

Sample	Fn/Mbr	Age	Stable mineral ratios								
			ZTR	GZi	Total	RZi	Total	ATi	Total	CZi	Total
CR20	Colorado River	Recent	21.7	44.2	380	4.5	222	64.6	198	0.0	212
CR22	Colorado River	Recent	14.1	42.9	366	7.1	225	60.1	213	0.0	209
CR23	Colorado River	Recent	11.6	51.1	235	10.4	222	65.4	228	0.0	199
B1	Alverson	E-M Mio.	10.5	90.9	66	71.4	21	77.1	35	0.0	6
B2	Alverson	M-L Mio.	6.0	96.1	128	82.8	29	80.0	35	0.0	5
B3	Elephant Trees	M-L Mio.	12.0	92.7	109	83.7	49	69.2	13	0.0	8
B4	Elephant Trees	M-L Mio.	14.0	95.1	81	92.6	54	75.0	16	0.0	4
B5	Lycium	L Mio.	13.8	90.8	141	75.9	54	66.7	15	0.0	13
B6	Lycium	L Mio.	22.7	85.7	98	85.1	94	40.0	5	0.0	14
B7	Lycium	L Mio.	14.7	84.8	92	73.6	53	77.8	36	0.0	14
WC 2	U. Megabreccia	L Mio.	97.3	23.1	13	94.3	174	0.0	5	0.0	10
WC1	Wind Caves	E Plio.	8.3	90.4	239	71.5	137	83.9	149	0.0	39
14-5	Wind Caves	E Plio.	17.9	59.5	173	7.9	76	82.7	52	0.0	70
14-3	Wind Caves	E Plio.	10.0	92.6	27	77.8	9	92.0	25	0.0	2
14-2	Wind Caves	E Plio.	11.5	87.9	33	66.7	12	94.4	36	0.0	4
16-2	Wind Caves	E Plio.	16.8	88.5	148	75.0	68	100.0	8	0.0	17
17-2	Wind Caves	E Plio.	7.4	90.8	130	53.8	26	90.6	53	0.0	12
17-3	Wind Caves	E Plio.	4.5	93.7	63	66.7	12	93.8	16	0.0	4
13-5	Wind Caves	E Plio.	39.0	59.2	174	0.0	71	NA	0	0.0	71
17-4	Wind Caves	E Plio.	20.2	62.1	182	4.2	72	79.0	62	0.0	69
17-7	Wind Caves	E Plio.	13.5	75.3	170	8.7	46	86.0	57	0.0	42
17-9	Wind Caves	E Plio.	20.8	63.2	182	4.3	70	83.1	77	0.0	67
18-5a	Wind Caves	E Plio.	16.7	70.0	210	3.1	65	87.3	63	0.0	63
18-6	Wind Caves	E Plio.	24.5	60.1	293	4.9	123	82.2	101	0.0	117
18-7	Wind Caves	E Plio.	16.0	71.9	185	5.5	55	84.0	81	0.0	52
18-10	Wind Caves	E Plio.	17.3	69.1	207	4.5	67	80.0	80	0.0	64
18-11	Wind Caves	E Plio.	13.6	77.9	231	3.8	53	80.8	73	0.0	51
18-12	Wind Caves	E Plio.	14.1	78.3	161	12.5	40	71.7	60	0.0	35
18-15	Wind Caves	E Plio.	7.6	87.2	133	10.5	19	83.0	100	0.0	17
18-16	Wind Caves	E Plio.	16.5	75.2	234	7.9	63	69.5	95	1.7	59
18-17	Wind Caves	E Plio.	13.6	77.8	189	12.5	48	85.7	56	0.0	42
19-14	Wind Caves	E Plio.	6.9	88.3	154	0.0	18	81.6	38	0.0	18
25-11	Wind Caves	E Plio.	14.9	78.4	134	12.1	33	65.4	78	0.0	29
Mh4b	Mud Hills	E Plio.	35.1	62.6	420	7.6	170	78.6	56	0.0	157
Mh5a	Mud Hills	E Plio.	21.2	87.9	232	57.9	228	87.3	204	0.0	96
Mh5b	Mud Hills	E Plio.	16.9	72.9	229	19.5	77	78.1	178	0.0	62
25-2a	Mud Hills	E Plio.	21.0	67.1	82	0.0	27	80.9	262	0.0	27
Yh 7	Yuha	E Plio.	34.6	62.5	325	2.7	258	80.6	211	0.0	251
Yh 8	Yuha	E Plio.	5.8	84.3	236	13.7	139	81.0	200	0.0	120
Yh9	Yuha	E Plio.	33.8	52.9	293	3.5	143	76.8	56	0.0	138
Ch10	Camel's head	E Plio.	15.3	68.0	384	3.7	187	69.9	136	0.0	180
Ch11	Camel's head	E Plio.	11.1	88.4	225	15.8	76	81.5	222	0.0	64
Db12	Camel's head	E Plio.	15.4	76.8	155	10.0	40	77.3	97	0.0	36
Db 13	Diablo	M Plio.	0.0	88.4	225	15.8	76	81.5	222	0.0	64
Db14	Diablo	M Plio.	6.2	68.1	279	4.5	223	81.3	187	0.0	213
25-8b	Olla	M Plio.	11.0	98.0	50	92.3	13	42.6	54	0.0	1
25-8c	Olla	M Plio.	7.0	98.6	220	75.0	12	57.6	59	0.0	3
25-9a	Olla	M Plio.	4.2	95.1	82	42.9	7	70.6	34	0.0	4
25-9b	Olla	M Plio.	11.9	71.4	112	3.0	33	67.4	46	0.0	32
26-1a	Olla	M Plio.	5.9	85.4	82	0.0	12	86.1	108	0.0	12
26-1b	Olla	M Plio.	19.4	11.9	84	3.9	77	71.4	7	0.0	74
26-3	Olla	M Plio.	4.7	88.1	268	11.9	84	69.9	196	0.0	74
CC16	Canebrake	M Plio.	10.8	90.6	234	41.5	123	61.1	208	0.0	72
Hu17	Hueso	L Plio.	9.1	87.8	320	41.7	108	62.5	184	0.0	63
BF 24	Bouse	L Mio.	3.9	45.0	189	25.2	139	97.7	220	0.0	104
BF 27	Bouse	L Mio.	0.0	53.0	66	35.4	48	93.8	80	0.0	31
150-1	name unknown	Pal. (?)	16.0	62.1	240	13.3	105	94.2	479	51.6	188
150-2	name unknown	Pal. (?)	10.5	79.1	172	20.0	45	69.2	13	5.3	38
2116	San Francisquito	Pal. (?)	34.0	56.3	327	0.0	143	97.4	77	0.0	143
2101	Coldwater	L Pal/Eoc.	5.7	48.6	288	3.4	207	92.3	222	0.0	200
2102	Sespe	Eoc-E. Mio.	6.3	70.4	216	6.4	110	97.0	201	0.0	103
2103	Sespe	Eoc-E. Mio.	7.9	80.5	87	5.6	18	87.5	56	0.0	17
2110	Sespe	E-M. Mio.	6.7	78.0	291	12.8	94	83.4	205	0.0	82
2108	Topanga	M. Mio.	5.0	71.2	198	6.6	61	89.5	153	0.0	57
2111	Topanga	M. Mio.	3.3	83.0	47	0.0	8	91.2	68	0.0	8

