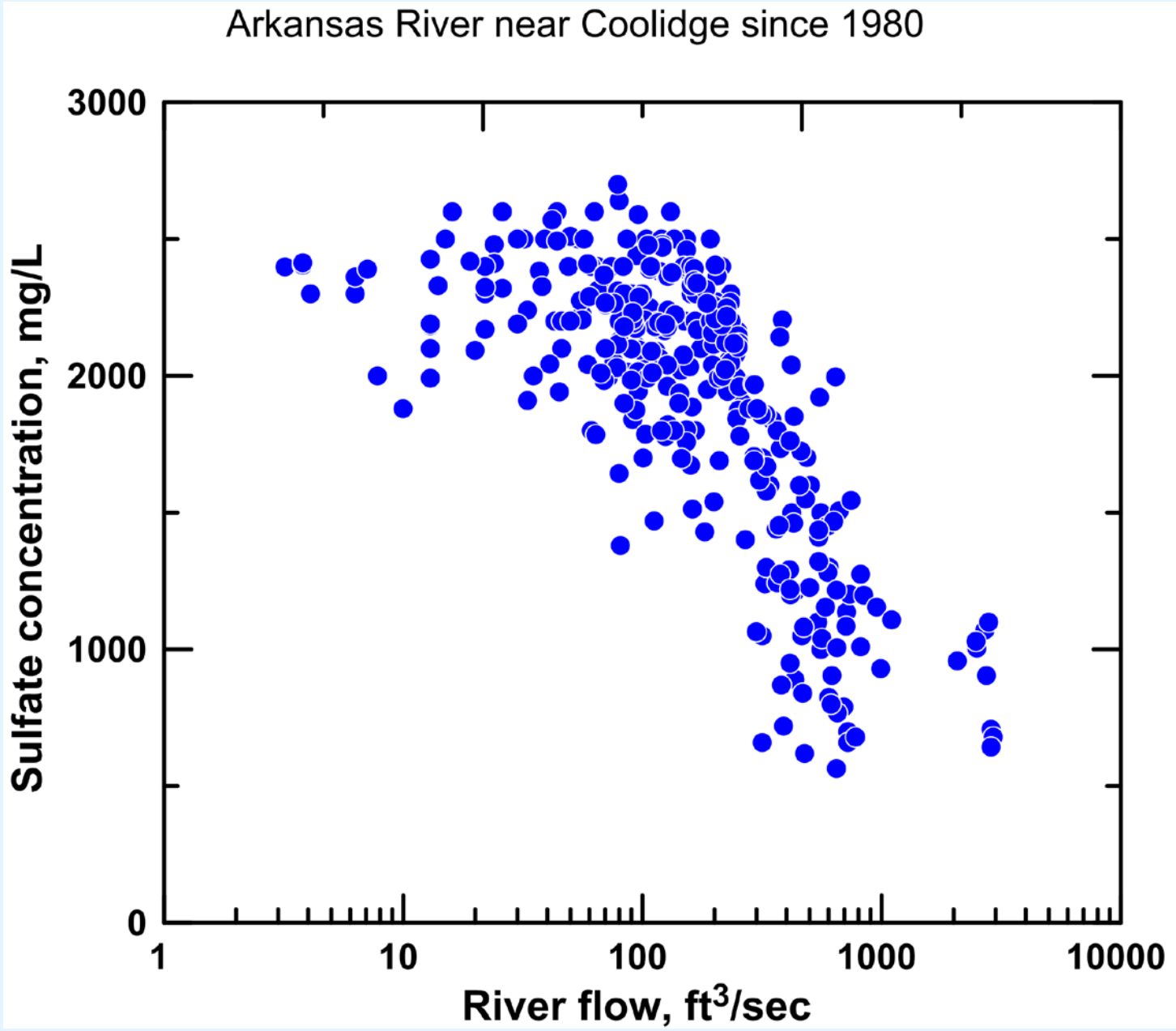
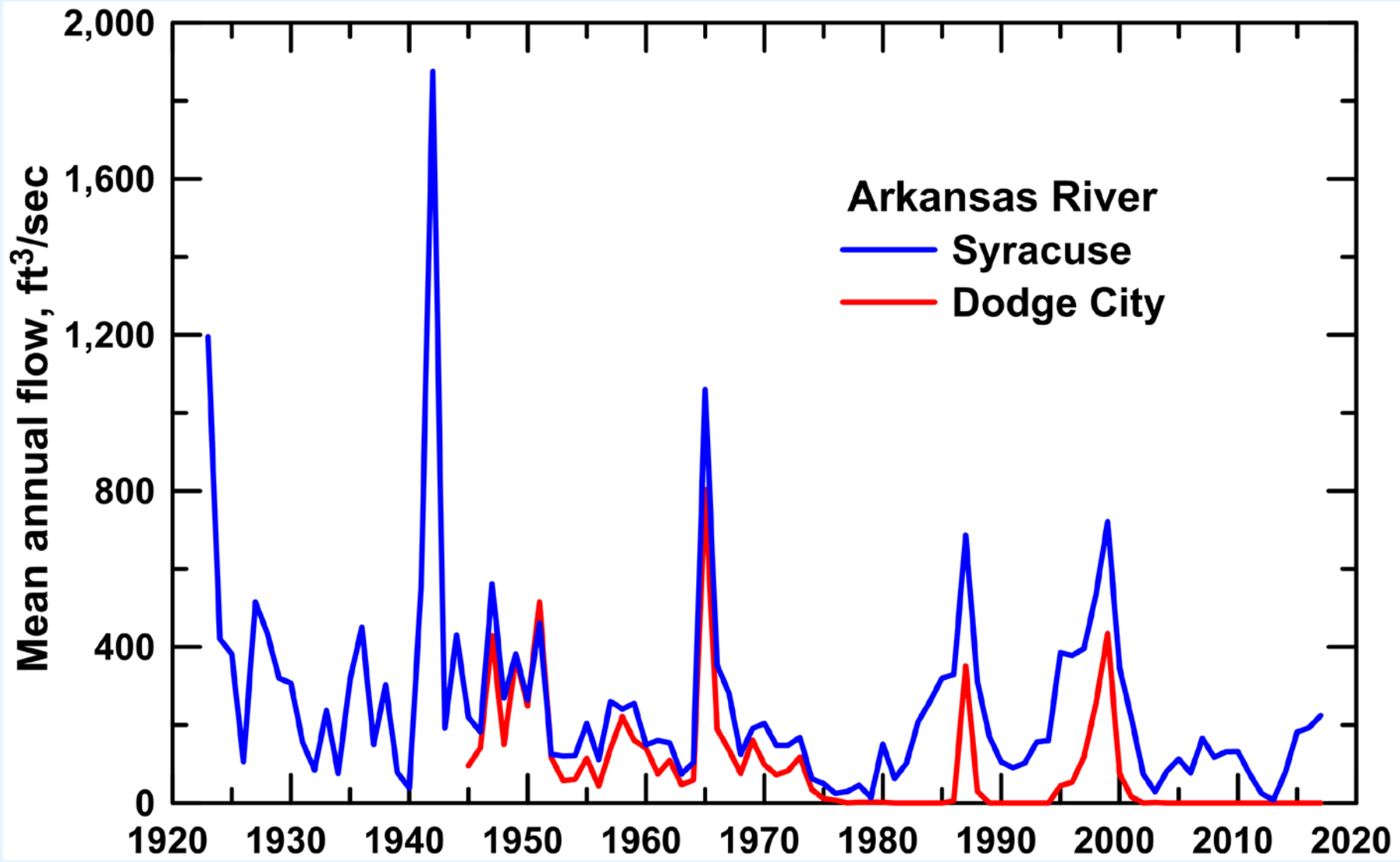


