Tectonic Setting of the Jurassic Smartville and Slate Creek Complexes, Northern Sierra Nevada, California: Supplementary Materials

This document contains a description of the analytical methods used in our U-Pb study and the results of a single $^{40}Ar/^{39}Ar$ analysis of hornblende. Our TIMS and SHRIMP U-Pb data are summarized in Tables DR1 and DR2, respectively. Common Pb analyses are listed in Table DR3. Sample locations and brief descriptions are given in Table DR4. Argon data are given in Table DR5.

ANALYTICAL METHODS

Zircon and feldspar were separated from rock samples at the University of California, Davis by standard methods of grinding, Wilfley table separation, heavy liquids, and magnetic separation. Purification and magnetic separation were completed at the Isotope Geochemistry Laboratory at the University of Kansas.

Multi-Grain TIMS Analyses

Isotopic analysis was carried out using standard methods of isotope dilution and mass spectrometry. Some of the earliest isotopic analyses were obtained with a 23 cm radius, single collector mass spectrometer of the Carnegie Institution of Washington NIMA design. Most samples, however, were analyzed with a VG Sector multicollector instrument. Some samples were analyzed at Syracuse University with a Micromass Sector 54 multicollector instrument.

Of a total of 62 fractions analyzed, 44 were done at Kansas in 1988 when analytical blanks were about 200 pg. total Pb. Because the Pb concentration in the zircons is commonly 6-10 ppm, we used quite large multigrain samples weighing between 10 and 50 mg. Most of these samples were spiked with a mixed ^{235}U-^{208}Pb solution. Eighteen analyses were done at Syracuse

in 1994 and 1995 when analytical blanks were about 30 pg. For these analyses we used multigrain samples weighing between about 3 and 0.5 mg, which were spiked with a mixed ^{235}U-^{205}Pb solution. Although all analyses were corrected for blank, the size of the samples made the corrections quite small. Data were reduced with the programs of Ludwig (1980; 1983, 2000) using the natural constants of Steiger and Jaeger (1977).

Pb isotopic analysis of feldspar separates was carried out on purified, unaltered samples ranging from 50 to 100 mg. We made initial step-wise dissolution studies on two samples (Table 2; Ludwig and Silver, 1977) to determine how much leaching was required to remove unsupported radiogenic Pb, observing that the isotopic composition of Pb obtained was essentially uniform in each dissolution step. Nevertheless, we leached each feldspar sample in 5% HF until 45-50 percent was dissolved, and then dissolved the remainder in 5% HF for analysis. Commonly a small residue was observed, but we did not attempt to dissolve it because we believed it likely contained undissolved accessory minerals such as zircon. All samples were spiked with a mixed ^{235}U-^{208}Pb solution and most were analyzed for U as well as Pb so that corrections for *in situ* U decay could be made if necessary.

Most of the zircon data were plotted on the inverse discordia ($^{207}Pb/^{206}Pb$ vs. $^{238}U/^{206}Pb$) diagram (Tera and Wasserburg, 1972) because (1) it emphasizes the $^{206}Pb/^{238}U$ age, which is most reliable for geologically young zircons, and (2) it is useful in showing the effects of inheritance of older zircon components. On such diagrams the lower intercept is commonly interpreted as the crystallization age of the sample whereas the upper intercept represents the composite age of inherited components. Because the data for three samples (87-12, 87-21, and 87-27; Fig. 7) suggested discordance was caused by Pb-loss, they were plotted on standard concordia diagrams (Wetherill, 1956).

SHRIMP Analyses

In order to confirm our geochronological results for some of the more critical samples, we re-analyzed five samples using the Sensitive High Resolution Ion Micro-Probe (SHRIMP-RG) managed jointly by the U.S. Geological Survey and Stanford University. Zircons, including fragments of the Geological Survey of Canada standard BR266, were mounted in epoxy and polished with diamond compound to reveal the zircon midpoints. The grains were then imaged at the Geological Survey of Canada with a Cambridge instruments scanning electron microscope operated in back-scattered electron (BSE) and cathodoluminescence (CATHO) mode in order to identify compositional zoning, cores/overgrowths, and fractures.

At the Stanford/USGS SHRIMP-RG laboratory the zircons were analyzed with a primary oxygen-ion beam of about 6-10 nanoamps focused in a spot of about 30-35 σm in diameter. Prior to beginning sample analysis, and after each 4-5 unknown analyses, the Stanford/USGS standard zircon R33 was analyzed. Analytical data were reduced with the SQUID program of Ludwig (2000). All ages were calculated following correction for common Pb on the basis of measured ^{207}Pb. For data from the standard, we accepted only those analyses that yielded ages, corrected on the basis of ^{207}Pb, that were within ±10 Ma of the accepted age of 419 Ma. We did not screen the SHRIMP data for the samples, but rather calculated the weighted mean age of all of the ^{207}Pb-corrected ages using the Isoplot algorithms of Ludwig (2000). Concordia plots were also made with the Isoplot program of Ludwig (2000).

Precision, Accuracy, and Resolution of Young U-Pb Zircon Ages

The precision of TIMS ages interpreted from the normal and inverse concordia diagrams (Wetherill, 1956; Tera and Wasserburg, 1972) depends critically upon the quality of the data and the extent to which the analyzed fractions are correlated. In a number of our samples, the

correlation of the data points is poor, presumably because of variable inherited components in the multigrain fractions. Although the SHRIMP age determinations are made from single zircon grains, uncertainties depend critically upon the number of analyses of both the standard and sample. If enough data are obtained, weighted mean ages can be very precise, but the accuracy may be rather less than the precision because of the critical dependence on both the assumed age and the reproducibility of the standard.. Although it is common practice to remove data outliers, the mean values of our determinations do not change significantly if the outliers are removed (±1 or 2 Ma). Consequently , we have retained all data and suggest that the larger uncertainties are a more conservative estimate of reliability.