Appendix 2. Stable mineral ratios of sand and sandstone samples from southwestern North America

Sample	Fm/Mbr	Age	ZTR	GZi	Total	RZi	Total	ATi	Total	CZi	Total
2112	Topanga	M. Mio.	6.5	74.2	221	12.3	65	93.8	210	0.0	57
OT12	Topanga	M. Mio.	5.4	71.5	267	8.5	141	89.9	217	0.0	129
2100	Topanga	M. Mio.	17.2	71.5	239	8.1	74	93.7	285	0.0	68
2115	Punchbowl	M-L. Mio.	3.3	42.1	19	0.0	11	72.7	11	0.0	11

Appendix 2 (continued). Stable mineral ratios of 69 Palaeocene-Recent sand and sandstone samples from southwestern North America. ZTR - zircon-rutile-tourmaline Index, GZi - garnet/zircon index, RZi - rutile/zircon index, ATi - apatite/tourmaline index, CZi - chrome-spinel/zircon index.

0.0 #DIV/0! 0 0.0 1 #DIV/0! 0 0.0 1

CR???

46.6 63.3 215 15.1 93 15.1 86 0.0 79

Total grains	Total mineral pairs				ZTR index
	G+Z	R+Z	A+T	C+Z	
437	113	65	70	63	21.7
547	69	46	76	41	14.1
484	67	37	42	31	11.6
277	66	21	35	6	10.5
596	128	29	35	5	6.0
442	109	49	13	8	12.0
415	81	54	16	4	14.0
427	141	54	15	13	13.8
428	98	94	5	14	22.7
416	92	53	36	14	14.7
184	13	174	5	10	97.3
408	78	28	31	6	8.3
476	173	76	52	70	17.9
110	27	9	25	2	10.0
122	33	12	36	4	11.5
404	148	68	8	17	16.8
417	130	26	53	12	7.4
288	63	12	16	4	4.5
182	174	71	0	71	39.0
421	182	72	62	69	20.2
400	170	46	57	42	13.5
400	182	70	77	67	20.8
438	210	65	63	63	16.7
576	293	123	101	117	24.5
426	185	55	81	52	16.0
481	207	67	80	64	17.3
493	231	53	73	51	13.6
405	161	40	60	35	14.1
471	133	19	100	17	7.6
559	234	63	95	59	16.5
413	189	48	56	42	13.6
360	154	18	38	18	6.9
403	134	33	78	29	14.9
519	420	170	56	157	35.1
514	232	88	159	28	21.2
687	229	77	178	62	16.9
367	82	27	262	27	21.0
413	325	125	81	122	34.6
566	85	18	63	16	5.8
462	293	143	56	138	33.8
502	181	59	48	57	15.3
398	81	21	117	15	11.1
403	155	40	97	36	15.4
409	193	84	33	79	0.0
405	63	19	32	19	6.2
400	50	13	54	1	11.0
530	220	12	59	3	7.0
401	82	7	34	4	4.2
402	112	33	46	32	11.9
458	82	12	108	12	5.9
408	84	77	7	74	19.4
443	115	19	28	14	4.7
425	134	24	53	10	10.8
463	120	29	47	14	9.1
507	29	18	56	16	3.9
464	21	8	20	7	0.0
833	240	105	479	188	16.0
465	172	45	13	38	10.5
426	327	143	77	143	34.0
424	38	22	43	22	5.7
429	66	27	74	27	6.3
318	87	18	56	17	7.9
