DEPARTMENT OF THE INTERIOR
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Table 1. -/ Oxygen isotope data and description of samples. [Oxygen isotope values for all samples were determined in the laboratory of Ivan Barnes (U.S. Geological Survey) in 1982 and 1983. All the reported values are the averages of the results of two analyses. The standard deviation of 68 replicate analyses of a granitoid whole rock sample is 0.25 per mil. The 95 percent confidence interval is ±0.5 per mil. Samples with prefixes CM, PM, TC, and WR were furnished by David B. Sams (California Institute of Technology)].

(A) MAGMATIC ROCKS

Rock type and unit	Sample number	Mineral content (in order of decreasing abundance)	$\delta^{18}O$ per mil. SMOW
Diorite-quartz diorite of the Tehachapi Mountains	DR-3098A	Plagioclase, hornblende, quartz, biotite	+ 7.0
Tonalite of Antimony Peak	DR-3023	Plagioclase, hornblende, quartz, biotite	+ 7.3
Tonalite of Bear Valley Springs	DR-3627B	Plagioclase, quartz, biotite, hornblende	+ 8.6
	DR-3670	Plagioclase, quartz, hornblende, biotite, K-feldspar	+ 8.6
	DR-4181	Plagioclase, quartz, hornblende, biotite	+ 8.3
	DR-5236	Plagioclase, quartz, biotite, hornblende, K-feldspar, clinopyroxene	+ 9.6
	CM-9	Plagioclase, quartz, biotite, hornblende, K-feldspar, clinopyroxene	+ 9.1
	CM-25	Plagioclase, quartz, hornblende, biotite, K-feldspar	+ 8.6
	CM-26	Plagioclase, quartz, hornblende, biotite, K-feldspar	+ 9.6
	TC-15(?)	Plagioclase, quartz, hornblende, biotite, (protomylonite)	+10.1
	TC-40	Plagioclase, quartz, hornblende, biotite, (protomylonite)	+10.1
	TC-42	Plagioclase, quartz, hornblende, biotite, (protomylonite)	+ 9.1
Tonalite of Mount Adelaide	DR-4189	Plagioclase, quartz, biotite, hornblende, K-feldspar	+ 9.0
	DR-4789A	Plagioclase, quartz, biotite, K-feldspar, hornblende	+ 9.3
Granodiorite of Hoffman Canyon	DR-3842A	Plagioclase, quartz, biotite, hornblende, K-feldspar	+10.0
Granodiorite of Dunlap Meadow	DR-5008	Plagioclase, quartz, hornblende, biotite, K-feldspar, clinopyroxene	+ 7.6
Granodiorite of Kern Bridge	DR-5031	Plagioclase, quartz, K-feldspar, biotite, hornblende	+ 9.9
Granodiorite of Rabbit Island	DR-4868	Plagioclase, quartz, K-feldspar, biotite, hornblende	+ 9.2
Granodiorite of Soto-Monkes	DR-3356	Plagioclase, quartz, biotite, K-feldspar, hornblende	+11.1
Granodiorite of Lebec	DR-3181	Plagioclase, quartz, biotite, K-feldspar, hornblende	+10.7
Granodiorite of Claraville	DR-4472	Plagioclase, quartz, biotite	+ 9.8
	TC-27	Plagioclase, quartz, K-feldspar, biotite	+11.3
Granodiorite of Alta Sierra	DR-4796-1	Plagioclase, quartz, K-feldspar, biotite, hornblende	+10.1
Granite of the Kern River	DR-4879A	Plagioclase, K-feldspar, quartz, biotite	+ 9.4
Felsic dike(?)	PM-505	Plagioclase, quartz, K-feldspar, biotite, muscovite, tourmaline, garnet	+14.1
	PM-536	Plagioclase, quartz, K-feldspar, biotite, muscovite	+12.7
	PC-35	Plagioclase, quartz, K-feldspar, biotite (cataclastic)	+10.0
Augen gneiss of Tweedy Creek (Mylonitized granite)	TC-12A	Plagioclase, K-feldspar, quartz, biotite	+10.8
Jawbone Canyon "granite porphyry"	Taylor (1968); location(?)	Mineral contents not given; most probably sample is from granodiorite of Claraville	+ 9.6

