

Figure Caption (for appendix)

Figure 1. Distribution of Na-rich altered igneous rocks, western United States. Numbers correspond to those in Table A.

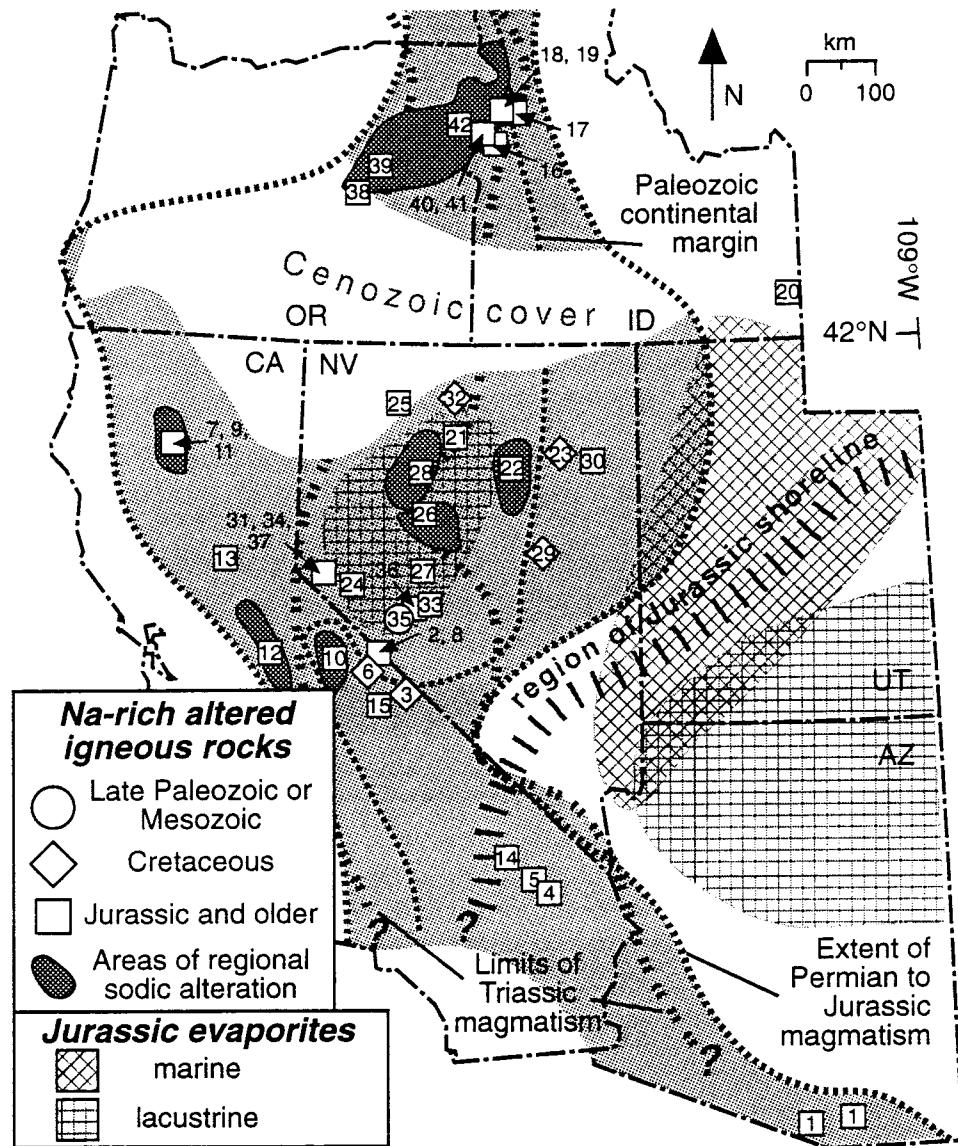


TABLE A. Summary of Na-Rich Alteration, Western United States

ID #	LOCATION	AGE ¹	ALTERATION	PRIMARY REFERENCES ²
ARIZONA				
1	Ko Vaya Super Unit intrusions	J	Na, NaCa?	Tosdal et al., 1989; Riggs, 1987
CALIFORNIA				
2	Benton Range	Tr	Na, NaCa	Crowder and Ross, 1973; this study
3	Birch Creek	K	NaK	Barton, 1987; this study
4	Bristol Mountains	J	Na, NaCa	Fox, 1989
5	Iron Hat	J	Na, NaCa	Hall et al., 1988; this study
6	McGee Mountain	K?	Na	Rinehart and Ross, 1964
7	Mule Mountain pluton	Dev	Na	Albers, 1964; Kinkel et al., 1956
8	Pellesier Flats	J	Na	Crowder and Ross, 1973; Anderson, 1937
9	Pit River stock	PTr	Na	Albers and Robertson, 1961
10	Ritter Range	J	Na, "alkali"	Hanson et al., 1993
11	Shasta district volcanic rocks	Pal - Tr	Na, NaCa?	Kinkel et al., 1956; Albers and Robertson, 1961; Casey and Taylor, 1982
12	Sierra Nevada Foothills	J	Na	Xenophontos and Bond, 1978; Saleeby et al., 1989; Albers, 1981
13	Smartville	J	Na	Xenophontos and Bond, 1978
14	Soda Mountain Fm. and intrusions	TrJ	Na, NaCa?	Grose, 1959
15	Tungsten Hills	Tr	Na	Chen and Moore, 1982; this study
IDAHO				
16	Cuddy Mountain	TrJ	Na	Fankhauser, 1969
17	Riggins Group and intrusions	Tr?	Na, NaCa?	Hamilton, 1963
18	Seven Devils Group	PTr	Na	Vallier, 1977; Fankhauser, 1969
19	Seven Devils intrusions	TrJ	Na, NaCa?	White, 1968
20	Unnamed tuff	J	Na	Gulbrandsen and Cressman, 1960
NEVADA				
21	Buffalo Mtn. pluton	J	NaCa, Na	Neff, 1969; this study
22	Cortez Mountains	J	Na, NaCa?	Muffler, 1964; this study
23	Dawley Canyon	K	NaK	Olson and Hinrichs, 1960; Barton, 1987; this study
24	Gray Hills pluton	J	Na, NaCa?	Bingler, 1978; this study
25	Happy Creek volcanic series and intrusions	P	Na	Willden, 1963
26	Humboldt complex	J	NaCa, Na	Speed, 1963; Vanko and Bishop, 1982; this study
27	Illinois stock	J	NaCa	Humphrey and Wyatt, 1958
28	Koipato volcanic rocks and intrusions	PTr	Na	Tatlock, 1961; Johnson, 1977; Knopf, 1924; this study