416	88	21	47	19	6.7
401	38	13	20	12	5.0
418	47	8	68	8	3.3

480	75	21	153	19	6.5
425	57	20	33	19	5.4
536	239	74	285	68	17.2
426	19	11	11	11	3.3

0	0	0	0	0	0.0
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356	215	93	86	79	46.6
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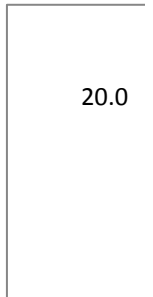
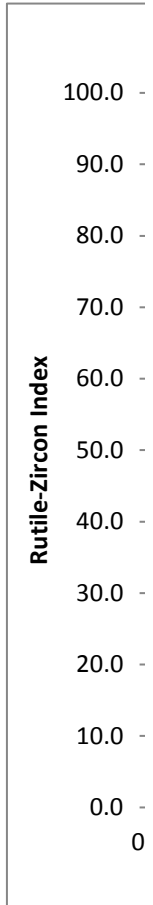
GZi	Stable mineral Ratios				Extra counts	
	RZi	ATi	CZi		Garnet	Zircon
	44.2	4.5	64.6	0.0	168	212
	42.9	7.1	60.1	0.0	157	209
	51.1	10.4	65.4	0.0	120	115
	90.9	71.4	77.1	0.0	60	6
	96.1	82.8	80.0	0.0	123	5
	92.7	83.7	69.2	0.0	101	8
	95.1	92.6	75.0	0.0	77	4
	90.8	75.9	66.7	0.0	128	13
	85.7	85.1	40.0	0.0	84	14
	84.8	73.6	77.8	0.0	78	14
	23.1	94.3	0.0	0.0	3	10
	90.4	71.5	83.9	0.0	216	23
	59.5	7.9	82.7	0.0	103	70
	92.6	77.8	92.0	0.0	25	2
	87.9	66.7	94.4	0.0	29	4
	88.5	75.0	100.0	0.0	131	17
	90.8	53.8	90.6	0.0	118	12
	93.7	66.7	93.8	0.0	59	4
	59.2	0.0	#DIV/0!	0.0	103	71
	62.1	4.2	79.0	0.0	113	69
	75.3	8.7	86.0	0.0	128	42
	63.2	4.3	83.1	0.0	115	67
	70.0	3.1	87.3	0.0	147	63
	60.1	4.9	82.2	0.0	176	117
	71.9	5.5	84.0	0.0	133	52
	69.1	4.5	80.0	0.0	143	64
	77.9	3.8	80.8	0.0	180	51
	78.3	12.5	71.7	0.0	126	35
	87.2	10.5	83.0	0.0	116	17
	75.2	7.9	69.5	1.7	176	58
	77.8	12.5	85.7	0.0	147	42
	88.3	0.0	81.6	0.0	136	18
	78.4	12.1	65.4	0.0	105	29
	62.6	7.6	78.6	0.0	263	157
	87.9	57.9	87.3	0.0	204	28
	72.9	19.5	78.1	0.0	167	62
	67.1	0.0	80.9	0.0	55	27
	62.5	2.7	80.6	0.0	203	122
	84.3	13.7	81.0	0.0	199	37
	52.9	3.5	76.8	0.0	155	138
	68.0	3.7	69.9	0.0	261	123
	88.4	15.8	81.5	0.0	199	26
	76.8	10.0	77.3	0.0	119	36
	88.4	15.8	81.5	0.0	199	26
	68.1	4.5	81.3	0.0	190	89
	98.0	92.3	42.6	0.0	49	1
	98.6	75.0	57.6	0.0	217	3
	95.1	42.9	70.6	0.0	78	4
	71.4	3.0	67.4	0.0	80	32
	85.4	0.0	86.1	0.0	70	12
	11.9	3.9	71.4	0.0	10	74
	88.1	11.9	69.9	0.0	236	32
	90.6	41.5	61.1	0.0	212	22
	87.8	41.7	62.5	0.0	281	39
	45.0	25.2	97.7	0.0	85	104
	53.0	35.4	93.8	0.0	35	31
	62.1	13.3	94.2	51.6	149	91
	79.1	20.0	69.2	5.3	136	36
	56.3	0.0	97.4	0.0	184	143
	48.6	3.4	92.3	0.0	140	148
	70.4	6.4	97.0	0.0	152	64
	80.5	5.6	87.5	0.0	70	17
	78.0	12.8	83.4	0.0	227	64
	71.2	6.6	89.5	0.0	141	57
	83.0	0.0	91.2	0.0	39	8

