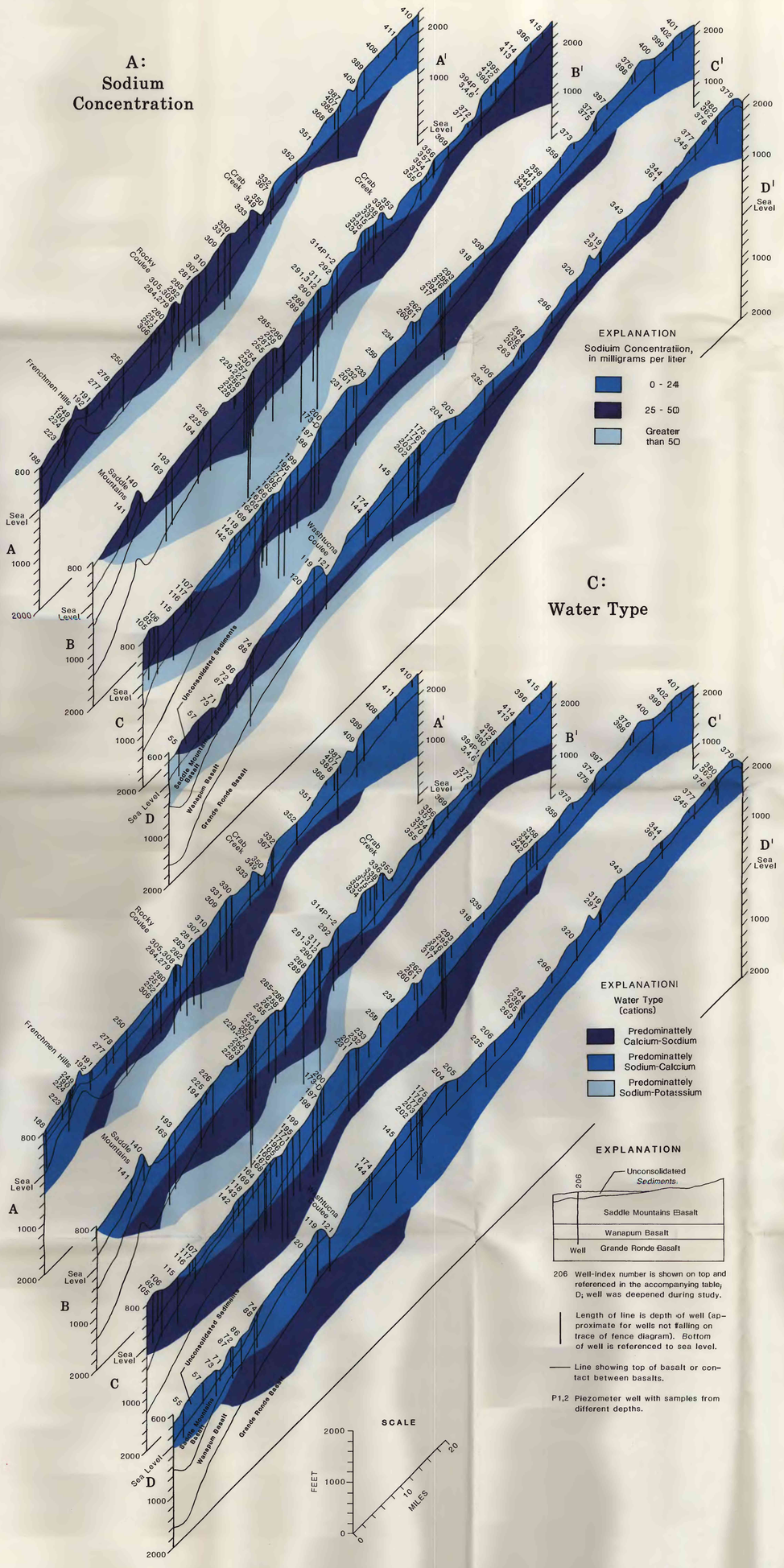
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