29	McCullough Butte	K	NaK	Barton, 1987
30	Melrose pluton	J	NaCa	Stubbs, 1984; Leland, 1990
31	Mt. Siegel batholith	J	NaCa, Na	Battles, 1990; this study
32	Osgood Mtns. intrusions	K	Na, NaK?	Hotz and Willden, 1964; this study
33	Royston district	Tr	Na, NaCa?	Seedorff, 1991
34	Shamrock batholith	J	NaCa, Na	Battles, 1990; this study
35	Silver Dyke	K?	Na?, NaCa?	Kerr, 1936; this study
36	Simon quartz keratophyre	Tr?	Na	Knopf, 1921
37	Yerington batholith	J	NaCa, Na	Carten, 1986; Dilles, 1984; Dilles et al., 1992; Dilles and Einaudi, 1992
OREGON				
38	Buck Creek tuff	J	Na	Dickinson, 1962
39	Canyon Mtn. Complex	PTr	Na	Thayer, 1963, 1977
40	Holbrook-Irondyke	P	Na	Vallier, 1967
41	Oxbow	PTr	Na	Vallier, 1967
42	Sparta district	PTr	Na, NaCa?	Gilluly, 1933

¹Age abbreviations: Dev = Devonian, J = Jurassic, K = Cretaceous, P = Permian, Pal = Paleozoic, Tr = Triassic

²See Battles (1990) for a complete list of references

REFERENCES

(accompany Table A; for GSA Data Repository)

- Albers, J. P., 1964, Geology of the French Gulch quadrangle, Shasta and Trinity Counties, California: U.S. Geological Survey Bulletin, v. 1141-J, p. J1-J70.

Albers, J. P., 1981, A lithologic-tectonic framework for the metallogenic provinces of California: Economic Geology, v. 76, p. 765-790.

Albers, J. P., and Robertson, J. F., 1961, Geology and ore deposits of the East Shasta copper-zinc district, Shasta County, California: U.S. Geological Survey Professional Paper 338, 107 p.

Anderson G. H., 1937, Granitization, albitization, and related phenomena in the northern Inyo range of California-Nevada: Geological Society of America Bulletin, v. 48, p. 1-74.

Barton, M. D., 1987, Lithophile element mineralization associated with Late Cretaceous two-mica granites in the Great Basin: Geology, v. 15, p. 337-340.

Battles, D. A., 1990, The hydrothermal evolution of the Shamrock batholith, western Nevada, and the origin of sodium-rich alteration in the western United States [Ph.D. thesis]: Los Angeles, University of California, 122 p.

Bingler, E. C., 1978, Geologic map of the Schurz quadrangle: Nevada Bureau of Mines and Geology Map 60.

