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Title of article Geochemistry of upper Proterozoic rift-related volcanics,  
northern Utah and southeastern Idaho

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see Geology v. 14, p. 864 - 867

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## METHODS

The samples were analyzed by X-ray fluorescence at the University of Utah using pressed powder pellets according to the methods of Nisbet et al. (1979). U.S. Geological Survey standards were used with the values of Flanagan (1973). Rare-earth elements were determined by instrumental neutron activation at Portland State University (Marvin Beeson, analyst) and Cornell University (G. D. Harper, analyst). Samples were prepared with a tungsten carbide mill for trace element analyses, whereas the three samples analyzed for rare-earth elements were powdered using a porcelain mortar and pestle to avoid Ta and Co contamination. Petrographic descriptions of the samples are given in Table 1. The results of the analyses are shown in Tables 2 and 3. BV-1 through BV-11 are samples collected progressively higher in a single stratigraphic section west of Clifton, Idaho.

## REFERENCES

- Flanagan, F. J., 1973, 1972 values for international geochemical reference samples: *Geochimica Cosmochimica Acta*, v. 37, p. 1189-1200.
- Govindaraju, K., 1984, 1984 compilation of working values and sample description for 170 international reference samples of mainly silicate rocks and minerals: *Geostandards Newsletter*, v. 8, p. 3-16.
- Nisbet, E. G.; Dietrich, V. J.; and Esenwein, A., 1979, Routine trace element determination in silicate minerals and rocks by X-ray fluorescence: *Fortschritte Mineralogie*, v. 57, p. 264-279.

TABLE 1. PETROGRAPHY OF ANALYZED SAMPLES

Sample	Locality	Lithology	Mineralogy*	Texture
LM-1	Little Mountain, Utah	Metadiabase	Albite(C), Epidote(C), Chlorite (C), Actinolite(C), Sphene(C), Quartz(S)	Poorly preserved fine-grained igneous texture
SYLM-1	Little Mountain, Utah	Pillow lava	Albite(A), Calcite(C), Chlorite(C), Sphene(C), Quartz(S)	Good relict igneous microcrystalline texture, aphyric
BV-4	Clifton Basin, Idaho	Pillow lava	Actinolite(A), Epidote(C), Sphene (C), Chlorite(C), Albite(C), Muscovite(S)	Very fine-grained, recrystallized, aphyric, rare quartz+epidote filled amygdules
BV-5	Clifton Basin, Idaho	Pillow lava	Albite(C), Epidote(C), Actinolite(C), Chlorite(C), Sphene(C)	Very fine-grained, recrystallized, aphyric
BV-6	Clifton Basin, Idaho	Pillow lava	Actinolite(A), Epidote(C), Albite(C), Muscovite(S), Calcite(S), Quartz(S)	Very fine-grained, few epidote filled amygdules
BV-7	Clifton Basin, Idaho	Pillow lava	Actinolite(A), Epidote(C), Chlorite(C), Albite(C), Sphene(C), Muscovite(S)	Very fine-grained, recrystallized, aphyric
BV-8	Clifton Basin, Idaho	Metadiabase	Actinolite(A), Epidote(C), Chlorite(C) Albite(C), Sphene(C)	Fine-grained equigranular
BV-9	Clifton Basin, Idaho	Pillow lava	Actinolite(A), Epidote(C), Chlorite(C), Albite(C), Muscovite(C), Sphene(C)	Sparse plagioclase phenocrysts in microlitic groundmass
BV-10	Clifton Basin, Idaho	Pillow rind	Actinolite(A), Epidote(C), Chlorite(C), Sphene(C), Albite?(C)	3-5% amygdules filled with epidote and chlorite
BV-11	Clifton Basin, Idaho	Metadiabase	Actinolite(A), Albite(C), Chlorite(C), Muscovite(C), Sphene(C), Quartz(S)	Poorly preserved fine-grained igneous texture
BN-12	Clifton Basin, Idaho	Pillow lava	Albite(A), Actinolite(C), Chlorite(C), Sphene(C), Epidote(S)	Good relict lathwork texture with common plagioclase phenocrysts
GH-1	Chinks Peak, Idaho	Greenschist	Chlorite(C), Albite(C), Epidote(C), Sphene(C), Calcite(C), Muscovite(S)	Foliated, large plagioclase pheno- crysts
GH-2	Chinks Peak, Idaho	Greenschist	Chlorite(A), Epidote(C), Calcite(C), Albite(C), Quartz(C), Sphene(C), Albite(C), Chlorite(C), Calcite(C), Sphene(C), Opaque(S)	Foliated, abundant plagioclase pheno- crysts which are broken and rotated
GH-3	Chinks Peak, Idaho	Greenstone	Chlorite(C), Albite(C), Muscovite?(C), Sphene(C), Calcite(S), Opaque(S)	Very fine-grained and homogenous
GH-4	Chinks Peak, Idaho	Greenschist	Albite(A), Chlorite(C), Sphene(C), Apatite(C), Quartz(R), Calcite(R), Biotite? or Stilpnomelane?(S)	Foliated, very fine-grained and homogeneous
GH-6	Chinks Peak, Idaho	Greenstone, clastic	Clasts have good microlitic texture, sparse plagioclase phenocrysts up to 4 mm diameter	Clasts have good microlitic texture, sparse plagioclase phenocrysts up to 4 mm diameter