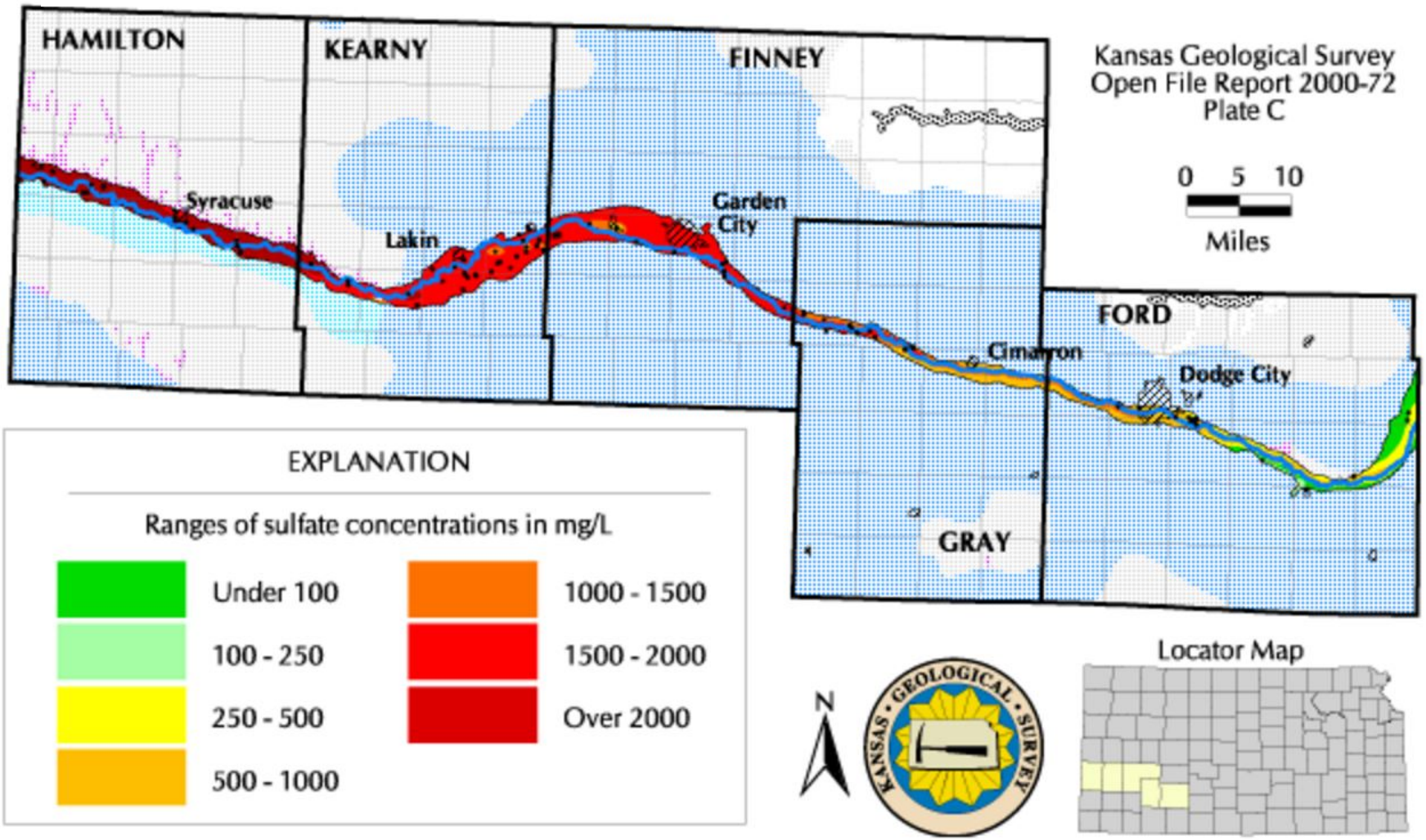
Arkansas River near Colorado-Kansas Line

1963-2010 for all data except 2009-2010 for U

	Flow ft^3/sec	TDS mg/L	SO4 mg/L	Cl mg/L	U µg/L	Gross α pCi/L
Average	244	3,260	1,960	137	63.5	57.6
Number of samples	554	486	553	551	27	36
Drinking water standard, MCL or (recommended)	-	(500)	(250)	(250)	30	15



Sulfate Concentration in the Alluvial Aquifer of the Arkansas River in Southwest Kansas



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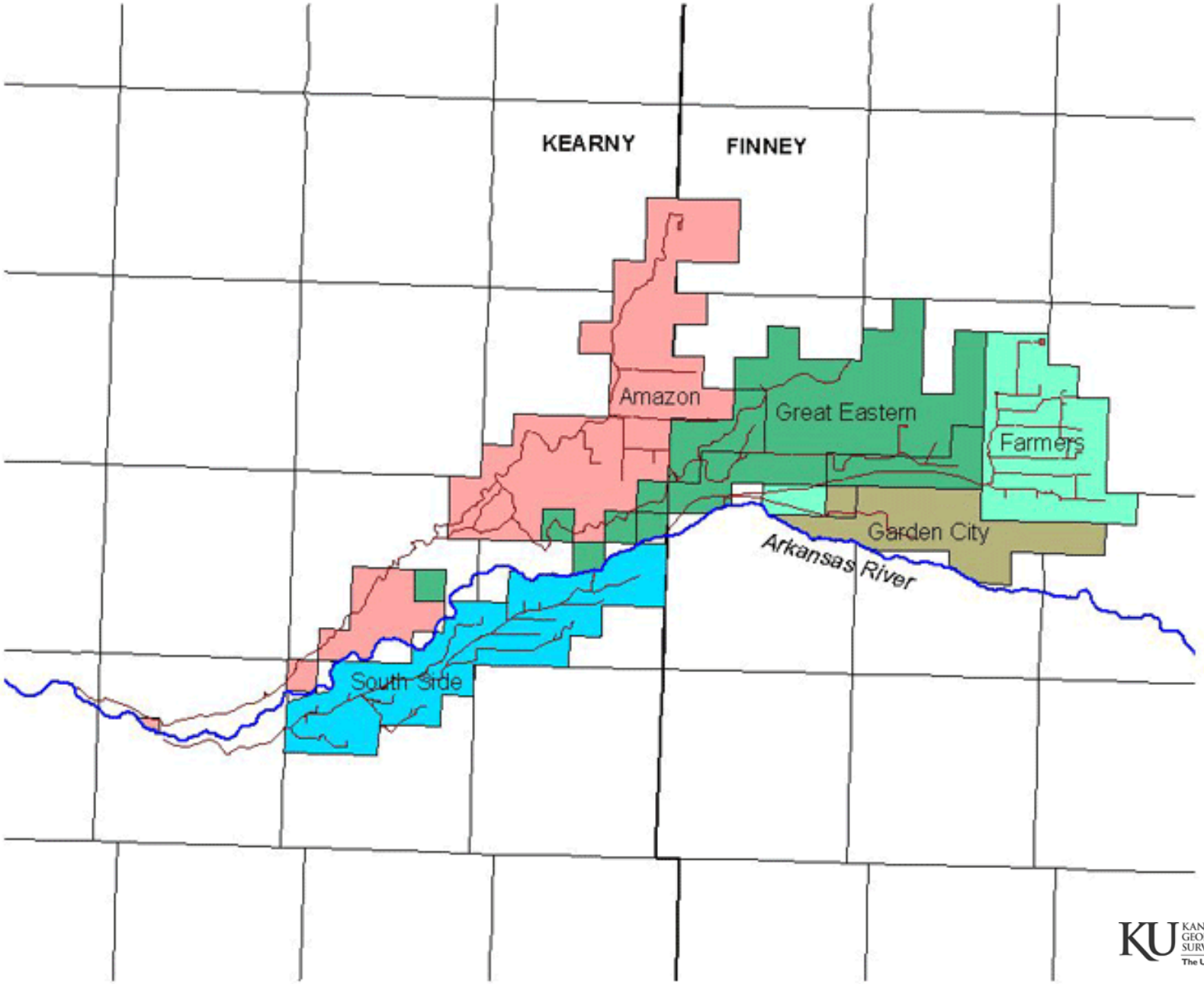
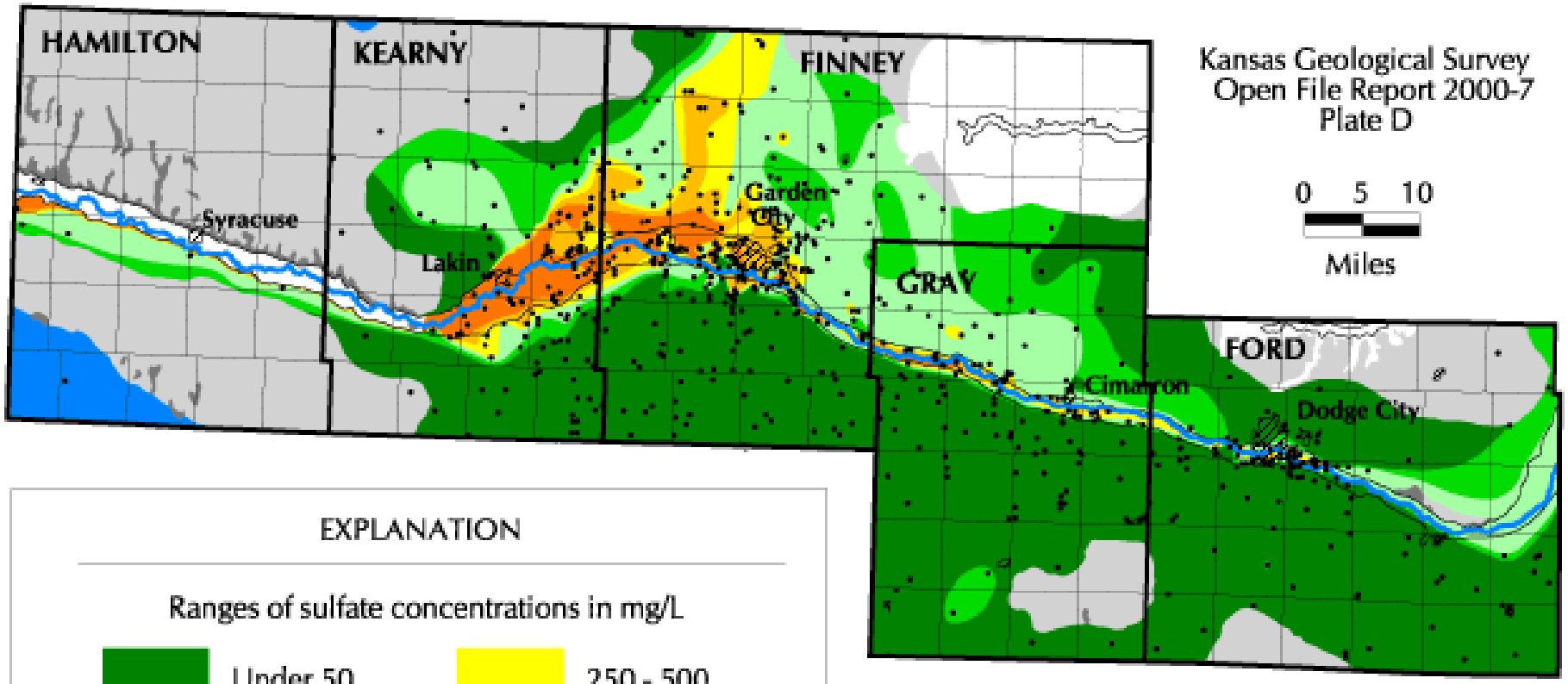
Historic Ditch Irrigation Service Areas