Carten, R. B., 1986, Sodium-calcium metasomatism; chemical, temporal, and spatial relationships at the Yerington, Nevada, porphyry copper deposit: Economic Geology, v. 81, p. 1495-1519.

Casey, W. H., and Taylor, B. E., 1982, Oxygen, hydrogen, and sulfur isotope geochemistry of a portion of the West Shasta Cu-Zn district, California: Economic Geology, v. 77, p. 38-49.

Chen, J. H., and Moore, J. G., 1982, Uranium-lead isotopic ages from the Sierra Nevada Batholith, California: Journal of Geophysical Research, v. 87, p. 4761-4784.

Crowder, D. F., and Ross, D. C., 1973, Petrography of some granitic bodies in the northern White Mountains, California-Nevada: U.S. Geological Survey Professional Paper 775, 28 p.

Dickinson, W. R., 1962, Metasomatic quartz keratophyre in central Oregon: American Journal of Science, v. 260, p. 249-266.

Dilles, J. H., 1984, The petrology and geochemistry of the Yerington batholith and the Ann-Mason porphyry copper deposit, western Nevada [Ph. D. thesis]: Palo Alto, Stanford University, 389 p.

Dilles, J. H., and Einaudi, M. T., 1992, Wall-rock alteration and hydrothermal flow paths about the Ann-Mason porphyry copper deposit, Nevada - A 6-km vertical reconstruction: Economic Geology, v. 87, p. 1963-2001.

Dilles, J. H., Solomon, G. C., Taylor, H. P., Jr., and Einaudi, M. T., 1992, Oxygen and hydrogen isotope characteristics of hydrothermal alteration at the Ann-Mason porphyry copper deposit, Yerington, Nevada: Economic Geology, v. 87, p. 44-63.

Fankhauser, R. E., 1969, Geology and mineralization of the southern Cuddy Mountains, Washington County, Idaho [M.S. thesis]: Corvallis, Oregon State University, 126 p.

Fox, L. K., 1989, Albitionization of Jurassic plutons in the southern Bristol Mountains, east-central Mojave Desert, southeastern California [Ph. D. thesis]: Santa Barbara, University of California, 342 p.

Gilluly, J., 1933, Replacement origin of the albite granite near Sparta, Oregon: U.S. Geological Survey Professional Paper 175-C, p. 63-81.

- Grose, L. T., 1959, Structure and petrology of the northeastern part of the Soda Mountains, San Bernardino County, California: Geological Society of America Bulletin, v. 70, p. 1509-1548.
- Gulbrandsen, R. A., and Cressman, E. R., 1960, Analcime and albite in altered Jurassic tuff in Idaho and Wyoming: Journal of Geology, v. 68, p. 458-464.
- Hall, D. L., Cohen, L. H., and Schiffman, P., 1988, Hydrothermal alteration associated with the Iron Hat iron skarn deposit, eastern Mojave desert, San Bernardino, California: Economic Geology, v. 83, p. 568-587.
- Hamilton, W. H., 1963, Metamorphism in the Riggins region, western Idaho: U.S. Geological Survey Professional Paper 436, 95 p.
- Hanson, R. B., Sorensen, S. S., Barton, M. D., and Fiske, R. S., 1993, Long-term evolution of fluid-rock interactions in magmatic arcs: Evidence from the Ritter Range pendant, Sierra Nevada, California, and numerical modeling: Journal of Petrology, v. 34, p. 23-62.
- Hotz, P. E., and Willden, R., 1964, Geology and mineral deposits of the Osgood Mountains quadrangle, Humboldt county, Nevada: U.S. Geological Survey Professional Paper 431, 128 p.
- Humphrey, F. L., and Wyatt, M., 1958, Scheelite in feldspathized granodiorite at the Victory mine, Gabbs, Nevada: Economic Geology, v. 53, p. 38-64.
- Johnson, M. G., 1977, Geology and mineral deposits of Pershing County, Nevada: Nevada Bureau of Mines and Geology Bulletin, v. 89, 115 p.
- Kerr, P. F., 1936, The tungsten mineralization at Silver Dyke, Nevada: Nevada Bureau of Mines and Geology Bulletin, v. 30, 70 p.

Kinkel, A. R., Hall, W. E., and Albers, J. P., 1956, Geology and base metal deposits of the west Shasta Cu-Zn district, Shasta County, California: U.S. Geological Survey Professional Paper 285, 156 p.

Knopf, A., 1921, Ore deposits of Cedar Mountain, Mineral County, Nevada: U.S. Geological Survey Bulletin, v. 725, p. 361-382.

