DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

TO ACCOMPANY
WRI REPORT 83-4119-F

MAP SHOWING OUTCROPS OF BASALTIC ROCKS OF EARLY QUATERNARY AND TERTIARY AGE, BASIN AND RANGE PROVINCE, NEVADA

Compiled by Kurt Roggensack and K. A. Sargent

INTRODUCTION

This map report is one of a series of geologic and hydrologic maps for all or parts of States within the Basin and Range province of the western United States. The map reports contain information on subjects that characterize the geohydrology of the province, including the ground-water hydrology, ground-water quality, surface distribution of selected rock types, tectonic conditions, areal geophysics, Pleistocene lakes and marshes and mineral and energy resources. This work is a part of the U.S. Geological Survey's program for geologic and hydrologic evaluation of the Basin and Range province to identify potentially suitable regions for further study relative to disposal of high-level nuclear waste (Bedinger, Sargent, and Reed, 1984).

This map was prepared from published geologic maps and reports utilizing the project guidelines defined in Sargent and Bedinger (1984). The map shows the known occurrences of basaltic rocks of early Quaternary and Tertiary age as portrayed by Stewart and Carlson (1978). As used in this study, basaltic rocks include basaltic andesite, trachyandesite, and basalt. The Description of Map Units includes: (1) Geologic age; (2) radiometric age where available; (3) lithology; (4) thickness where available; and (5) sources of data for the basaltic units in the study area. Outcrops are outlined and numbered within each county. No information was readily available for the rock outcrops that are unnumbered. The listed radiometric ages do not necessarily represent the entire age range of the geologic unit.

DESCRIPTION OF MAP UNITS

[To convert feet (ft) to meters, multiply feet by 0.3048; to convert miles (mi) to kilometers, multiply miles by 1.609]

County-area number	Map symbol	Geologic and radiometric age in millions of years (m.y.)	Lithology and comments	References for county area
		CARSON CITY COUNTY (CC)		
CC-1	QTb	Quaternary and Tertiary 1.36±0.29 m.y.	McClellan Peak Olivine Basalt and Lousetown Formation: Vesicular fine-grained basaltic andesite and olivine-basalt flows interbedded with basaltic andesite scoria; unit 35 to 50 ft thick.	Bingler, 1977; Moore, 1969
		CHURCHILL COUNTY (CH)		
CH-1	Tba	Pliocene	Bunejug and Truckee Formations: Basalt and andesite flows; may include interbedded sedimentary rocks.	Morrison, 1964; Willden and Speed, 1974
CH-2	Tba	Pliocene(?)	Basalt and andesite flows as much as 1,600 ft thick.	Willden and Speed, 1974
CH-3	QTb	Quaternary and Tertiary	Basalt of Rattlesnake Hill: Basalt flows and agglomerate, overlain predominantly by lake sediments and eolian sand.	Morrison, 1964
CH-4	Tba	Tertiary	Bunejug and Truckee Formations: Basalt and andesite flows and intercalated sediments; overlie andesitic and rhyolitic rock.	Morrison, 1964; Willden and Speed, 1974
CH-5	Tba	Tertiary 17.6 m.y.	Bunejug Formation: Upper unit, scoriaceous olivine-basalt flows, 10 to 15 ft thick, interbedded with basaltic tuff and tuff breccia; aggregate thickness 50 to 150 ft. Lower unit, dense to scoriaceous basalt and andesite flows as much as 40 ft thick; interbedded tuff comprises as much as 20 percent of unit; aggregate thickness 0 to 400 ft thick. Formation thickness as much as 550 ft thick. Flows dip moderately and are largely underlain by volcanics and sediments of the Truckee Formation. Bunejug Formation designated as Pliocene and Pleistocene(?) by Morrison (1964), but Willden and Speed (1974) give a 17 m.y. age for similar rocks in Cocoon Mountains.	Luedke and Smith, 1981; Morrison, 1964; Willden and Speed, 1974