The age determinations (Table DR1, DR2) reported here have combined uncertainties that are comparable to the duration of the sequence of events we are trying to resolve. For example, the isotopic data require that Smartville dikes (162 ±1 Ma; Saleeby et al, 1989) intrude nominally younger rocks ranging from 162 ± 2 to156 ± 3 Ma. The isotopic data also suggest that the upper volcanic unit is *c.* 164 Ma (Saleeby et al., 1989), whereas the fossils require them to be younger than 159 ± 4 Ma (Gradstein et al., 1995). Our ability to resolve events in these young rocks is limited by the combined uncertainties of using different radiometric methods and by uncertainties in the geologic time scale. Consequently, we take a somewhat conservative view of minor differences in measured ages and suggest that our ability to resolve events is about 3 - 5 Ma, at best.

^{40}AR/^{39}AR ANALYSIS OF HORNBLENDE 86-11

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Hornblende from sample *86-11* was dated by the ^{40}Ar/^{39}Ar method using step heating in a resistance furnace, as described by Hacker et al. (1996). The data are summarized in Table DR5. The three lowest temperature steps show contamination by a high-K phase, perhaps biotite (Fig. DR1). The remaining steps, which comprise 89% of the ^{39}Ar released do not form a plateau, but yield a weighted mean age of 159.2 ± 0.7 Ma (1ω); these steps do not form an isochron. The 5 highest temperature steps, with 28% of the total ^{39}Ar, are internally concordant and give a weighted mean age of 161.3 ± 0.8 Ma and an isochron age of 161.1 ± 1.4 Ma (MSWD =0.86; ^{40}Ar/^{36}Ar = 302 ± 27). Absent the zircon age of 157 ± 1 Ma, we would favor 159.2 ± 0.7 Ma for the age of the hornblende. Indeed, 2ω uncertainties of these ages overlap. In light of the zircon age, however, one might reasonably conclude that the high-temperature steps are affected by excess Ar and that the middle part of the spectrum suggests a hornblende ^{40}Ar/^{39}Ar age of ~157 Ma.

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FIGURE CAPTION

Figure DR1. Step heating spectrum for hornblende, sample *86-11*.

TABLE DR1. TIMS ANALYTICAL DATA FOR ZIRCON FRACTIONS

Samples	Concentrations[†]			Pb Isotopic Compositions[‡]			Radiogenic Ratios[§]			Ages[#]		
	Wt (mg)	U (ppm)	Pb (ppm)	206/204	207/206	208/206	206/238	207/235	207/206	206/238 (Ma)	207/235 (Ma)	207/206 (Ma)
Smartville Complex												
86-3 Pilot Peak pluton, quartz diorite												
m(3)	21.80	85.7	2.23	1559	0.05997	0.15570	0.02482	0.17327	0.05064	158 ±4	162 ±4	224 ±4
m(2)	11.82	99.2	3.06	547	0.08506	0.19694	0.02729	0.22062	0.05864	174 ±3	202 ±4	554 ±2
m(1)	38.80	92.8	2.35	2202	0.05596	0.14934	0.02428	0.16526	0.04936	155 ±1	155 ±1	165 ±7
m(0)	6.26	108.9	2.87	780	0.06835	0.18081	0.02464	0.16853	0.04961	157 ±2	158 ±2	177 ±15
m(-2)	9.58	115.2	3.01	1094	0.06248	0.16095	0.02477	0.16778	0.04913	158 ±1	158 ±1	154 ±17
m(-2)AA	27.26	120.0	3.13	3195	0.05436	0.14526	0.02514	0.17272	0.04983	160 ±1	162 ±2	187 ±21
+100	14.30	95.0	2.57	694	0.07016	0.18149	0.02471	0.16722	0.04909	157 ±1	157 ±1	152 ±3
+100AA	7.20	98.4	2.62	1022	0.06421	0.16963	0.02519	0.17340	0.04993	160 ±1	162 ±2	192 ±24
86-4 Pilot Peak pluton, quartz diorite												
m(-2) +150	39.50	183.4	5.01	2184	0.05592	0.19654	0.02516	0.17093	0.04927	160 ±1	160 ±1	161 ±2
m(-2)-200	7.00	241.1	7.97	708	0.07167	0.40500	0.02549	0.17950	0.05107	162 ±3	168 ±3	244 ±2
m(-2)-200 AA(2)	20.60	231.4	6.19	4212	0.05366	0.15780	0.02561	0.17743	0.05024	163 ±1	166 ±1	206 ±2
86-5 Pilot Peak pluton, monzodiorite												
m(-2)AA	22.75	145.7	3.99	1534	0.05830	0.19826	0.02508	0.16876	0.04880	160 ±1	158 ±1	138 ±17
m(-2)	10.04	133.0	3.76	642	0.07252	0.21722	0.02499	0.17141	0.04975	159 ±1	161 ±2	183 ±28