Sulfate Concentration for the High Plains Aquifer in the Upper Arkansas River Corridor in Southwest Kansas



Kansas Geological Survey
Open File Report 2000-7
Plate D

0 5 10
Miles

EXPLANATION

Ranges of sulfate concentrations in mg/L

- Under 50
- 50 - 100
- 100 - 250
- 250 - 500
- 500 - 1000
- Over 1000

N

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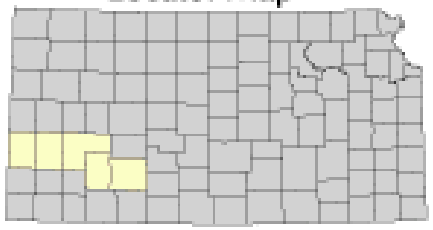
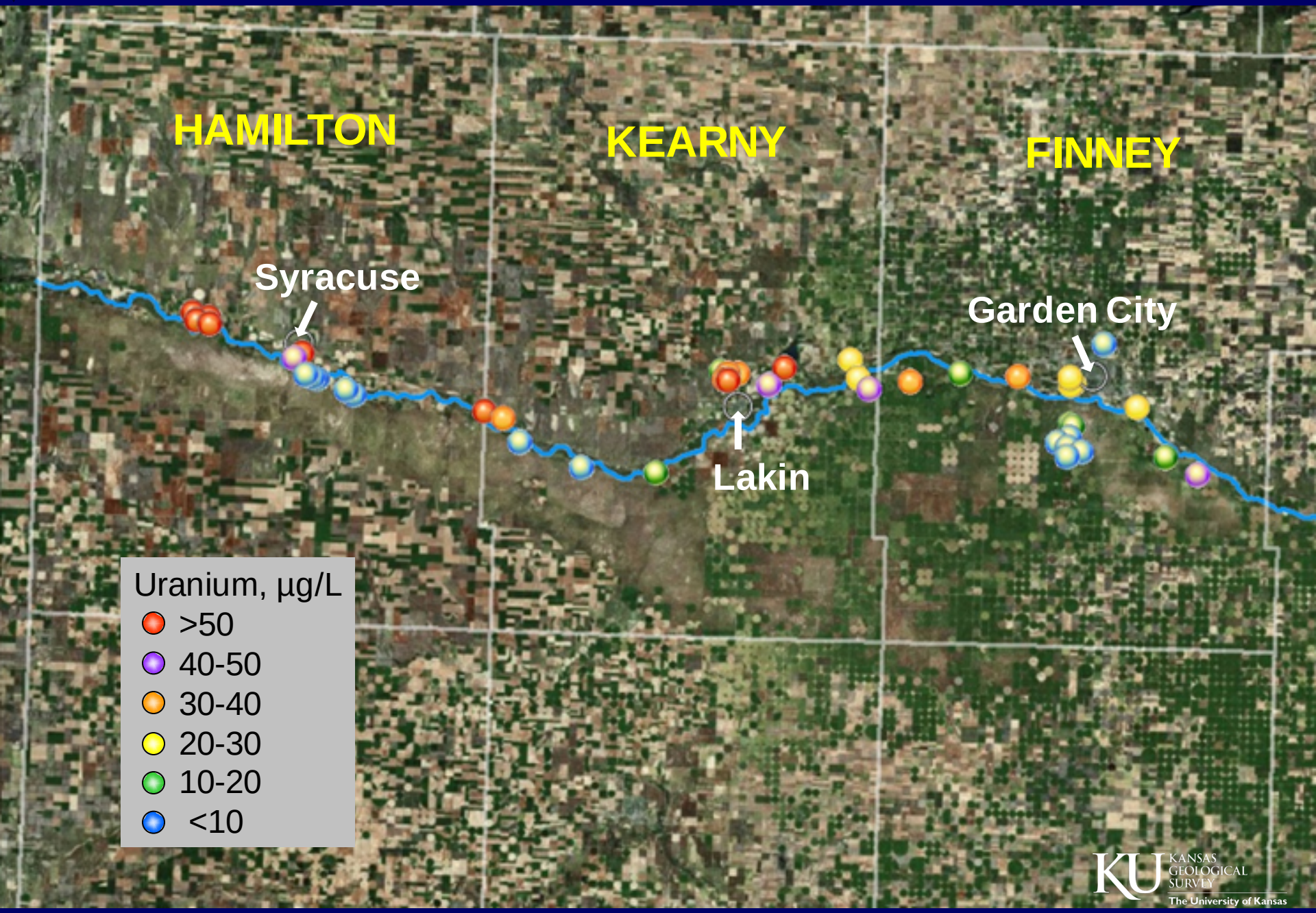
Locator Map



· Wells with water quality samples

High Plains aquifer extent:

- Area of little or no saturated thickness


HAMILTON
KEARNY
FINNEY
Syracuse
Lakin
Garden City
Uranium, µg/L
>50
40-50
30-40
20-30
10-20
<10
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Uranium, µg/L
>50
40-50
30-40
20-30
10-20
<10
Lakin
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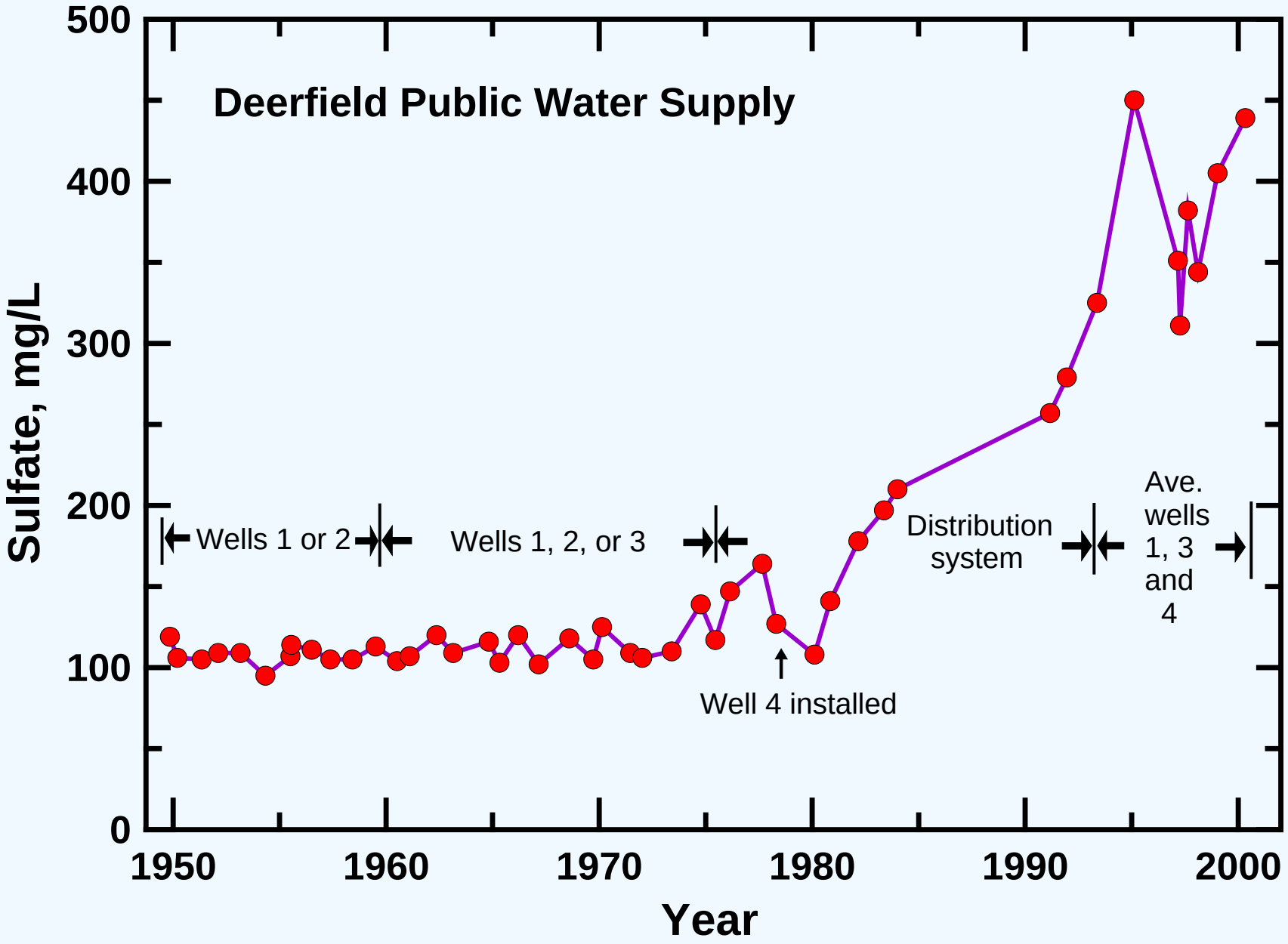

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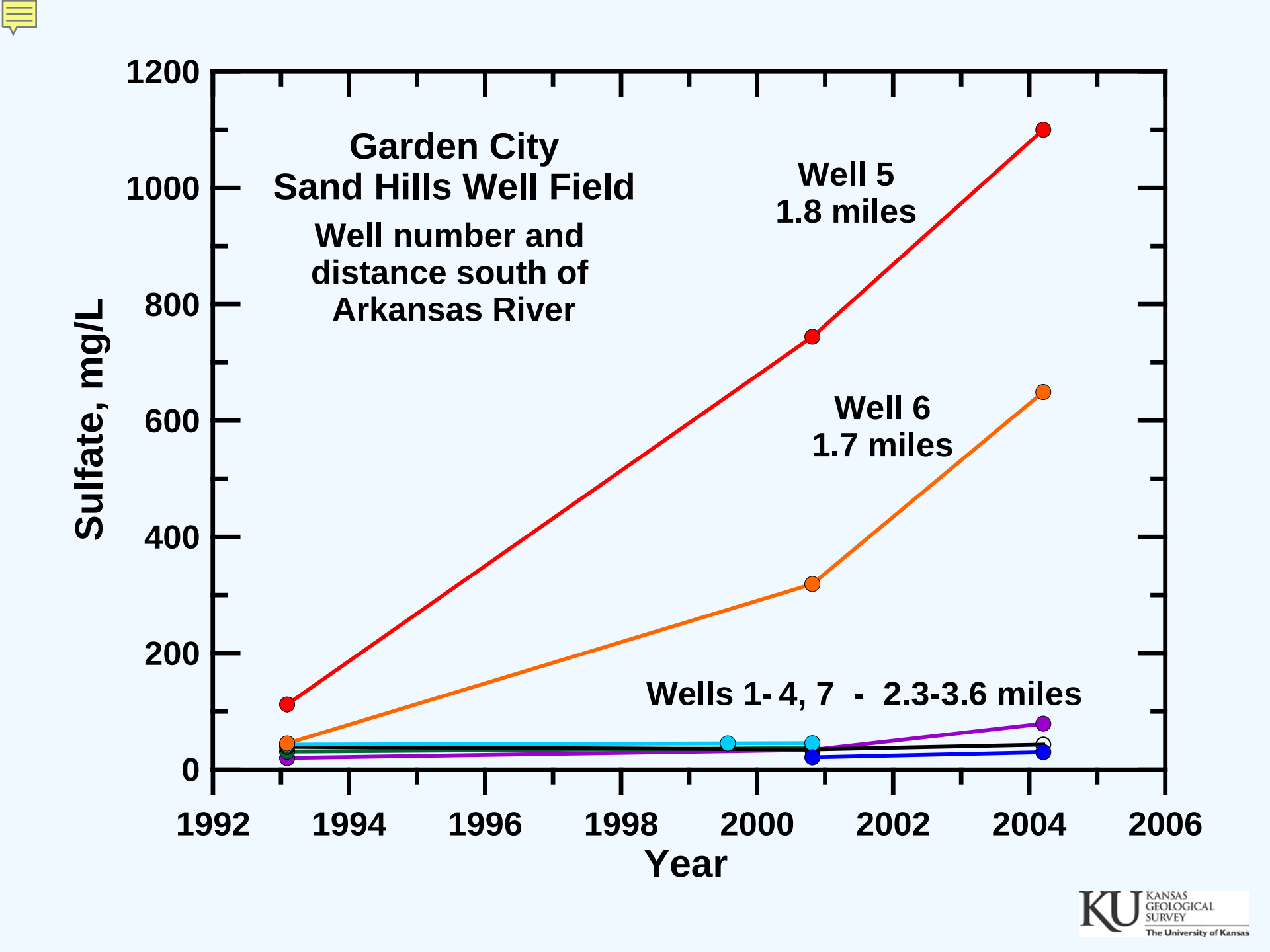