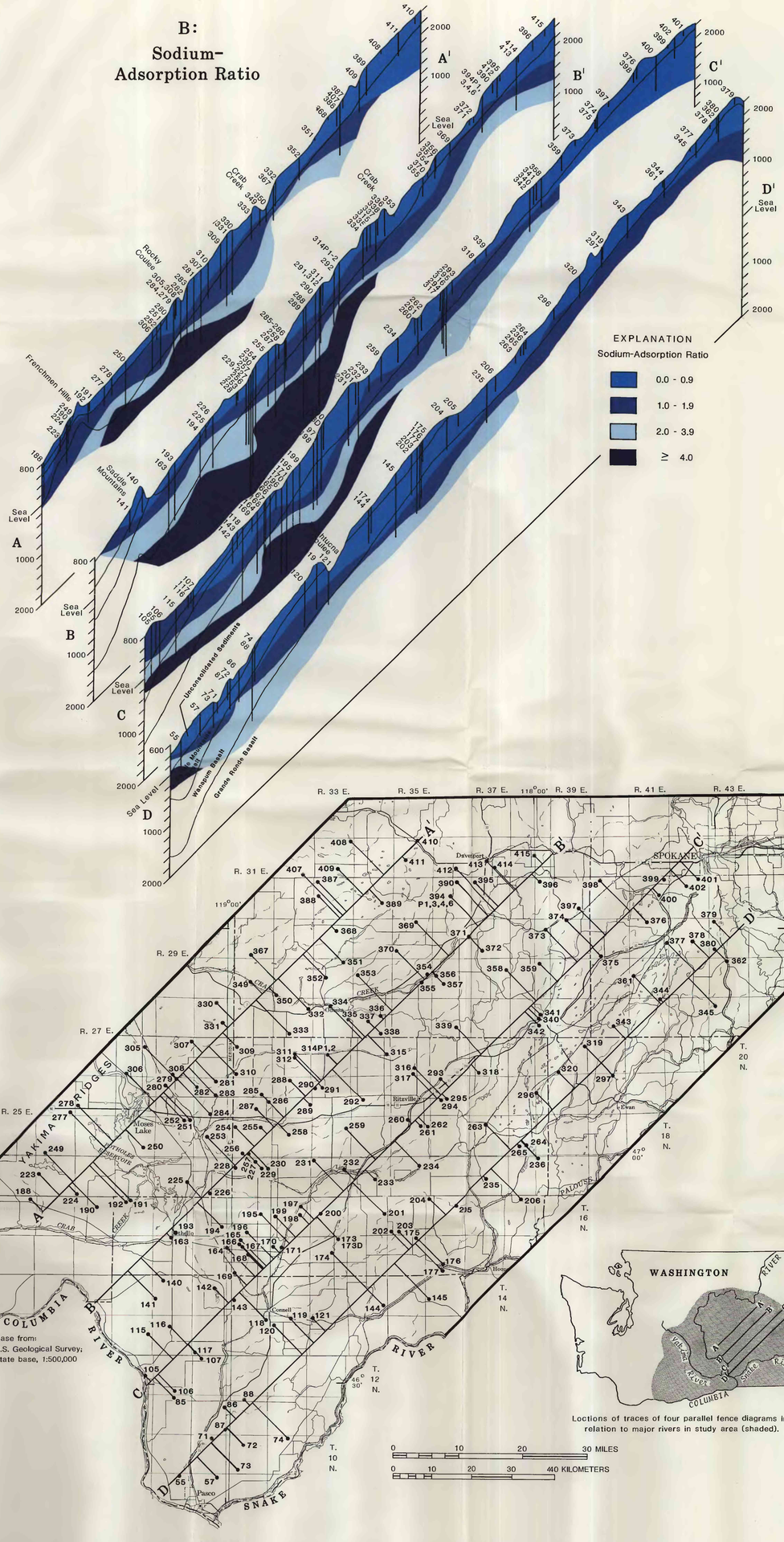
Prepared in Cooperation With
STATE OF WASHINGTON DEPARTMENT OF ECOLOGY

WATER RESOURCES INVESTIGATIONS
REPORT 85-4005 PLATE 1

A: Sodium Concentration



B: Sodium-Adsorption Ratio



C: Water Type

Loctions of traces of four parallel fence diagrams in relation to major rivers in study area (shaded).