TABLE DR1. CONTINUED

Samples	Concentrations†			Pb Isotopic Compositions‡			Radiogenic Ratios§			Ages#		
	Wt (mg)	U (ppm)	Pb (ppm)	206/204	207/206	208/206	206/238	207/235	207/206	206/238 (Ma)	207/235 (Ma)	207/206 (Ma)
86-6 Banner Grange pluton, granodiorite												
nm(-1)AA	9.65	162.4	4.42	2321	0.05658	0.18237	0.02554	0.17723	0.05033	163 ±1	166 ±1	210 ±2
nm(-1)	13.27	294.8	7.31	2183	0.05541	0.14153	0.02396	0.16105	0.04875	153 ±1	152 ±2	136 ±24
m(-1)	29.37	412.6	9.99	3412	0.05370	0.12751	0.02371	0.16168	0.04946	151 ±1	152 ±1	170 ±2
m(2)	22.85	697.4	11.23	2901	0.05451	0.10158	0.01611	0.10999	0.49520	103 ±1	106 ±1	172 ±1
86-7 San Juan Ridge pluton (west), tonalite												
nm(-1)	0.37	125.9	3.27	829	0.06654	0.17194	0.02430	0.16419	0.04900	155 ±3	154 ±3	148 ±20
m(-1)	28.50	150.8	3.91	4370	0.05302	0.13883	0.02523	0.17295	0.04973	161 ±1	162 ±1	182 ±2
m(0)	0.47	239.8	6.16	1431	0.05958	0.16983	0.02414	0.16458	0.04944	154 ±3	155 ±3	169 ±2
86-10 San Juan Ridge pluton (east), tonalite dike												
nm(0)-200 AA	10.70	227.2	9.40	131	0.16361	0.44304	0.02565	0.18337	0.05184	163 ±1	171 ±1	279 ±7
Tonalite at Deer Creek												
86-9 Tonalite												
m(0)AA	14.92	101.7	3.28	1941	0.05958	0.13727	0.03128	0.22476	0.05211	199 ±1	206 ±1	290 ±2
m(1) +140	0.06	2172.7	69.56	1841	0.06019	0.13329	0.03128	0.22558	0.05230	199 ±4	207 ±4	299 ±14
m(1) -140	1.29	195.9	5.83	1527	0.05965	0.14673	0.02875	0.19858	0.05010	183 ±5	184 ±5	200 ±14
m(4)	0.94	162.0	4.82	1134	0.06296	0.15448	0.02867	0.19798	0.05008	182 ±3	183 ±3	199 ±4

TABLE DR1. CONTINUED

Samples	Concentrations[†]			Pb Isotopic Compositions[‡]			Radiogenic Ratios[§]			Ages[#]		
	Wt (mg)	U (ppm)	Pb (ppm)	206/204	207/206	208/206	206/238	207/235	207/206	206/238 (Ma)	207/235 (Ma)	207/206 (Ma)
Slate Creek Complex												
87-12 metadiorite												
nm(-1)	7.00	231.6	10.06	243	0.10859	0.31305	0.03292	0.21960	0.04838	209 ±1	202 ±1	118 ±4
m(-1)	38.30	256.4	8.73	14027	0.05157	0.16029	0.03264	0.22766	0.05059	207 ±2	208 ±2	222 ±7
m(0)cl	0.89	151.1	4.70	5537	0.05279	0.16043	0.02984	0.20713	0.05034	190 ±5	191 ±5	211 ±5
87-13 metatonalite												
nm(0)AA	20.60	138.0	4.70	2271	0.05878	0.14982	0.03256	0.23530	0.05242	207 ±1	215 ±1	304 ±6
87-14 metadiorite												
nm(-3)	3.00	73.2	2.22	3993	0.05344	0.12067	0.03006	0.20652	0.04982	191 ±3	191 ±3	187 9
nm(-1)	1.47	107.4	3.52	788	0.06947	0.17257	0.03024	0.21248	0.05096	192 ±3	196 ±3	239 ±5
87-21 metatonalite												
-240AA	6.30	210.2	7.39	1540	0.06075	0.20713	0.03206	0.22684	0.05131	203 ±1	208 ±1	255 ±2
nm(-1)-200	0.84	103.6	3.42	3263	0.05253	0.16432	0.03141	0.21723	0.05016	199 ±5	200 ±5	203 ±6
nm(0)+200	0.74	159.9	5.17	8635	0.05032	0.16958	0.03080	0.21347	0.05027	196 ±4	197 ±4	207 ±2
m(0)	0.67	192.6	6.40	4631	0.05310	0.17887	0.03134	0.21665	0.05014	199 ±4	199 ±4	201 ±4
nm(2)	0.79	177.2	5.25	5424	0.05289	0.16087	0.02838	0.19714	0.05039	180 ±5	183 ±5	213 ±9

TABLE DR1. CONTINUED

Samples	Concentrations†			Pb Isotopic Compositions‡			Radiogenic Ratios§			Ages#		
	Wt (mg)	U (ppm)	Pb (ppm)	206/204	207/206	208/206	206/238	207/235	207/206	206/238 (Ma)	207/235 (Ma)	207/206 (Ma)
Cross-cutting Intrusions												
86-2 Plagioclase prophyry dike in Pleasant Valley Pluton												
dark round	0.16	430.0	81.65	841	0.14916	0.18698	0.16473	3.04703	0.13415	983 ±20	1419 ±30	2153 ±1
clear light	3.99	560.7	13.48	346	0.10568	0.22815	0.01986	0.17568	0.06417	127 ±3	164 ±3	747 ±8
86-11 Yuba Rivers pluton, tonalite												
nm(-1)AA	54.20	277.2	7.03	6490	0.05167	0.13645	0.02477	0.16895	0.04947	158 ±1	159 ±1	170 ±2
86-12 Yuba Rivers pluton, foliated tonalite												
m(0)-240 AA	2.52	347.6	9.02	1134	0.06308	0.12716	0.02536	0.17560	0.05022	161 ±1	164 ±1	205 ±4
m(1)+240 AA	11.70	303.4	7.77	1562	0.05929	0.11371	0.02522	0.17375	0.04997	161 ±1	163 ±1	194 ±2
86-13 Grizzly Pluton, tonalite												
nm(0)AA	30.30	356.9	7.83	3848	0.05428	0.09571	0.02210	0.15401	0.05054	141 ±1	145 ±1	220 ±6
87-1 Yuba Rivers pluton, tonalite												
nm(-1) -200AA	13.50	264.5	6.62	3060	0.05433	0.10793	0.02500	0.17093	0.04960	159 ±1	160 ±1	176 ±2
m(-1) -200AA	10.20	327.1	8.18	1706	0.05793	0.11153	0.02476	0.16860	0.04939	158 ±1	158 ±1	167 ±3
87-10 Yuba Rivers pluton, garnet-muscovite granodiorite												
nm(0)AA	10.90	724.1	17.18	3409	0.05419	0.08034	0.02424	0.16700	0.04995	154 ±1	157 ±1	193 ±2
87-20 Yuba Rivers pluton, clinopyroxene diorite												
m(-4)+75m	15.40	404.0	10.86	3008	0.05467	0.17744	0.02524	0.17354	0.04986	161 ±1	163 ±1	189 ±2