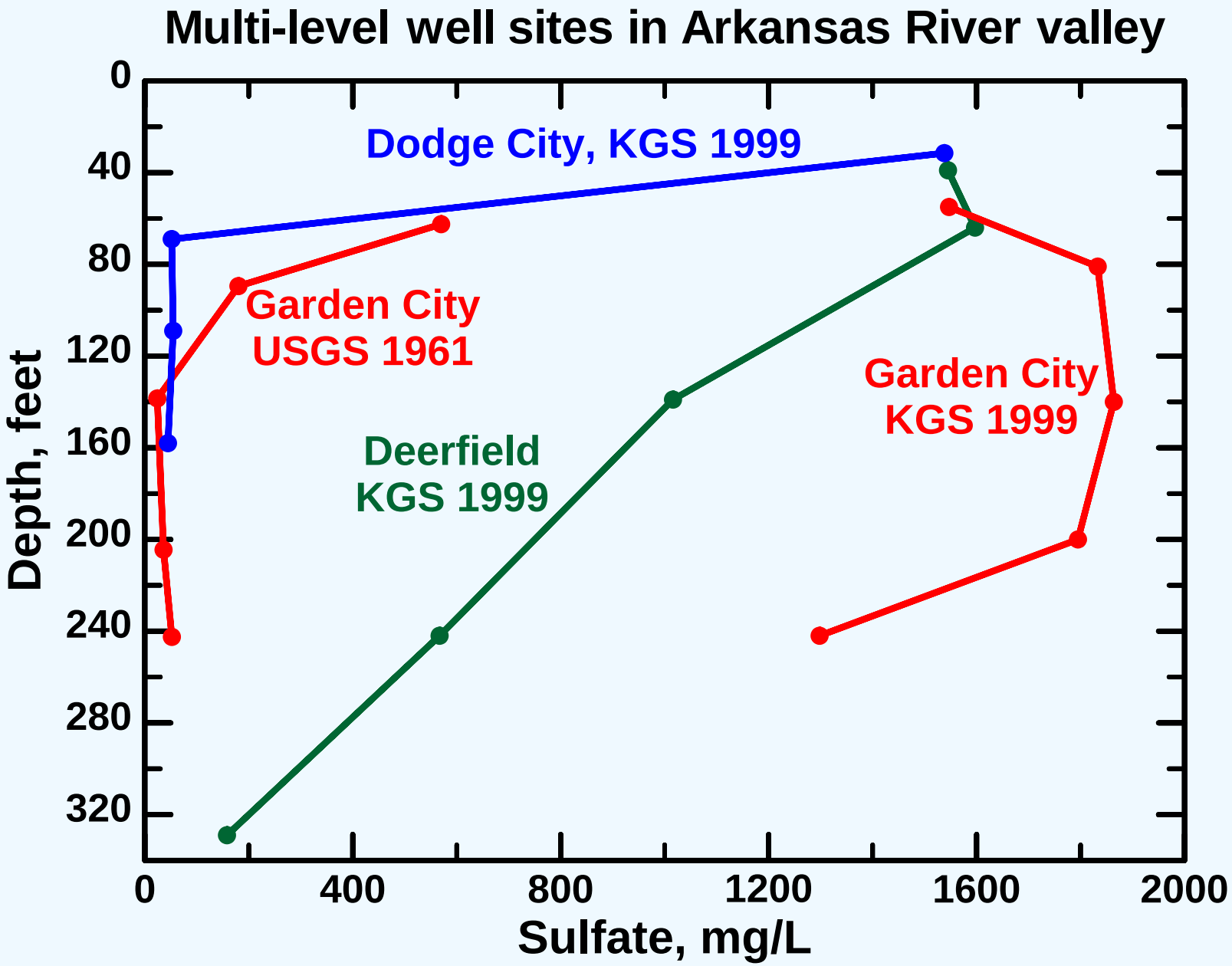

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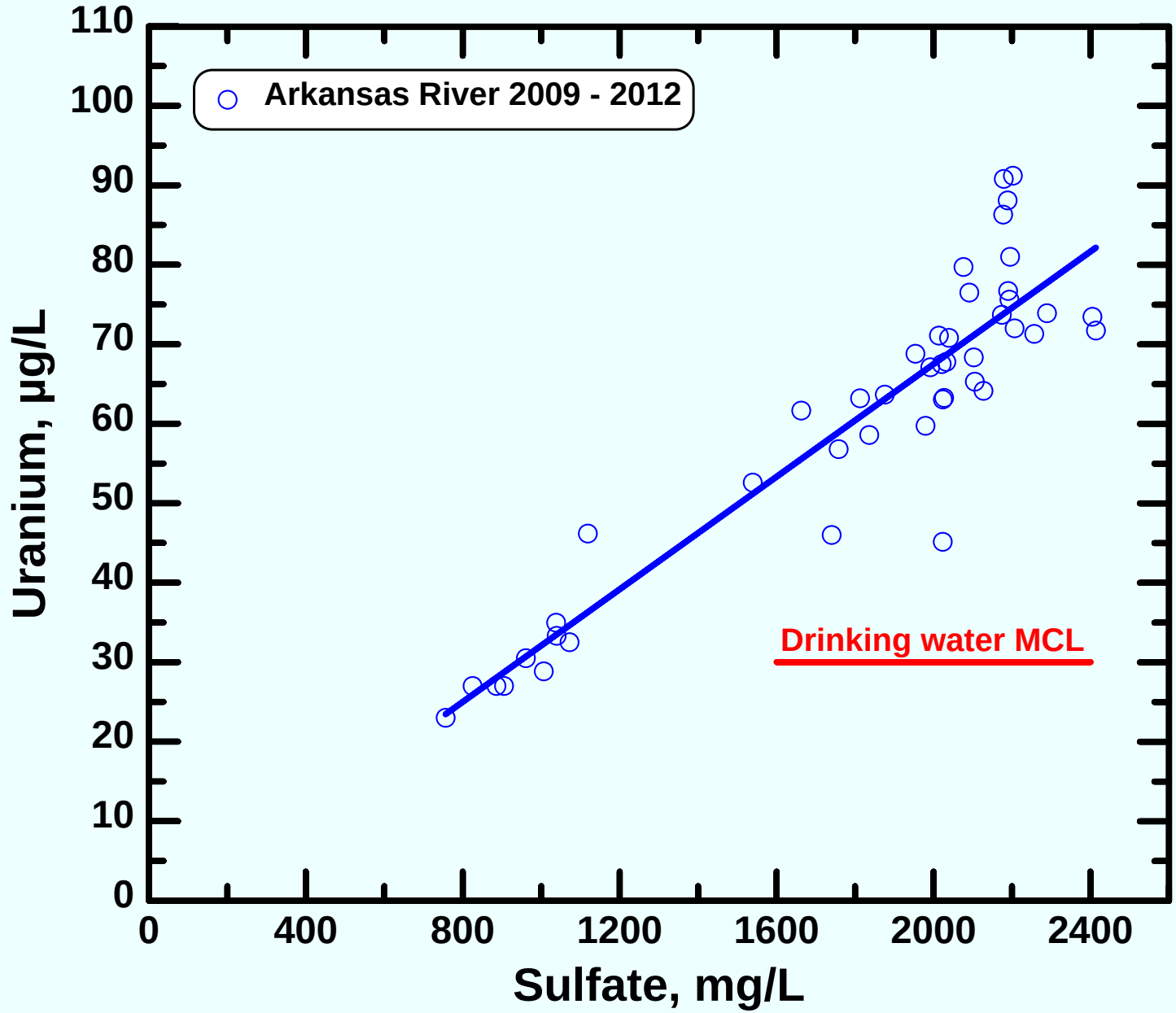
Arkansas River Water



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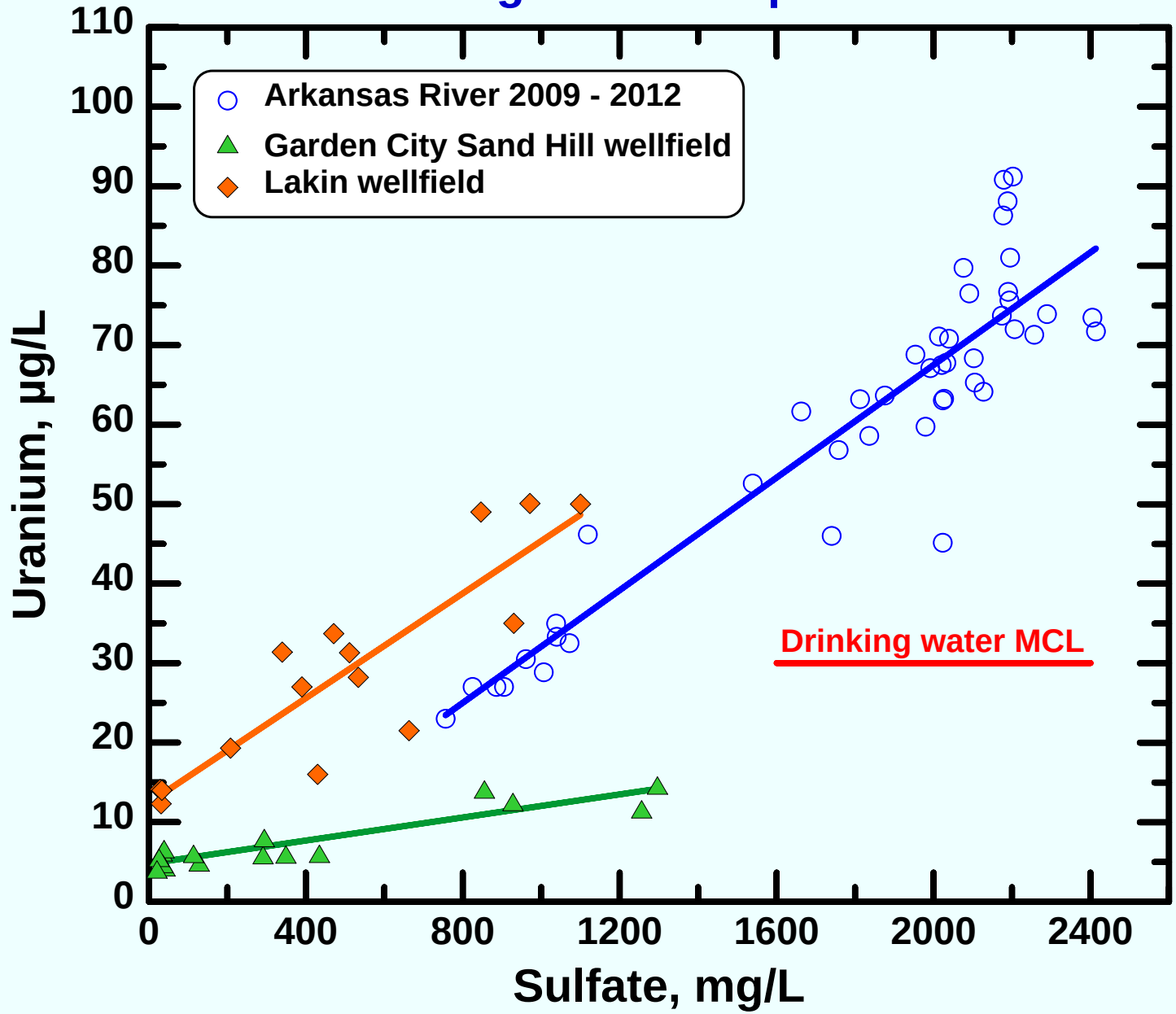
Arkansas River and High Plains Aquifer Groundwater