TABLE 1.--Index numbers and data plotted on fence diagrams of regional flow path

Index map number[1]	Well Number	Geologic unit[2]	Depth (feet)	Sodium-adsorption ratio	Dissolved sodium (mg/L)	Ionic Species[3,4] Cation type	Anion type
			Fence diagram A-A'				
188	16/25E-01Q01	S/W	907	1.4	41	Ca-Na	HCO3-C1-SO4
693	17/26E-19H01	W	310	2.0	72		
694	17/27E-31D01	W/G	810	1.2	56		C1-SO4-HCO3
190	16/27E-10N01	S	250	1.0	39		HCO3-C1-SO4
269	18/26E-32C01	W	450	0.9	30		
192	16/28E-09M01	W	290	1.3	47		
191	16/26E-04A01	S	179	0.7	31		
277	19/26E-36E01	W	515	1.3	35		
278	19/27E-30N01	W	460	1.1	33	Na	
250	18/28E-26F01	W/G	801	9.0	84	Na-Ca	
306	20/28E-32K01	W/G	712	1.8	37	Na-Ca	
252	18/29E-02A01	W	270	9.7	68	Na-Ca	
251	18/29E-01A01D1	W/G	865	7.9	64	Ca-Na	
280	19/25E-08L01	W	273	0.9	27	Ca-Na	
279	19/25E-02N01	W/G	1200	5.7	67	Na	
284	19/30E-33B01	W	245	1.3	30	Ca-Na	C1-SO4
303	20/28E-11N01	W	110	0.6	19		HCO3
308	20/29E-33B01	W	112	1.0	29		C1-SO4
282	19/32E-02L01	W/G	930	13.4	78	Na	HCO3-C1-SO4
283	19/30E-15L01	W/G	1170	14.8	81		
281	19/30E-03D01	W/G	1150	9.0	79	Ca-Na	
307	20/29E-01A01	W/G	1360	1.9	39	Na-Ca	
310	20/31E-31M01	W/G	620	1.4	34	Ca-Na	
309	20/31E-07H02	W/G	800	1.7	44	Ca-Na	
331	21/30E-23J01D1	G	1330	3.6	56	Na-Ca	
330	21/30E-03D02	G	1340	2.7	50		
333	21/32E-31C01	W/G	744	1.9	44		
349	22/31E-21F01	G	100	1.2	36	Ca-Na	
350	22/32E-30D01	W/G	505	1.6	33		
329	21/32E-13H01D1	W/G	225	0.7	23		
367	23/31E-33E01	G	685	4.1	55	Na-Ca	
352	22/33E-17N01	W/G	615	3.7	54		
351	22/33E-02K01	W	165	0.6	22	Ca-Na	
368	23/33E-10A01	W	146	0.5	23		C1-SO4-HCO3
388	24/33E-18M01	W	350	0.9	18	Na-Ca	HCO3-C1-SO4
407	25/32E-35P01	G	1130	2.4	39	Ca-Na	
387	24/30E-04Q01	W	185	0.7	16		
409	25/33E-27A02	W/G	865	1.4	28		
389	24/34E-23L01	W/G	596	0.6	14		
408	25/33E-01B01	W	60	0.7	19		
411	25/35E-22D01	W	410	0.7	16		
410	25/35E-03C01D1	W	200	0.9	23		
			Fence diagram B-B'				
141	14/29E-19Q01	S	420	1.2	41	Ca-Na	HCO3-C1-SO4
140	14/29E-05A01	S	305	1.0	39	Na	
163	15/29E-04A02	W/G	1210	8.3	88	Na	
193	16/29E-34D01	W/G	1060	11.5	79	Na	
194	16/30E-26A02D1	W/G	1050	11.6	72		
225	17/29E-24C01	W	210	3.9	88	Na-Ca	
226	17/30E-33K01	W/G	1000	2.2	69	Ca-Na	
228	17/31E-07E01	W	126	1.1	45		
253	18/30E-16R01	W	185	0.9	45		C1-SO4-HCO3
256	18/31E-32R01	W/G	1260	2.2	43	Na-Ca	HCO3-C1-SO4
229	17/31E-11Q01	W/G	1130	2.0	42		
227	17/31E-03R01	W/G	1360	2.3	52		
257	18/31E-33D01	G	2400	17.0	88	Na	
230	17/31E-12D01	G	1950	8.6	68	Na-Ca	
254	18/31E-07E01D1	W/G	1160	2.6	68	Ca-Na	
255	18/31E-13E01	W/G	982	3.3	56	Na-Ca	
287	19/31E-27G01D1	W/G	1410	10.0	76	Na	
258	19/32E-16C02	W	280	3.9	51	Na-Ca	
286	19/31E-24J01	W/G	1060	5.9	83	Ca-Na	