TABLE DR1. CONTINUED

Samples	Concentrations[†]			Pb Isotopic Compositions[‡]			Radiogenic Ratios[§]			Ages[#]		
	Wt (mg)	U (ppm)	Pb (ppm)	206/204	207/206	208/206	206/238	207/235	207/206	206/238 (Ma)	207/235 (Ma)	207/206 (Ma)
87-22 Indian Valley pluton, tonalite												
nm(-1) -100 AA	28.60	445.8	10.73	4992	0.05171	0.11743	0.02384	0.16052	0.04884	152 ±1	151 ±1	140 ±7
87-24 Indian Valley Pluton, tonalite dike												
m(0)-200	0.34	431.0	10.51	1815	0.05690	0.14161	0.02355	0.15957	0.04914	150 ±3	150 ±3	154 ±2
87-27 Scales pluton, tonalite												
nm(-3)	2.07	646.0	16.75	1561	0.05868	0.09180	0.02606	0.17730	0.04935	166 ±2	166 ±2	164 ±5
m(-3)+200 AA	17.50	524.6	13.65	9382	0.05103	0.09342	0.02642	0.18043	0.04953	168 ±1	168 ±1	173 ±1
m(0)	0.86	2274.1	52.53	15539	0.05042	0.04430	0.02457	0.16778	0.04953	157 ±3	158 ±3	173 ±4
m(6)	1.10	1749.4	41.39	4014	0.05303	0.05667	0.02474	0.16858	0.04942	158 ±3	158 ±3	168 ±2
88-26 Cascade pluton, tonalite												
nm(-2)AA	1.26	217.2	4.93	4659	0.05227	0.12140	0.02247	0.15235	0.04917	143 ±2	144 ±2	156 ±4
nm(-1)AA	1.12	251.8	5.75	8000	0.05157	0.12560	0.02259	0.15504	0.04979	144 ±2	146 ±2	185 ±21
nm(0)	2.49	272.0	6.34	1605	0.05829	0.13023	0.02255	0.15297	0.04919	144 ±2	145 ±2	157 ±13

Notes: Sample abbreviations: nm, nonmagnetic; m, magnetic; numbers in parentheses, degrees of tilt on Frantz separator at 1.7 amperes; (+), larger than; (-), smaller than; numbers outside parentheses, mesh size ; AA, air abraded.

[†]Total U and Pb, corrected for analytical blank.

[‡]Measured ratios, not corrected for blank or mass discrimination.

[§]Ratios corrected for mass discrimination, analytical blank, and non-radiogenic Pb (Stacey and Kramers, 1975 model).

[#]Errors given at 2 standard deviations.

TABLE DR2. SHRIMP ANALYTICAL DATA

Spot Number	Com ^{206}Pb (%)	U (ppm)	Th (ppm)	Raw 238/206	1 ω (%)	Raw 207/206	1 ω (%)	4corr 207r/235	1 ω (%)	4corr 206r/238	err (%)	7corr 206/238 age (Ma)	1ω
Smartville complex													
86-6 Banner Grange pluton													
86-6-05	0	221.4	173.9	39.29	1.3	0.050	3.2	0.175	3.5	0.025	1.3	161.9	2.1
86-6-09	0	71.1	45.6	39.50	1.9	0.051	5.9	0.178	6.2	0.025	1.9	160.8	3.1
86-6-10	0	97.2	64.2	39.77	1.7	0.051	5.3	0.177	5.6	0.025	1.7	159.8	2.7
86-6-39	0	64.3	39.8	41.63	1.9	0.050	6.4	0.167	6.7	0.024	1.9	152.8	2.9
86-6-45	0	293.1	286.7	39.29	1.2	0.049	2.9	0.173	3.1	0.025	1.2	162.0	2.0
86-6-46	0	98.8	66.5	41.52	2.2	0.051	5.2	0.169	5.6	0.024	2.2	153.1	3.4
86-6-47	0	78.0	54.5	41.46	2.3	0.054	5.5	0.179	6.0	0.024	2.3	152.7	3.5
86-6-51	0	221.5	207.2	38.36	1.3	0.051	3.2	0.185	3.5	0.026	1.3	165.5	2.2
86-6-56	0	190.7	150.2	39.47	1.4	0.050	3.7	0.175	3.9	0.025	1.4	161.1	2.2
86-6-59	0.4485	284.2	261.4	42.72	1.3	0.051	3.0	0.152	5.4	0.023	1.3	148.8	1.9
86-6-61	0.4665	190.7	151.1	40.79	1.4	0.049	3.7	0.153	5.9	0.024	1.4	156.1	2.2
86-6-64	0	191.7	152.3	40.72	1.4	0.048	3.8	0.162	4.1	0.025	1.4	156.6	2.2
86-6-66	0.9667	190.9	137.4	39.77	1.4	0.052	3.7	0.150	10.0	0.025	1.5	159.6	2.2
86-6-73	0	90.8	61.7	40.76	1.7	0.053	5.2	0.178	5.5	0.025	1.7	155.6	2.6
86-6-74	0	116.8	71.9	41.93	1.6	0.053	4.8	0.175	5.1	0.024	1.6	151.1	2.4
86-7 San Juan Ridge pluton (west)													
86-7-11	0	182.1	77.1	40.12	1.4	0.051	5.0	0.176	5.2	.0249	1.4	158.4	2.2
86-7-15	0	139.0	63.7	40.99	1.5	0.052	4.9	0.174	5.1	.0244	1.5	154.9	2.4
86-7-16	0	342.2	161.8	40.70	1.2	0.052	2.8	0.177	3.1	.0246	1.2	155.9	1.9
86-7-17	0	104.0	41.3	44.35	1.8	0.048	6.3	0.150	6.6	.0225	1.8	143.8	2.6
86-7-20	0	94.4	39.2	40.26	1.7	0.055	5.2	0.190	5.5	.0248	1.7	157.0	2.7
86-7-26	0.2733	549.9	339.0	41.26	1.3	0.051	2.4	0.170	2.7	.0242	1.3	154.1	2.0
86-7-39	0	378.2	196.7	42.15	1.2	0.050	2.7	0.162	2.9	.0237	1.2	151.1	1.8
86-7-42	1.8854	103.0	41.5	40.99	2.3	0.055	5.2	0.184	5.7	.0244	2.3	154.3	3.6