CLARK COUNTY (CL)				
CL-1	Tba	Miocene 12.7±0.8 m.y.	Augite andesite and autoclastic volcanic breccia, between 2,500 and 3,000 ft thick.	Anderson, 1973; Anderson and others, 1972; Bohannon, 1981
CL-2	Tb	Miocene 8 and 11.3 m.y.	Olivine basalt and olivine-augite basalt. Thickness, 0 to more than 300 ft.	Anderson and others, 1972; Bohannon, 1981; Eberly and Stanley, 1978
CL-3	Tba	Miocene	Mount Davis Volcanics: Basaltic to rhyolitic lava flows. Basaltic andesite common in lower part. Unit estimated as much as 1,000 ft thick (Anderson and others, 1972).	Anderson and others, 1972; Bingler and Bonham, 1973
CL-4	Tba	Miocene 11.8 to 14.6 m.y.	Mount Davis Volcanics: Basaltic to rhyolitic lavas interbedded with clastic rocks, bedded tuff, and rubble. Thickest known section about 2,000 ft thick north of Nelson.	Anderson, 1971; Anderson and others, 1972; Longwell, 1963
CL-5	Tba	Miocene 12.0±0.4 to 13.7±0.2 m.y.	Basalt.	Luedke and Smith, 1981; Marvin and others, 1973
CL-6	Tba	Tertiary	Basaltic and andesitic rocks. Corresponds to Muddy Creek Formation of Longwell (1963).	Longwell, 1963; Volborth, 1973
CL-7	Tba	Miocene 10 to 16+ m.y.	Mount Davis Volcanics: Basaltic to rhyolitic lavas; basaltic andesite common in lower part. Also, rhyolite dikes, plugs, domes, and flows, and bedded pyroclastic rocks in lower part in northern part of area.	Anderson and others, 1972; Bingler and Bonham, 1973; Luedke and Smith, 1981
ELKO COUNTY (EL)				
EL-1	Tb	Miocene 10±0.5 m.y.	Banbury Formation: Tholeiitic olivine-basalt flows partly overlain by gravel and underlain by gravel and locally tuff; includes basaltic cinder, tuff, and lava cones.	Hope and Coats, 1976
EL-2	Tb	Miocene	Basalt dipping gently south-southeastward. dip. Unit is faulted and more than 200 ft thick, as shown in cross section.	Granger and others, 1957
EL-3	Tb	Eocene	Basaltic latite flows, very fine grained and locally vesicular. Unit includes feeder dikes.	Hope and Coats, 1976

EL-4	Tb	Tertiary	Aphanitic andesite and basaltic andesite, 0 to 1,000 ft thick.	Hope and Coats, 1976; Smith and Ketner, 1978; Solomon and Moore, 1982a, 1982b
	Tba	Oligocene 30.9±1.0 and 35.2±1.1 m.y.	Dense andesite and basaltic andesite flows and minor basaltic tuffs and tuff-breccias. Thickness as much as 1,000 ft.	

ESMERALDA COUNTY (ES)

ES-1	Tba	Tertiary	Vesicular basalt flows which lack scoria. Thickness as much as 400 ft in Monte Cristo Range.	Ferguson and others, 1953
ES-2	QTb	Quaternary and Tertiary	Olivine basalt to basalt, vesicular to non-vesicular, includes cinder cones, 0 to 200 ft thick.	Stewart, 1979
ES-3	QTb	Quaternary and Tertiary	Fine-grained, commonly vesicular olivine basalt and basaltic andesite to trachyandesite; includes basaltic agglomerate, cinders, dikes, and plugs. Correlates with andesite of Davis Mountain to the north and with basalt of Mount Montgomery to the south. Cross section indicates thickness as much as 300 ft.	McKee and others, 1982; Robinson and Crowder, 1973; Stewart, 1979
ES-4	QTb	Quaternary and Tertiary	Trachybasalt lava, cinders, and bombs. Contours indicate 80-ft thickness.	Robinson and others, 1976
ES-5	QTb	Quaternary and Tertiary	Basalt flows and cinder cone.	Albers and Stewart, 1972; Stewart and Carlson, 1978
	Tba	Pliocene	Basaltic andesite flows.	
ES-6	QTb	Quaternary and Tertiary 4.8 m.y.	Vesicular, porphyritic, locally scoriaceous trachy-basalt flows, locally inter-layered with sediments.	Krauskopf, 1971; Robinson and others, 1976; Stewart and others, 1974
ES-7	Tba	Miocene	Mira Basalt: Basalt flow interlayered in the Siebert Tuff; 100 ft thick.	Albers and Stewart, 1972; Luedke and Smith, 1981
		6.8±1.5 to 8.7±1.5 m.y.	Malpais Basalt: Olivine-basalt flow that overlies sediments of the Thirsty Canyon Tuff (7.5 m.y.) and the Rabbit Spring Formation; 0 to 100 ft thick.	
		13.5±3.0 m.y.	Basalt flows north of Goldfield.	
ES-8	QTb	Quaternary and Tertiary	Olivine basalt, locally scoriaceous. Basalt in adjacent California is more than 200 ft thick.	McKee and Nelson, 1967