(B) METASEDIMENTARY ROCKS

Rock type and unit		Sample number	Mineral content (in order of decreasing abundance)	$\delta^{18}O$ per mil. SMOW
Quartzite (metachert?) in Rand Schist		DR-3031C	Quartz, biotite, muscovite, plagioclase, pale pink garnet	+16.4
		DR-3063	Quartz, plagioclase, biotite, garnet	+18.1
		DR-3281	Quartz, pale pink garnet, muscovite, biotite	+19.5
		DR-3344	Mostly quartz (no thin section)	+17.0
		DR-4055A	Mostly quartz (no thin section)	+14.8
		DR-4056A	Quartz, pale pink garnet, biotite, muscovite	+11.9
Gneiss, amphibolite, and granulite of the San Emigdio-Tehachapi Mountains	Quartzite	DR-3381B	Quartz, biotite, pink garnet, chlorite, graphite, muscovite	+19.7
	Graphitic quartzite	DR-3417	Quartz, graphite, biotite, hornblende, plagioclase	+16.8
	Calc-hornfels	DR-3546	Clinopyroxene, plagioclase, quartz, epidote	+12.6
	Impure quartzite	DR-3553	Quartz, plagioclase, biotite, red opaque grains	+13.1

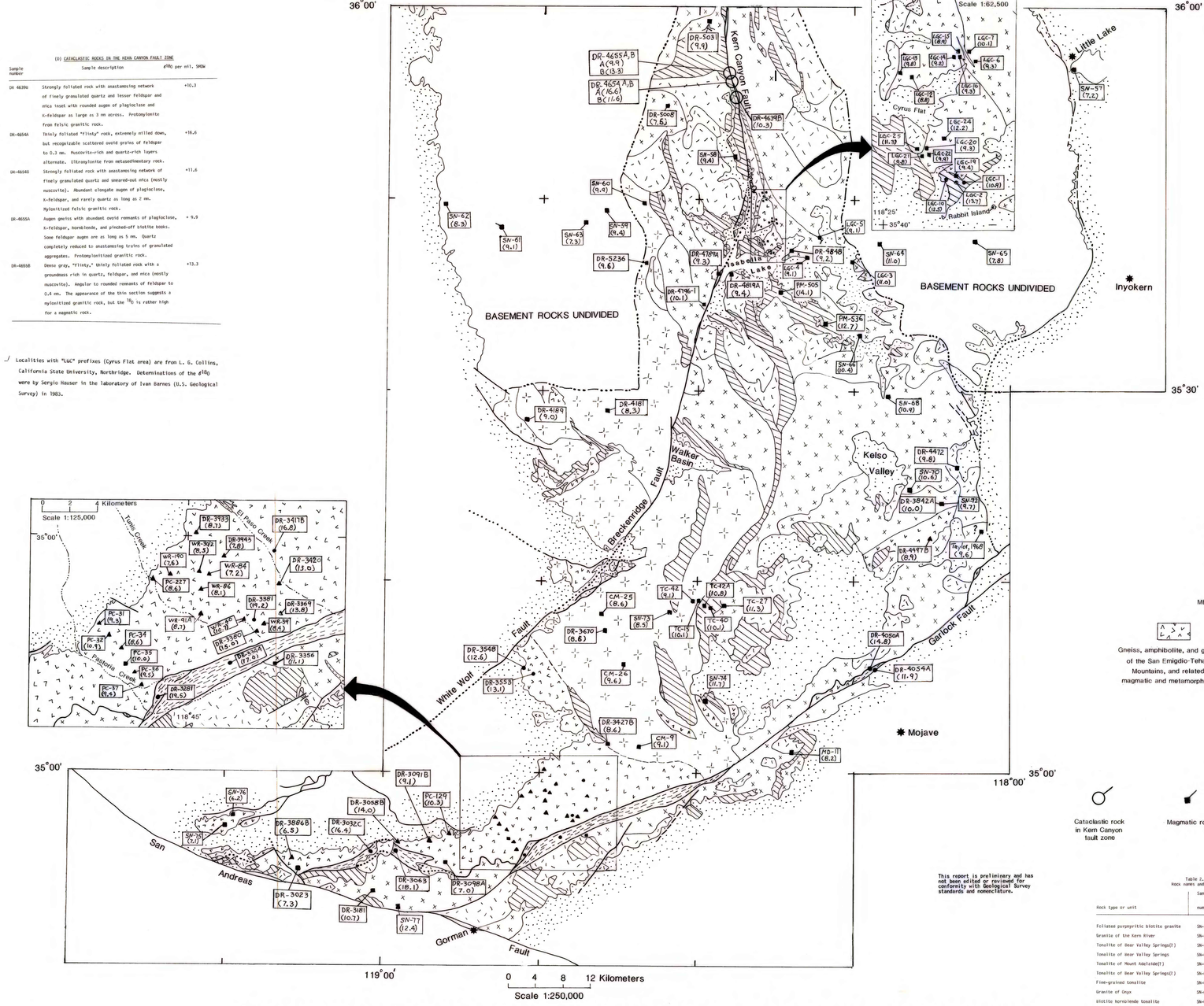
(C) METAMORPHIC ROCKS (PROTOLITH UNCERTAIN)