TABLE DR2. CONTINUED

Spot Number	Com 206Pb (%)	U (ppm)	Th (ppm)	Raw 238/206	1 ω (%)	Raw 207/206	1 ω (%)	4corr 207r/235	1 ω (%)	4corr 206r/238	1 ω (%)	7corr 206/238 age (Ma)	1ω
86-7-44	0	376.2	203.5	40.39	1.2	0.049	2.7	0.166	3.0	.0248	1.2	157.8	1.9
86-7-48	0.9619	152.0	80.9	39.80	1.5	0.051	4.4	0.176	4.7	.0251	1.5	159.7	2.4
86-7-51	0	120.6	48.0	39.88	1.9	0.051	4.8	0.177	5.2	.0251	1.9	159.2	3.0
86-7-58	0	173.0	91.2	40.48	1.5	0.049	4.2	0.168	4.5	.0247	1.5	157.3	2.3
86-7-63	0	641.5	352.6	41.04	1.2	0.049	2.3	0.166	2.5	.0244	1.2	155.2	1.8
86-7-64	0	118.9	54.6	37.65	1.5	0.053	5.7	0.196	5.9	.0266	1.5	168.1	2.6
86-10 San Juan Ridge pluton (east, dike)													
86-10-02	0	366.7	218.6	38.32	0.7	0.047	2.7	0.170	2.8	0.026	0.7	166.5	1.2
86-10-04	0	305.5	193.2	38.31	0.7	0.050	3.9	0.179	3.9	0.026	0.7	166.1	1.2
86-10-05	0.4106	275.3	185.2	39.10	0.8	0.050	3.2	0.165	5.0	0.025	0.8	162.6	1.3
86-10-08	1.7426	284.8	225.4	38.68	0.8	0.057	3.0	0.150	11.7	0.025	1.0	163.0	1.4
86-10-16	0	184.5	89.7	39.85	1.7	0.051	3.8	0.176	4.2	0.025	1.7	159.4	2.6
86-10-18	0.1817	520.9	547.3	38.37	0.6	0.050	2.3	0.174	2.9	0.026	0.6	165.7	1.0
86-10-21	-0.4138	396.3	250.8	38.60	0.7	0.047	2.8	0.179	5.0	0.026	0.7	165.4	1.1
86-10-26	-0.5128	336.6	247.1	38.99	0.7	0.052	2.9	0.199	5.4	0.026	0.8	162.8	1.2
8610-42C	0.1378	528.8	230.1	2.94	0.3	0.142	0.5	6.628	0.6	0.34	0.3	1822.3	6.1
8610-42R	0	236.9	103.5	2.57	0.5	0.160	0.8	8.580	0.9	0.39	0.5	2036.4	10.8
86-10-31	3.8878	144.7	73.1	40.00	1.1	0.069	5.3	0.123	19.0	0.024	1.3	155.3	1.8
86-10-37	0	332.5	254.4	41.25	0.7	0.052	3.0	0.172	3.1	0.024	0.7	154.0	1.2
86-10-38	0.842	242.2	129.9	39.67	1.2	0.050	4.4	0.150	7.7	0.025	1.3	160.3	2.0
86-10-56	0	214.8	131.6	40.65	0.9	0.053	3.7	0.180	3.9	0.025	0.9	155.9	1.5
86-10-54	0	386.6	307.7	40.62	0.7	0.051	2.8	0.172	2.9	0.025	0.7	156.5	1.1
86-10-59	0	238.1	126.6	39.47	0.9	0.047	3.6	0.166	3.7	0.025	0.9	161.7	1.4
86-10-62	0	244.9	130.7	39.88	0.8	0.050	3.4	0.173	3.5	0.025	0.8	159.5	1.4
86-10-73	0.6842	323.0	244.8	39.52	0.7	0.053	2.8	0.164	6.1	0.025	0.8	160.4	1.2