		EUREKA COUNTY (EU)		
EU-1	Tba	Miocene 14.5±1.5 to 16.3±0.9 m.y.	Basaltic andesite flows dipping gently eastward. Mostly underlain by gravel but in northern part underlain by the Ordovician Vinini Formation. Thickness 0 to 350 ft.	Gilluly and Masursky, 1965; Luedke and Smith, 1981
EU-2	Tb	Tertiary	Olivine basalt and basalt flows and cones.	Roberts and others, 1967
	Tba	Tertiary	Andesite flows 0 to 200 ft thick underlain by 0 to 700 ft of rhyolitic tuff and breccia; overlain by thick quartz-latite flows.	
EU-3	Tba	Miocene 14.7±1.0 m.y.	Basaltic andesite.	Luedke and Smith, 1981
		HUMBOLDT COUNTY (H)		
H-1	QTb	Quaternary(?) and Tertiary 1.2 and 9.87±1.2 m.y.	Mesa Basalt and basalt of Catnip Creek: Basalt and minor andesitic basalt, scoriaceous; minor interbeds of tuffaceous sedimentary rocks. Date of 1.2 m.y. from near Big Springs Butte may be inaccurate (Cathrall and others, 1978). Individual flows 0 to 10 ft thick; overall thickness as much as 130 ft.	Cathrall and others, 1978; Merriam, 1910; Walker and Repenning, 1965; Walker and Swanson, 1969
H-2	Tba	Miocene 16.5±1.5 m.y.	Steens Basalt: Basalt and andesite flows and minor interbeds of tuffaceous sedimentary rocks, volcanics, and scoria. Individual flows 0 to 25 ft thick; aggregate thickness of as much as 1,700 ft on northeast side of Disaster Peak.	Greene, 1976; Luedke and Smith, 1981; Walker and Repenning, 1965
H-3	Tba	Miocene 15.6±0.3 m.y.	Basalt.	Luedke and Smith, 1981
H-4	Tb	Tertiary	Thin, porphyritic and vesicular flows. Unit thickness as much as 50 ft as indicated by cross section.	Smith, 1973
H-5	Tba	Pliocene and Miocene	Basalt flows interbedded with sediments and overlain by rhyolite in the northeast part of Jackson Mountains. Aerial magnetic map indicates basalt extends from the northeast part of the mountains eastward for 2 mi under a thin alluvial cover. Cross section near Buff Peak shows unit approximately 1,000 ft thick, but generally flows are 600 ft thick.	Roberts, 1940; Willden, 1963
H-6	Tb	Miocene 14.7±0.5 m.y.	Basalt.	Luedke and Smith, 1981

H-7	Tba	Miocene 22.0±0.7 m.y.	Basaltic andesite, andesite, and olivine-basalt flows, fine grained to aphanitic, and locally highly vesicular. Total thickness as much as 1,250 ft, but generally only 300 ft thick, as determined from cross section.	Erickson and Marsh, 1974b; Hotz and Willden, 1964
H-8	QTb	Quaternary and Tertiary 4.98±0.15 m.y.	Vesicular basalt and dense, olivine-basalt flows, fine grained to aphanitic; locally scoriaceous. Maximum exposed thickness is 200 ft, but a cross section shows thickness as much as 300 ft.	Erickson and Marsh, 1974a; Hotz and Willden, 1964; Luedke and Smith, 1981
H-9	QTb	Quaternary and Tertiary	Basalt flows, 0 to 100 ft thick.	Ferguson and others, 1951; Gilluly, 1967
	Tba	Tertiary	Basalt flows, 100 ft exposed.	

LANDER COUNTY (LA)

LA-1	Tb	Miocene 10.0±0.3 and 8.5±0.7 m.y.	Massive, slightly vesicular olivine-basalt flows. Overlie lenticular sedimentary body that rests on a thick sequence of basaltic andesite flows.	Luedke and Smith, 1981; Stewart and and McKee, 1977
	Tba	14.8 and 16.3 m.y.	Basaltic andesite flows, weakly columnar and platy jointing. Flows 10 to 100 ft thick, aggregate thickness as much as 1,000 ft.	
LA-2	QTb	Quaternary and Tertiary	Basalt and olivine-basalt flows, dikes, and cinder cones. Flow tops are scoriaceous; bottoms, vesicular; locally weak columnar jointing. Flows dip gently to south. Individual flows 25 to 60 ft thick; aggregate thickness of 150 ft.	Roberts, 1964; Stewart and McKee, 1977
LA-3	Tb	Pliocene(?)	Basalt flows, locally vesicular and scoriaceous. Total thickness of the unit as much as 130 ft in cross section.	McKee, 1968

LINCOLN COUNTY (LI)