285	19/31E-14K02	W/G	630	1.4	50	Ca-Na	C1-SO4-HCO3
289	19/32E-24N01	G	2260	25.5	89	Na	HCO3-C1-SO4
288	19/32E-04K02	W/G	710	1.4	33	Ca-Na	
290	19/33E-07R01	G	1720	5.8	59	Na-Ca	
291	19/31E-08Q02	G	2430	10.6	68	Na	HCO3
312	20/32E-19L01D2	W/G	1060	4.0	55	Na-Ca	HCO3-C1-SO4
311	20/32E-15D02	W	220	0.7	19	Ca-Na	
292	19/34E-20B02	W/G	1120	7.1	60	Na	HCO3
314-P1	20/33E-16E03	W	210	2.2	43	Na-Ca	
314-P2	20/33E-16E06	G	704	8.4	62		
334	21/33E-03K01	W/G	595	2.1	48		HCO3-C1-SO4
335	21/33E-24B01	W	180	2.0	113	Ca-Na	C1-SO4-HCO3
315	20/34E-13K01	W	340	1.7	33		HCO3-C1-SO4
337	21/34E-21K01	W/G	737	1.2	38		
338	21/34E-33A01	W	327	1.0	27		
336	21/34E-14M01	W	150	0.8	33		C1-SO4-HCO3
353	22/33E-19M01	W	45	0.9	24		HCO3-C1-SO4
355	22/35E-23E01D1	W/G	366	0.7	19		
370	23/35E-32F01	W	260	0.5	16		
354	22/35E-13H01	W	67	5.1	103	Na-Ca	
356	22/36E-19M02D1	W/G	212	0.5	11	Ca-Na	
357	22/36E-20A01	W/G	400	0.4	11		
369	23/35E-03M01D1	W/G	445	1.4	38		
371	23/36E-13A01	W	247	0.5	19		
372	23/37E-09F01	W	273	0.8	21		
394-P1	24/36E-16A02	W	160	0.5	12		
394-P3	24/36E-16A04	W	281	1.0	17		
394-P4	24/36E-16A05	W	365	5.3	38	Na-Ca	
394-P5	24/36E-16A08	W	250	2.0	40	Ca-Na	
390	24/35E-03D01	W	125	0.5	9.2	Ca-Mg	HCO3-C1-SO4
412	25/36E-27D01	W	324	0.5	15		
395	24/37E-04Q01	W	326	0.5	11	Na-Ca	
413	25/37E-21D4	G	975	3.1	45	Na	HCO3
414	25/37E-27E01	W	100	0.6	11	Ca-Na	HCO3-C1-SO4
396	24/38E-02D01	W	85	1.0	26		
415	25/38E-13A01	W	121	0.9	26		
			Fence diagram C-C'				
105	12/28E-23H01D1	S	413	3.8	62	Na-Ca	HCO3-C1-SO4
85	11/29E-03A01	S	552	4.7	31		
106	12/29E-34B01D1	S/W	997	6.5	72		
115	13/28E-13N01	W	1110	18.0	75	Na	
116	13/29E-08M01	S	456	1.7	38	Na-Ca	
107	12/30E-12Q01	S/W	458	6.5	21	Ca-Na	C1-SO4-HCO3
117	13/30E-31B01	S	285	2.2	51	Ca-Mg	HCO3-C1-SO4
142	14/30E-19P01	W	433	0.8	21	Na	
143	14/31E-19B01	S/W	1300	2.7	22	Na-Ca	
169	15/31E-01D01	G	1260	2.4	28	Ca-Na	
168	15/31E-31B01	W	304	0.4	18		C1-SO4-HCO3
164	15/30E-13L01	W/G	1320	2.7	44	Na-Ca	HCO3-C1-SO4
165	15/31E-08J01D1	W/G	1210	3.0	54		
167	15/31E-08M01	W/G	1030	4.7	67	Na	
166	15/31E-16G01	W/G	1410	9.5	78	Na	
195	16/31E-33P01	W	540	1.4	31	Ca-Na	
170	15/32E-07J01	G	1890	5.4	57	Na-Ca	
171	15/32E-04K01	W/G	1980	5.8	50	Na	
196	16/31E-14K01	W/G	1340	3.5	61	Ca-Na	
199	16/32E-19G01D2	W/G	1540	10.0	77	Na	
198	16/32E-14K01	W/G	1310	3.3	57	Na-Ca	
197	16/32E-11D01D1	W/G	1400	3.1	47	Ca-Na	
172	15/33E-02A01	W/G	830	0.7	18	Na-Ca	
173-P2	15/33E-02A01D1	W/G	1200	1.2	27	Ca-Na	
200	16/33E-17B02	W	600	0.6	15	Na	HCO3
201	17/33E-06D03	W/G	1200	2.8	41	Na-Ca	HCO3-C1-SO4
202	17/33E-13D02	W	400	0.4	9.4	Na-Ca	C1-SO4-HCO3
232	17/33E-12F02	G	1020	4.2	53	Na-Ca	HCO3-C1-SO4