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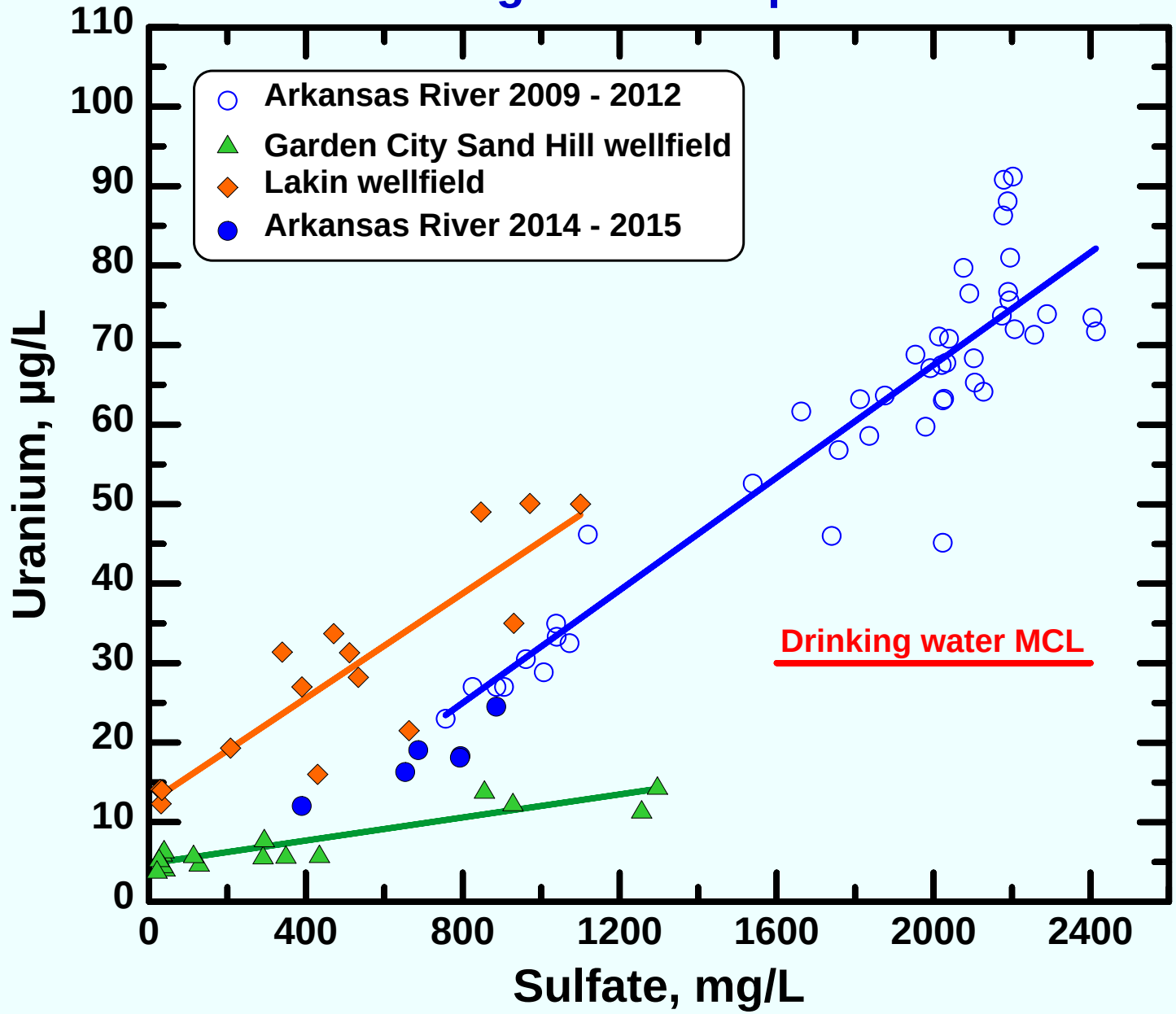

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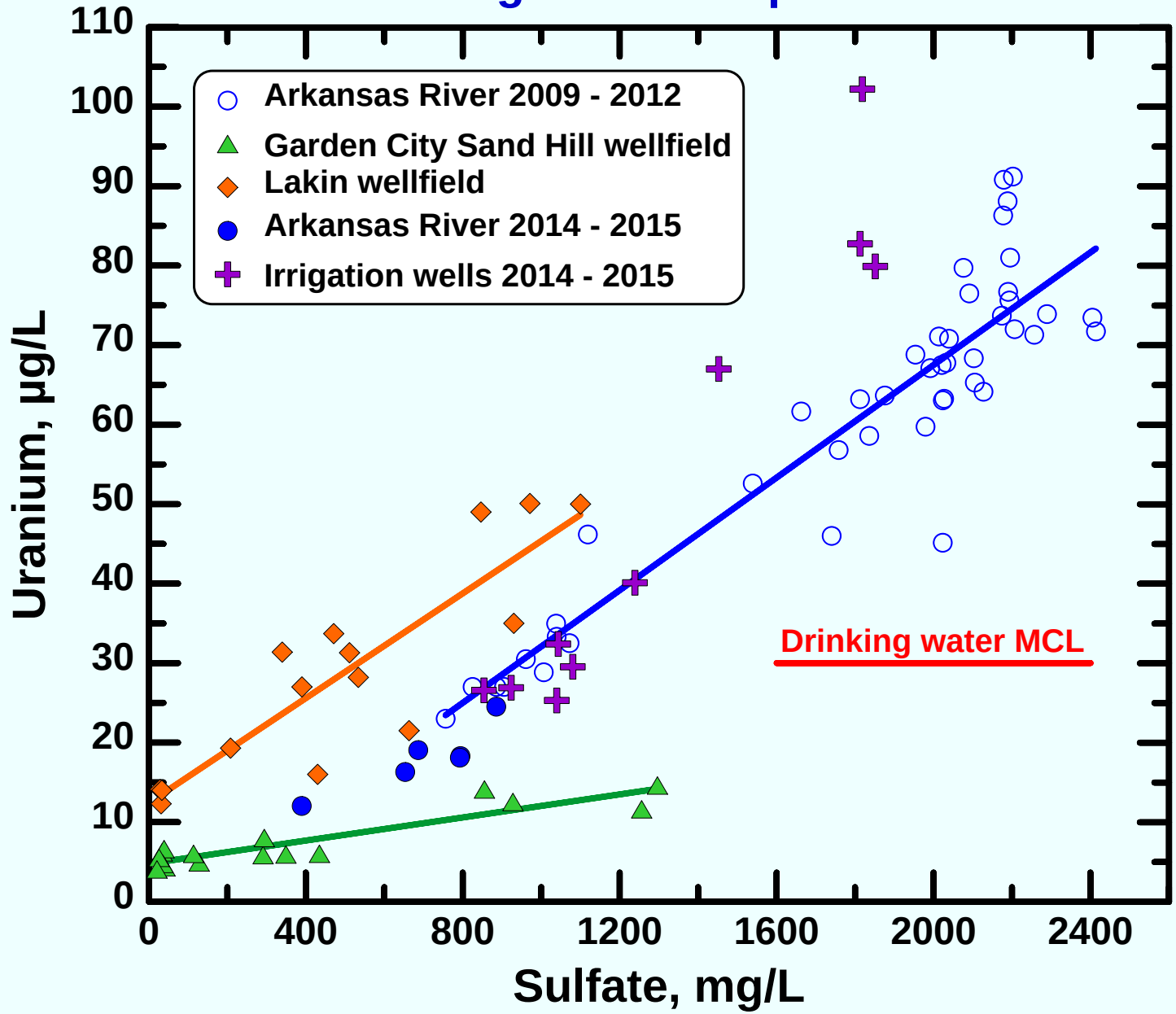
Arkansas River and High Plains Aquifer Groundwater