LI-1	Tb	Miocene 8.5±0.3 m.y.	Olivine-basalt flows less than 100 ft thick. Locally, flows may be as old as 17 m.y. (Ekren and others, 1977).	Armstrong, 1970; Ekren and others, 1977; Luedke and Smith, 1981

LYON COUNTY (LY)

LY-1	Tba	Miocene 7.25±0.30 to 12.2 m.y.	Basalt and olivine-basalt flows, intensely faulted; underlain by gravels and Tertiary andesitic and sedimentary rocks.	Gilbert and Reynolds, 1973; Knopf, 1918; Luedke and Smith, 1981; Moore, 1969

LY-2	Tba	Miocene 6.57±0.27 to 12.2 m.y.	Lousetown Formation: Basalt and basaltic andesite flows and interbeds of scoriaceous basalt breccia and diatomaceous sediments.	Luedke and Smith, 1981; Moore, 1969; Stewart and others, 1981
			MINERAL COUNTY (M)	
M-1	Tba	Miocene 7.3±0.4 m.y.	Basaltic andesite flows, cross section through the Wassuk Range indicates a thickness of more than 200 ft. In Gray Hills, flows are about 30 ft thick.	Bingler, 1978
M-2	Tba	Pliocene and Miocene 5.7±0.2 and 8.5±0.3 m.y.	Vesicular basalt flows overlain by minor aphyric or porphyritic latite. Latite flows 0 to 200 ft thick; basalt flows 0 to 1,000 ft thick.	Ekren and Byers, 1978c; Ferguson and others, 1954; Luedke and Smith, 1981
M-3	Tba	Miocene	Aphyric to porphyritic latite (Ekren and Byers, 1978b); described as basalt by Stewart and Carlson (1978) and Luedke and Smith (1981); 0 to 160 ft thick.	Ekren and Byers, 1978b; Ferguson and others, 1953; Luedke and Smith, 1981; Stewart and Carlson, 1978
M-4	QTb	Quaternary and Tertiary 2.8±0.1 m.y.	Andesite and basalt of Beauty Peak volcano.	Kleinhampl and others, 1975; Luedke and Smith, 1981
M-5	QTb	Quaternary and Tertiary 1.1±0.2 to 4.5±0.2 m.y. and 5 to 10 m.y.	Alkali(?)-olivine basalt and basalt. Youngest age dates from southern outcrops.	Kleinhampl and others, 1975; Luedke and Smith, 1981
M-6	QTb	Quaternary and Tertiary 2.8±0.1 to 3.9±0.4 m.y.	Basalt-scoria cones.	Ferguson and others, 1954; Luedke and Smith, 1981
M-7	QTb	Quaternary and Tertiary 2.7±0.1 and 3.1±0.1 m.y.	Basalt of Mount Montgomery: Very vesicular olivine-basalt flows, cinders and agglomerate. In northeast part of area flows overlie conglomerate and are interlayered with the rhyolite of Sugarloaf Canyon. May be correlative with basalt of Benton Range (3 m.y.). Individual flows 30 to 50 ft thick; total thickness generally 150 ft but may be as much as 1,000 ft.	Crowder and others, 1972; Dalrymple and Hirooka, 1965; Ferguson and others, 1954; Luedke and Smith, 1981; McKee, 1982; Stewart, 1979, 1981a, 1981b
			NYE COUNTY, NORTHERN HALF (NN)	
NN-1	Tba	Tertiary	Porphyritic andesite, olivine-bearing trachyandesite, and vesicular basalt flows, 0 to more than 800 ft thick. At Sherman Peak, trachyandesite overlies ash-flow tuff. Aggregate thickness 1,800 ft.	Bonham, 1970; Ferguson and Cathcart, 1954; Vitaliano, 1963; Vitaliano and Callaghan, 1963; Vitaliano and Vitaliano, 1972