74.2	12.3	93.8	0.0	164	57
71.5	8.5	89.9	0.0	191	76
71.5	8.1	93.7	0.0	171	68
42.1	0.0	72.7	0.0	8	11

#DIV/0!	0.0	#DIV/0!	0.0	0	0
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63.3	15.1	15.1	0.0	136	79
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Zircon	Rutile	CS	Apatite	Tourmaline		
212	10	0	128	70		
209	16	0	128	85	3	
199	23	0	149	79		
6	15	0	27	8		
5	24	0	28	7		
8	41	0	9	4		
4	50	0	12	4		
13	41	0	10	5		
14	80	0	2	3		
14	39	0	28	8		
10	164	0	0	5		
39	98	0	125	24		
70	6	0	43	9		
2	7	0	23	2		
4	8	0	34	2		
17	51	0	8	0		
12	14	0	48	5		
4	8	0	15	1		
71	0	0	0	0		
69	3	0	49	13		
42	4	0	49	8		
67	3	0	64	13		
63	2	0	55	8		
117	6	0	83	18		
52	3	0	68	13		
64	3	0	64	16		
51	2	0	59	14		
35	5	0	43	17		
17	2	0	83	17		
58	5	1	66	29		
42	6	0	48	8		
18	0	0	31	7		
29	4	0	51	27		
157	13	0	44	12		
96	132	0	178	26	3	
62	15	0	139	39		
27	0	0	212	50		
251	7	0	170	41	7	
120	19	0	162	38	6	
138	5	0	43	13		
180	7	0	95	41	2	
64	12	0	181	41		
36	4	0	75	22		
64	12	0	181	41		
213	10	0	152	35		
1	12	0	23	31		
3	9	0	34	25		
4	3	0	24	10		
32	1	0	31	15		
12	0	0	93	15		
74	3	0	5	2		
74	10	0	137	59		
72	51	0	127	81	2	
63	45	0	115	69	4	
104	35	0	215	5		
31	17	0	75	5		
91	14	97	451	28		
36	9	2	9	4		
143	0	0	75	2		
200	7	0	205	17	3	
103	7	0	195	6		
17	1	0	49	7		
82	12	0	171	34	1	
57	4	0	137	16		
8	0	0	62	6		



57	8	0	197	13	1
129	12	0	195	22	1
68	6	0	267	18	
11	0	0	8	3	

Rutile-Zircon Index

18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0

1 0 0 0 0

79 14 0 13 73