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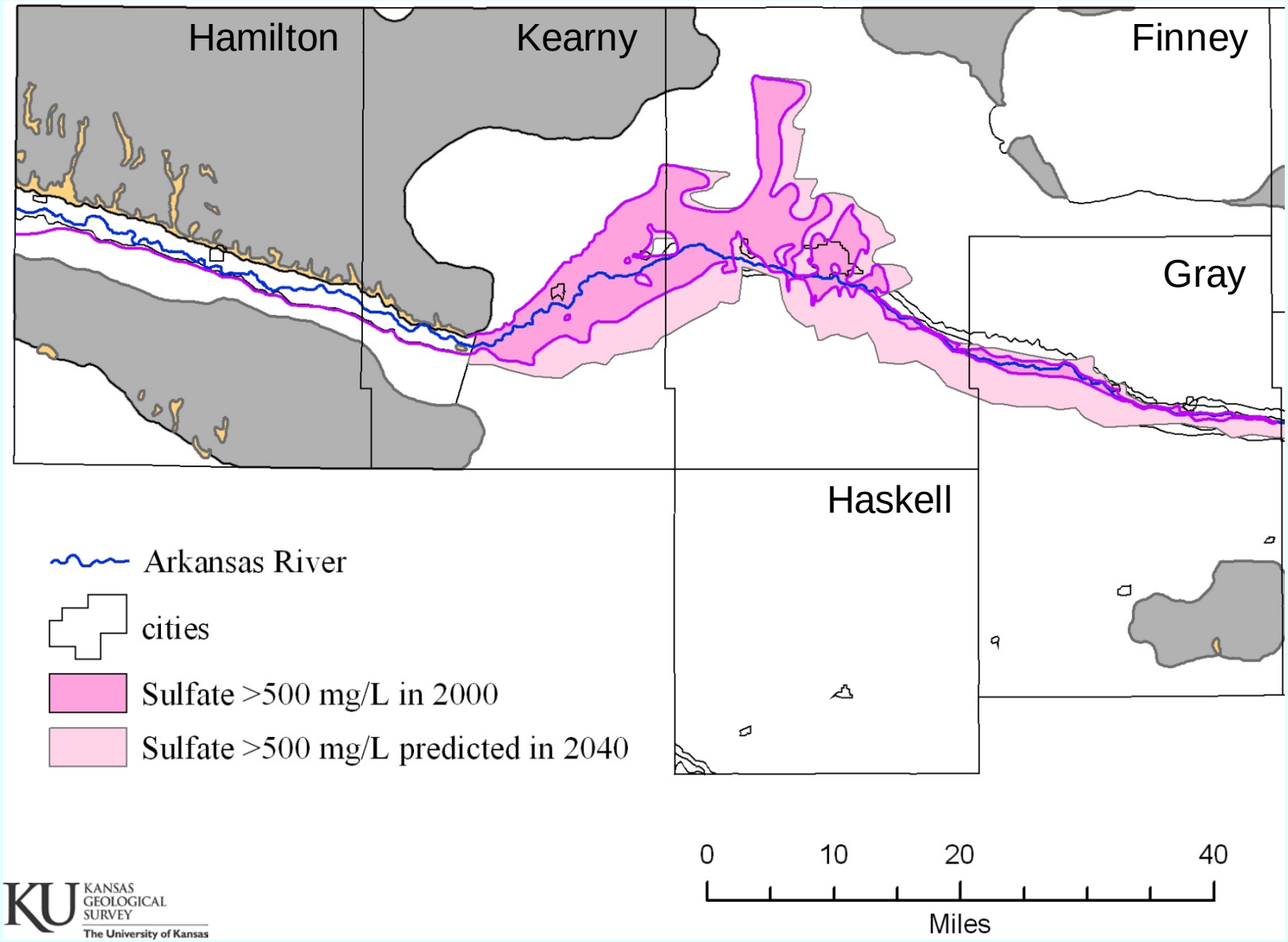
Predicted Migration of Saline Groundwater in the High Plains Aquifer from 2000 to 2040 Based on Average 1990s Use



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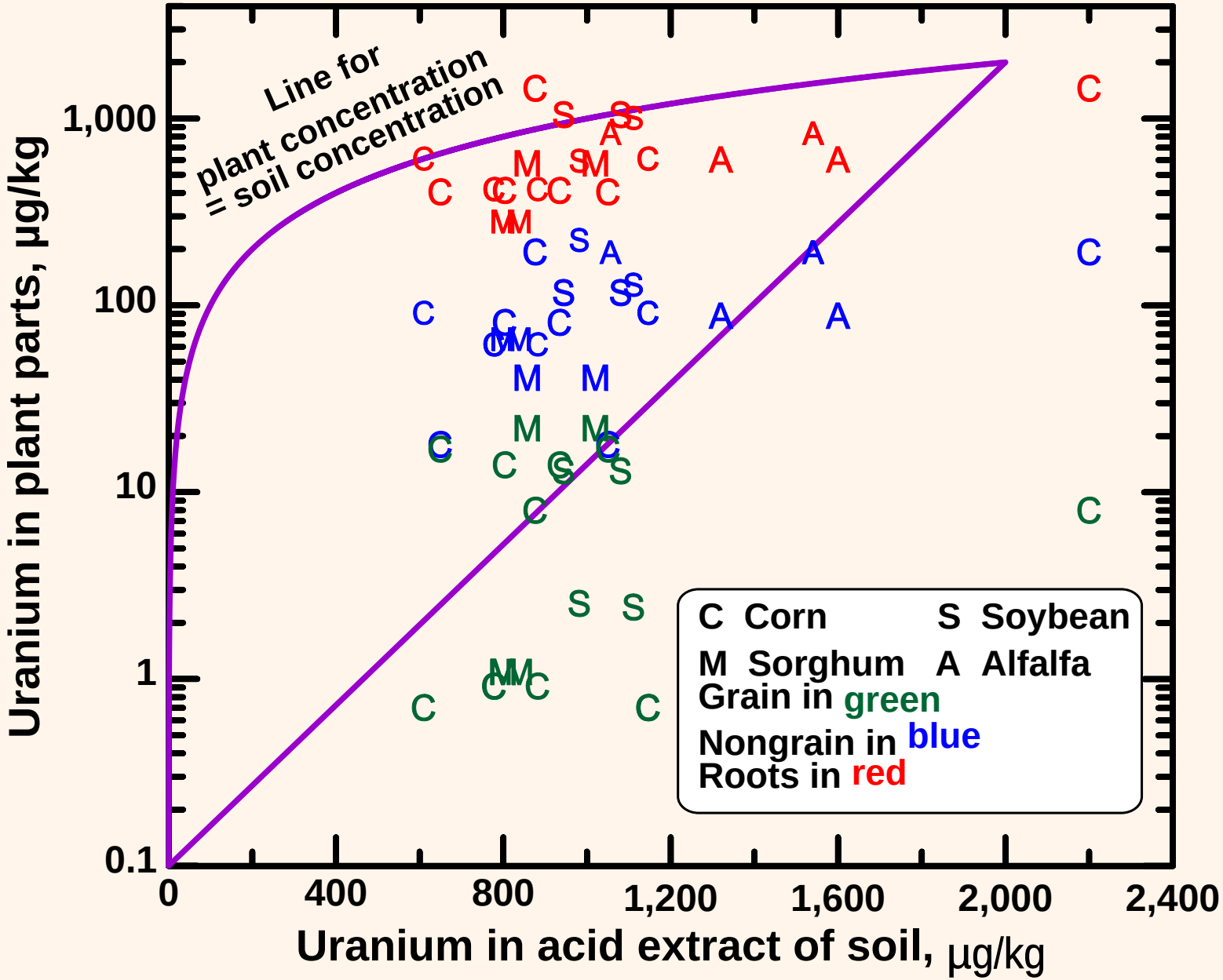
STUDY OF FATE OF URANIUM IN CROPS

- Concentration in irrigation waters
- Concentration in total soil and water and acid extracts of soil
- Concentration in different crops (corn, milo, soybean, alfalfa)
- Concentration in different parts of crops (roots, above ground nongrain, grain)



CONCLUSIONS

- Salinity and uranium are accumulating within the High Plains aquifer in the now essentially closed basin of the upper Arkansas River corridor.
- The areal and vertical distributions of salinity and uranium concentrations are related to the location of the river channel, irrigation canals, and ditch irrigation areas, and the lithology of the aquifer.
- Uranium concentrations exceed the maximum contaminant level for public supplies of drinking water in many areas of the High Plains aquifer.
- Uranium in crops in areas of saline groundwaters is highest in roots and lowest in grain, with nongrain above ground material between these parts.