NN-2	Tba	Miocene	Hornblende andesite and hornblende rhyodacite, both slightly porphyritic. Total thickness as much as 250 ft.	Ekren and Byers, 1978a
NN-3	Tb	Miocene 10.2±0.9 m.y.	Porphyritic basalt lavas and dikes, 0 to 100 ft thick.	Ekren, Hinrichs and others, 1973; Luedke and Smith, 1981
NN-4	Tba	Tertiary	Basaltic andesite and dacite flows of uncertain age relationship. Locally covered by veneer of alluvium. Cross sections indicate thickness of 0 to 150 ft.	Scott, 1965
NN-5	Tba	Miocene 14.7±0.5 to 18.9±1.5 m.y.	Porphyritic trachyandesite flows, intrusives, vents, and scoria. Minor sedimentary and pyroclastic rocks; local deuteric alteration. Flows overlie volcanics of Lime Mountain and the Siebert Formation. Individual flows 10 to 15 ft thick; total thickness 0 to 1,000 ft.	Armstrong and others, 1972; Bonham and Garside, 1979
NN-6	QTb	Quaternary and Tertiary	Aphanitic basaltic andesite, 0 to 100 ft thick.	Ekren and others, 1972
NN-7	Tba	Tertiary	Basalt, 0 to 70 ft thick in cross section.	Scott, 1965
NN-8	Tba	Miocene	Glassy basaltic andesite flows showing hackly jointing; maximum thickness 65 ft.	Gardner and others, 1980
NN-9	QTb	Quaternary and Tertiary 5.7±0.2 m.y.	Porphyritic olivine-basalt flows, 0 to 200 ft thick, locally intercalated with beds of colluvium and alluvium as much as 100 ft thick.	Ekren, Rogers, and others, 1973; Luedke and Smith, 1981; Marvin and others, 1973
		NYE COUNTY, SOUTHERN HALF (NS)		
NS-1	Tba	Miocene ~12 and <15 m.y.	Olivine-basalt and trachyandesite flows and locally plugs. Younger than Donavan Peak volcanics (15 m.y.) and probably similar in age to basalt of Black Cap Mountain (12 m.y.). Individual flows 10 to 35 thick; maximum exposed thickness 365 ft.	Albers and Stewart, 1972; Bonham and Garside, 1979
NS-2	Tba	Miocene	Olivine-basalt flows and some interbedded basalt cinders; less than 400 ft thick.	Gardner and others, 1980
NS-3	Tba	Tertiary <7.5 and 12.0±0.5 m.y.	Basalt flows that overlie the Thirsty Canyon Tuff (7.5 m.y.). Contours indicate greater than 800 ft in thickness. Date of 12 m.y. reported by Armstrong and others (1972).	Armstrong and others, 1972; Cornwall, 1972; Luedke and Smith, 1981
NS-4	Tb	Pliocene	Basalt of Basalt Ridge: Porphyritic basalt.	Ekren and others, 1971

NS-5	Tba	Miocene 10.4±1.4 to 12.9±1.2 m.y.	Andesite and basalt flows.	Luedke and Smith, 1981
NS-6	QTb	Miocene 9.2 and 10.4 m.y.	Aphanitic olivine-basalt flows and dikes, some scoria; locally, probable cone or vent; 0 to more than 200 ft thick.	Ekren and others, 1967, 1971; Luedke and Smith, 1981; Rogers and others, 1967
NS-7	QTb	Quaternary and Tertiary	Basalt of Basalt Ridge: Porphyritic, alkalic olivine basalt, commonly vesicular, 0 to more 150 ft.	Ekren and others, 1971; Noble and Christiansen, 1968; Rogers and others, 1968
	Tb	Pliocene	Porphyritic basalt and trachyandesite, 0 to 50 ft thick.	
	Tb	Pliocene	Andesitic basalt of Mount Helen: Andesitic basalt flows and dikes, porphyritic, glassy to finely crystalline groundmass, 0 to 50 ft thick. Restricted to northern part of area.	
NS-8	QTb	Quaternary and Tertiary >7.5 m.y.	Dense, porphyritic basalt, includes feeder dike. Generally 0 to 100 ft thick, but largest body, a basalt dome, could be more than 800 ft thick as indicated by contours (Cornwall, 1972). This body underlies the Thirsty Canyon Tuff (7.5 m.y.).	Cornwall, 1972; Ekren and others, 1966, 1971; Lipman and others, 1966
NS-9	QTb	Quaternary and Tertiary 2.8 m.y.	Non-porphyritic trachy-basalt flows, cinder beds, and spatter cones, 0 to 250 ft thick.	Byers and Cummings, 1967; Byers and others, 1966, 1976; Carr and Quinlivan, Christiansen and Lipman, 1965; Hinrichs and others, 1967; Kistler, 1968; Luedke and Smith, 1981
	Tb	Pliocene	Rubbly, scoriaceous trachy-andesite and trachybasalt flows and vents. Locally interbedded with gravels and tuffaceous sediments. Individual flows 0 to 100 ft thick; aggregate thickness 0 to 1,000 ft. 1,000 ft.	
	Tb	Miocene 10.6±0.34 to 10.9±0.45 m.y.	Northernmost Tb outcrop is olivine-basalt flows. Contours indicate 0 to 120 ft thick.	
NS-10	QTb	Quaternary and Tertiary	Turnridge stock: Microgabbro and basalt intrusives as dikes and plugs. Byers and Barnes (1967) describe unit as basalt flows and note cinder cones at base. Cross-sectional thickness is more than 200 ft.	Byers and Barnes, 1967; Spengler and others, 1979