Rock type and unit	Sample number	Mineral content (in order of decreasing abundance)	$\delta^{18}O$ per mil. SMOW
Gneiss, amphibolite, and granulite of the San Emigdio-Tehachapi Mountains	Quartzo-feldspathic gneiss	DR-3058B	Quartz, plagioclase, biotite, muscovite, graphite, garnet	+14.0
	Amphibolite	DR-3091B	Plagioclase, hornblende, quartz, biotite	+ 9.1
	Quartzo-feldspathic gneiss to granofels	DR-3369	Quartz, plagioclase, clinopyroxene, biotite, garnet, graphite, hornblende	+13.8
	Quartzo-feldspathic gneiss to granofels	DR-3380	Quartz, plagioclase, biotite, garnet, graphite	+15.0
	Hypersthene granulite (quartzo-feldspathic)	DR-3620	Plagioclase, quartz, biotite, hypersthene, clinopyroxene(?)	+15.0
	Amphibolite (schistose)	DR-3886B	Plagioclase, hornblende, quartz	+ 6.5
	Quartzo-feldspathic gneiss	DR-3933	Quartz, plagioclase, biotite, hornblende	+ 8.7
	Hypersthene granulite (mafic)	DR-3943	Plagioclase, hornblende, hypersthene, quartz	+ 7.8
	Quartzo-feldspathic gneiss	PC-31	Quartz, plagioclase, K-feldspar, biotite	+ 9.3
	Quartzo-feldspathic gneiss	PC-32	Quartz, plagioclase, K-feldspar, biotite	+10.9
	Tonalitic gneiss	PC-34	Plagioclase, hornblende, quartz, biotite	+ 8.6
	Quartzo-feldspathic gneiss	PC-36	Quartz, plagioclase, biotite, muscovite	+ 9.5
	Quartzo-feldspathic gneiss	PC-37	Plagioclase, quartz, K-feldspar, biotite, hornblende	+ 9.4
	Garnetiferous quartzo-feldspathic gneiss (coarse-grained)	PC-129	Plagioclase, quartz, biotite, garnet, hornblende	+10.3
	Hypersthene granulite	PC-227	Plagioclase, hornblende, hypersthene, clinopyroxene	+ 8.6
	Amphibolite	WR-30/2	Plagioclase, hornblende (some "uralite"?), quartz	+ 8.5
	Gneissic amphibolite (cataclastic)	WR-39	Plagioclase, hornblende, quartz, biotite	+ 8.4
	Quartzo-feldspathic gneiss (cataclastic)	WR-40	K-feldspar, quartz, plagioclase, biotite, hornblende	+10.7
	Hypersthene granulite	WR-84	Hornblende, plagioclase, hypersthene	+ 7.2
	Amphibolite	WR-86	Hornblende, plagioclase	+ 8.1
	Quartzo-feldspathic gneiss to granofels	WR-91A	Plagioclase, quartz, biotite, muscovite	+ 8.7
	Hypersthene granulite	WR-190	Plagioclase, hornblende, hypersthene	+ 7.6
Mafic terrane of Jawbone Canyon	Amphibolite	DR-4497B	Plagioclase, hornblende, biotite	+ 8.9