ACKNOWLEDGEMENTS

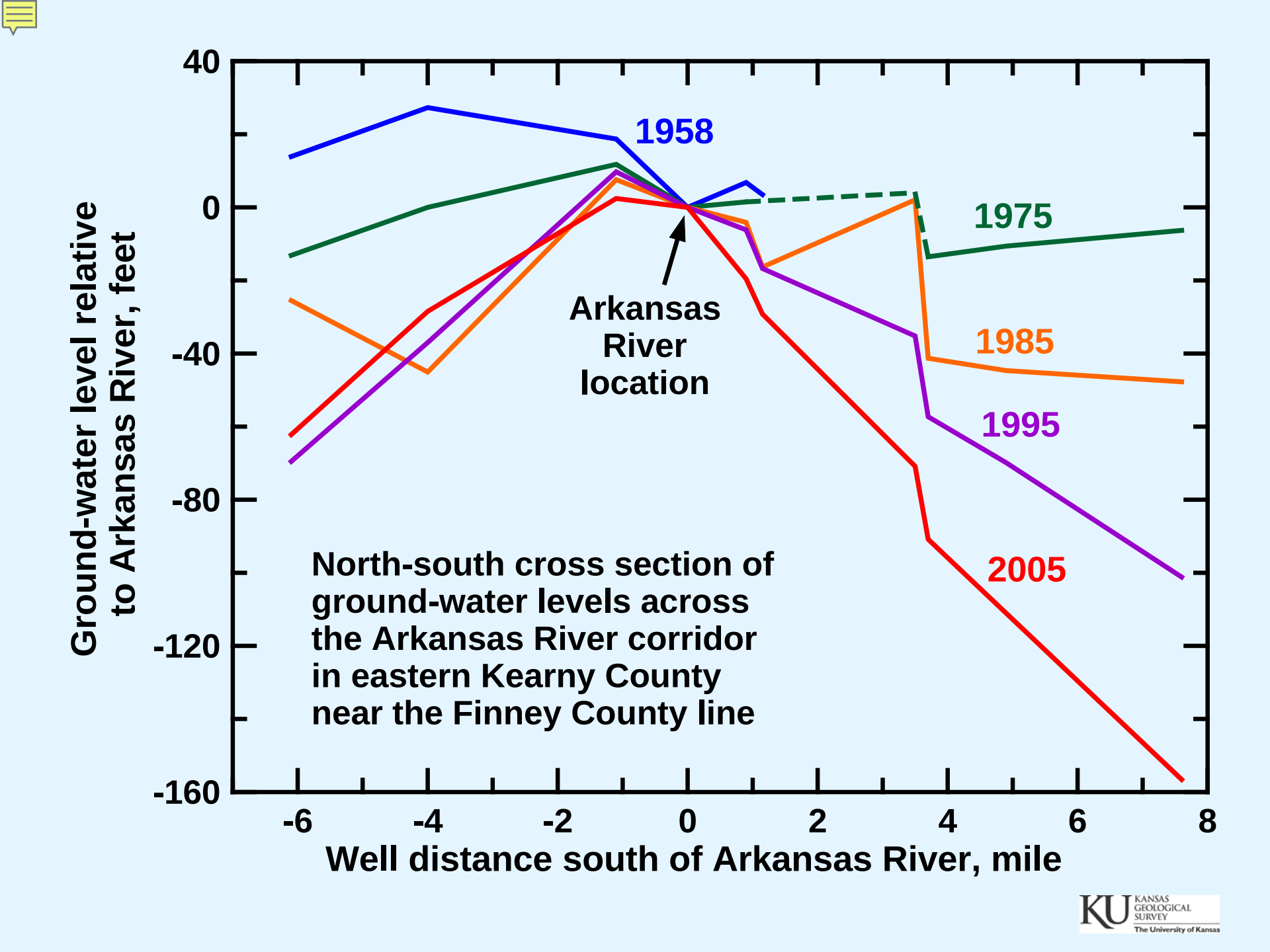
Kansas Water Plan Funding

U.S. Environmental Protection Agency Grant

Kansas Water Resources Institute Grant

GMD3 In-kind Services

QUESTIONS ?


40
0
-40
-80
-120
-160
-6
-4
-2
0
2
4
6
8
Ground-water level relative to Arkansas River, feet
Well distance south of Arkansas River, mile
1958
1975
1985
1995
2005
Arkansas River location
North-south cross section of ground-water levels across the Arkansas River corridor in eastern Kearny County near the Finney County line
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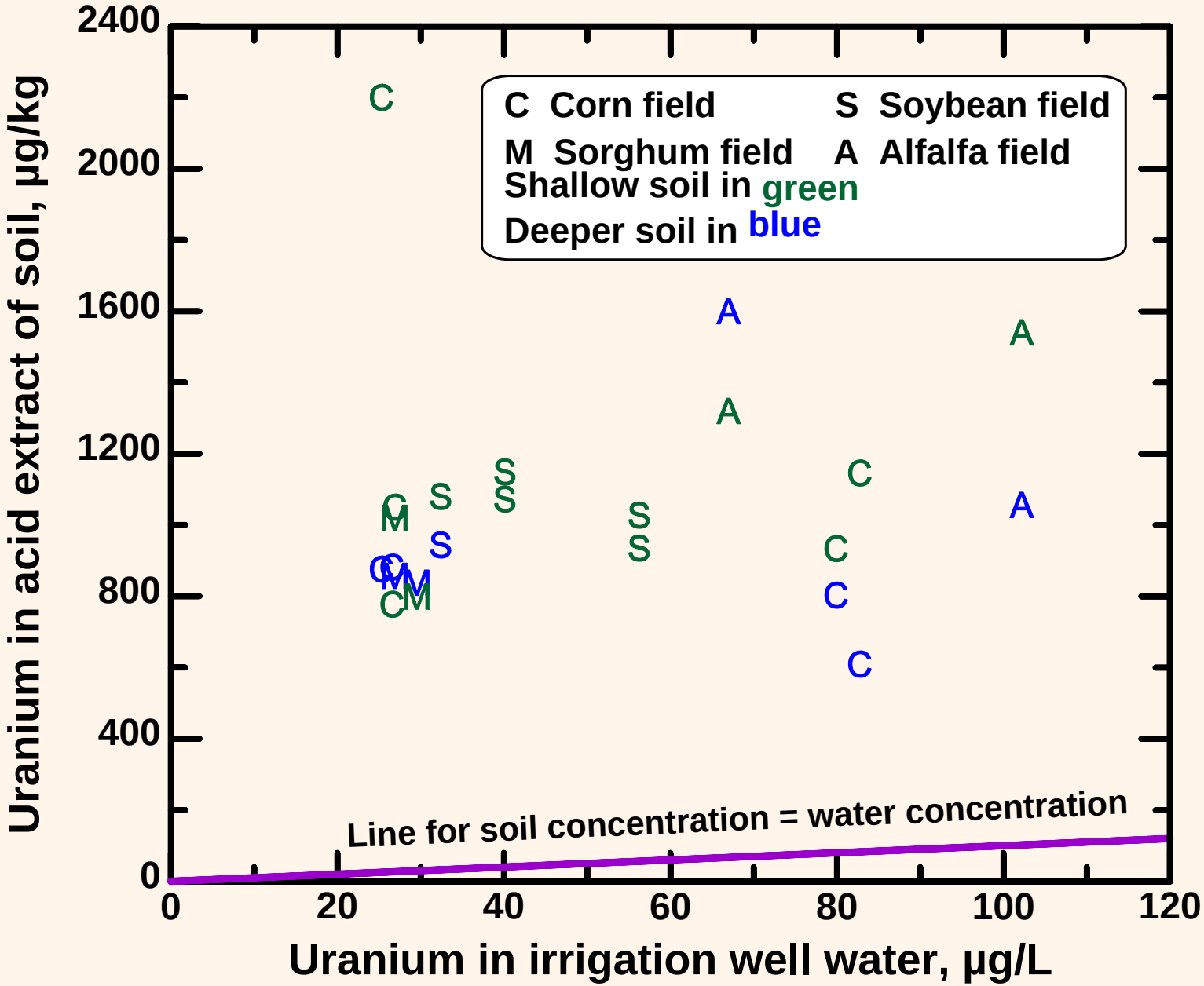

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