NS-11	Tb	Tertiary	Easternmost outcrops are fine-grained to aphanitic, porphyritic basalt flows interbedded with tuff tilted and faulted. Porphyritic latite flows and latite intrusives are also present.	Cornwall, 1972; Cornwall and Kleinhampl, 1961, 1964
		Miocene 10.8 to <13.5 m.y.	Porphyritic, fine grained basalt flows and dikes; local basanite facies. Interlayered with Paintbrush and Timber Mountain Tuffs (10.8 to 13.5 m.y.) and some flows overlie Timber Mountain Tuff. Cross-sectional thickness more than 200 ft.	
NS-12	QTb	Quaternary and Tertiary 3.7 m.y.	Basalt flows and locally pyroclastics.	Crowe and Carr, 1980; Crowe and others, 1983; Ekren and Sargent, 1965; McKay and Williams, 1964; Sargent and others, 1970; Sargent and Stewart, 1971
	Tb	Pliocene	Basalt of Kiwi Mesa: Dense to scoriaceous, amygdaloidal olivine basalt. Locally deuterically altered, and weathers crumbly; 0 to 250 ft thick. Basalt of Skull Mountain: Dense, amygdaloidal, locally scoriaceous olivine basalt; 0 to 300 ft thick.	

PERSHING COUNTY (P)

P-1	Tba	Tertiary	Basalt flows and breccias, some interbedded sediments. Cross section shows southernmost outcrop to be more than 100 ft thick, but thickness may include some tuff.	Silberling and Wallace, 1967
P-2	Tba	Miocene 11.8±0.4 and 13.2±0.4 m.y.	Basalt flows, scoriaceous, ropy to massive. Dates are from McKinney Pass area. Cross section shows thickness as much as 500 ft.	Ferguson and others, 1951; Luedke and Smith, 1981; Muller and others, 1951
P-3	Tba	Miocene 10.6±0.3 to 11.2±0.3 m.y.	Basalt and minor andesite flows, breccias, vents, and pyroclastics. Flows have scoriaceous tops, and locally are interbedded with gravel and tuffaceous material. Basalts partly overlie metasediments, and have undergone slope failure. Cross section shows thickness as much as 250 ft.	Luedke and Smith, 1981; Wallace, Silberling, and others, 1969; Wallace, Tatlock, and others, 1969
P-4	Tb	Oligocene	Massive and blocky olivine-basalt flows, locally vesicular. The five or six flows average about 30 ft thick; aggregate thickness of 150 ft. Flows underlie Caetano Tuff (Oligocene).	Johnson, 1977

		STOREY COUNTY (S)		
S-1	QTb	Quaternary and Tertiary 1.2 to 2.3 m.y.	Vesicular, olivine-basalt to pyroxene-andesite flows, pyroclastics, and intrusives; overlie gravels and volcanics and sediments of the Truckee Formation. Unit called Lousetown Formation by Rose (1969), Thompson (1956) and Thompson and White (1964), but Bonham (1969) states that the age is too young. Aggregate thickness as much as 350 ft.	Bonham, 1969; Luedke and Smith, 1981; Rose, 1969; Thompson, 1956; Thompson and White, 1964
	Tb	Miocene 6.90±0.19 m.y.	Lousetown Formation: Vesicular, olivine-basalt to pyroxene-andesite flows, pyroclastics, and intrusives; overlie gravels and volcanics and sediments of the Truckee Formation. Aggregate thickness is as much as 350 ft.	
	Tba	Miocene 13.9 m.y.	Chloropagus Formation: Locally brecciated basalt and andesite flows interbedded with sediments, tuffs, and intrusives. Overlies Old Gregory Formation and overlaps both the Alta Formation and Hartford Hill Rhyolite Tuff Formation 0 to more than 2,500 ft thick.	
		WASHOE COUNTY (WS)		
WS-1	QTb	Quaternary(?) and Tertiary 9.87±1.2 m.y.	Basalt of Catnip Creek and Mesa Basalt: Basalt flows, 0 to 10 ft thick; total thickness as much as 135 ft.	Bonham, 1969; Cathrall and others, 1978; Merriam, 1910; Walker and Repenning, 1965
	Tb	Pliocene and Miocene 8.84±1.1 m.y.	Includes basalt of Catnip Creek: Vesicular to scoriaceous olivine-basalt flows, dikes, and plugs; local columnar jointing. Individual flows 10 to 20 ft thick; aggregate thickness as much as 135 ft. Basalt of Catnip Creek is in northeast part of area.	
	Tba	Miocene 15.3±0.9 m.y.	Andesite of Bald Mountain and andesite of Round Mountain: Predominantly andesite but also basalt and trachyte flows and breccias. Interbedded with tuffaceous sedimentary rocks; overlain by tuffs and basalts; unit as much as 1,500 ft thick.	
WS-2	Tba	Pliocene and Miocene	Basaltic flows, basalt lapilli tuffs, and lapillistones intercalated with tuffs and sediments in the High Rock sequence.	Bonham, 1969