(D) CATACLASTIC ROCKS IN THE KERN CANYON FAULT ZONE

Sample number	Sample description	$\delta^{18}O$ per mil. SMOW
DR 4639B	Strongly foliated rock with anastomosing network of finely granulated quartz and lesser feldspar and mica inset with rounded augen of plagioclase and K-feldspar as large as 3 mm across. Protomylonite from felsic granitic rock.	+10.3
DR-4654A	Thinly foliated "flinty" rock, extremely milled down, but recognizable scattered ovoid grains of feldspar to 0.3 mm. Muscovite-rich and quartz-rich layers alternate. Ultramylonite from metasedimentary rock.	+16.6
DR-4654B	Strongly foliated rock with anastomosing network of finely granulated quartz and smeared-out mica (mostly muscovite). Abundant elongate augen of plagioclase, K-feldspar, and rarely quartz as long as 2 mm. Mylonitized felsic granitic rock.	+11.6
DR-4655A	Augen gneiss with abundant ovoid remnants of plagioclase, K-feldspar, hornblende, and pinched-off biotite books. Some feldspar augen are as long as 5 mm. Quartz completely reduced to anastomosing trains of granulated aggregates. Protomylonitized granitic rock.	+ 9.9
DR-4655B	Dense gray, "flinty," thinly foliated rock with a groundmass rich in quartz, feldspar, and mica (mostly muscovite). Angular to rounded remnants of feldspar to 0.4 mm. The appearance of the thin section suggests a mylonitized granitic rock, but the $\delta^{18}O$ is rather high for a magmatic rock.	+13.3

-/ Localities with "LGC" prefixes (Cyrus Flat area) are from L. G. Collins, California State University, Northridge. Determinations of the $\delta^{18}O$ were by Sergio Hauser in the laboratory of Ivan Barnes (U.S. Geological Survey) in 1983.



GENERALIZED GEOLOGIC MAP OF THE SOUTHERN SIERRA NEVADA, CALIFORNIA, SHOWING THE LOCATION OF BASEMENT SAMPLES FOR WHICH WHOLE ROCK ^{18}O HAS BEEN DETERMINED

Compiled by
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NOTES AND SUGGESTIONS

More than 80 determinations of $\delta^{18}O$ on basement rocks of the southern Sierra Nevada have recently become available from the laboratories of the U.S. Geological Survey. These data, plus published oxygen isotope data by Masi and others (1981) and Taylor (1968), seem worthy of compilation at this time to identify the current coverage and hopefully guide future oxygen isotope work in the southern Sierra Nevada. All of the samples are relatively fresh basement rocks and it is unlikely that they have undergone any significant changes in $\delta^{18}O$ due to post-crystallization (or post-metamorphic) alteration.

Some of these samples were selected to see if $\delta^{18}O$ data would help distinguish between igneous and sedimentary protoliths for the high-grade metamorpic rocks of the Sierran tail. The data of table 1C shows that some of the quartzofeldspathic gneiss, granofels, and granulite samples, such as DR-3380 and 3420 are strongly enriched in ^{18}O and probably have a sedimentary parent. On the other hand, most of the mafic gneiss and granulite samples are much less enriched in ^{18}O and probably are meta-igneous rocks.