Knopf, A., 1924, Geology and ore deposits of the Rochester district, Nevada: U.S. Geological Survey Bulletin, v. 762, 78 p.

Leland, J., 1990, Geology and petrogenesis of the Melrose stock, Elko County, Nevada [M.S. thesis]: Los Angeles, University of California, 134 p.

Muffler, L. J. P., 1964, Geology of the Frenchie Creek quadrangle, north-central Nevada: U.S. Geological Survey Bulletin, v. 1179, 99 p.

Neff, T. R., 1969, Petrology and structure of the Buffalo Mountain Pluton, Humboldt County, Nevada [Ph.D. thesis]: Palo Alto, Stanford University, 120 p.

Olson, J. C., and Hinrichs, E. N., 1960, Beryl-bearing pegmatites in the Ruby Mountains and other areas in Nevada and northwestern Arizona: U.S. Geological Survey Bulletin 1082D, 200 p.

Riggs, N., 1987, Stratigraphy, structure, and geochemistry of Mesozoic rocks in the Pajarito Mountains, Santa Cruz County, Arizona, *in* Dickinson, W., and Klute, M., eds., Mesozoic rocks of southern Arizona and adjacent regions: Arizona Geological Society Digest, v. 18, p. 165-176.

Rinehart, C. D., and Ross, D. C., 1964, Geology and mineral deposits of the Mount Morrison quadrangle, Sierra Nevada, California: U.S. Geological Survey Professional Paper 385, 106 p.

Saleeby, J. B., Shaw, H. F., Niemeyer, S., Moores, E. M., and Edelman, S. H., 1989, U/Pb, Sm/Nd, and Rb/Sr geochronological and isotopic study of northern Sierra

Nevada ophiolitic assemblages, California: Contributions to Mineralogy and Petrology, v. 102, p. 205-220.

Seedorff, E., 1991, Royston district, western Nevada: A Mesozoic porphyry copper system that was tilted and dismembered by Tertiary normal faults, *in* Gaines, G.L. et al., eds., Geology and ore deposits of the Great Basin symposium proceedings: Geological Society of Nevada, p. 359-392.

Speed, R. C., 1963, Deuteric scapolitization of gabbros near Lovelock, Nevada: Geological Society of America Special Paper 76, p. 225.

Stubbs, G. S., 1984, Geology of a contact zone: Dolly Varden Mountains, Elko County, Nevada [M.S. thesis]: Boulder, University of Colorado, 86 p.

Tatlock, D. B., 1961, Redistribution of K, Na, and Al in some felsic rocks in Nevada and Sweden: Mining Engineering, v. 13, p. 1256.

Thayer, T. P., 1963, The Canyon Mountain Complex, Oregon and the alpine mafic magma stem: U.S. Geological Survey Professional Paper 475-C, p. C82-85.

Thayer, T. P., 1977, The Canyon Mountain Complex, Oregon and some problems of ophiolites: Oregon Department of Geology and Mineral Industries Bulletin, v. 95, p. 93-105.

Tosdal, R. M., Haxel, G. B., and Wright, J. E., 1989, Jurassic geology of the Sonoran desert region, southern Arizona, southeastern California, and northernmost Sonora: Construction of a continental-margin arc, *in* Jenney, J. P., and Reynolds, S. J., eds., Geologic evolution of Arizona: Arizona Geological Society Digest, v. 17, p. 397-434.

Vallier, T. L., 1967, Geology of part of the Snake River Canyon and adjacent areas in northeastern Oregon and western Idaho [Ph.D. thesis]: Corvallis, Oregon State University, 267 p.

Vallier, T. L., 1977, The Permian and Triassic Seven Devils Group, western Idaho and northeastern Oregon: U.S. Geological Survey Bulletin, v. 1437, 58 p.

Vanko, D. A., and Bishop, F. C., 1982, Occurrence and origin of marialitic scapolite in the Humboldt lopolith, N.W. Nevada: Contributions to Mineralogy and Petrology, v. 81, p. 277-289.

White, W. H., 1968, Plutonic rocks of the southern Seven Devils Mountains, Idaho [Ph.D. thesis]: Corvallis, Oregon State University, 177 p.

Willden, R., 1963, General geology of the Jackson Mountains, Humboldt County, Nevada: U.S. Geological Survey Bulletin, v. 1141-D, p. D1-65.

Xenophontos, C., and Bond, G., 1978, Petrology, sedimentation, and paleogeography of the Smartville Terrane (Jurassic) - Bearing on the genesis of the Smartville ophiolite, *in* Howell, D.G., and McDougall, K.A., eds., Mesozoic paleogeography of the western United States: Los Angeles, California, Society of Economic Paleontologists and Mineralogists, p. 291-302.