233	17/34E-23D01	W	165	0.5	32	Ca-Na	HCO3
239	18/33E-12C02	W	500	1.1	24		HCO3-C1-SO4
234	17/36E-11H01D2	W	369	0.6	13		HCO3
260	18/35E-04B01	W	180	0.5	11		HCO3-C1-SO4
261	18/35E-11K01	W/G	747	1.6	33	Na-Ca	
262	18/35E-12Q01	W	256	0.6	26	Ca-Na	
317	20/35G-34M02	W	330	0.4	11		
296	19/36E-20K01D1	W/G	1020	4.1	49	Na-Ca	
316	20/35E-27A01	W/G	1260	3.1	46		
295	19/36E-21CC1D1	W/G	1280	3.9	51	Ca-Na	
293	19/36E-05Q01	W	155	1.9	67		
318	20/37E-32Q01	W	180	0.5	14		
329	21/36E-27P02	W	200	1.2	29		
342	21/38E-23L01	G	502	2.1	36	Na-Ca	HCO3
340	21/38E-14J01	W	178	0.7	16	Ca-Na	HCO3-C1-SO4
341	21/38E-14Q01	W	353	0.7	20		
358	22/37E-12C02D1	W/G	510	1.5	33		
359	22/38E-02D01D1	W	300	0.5	14		
373	23/38E-12A01	W	100	0.8	18		
375	23/40E-32H01D1	W	160	0.5	12		
374	23/39E-04K01	W/G	300	0.6	15		
397	24/39E-26K01	W	100	0.4	12		HCO3
398	24/40E-30Q1	W	50	0.4	24		HCO3-C1-SO4
376	23/41E-04F01	W	100	0.4	8.2		HCO3
400	24/41E-14D01	G	775	0.9	16		
399	24/41E-01J02	W	60	0.9	24		HCO3-C1-SO4
402	24/42E-09Q03	W	325	0.4	4.2	Ca-Mg	HCO3
401	24/42E-02E02	W	100	0.9	24	Ca-Na	HCO3-C1-SO4
			Fence diagram D-D'				
55	09/29E-02D02	S	473	8.4	90	Na	
57	09/30E-02D01	S	211	0.9	31	Ca-Na	HCO3-C1-SO4
73	10/31E-32L02	S	350	1.1	29		
71	10/30E-03Q01	S	230	1.0	35		
87	11/30E-36M01	S	237	0.6	26		
86	11/30E-12Q01	S/W	410	3.4	80	Na-Ca	
72	10/31E-09D01	S/W	310	0.9	31	Ca-Na	
88	11/31E-04F01	W	1310	2.4	46	Na-Ca	
74	10/32E-03N01	W	540	1.8	61	Ca-Na	C1-SO4-HCO3
100	13/32E-07E02	W	652	0.7	18		HCO3-C1-SO4
119	13/32E-03C01	W	300	2.1	50	Na-Ca	
121	13/33E-06N01D1	W/G	380	1.2	72	Ca-Na	
144	14/34E-25P01D1	W	220	1.0	40		
174	15/33E-19M02	W	480	0.4	15		
145	14/36E-19N01	W/G	940	2.3	81		HCO3
202	16/35E-31H01	W/G	600	1.3	12		HCO3-C1-SO4
203	16/35E-32N01D1	W/G	1100	0.5	12		HCO3
177	15/36E-33A02	W	510	1.4	39		HCO3-C1-SO4
176	15/36E-28W01D1	W/G	380	1.6	47		HCO3
175	15/35E-02Q01	W	342	1.2	26		HCO3-C1-SO4
204	16/36E-06E02	W/G	560	0.4	13		
205	16/36E-11M01D1	W	200	0.3	8.3		
235	17/37E-21G01	W/G	755	2.6	39	Na-Ca	
206	16/38E-04B01D1	W	300	5.2	40	Ca-Na	
263	18/37E-09C02	W	294	0.6	15		
265	18/38E-29D01	W	125	0.4	8.9		
236	17/38E-02X01	W	140	0.5	18		
264	18/38E-28N02	W	155	0.4	9.0		
296	19/38E-14K02	W	200	1.2	28		
320	20/39E-32A01D1	W/G	363	1.3	33		
319	20/39E-12M02	W	284	0.6	13		HCO3
297	19/40E-02B01	W/G	423	1.3	28		HCO3-C1-SO4
343	21/40E-27N01	W/G	400	1.1	23		
361	22/41E-18D01D1	W	196	0.6	15		HCO3-C1-SO4
344	21/41E-02Q01	W/G	450	1.1	27		HCO3
345	21/43E-07L01	W	225	0.5	10		
377	23/41E-24P02D1	G	300	0.6	20		
378	23/42E-22A01	W	52	0.4	7.5		HCO3-C1-SO4
380	22/43E-04F02	W/G	566	1.1	22		HCO3
362	23/43E-30K03	W	365	0.7	15		
379	23/43E-06Q01	W	125	0.4	8.1		

