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GEOCHEMISTRY OF NATURAL WATERS IN THE KONZA PRAIRIE

by

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Springs occur in several limestone and dolomitic limestone units separated by shales in the main watershed of the Konza Prairie. The stratigraphic section is most of the Council Grove Group in the Gearyan Stage of the Lower Permian Series. Predominant dissolved constituents of the ground waters are calcium, magnesium, bicarbonate, and sulfate (Table 1). The waters are probably saturated with respect to calcite, and saturated or slightly undersaturated with respect to dolomite based on the data in Table 1 and field pH measurements, chemical analyses, and mineral equilibria calculations made for springs in similar carbonate aquifers in Pottawatomie County, Kansas (Whittemore and Switek, 1977). Differences in the chemistry among the different springs in the Konza Prairie are controlled mainly by the presence of thin gypsum units or small amounts of gypsum nodules or crystals within the strata. Thus, sulfate concentration shows the greatest range in samples collected during the same hydrologic conditions. Variations in the concentrations of constituents in a spring are inversely correlated with its discharge as shown by changes in sulfate in Table 2 and by Whittemore and Switek (1977) for similar springs in Pottawatomie County. These changes are caused by varying amounts of recharge from infiltrating precipitation; greater amounts of recharge dilute the ground waters resulting in lower concentrations of constituents.

The chemistry of the baseflow in the main stream largely reflects a mixture of the spring waters in the watershed (Table 1). Flows from the two springs of highest sulfate concentration are small relative to

flows from springs in the Crouse Limestone, Neva Limestone Member, and Burr Limestone Member, hence their smaller influence on the water chemistry. Higher nitrate concentrations in the spring waters from the Burr Limestone Member and the stream water might be caused by animal wastes leached in the past into ground waters in the lower part of the watershed. This would have been the location of the greatest concentration of cattle and other animals as it is the general area of the farm buildings.

The general chemical character of stream and ground waters in the Konza Prairie differs greatly from that in the Hubbard Brook Experimental Forest in New Hampshire. These differences are due principally to the relatively soluble carbonate bedrock of the Konza Prairie versus the relatively insoluble schist, granite, and glacial till of the Hubbard Brook Forest. Concentrations of calcium, magnesium, and bicarbonate are more than an order of magnitude greater, sodium and sulfate are several times to nearly an order of magnitude more, potassium and chloride a few times larger, and dissolved silica about twice as great in the Prairie than in the Forest waters. Dissolved nitrate concentrations are generally in the same range, however.

Variations in the concentrations of dissolved constituents in the stream waters of the Konza Prairie are expected to be much greater than observed for the Hubbard Brook tributaries. The primary cause is the greater difference between the total dissolved solids of the baseflow (approximately 400 mg/l) and the precipitation (generally 5-10 mg/l) than for the New Hampshire site where baseflows contained only about 20 mg/l. Secondly, the Kansas area has more variable weather with longer dry periods in which base flows become more concentrated, and generally more intense thundershowers.

Table 1.

Concentrations of Dissolved Inorganic Constituents in Surface and Ground Waters of the
Konza Prairie. All values are in mg/l except where noted. Samples were collected from
November 16 to December 7, 1979.

Type of Water	Geologic Unit ^a	Sp.C. ^b	Ca	Mg	Na	K	HCO ₃	SO ₄	Cl	NO ₃	PO ₄	F	Sr	Ba (μ g/l)	Li (μ g/l)	B (μ g/l)	I (μ g/l)	SiO ₂
Spring	Funston Limestone	580	86	20.3	8.2	0.81	343	37	2.6	-	-		1.9	112	26	55	0.8	11
Spring	Crouse Limestone	562	81	19.3	9.2	0.89	308	48	2.1	0.1	0.09	0.4	1.1	95	9	31	0.6	9.7
Spring	Middleburg Limestone Member	704	108	26.0	7.2	0.71	342	108	1.0	0.8	0.05	0.4	1.9	91	15	38	0.5	11
Spring	Eiss Limestone Member	860	133	30.2	7.7	0.66	339	197	1.5	0.7	0.04	0.4	3.6	92	17	76	0.5	12
Spring	Neva Limestone Member	663	100	21.6	7.7	0.77	339	78	2.4	0.6	0.05	0.4	1.3	123	12	40	0.6	12
Spring	Burr Limestone Member	640	95 ^c	24.7	6.1	3.5	369	50	1.0	3.0	0.10		1.7	152	14	44	1.0	11
Stream	--	717	104	24.6	9.4	0.97	390	67	5.3	4.7	0.13		3.0	137	14	46	1.0	14

^a Bedrock strata from which spring issues in order of increasing age and decreasing elevation

^b Specific conductance in μ mhos/cm at 25°C

^c Estimated

Table 2. Variation in Spring-Water Chemistry with Discharge
in the Main Watershed of the Konza Prairie

<u>Spring Location</u>	<u>Sp.C (μmho/cm)</u>	<u>SO₄ (mg/l)</u>	<u>Flow^a (liter/sec)</u>	<u>Date Collected</u>
Crouse Limestone	530	33	b	4-8-78
	562	48		12-2-79
Eiss Limestone	745	134	0.4	4-8-78
Member	860	197	0.1	11-16-79
Neva Limestone	608	43	2	4-8-78
Member	663	78	1	11-16-79

^a Visual estimate

^b Flow greater on first date of sampling

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Whittemore, D.O., J. Switek (1977) Geochemical controls on trace element concentrations in natural waters of a proposed coal ash landfill site. Contrib. No. 188, Kansas Water Resources Research Institute, Manhattan, Kansas.

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