WS-3	QTb	Quaternary and Tertiary	Basalt and andesite flows.	Bonham, 1969
	Tb	Pliocene and Miocene	Vesicular to scoriaceous olivine-basalt flows, dikes, and plugs. Flows intercalated with sediments and volcanics of Pliocene(?) age; locally columnar jointed. Individual flows 10 to 20 ft thick; aggregate thickness more than 1,000 ft.	
WS-4	Tb	Pliocene and Miocene	Olivine basalt, vesicular to scoriaceous.	Bonham, 1969; Luedke and Smith, 1981; MacJannet, 1957; Willden and Speed, 1974
	Tba	Miocene 12.4 to 15.2±2.4 m.y.	Pyramid Formation of MacJannet (1957) and Chloropagus and Old Gregory Formations: Olivine basalt, basaltic andesite, and andesite flows, vents, and dikes; some local scoria; flow partings and very vesicular flow tops. Intercalated with siliceous pumice and lapilli tuff as well as sediments and volcanics of the Coal Valley and Truckee Formations. Locally cut by faults with as much as 1,000 ft vertical displacement. Thickness 0 to 3,000 ft.	

REFERENCES CITED

Albers, J. P., and Stewart, J. H., 1972, Geology and mineral deposits of Esmeralda County, Nevada: Nevada Bureau of Mines and Geology Bulletin 78, 80 p.

Anderson, R. E., 1971, Thin-skin distension in Tertiary rocks of southeastern Nevada: Geological Society of America Bulletin, v. 82, no. 1, p.43-58.

_____1973, Large-magnitude late Tertiary strike-slip faulting north of Lake Mead, Nevada: U.S. Geological Survey Professional Paper 794, 18 p.

Anderson, R. E., Longwell, C. R., Armstrong, R. L., and Marvin, R. F., 1972, Significance of K-Ar ages of Tertiary rocks from the Lake Mead region, Nevada-Arizona: Geological Society of America Bulletin, v. 83, no. 2, p. 273-287.

Armstrong, R. L., 1970, Geochronology of Tertiary igneous rocks eastern Basin and Range province, western Utah, eastern Nevada, and vicinity, U.S.A.: Geochimica et Cosmochimica Acta, v. 34, no. 2, p. 203-232.

Armstrong, R. L., Dick, H., and Vitaliano, C. J., 1972, K/Ar dates and strontium isotope initial ratios of some Cenozoic volcanic rocks from west-central Nevada: Isochron/West, no. 3, p. 23-28.

Bedinger, M. S., Sargent, K. A., and Reed, J. E., 1984, Geologic and hydrologic characterization and evaluation of the Basin and Range Province relative to the disposal of high-level radioactive waste--Part I, Introduction and guidelines: U.S. Geological Survey Circular 904-A, [in press].

Bingler, E. C., 1977, Geologic map of the New Empire Quadrangle, Nevada: Nevada Bureau of Mines and Geology Map 59, scale 1:24,000.

_____1978, Geologic map of the Schurz Quadrangle, Lyon and Mineral Counties, Nevada: Nevada Bureau of Mines and Geology Geologic Map 60, scale 1:48,000.

Bingler, E. C., and Bonham, H. F., Jr., 1973, Reconnaissance geologic map of McCullough Range and adjacent areas, Clark County, Nevada: Nevada Bureau of Mines and Geology Map 45, scale 1:125,000.

Bohannon, R. G., 1981, Geologic map, tectonic map, and structure sections of the Muddy and northern Black Mountains, Clark County, Nevada: U.S. Geological Survey Open-File Report 81-796, scale 1:62,500.

Bonham, H. F., Jr., 1969, Geology and mineral deposits of Washoe and Storey Counties, Nevada, with a section on Industrial rock and mineral deposits, by K. G. Papke: Nevada Bureau of Mines and Geology Bulletin 70, 140 p.