TABLE DR2. CONTINUED

Spot Number	Com 206Pb (%)	U (ppm)	Th (ppm)	Raw 238/206	1 ω (%)	Raw 207/206	1 ω (%)	4corr 207r/235	1 ω (%)	4corr 206r/238	1 ω (%)	7corr 206/238 age (Ma)	1ω
Slate Creek complex													
87-14 Quartz metadiorite													
87-14-03	3.8196	14.3	4.7	32.15	3.4	0.060	11.2	0.117	80.4	0.03	4.3	195.0	6.8
87-14-07	1.1574	118.5	35.3	30.54	1.7	0.049	4.0	0.177	7.5	0.032	1.8	208.0	3.6
87-14-10	0	41.9	9.0	30.86	2.3	0.056	6.6	0.249	7.0	0.032	2.3	204.2	4.7
87-14-11	1.1854	77.2	36.1	31.44	2.4	0.052	5.4	0.182	13.4	0.031	2.5	201.5	4.9
87-14-15	0	270.7	121.6	31.02	1.6	0.051	3.0	0.225	3.4	0.032	1.6	204.5	3.3
87-14-18	2.4692	162.8	59.1	32.33	1.8	0.083	4.1	0.264	11.9	0.03	1.9	188.4	3.4
87-14-19	2.8362	47.7	10.5	30.54	2.1	0.052	6.1	0.126	31.6	0.032	2.3	207.1	4.4
87-14-21	0.895	111.6	32.2	30.10	1.8	0.051	4.2	0.199	10.3	0.033	1.8	210.5	3.7
87-14-23	0	113.4	55.0	31.79	1.8	0.049	4.3	0.214	4.6	0.031	1.8	199.9	3.5
87-14-26	0	139.1	37.3	31.70	1.7	0.052	3.7	0.228	4.0	0.032	1.7	199.7	3.4
87-14-32	-0.7804	260.2	134.2	31.17	1.6	0.052	2.8	0.259	6.1	0.032	1.6	203.1	3.2
87-14-40	0	60.1	17.8	31.07	2.1	0.050	6.0	0.222	6.3	0.032	2.1	204.3	4.2
87-14-41	0	206.3	91.8	31.44	1.6	0.051	3.2	0.222	3.6	0.032	1.6	201.7	3.3
87-14-42	0	107.8	24.4	30.92	1.8	0.050	4.5	0.223	4.9	0.032	1.8	205.2	3.7
87-14-45	0	50.8	18.5	32.77	2.2	0.056	6.3	0.235	6.7	0.031	2.2	192.4	4.2
87-14-48	0.9067	90.0	31.8	31.66	1.9	0.052	4.8	0.194	9.9	0.031	1.9	199.9	3.8
Cross-cutting intrusion													
87-27 Scales pluton													
87-27-52	0	294.7	106.6	37.59	1.6	0.050	3.0	0.185	3.4	0.027	1.6	169.1	2.7
87-27-53	0	389.3	200.3	37.64	1.6	0.049	2.7	0.180	3.1	0.027	1.6	169.1	2.6
87-27-57	0	217.9	94.2	38.60	1.7	0.048	3.6	0.173	3.9	0.026	1.7	165.0	2.7
87-27-58	0	251.5	134.7	38.72	1.6	0.047	3.2	0.169	3.6	0.026	1.6	164.7	2.7
87-27-59	0	224.4	85.1	36.61	1.6	0.046	3.9	0.175	4.2	0.027	1.6	174.4	2.8
87-27-60	0	320.3	163.1	38.13	1.6	0.047	2.8	0.169	3.3	0.026	1.6	167.4	2.6
87-27-61	0	121.7	41.1	38.64	1.8	0.053	4.2	0.190	4.5	0.026	1.8	164.0	2.9

TABLE DR2. CONTINUED

Spot Number	Com 206Pb	U	Th	Raw 238/206	1 ω	Raw 207/206	1 ω	4corr 207r/235	1 ω	4corr 206r/238	1 ω	7corr 206/238 age	1ω
	(%)	(ppm)	(ppm)		(%)		(%)		(%)		(%)	(Ma)	
87-27-06	0	347.7	154.1	38.79	1.5	0.050	2.6	0.179	3.0	0.026	1.5	163.9	2.5
87-27-11	0	173.4	80.3	38.48	1.7	0.050	3.6	0.180	4.0	0.026	1.7	165.2	2.8
87-27-21	0	144.9	49.5	38.96	1.7	0.053	4.0	0.189	4.3	0.026	1.7	162.6	2.8
87-27-32	0	188.9	61.9	39.02	1.8	0.051	3.8	0.180	4.2	0.026	1.8	162.8	3.0
87-27-34	0	503.6	194.2	37.31	1.5	0.050	2.1	0.183	2.6	0.027	1.5	170.5	2.5
87-27-75	0	595.6	308.7	38.06	1.5	0.049	2.0	0.179	2.5	0.026	1.5	167.2	2.5

Notes: 4 corr 207r/235 and 206r/238 refer to atomic ratios corrected for common Pb on the basis of measured 204Pb; 7 corr 206/238 age refers to age calculated from the atomic ratio corrected for common Pb on the basis of measured 207Pb.

TABLE DR3. FELDSPAR COMMON PB DATA

Samples	Age (Ma)	U (ppm)	Pb (ppm)	U/Pb	206/204	207/204	208/204	Initial wt. (mg)	Wt.% analyzed
Smartville Complex									
86-2	106	nd	0.917	nd	18.541 ±0.021	15.574 ±0.025	38.239 ±0.081	124.4	41.7
86-3	157	0.009	1.237	0.007	18.629 ±0.021	15.593 ±0.025	38.362 ±0.079	173.9	74.7
86-6	158	nd	0.054	nd	19.416 ±0.079	15.629 ±0.063	39.361 ±0.171	203.3	86.2
86-10	162							224.5	
step 0		0.574	122.33	0.005	19.619 ±0.021	15.726 ±0.025	38.956 ±0.080		HNO3 leach
step 1		0.094	1.844	0.054	19.178# ±0.023	15.686 ±0.025	38.679 ±0.081		44.4
step 2		0.098	1.696	0.058	19.274 ±0.513	15.748 ±0.419	38.872 ±1.038		31.4
step 3		0.051	1.451	0.036	19.388 ±0.077	15.601 ±0.064	38.576 ±0.165		19.0
step 4		0.261	1.633	0.159	19.359# ±0.127	15.696# ±0.083	38.666 ±0.221		4.2
step 5		1.056	6.158	0.171	19.082 ±0.256	15.475 ±0.200	38.015 ±0.498		1.0
step 6		8.121	48.216	0.168	22.964 ±3.97	16.783 ±2.92	40.753 ±7.010		0.0
Tonalite at Deer Creek									
86-9	179	0.004	0.164	0.022	18.587 ±0.046	15.631 ±0.043	38.393 ±0.118	125.2	78.7
Slate Creek Complex									
87-12	207							133.5	
step 1		0.072	0.15	0.477	18.895# ±0.522	15.802# ±0.122	39.225 ±0.526		5.9
step 2		nd	nd	nd	nd	nd	nd		8.8
step 3		nd	0.84	nd	18.355 ±0.185	15.496 ±0.157	37.853 ±0.386		15.8
step 4		nd	nd	nd	nd	nd	nd		6.4
step 5		0.014	0.105	0.137	18.054# ±0.057	15.519# ±0.046	37.921 ±0.137		49.3
step 6		nd	2.935	nd	18.445 ±0.040	15.54 ±0.038	37.991 ±0.106		13.8