[1]Underscore indicates well with corresponding data that do not conform to shaded zone indicated on map.

[2]Symbols for formations are G, Grande Ronde Basalt; W, Wanapum Basalt; and S, Saddle Mountains Basalt.

[3]Ionic species, adapted from Back (1961):

Ionic species	Percentage of constituents, in equivalents per million			
	Ca+Mg	Na+K	HCO3+CO3	Cl+SO4
Cation type:				
Calcium plus magnesium	90-100	0-10	--	--
Calcium plus sodium	50-90	10-50	--	--
Sodium plus calcium	10-50	50-90	--	--
Sodium plus potassium	0-10	90-100	--	--
Anion type:				
Bicarbonate	--	--	90-100	0-10
Bicarbonate plus chloride plus sulfate	--	--	50-90	10-50
Chloride plus sulfate plus bicarbonate	--	--	10-50	50-90
Chloride plus sulfate	--	--	0-10	90-100

Symbols: Ca, calcium; Mg, magnesium; Na, sodium; K, potassium; HCO3, bicarbonate; CO3, carbonate; Cl, chloride; SO4, sulfate.

[4]Asterisk indicates no data available.

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PLATE 1.--FENCE DIAGRAMS SHOWING VARIATION OF SODIUM CONCENTRATION, SODIUM-ADSORPTION RATIO, AND WATER TYPE IN BASALT AQUIFERS, COLUMBIA PLATEAU, WASHINGTON.