\*A = abundant, C = common, S = sparse

TABLE 2. TRACE ELEMENT ANALYSES BY X-RAY FLUORESCENCE

	TiO <sub>2</sub> *	Ti	Nb	Zr	Y	Sr	Rb	V	Ni	Ti/V	Zr/Nb	Zr/Y	Nb/Y	Zr/TiO <sub>2</sub>
LM-1	1.68	10072	21	114	25	275	4	306	80	33	5.4	4.6	0.84	0.0068
SYLM-1	1.67	10012	18	100	23	62	1	333	63	30	4.8	4.3	0.78	0.0060
BV-4	1.97	11810	17	123	27	158	44	370	97	32	7.2	4.6	0.63	0.0062
BV-5	1.93	11570	18	118	27	172	13	346	100	33	6.6	4.4	0.67	0.0061
BV-6	1.87	11211	17	114	21	130	18	268	90	42	6.7	5.4	0.81	0.0061
BV-7	1.73	10371	17	112	27	245	4	324	96	32	6.6	4.1	0.63	0.0065
BV-8	1.64	9832	16	112	26	787	15	300	87	33	7.0	4.3	0.62	0.0068
BV-9	2.02	12110	17	120	28	115	14	324	101	37	7.1	4.3	0.61	0.0059
BV-10	2.26	13549	22	129	25	73	9	271	89	50	5.9	5.2	0.88	0.0057
BV-11	1.75	10491	20	128	26	406	42	297	60	35	6.4	4.9	0.77	0.0073
BN-12	2.96	17745	26	176	26	69	7	282	94	63	6.8	6.8	1.00	0.0059
GH-1	3.32	19903	47	240	30	1056	22	286	22	70	5.1	8.0	1.57	0.0072
GH-2	2.87	17206	44	207	28	892	17	232	47	74	4.7	7.4	1.57	0.0072
GH-3	4.54	27217	92	276	29	201	16	505	55	54	3.0	9.5	3.17	0.0061
GH-4	3.14	18824	38	192	38	947	67	317	121	59	5.1	5.1	1.00	0.0061
GH-6	3.59	21522	220	688	39	532	23	205	8	105	3.1	17.6	5.64	0.0192

\*Weight %, all other elements in ppm

TABLE 3. INSTRUMENTAL NEUTRON ACTIVATION ANALYSES

	Portland State Univ.		Cornell University		
	LM-1	BV-7	BV-7	GH-3	W-1 <sup>a</sup>
La	9.8	10.1	10.0	47.8	10.86 ±0.12 (11)
Ce	24.5	26.6	23.6	98.3	23.04 ±0.73 (23)
Sm	4.35	4.28	4.00	9.11	3.29 ±0.02 (3.5)
Eu	1.34	1.48	1.53	2.62	1.04 ±0.02 (1.11)
Tb			0.84	1.01	0.68 ±0.04 (0.65)
Yb	2.70	2.10	2.20	2.10	2.09 ±0.06 (2.1)
Lu	0.42	0.35	0.28	0.28	0.29 ±0.01 (0.34)
Hf	2.80	2.46	2.40	5.80	2.32 ±0.13 (2.6)
Ta	0.72	0.77	b	5.34	0.47 ±0.07 (0.50)
Th	c	0.90	0.84	5.27	2.07 ±0.11 (2.42)
Sc	38	36	34	23	36.3 ±0.2 (35)
Cr	143	162	191	95	129 ±2 (120)
Ni			101	53	84 ±12 (75)
Co	49	44	b	49	45.6 ±0.3 (46)
Na2O	2.42	1.81	1.62	3.30	2.16 ±0.02 (2.14)
FeO*	11.91	10.51	9.94	11.26	

<sup>a</sup>

USGS standard, recommended values in parentheses (Govindaraju, 1984)

<sup>b</sup>

Sample ground in tungsten carbide resulting in Co and Ta contamination

<sup>c</sup>

Below detection