TABLE DR3. CONTINUED

Samples	Age (Ma)	U (ppm)	Pb (ppm)	U/Pb	206/204	207/204	208/204	Initial wt. (mg)	Wt.% analyzed
Cross-cutting Intrusions									
Yuba Rivers Pluton									
86-12	157	0.057	0.761	0.075	18.661	15.586	38.301	118.4	53.4
					±0.021	±0.025	±0.080		
87-20	157	nd	18.731	nd	18.728	15.681	38.597	108.4	21.4
					±0.054	±0.052	±0.142		
Indian Valley Pluton									
87-22	152	0.051	9.615	0.332	18.525	15.545	38.159		35.9
					±0.021	±0.025	±0.079		
NBS 981 Common Pb					16.935	15.49	36.706		
13 analyses between 6/88 and 12/89					±0.023	±0.011	±0.048		
NBS Values					16.937	15.491	36.721		
					±0.022	±0.011	±0.021		

Notes: Uncertainties ± 2 sigma. nd, not determined.
[#] indicates corrected for in situ U decay.

Table DR4. Locations and Brief Descriptions of Analyzed Sample

Sample No.	Location: Quadrangle (7.5 Minute)	Location: UTME (meters)	Location: UTMN (meters)	Unit	Lithology
Smartville complex					
86-3	Rough and Ready	657880	4337220	PPP	Qtz diorite
86-4	Rough and Ready	655520	4336420	PPP	Qtz diorite
86-5	Rough and Ready	661010	4332380	PPP	Monzodiorite
86-6	Wolf	659930	4329010	BGP	Granodiorite
86-7	French Corral	659300	4346520	SJRP	Tonalite
86-10	Grass Valley	662520	4345500	SJRP	Leucotonalite dike
Tonalite at Deer Creek					
86-9	Grass Valley	662520	4345500	DCT	Tonalite at Deer Creek
Slate Creek complex					
87-12	American House	667890	4391390	SCCp	Metadiorite
87-13	American House	666970	4391960	SCCp	Metatonalite
87-14	American House	666100	4390820	SCCp	Qtz metadiorite
87-21	Camptonville	668480	4371410	SCCp	Metatonalite
Cross-cutting intrusions					
86-2	French Corral	656680	4350840		Plag. porphyry dike
86-11	Nevada City	671360	4348300	YRP	Hbl tonalite
86-12	French Corral	660950	4356410	YRP	Foliated tonalite
86-13	Pulga 15'	637070	4412010	GP	Bt-Hbl tonalite
87-1	Camptonville	663850	4371320	YRP	Tonalite
87-10	Camptonville	663920	4361120	YRP	Grt Ms granodiorite
87-20	Nevada City	663630	4350720	YRP	Cpx diorite
87-22	Goodyears Bar	673280	4375840	IVP	Tonalite
87-24	Goodyears Bar	675260	4375890	IVP	Tonalite dike in FCC
87-27	Goodyears Bar	672220	4385320	SP	Hbl tonalite
88-26	American House	664940	4390020	CP	Hbl tonalite

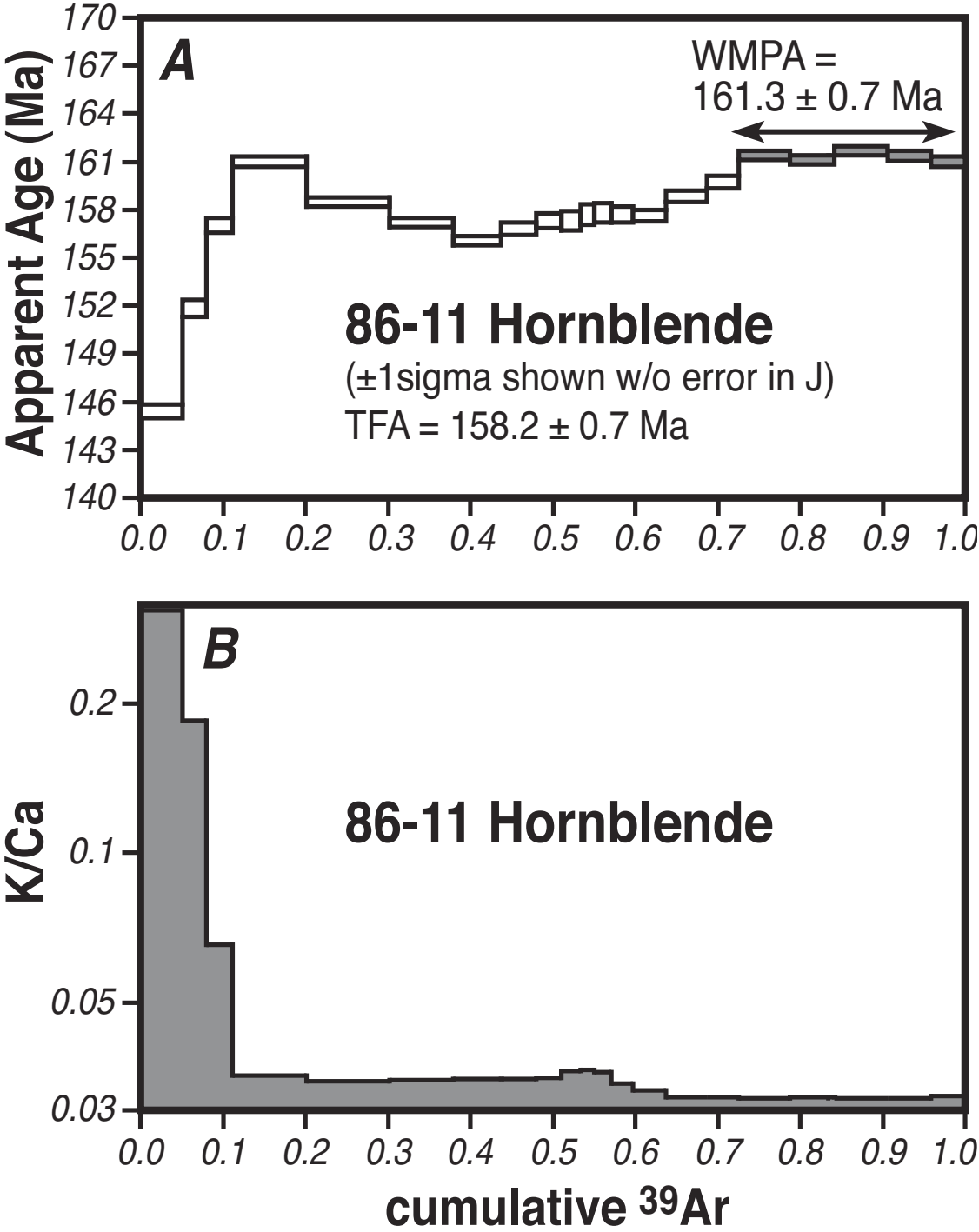
Notes: BGP, Banner Grange pluton; CP, Cascade pluton; DCT, tonalite at Deer Creek; FCC, Fiddle Creek complex; GP, Grizzly pluton; IVP, Indian Valley pluton; PPP, Pilot Peak pluton; PVP, Pleasant Valley pluton; SCCp, Slate Creek complex plutonic unit; SJRP, San Juan Ridge pluton; SP, Scales pluton; YRP, Yuba Rivers pluton.