Masi and others (1981) have noted that granitic rocks of the southernmost Sierra Nevada are somewhat enriched in ^{18}O relative to the rest of the Sierra Nevada. Their data (table 2) as well as the recent determinations (table 1A) show a significant number of rocks with $\delta^{18}O$ greater than +10. According to Taylor (1978), values higher than +10 are suspect as true magmatic rocks, and point to significant assimilation or contamination by sedimentary crustal material. The "^{18}O enriched" granitic rocks of the southern Sierra Nevada clearly need more attention, and, in particular, oxygen isotopic studies of mineral separates are needed. It is noteworthy that Masi and others (1981) report enriched $\delta^{18}O$ values of +11.7 and +11.1 for quartz and +9.8 and +10.2 for feldspar on mineral separates from samples SN-59 and 66. The oxygen isotopic fractionation between the quartz and feldspar is indicative of equilibrium at magmatic temperatures. The quartz values, however, are at least suspect of reflecting contamination of the magma by sedimentary material.

Some limits on the precision and reproducibility of the data in tables 1 and 2 can be suggested from the following. DR-3842A (table 1A) and SN-72 (table 2) are the same specimen. The earlier value for $\delta^{18}O$ cited by Masi and others (1981) is +9.7 and the more recent determination is +10.0. Taylor (1968) also noted that his determination from Jawbone Canyon (table 1A) has a ±0.2 uncertainty.

EXPLANATION

SURFICIAL ROCKS (Cenozoic)

Alluvial deposits, and sedimentary and volcanic rocks, undivided

MAGMATIC ROCKS (largely or wholly Cretaceous)
(Pluton boundaries shown)

Granite | Granodiorite | Tonalite

METAMORPHIC ROCKS (largely or wholly Mesozoic)

Gneiss, amphibolite, and granulite of the San Emigdio-Tehachapi Mountains, and related (?) magmatic and metamorphic rocks

Rand Schist

Siliceous, calcareous, and pelitic metasedimentary rocks; lesser metavolcanic rocks

Key to map symbols

Cataclastic rock in Kern Canyon fault zone

Magmatic rock

Metasedimentary rock

DR-3420 (14.9) Sample number, $+\delta^{18}O$ per mil. SMOW

Metamorphic rock, protolith uncertain

Table 2. Oxygen isotope data for selected magmatic rocks (Masi and others, 1981). Rock names and modes are based on samples collected by D. C. Ross, at or near these localities

Rock type or unit	Sample number	Mineral content (modes of stained slabs) Plagioclase	K-feldspar	Quartz	Biotite	Hornblende	Other	$\delta^{18}O$ per mil. SMOW
Foliated porphyritic biotite granite	SN-57	(not known)						+ 7.2
Granite of the Kern River	SN-58	42	16	26	12	4		+ 9.4
Tonalite of Bear Valley Springs(?)	SN-59	40	19	27	10	4		+ 9.4
Tonalite of Bear Valley Springs	SN-60	41	19	24	12	4		+ 9.9
Tonalite of Mount Adelaide(?)	SN-61	60	5	24	9	2		+ 9.1
Tonalite of Bear Valley Springs(?)	SN-62	56	-	18	15	11		+ 9.3
Fine-grained tonalite	SN-63	56	5	21	13	5		+ 7.3
Granite of Onyx	SN-64	34	39	26	1	--		+11.0
Biotite hornblende tonalite	SN-65	59	5	16	10	10		+ 7.8
Porphyritic granodiorite of Castle Rock	SN-66	49	17	24	10	--		+10.4
Granodiorite of Claraville	SN-68	56	12	23	8	--	Sphene 1	+10.9
Fine-grained granite	SN-70	(not known)						+10.6
Granodiorite of Hoffman Canyon	SN-72	48	11	25	13	3		+ 9.7
Felsic granodiorite (facies of tonalite of BVS)	SN-73	42	20	31	5	2		+ 8.5
Tonalite of Bear Valley Springs	SN-74	60	--	14	17	9		+11.7
Hornblende tonalite of Eagle Nest Peak	SN-75	53	--	19	1	27		+ 7.1
Gabbro of Eagle Nest Peak	SN-76		(not known)					+ 6.2
Granodiorite of Lebec	SN-77	41	17	27	13	2		+12.4
Hornblende-biotite granodiorite	MD-11	47	16	20.5	8.5	8		+ 8.7

REFERENCES CITED

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