TABLE DR5. ARGON DATA FOR HORNBLENDE 86-11

T	t	40	40/39	38/39	37/39	36/39	K/Ca	× ^{39}Ar	^{40}Ar*	Age
(^{O}C)	(min)	(mol)								(Ma)
800	8	6.4e-14	24.5034	5.3e-3	1.5941	0.0209	0.31	0.05064	0.748	145.4 ± 0.8
850	8	3.4e-14	22.6955	8.6e-3	2.6632	0.0119	0.18	0.07940	0.845	151.8 ± 0.9
900	8	4.2e-14	24.7674	2.6e-2	7.5035	0.0166	0.065	0.11224	0.802	157.0 ± 0.8
935	8	1.2e-13	25.2021	6.0e-2	13.7865	0.0162	0.036	0.20170	0.809	161.0 ± 0.8
950	8	1.2e-13	22.8668	7.2e-2	14.1334	0.0095	0.035	0.30139	0.878	158.5 ± 0.8
960	8	8.9e-14	22.3496	8.5e-2	14.0766	0.0083	0.035	0.37923	0.891	157.2 ± 0.8
970	8	6.5e-14	22.0666	9.8e-2	13.9973	0.0078	0.035	0.43659	0.895	156.0 ± 0.8
980	8	4.8e-14	21.8506	1.1e-1	13.9914	0.0067	0.035	0.47939	0.909	156.8 ± 0.8
990	8	3.5e-14	21.8371	1.0e-1	13.8654	0.0065	0.035	0.51058	0.912	157.3 ± 0.9
1000	8	2.6e-14	21.8885	9.3e-2	13.4756	0.0066	0.036	0.53346	0.910	157.3 ± 0.9
1010	8	2.0e-14	21.7163	8.2e-2	13.3873	0.0059	0.037	0.55103	0.920	157.7 ± 1.0
1030	8	2.1e-14	21.5920	7.5e-2	13.5624	0.0054	0.036	0.57035	0.925	157.8 ± 1.0
1050	8	2.9e-14	21.7993	7.6e-2	14.2480	0.0062	0.034	0.59661	0.916	157.7 ± 0.9
1070	8	4.5e-14	21.8716	8.5e-2	14.7572	0.0065	0.033	0.63655	0.913	157.6 ± 0.8
1090	8	5.7e-14	22.0950	9.3e-2	15.1784	0.0067	0.032	0.68692	0.911	158.8 ± 0.8
1105	8	4.3e-14	22.2684	9.3e-2	15.2230	0.0069	0.032	0.72498	0.909	159.8 ± 0.8
1140	8	7.2e-14	22.3894	1.0e-1	15.2877	0.0065	0.032	0.78822	0.914	161.4 ± 0.8
1160	8	6.1e-14	22.0229	1.0e-1	15.2313	0.0054	0.032	0.84202	0.927	161.1 ± 0.8
1180	8	7.2e-14	21.9353	9.9e-2	15.2800	0.0049	0.032	0.90603	0.934	161.7 ± 0.8
1210	8	5.8e-14	21.8604	9.5e-2	15.2609	0.0048	0.032	0.95794	0.936	161.3 ± 0.8
1250	8	4.7e-14	21.8439	9.5e-2	15.1559	0.0049	0.032	1.00000	0.934	161.0 ± 0.8

Notes. J=0.0045814; t, dwell time; 40(mol), moles corrected for blank and reactor-produced 40. Ratios corrected for blanks, decay, and interference. × ^{39}Ar is cumulative fraction. ^{40}Ar*, rad fraction.

Figure DR1. Sample *86-11*: $^{40}Ar/^{39}Ar$ data for hornblende. A. Apparent age spectrum. B. K/Ca spectrum. Abbreviations: TFA, total fusion age; WMPA, weighted mean plateau age.



D&B figure DR1