_____1970, Geology map and sections of a part of the Shoshone Mountains, Lander and Nye Counties, Nevada: Nevada Bureau of Mines Map 38, scale 1:62,500.

Bonham, H. F., Jr., and Garside, L. J., 1979, Geology of the Tonopah, Lone Mountain, Klondike, and northern Mud Lake Quadrangles, Nevada: Nevada Bureau of Mines and Geology Bulletin 92, 142 p.

Byers, F. M., Jr., and Barnes, Harley, 1967, Geologic map of the Paiute Ridge Quadrangle, Nye and Lincoln Counties, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-577, scale 1:24,000.

Byers, F. M., Jr., Carr, W. J., Christiansen, R. L., Lipman, P. W., Orkild, P. P., and Quinlivar, W. D., 1976, Geologic map of the Timber Mountain caldera area, Nye County, Nevada: U.S. Geological Survey Miscellaneous Investigations Series Map I-891, scale 1:48,000.

Byers, F. M., Jr., and Cummings, David, 1967, Geologic map of the Scrugham Peak Quadrangle, Nye County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-695, scale 1:24,000.

Byers, F. M., Jr., Rogers, C. L., Carr, W. J., and Luft, S. J., 1966, Geologic map of the Buckboard Mesa Quadrangle, Nye County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-552, scale 1:24,000.

Carr, W. J., and Quinlivan, W. D., 1966, Geologic map of the Timber Mountain Quadrangle, Nye County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-503, scale 1:24,000.

Cathrall, J. B., Green, R. C., Plouff, D., Seems, D. F., and Grenshaw, G. L., 1978, Mineral resources of the Charles Sheldon wilderness study area, Humboldt and Washoe Counties, Nevada, and Lake and Harney Counties, Oregon: U.S. Geological Survey Open-File Report 78-1002, 145 p.

Christiansen, R. L., and Lipman, P. W., 1965, Geologic map of the Topopah Springs NW Quadrangle, Nye County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-444, scale 1:24,000.

Cornwall, H. R., 1972, Geology and mineral deposits of southern Nye County, Nevada: Nevada Bureau of Mines and Geology Bulletin 77, 49 p.

Cornwall, H. R., and Kleinhampl, F. J., 1961, Geology of the Bare Mountain Quadrangle: U.S. Geological Survey Geologic Quadrangle Map GQ-157, scale 1:62,500.

_____1964, Geology of Bullfrog Quadrangle and ore deposits related to Bullfrog Hills caldera, Nye County, Nevada, and Inyo County, California: U.S. Geological Survey Professional Paper 454-J, 25 p.

Crowder, D. F., Robinson, P. F., and Harris, D. L., 1972, Geologic map of the Benton Quadrangle, Mono County, California, and Esmeralda and Mineral Counties, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-1013, scale 1:62,500.

Crowe, B. M., and Carr, W. J., 1980, Preliminary assessment of the risk of volcanism at a proposed nuclear waste repository in the southern Great Basin: U.S. Geological Survey Open-File Report 80-357, 15 p.

Crowe, B. M., Self, Stephen, Vaniman, D. T., Amos, R. C., and Perry, Frank, 1983, Aspects of potential magmatic disruption of a high-level radioactive waste repository in southern Nevada: Journal of Geology, v. 91, p. 259-276.

Dalrymple, G. B., and Hirooka, Kimio, 1965, Variation of potassium, argon, and calculated age in a late Cenozoic basalt: Journal of Geophysical Research, v. 70, p. 5291-5296.

Eberly, L. D., and Stanley, T. B., 1978, Cenozoic stratigraphy and geologic history of southwestern Arizona: Geological Society of America Bulletin, v. 89, no. 6, p. 921-940.

Ekren, E. B., Anderson, R. E., Orkild, P. P., and Hinrichs, E. N., 1966, Geologic map of the Silent Butte Quadrangle, Nye County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-493, scale 1:24,000.

Ekren, E. B., Anderson, R. E., Rogers, C. L., and Noble, D. C., 1971, Geology of northern Nellis Air Force Base Bombing and Gunnery Range, Nye County, Nevada: U.S. Geological Survey Professional Paper 651, 91 p.

Ekren, E. B., and Byers, F. M., Jr., 1978a, Preliminary geologic map of the Luning NE Quadrangle, Mineral and Nye Nevada: U.S. Geological Survey Open-File Report 78-915, scale 1:48,000.

_____1978b, Preliminary geologic map of the Luning SE Quadrangle, Mineral and Nye Counties, Nevada: U.S. Geological Survey Open-File Report 78-918, scale 1:24,000.

_____1978c, Preliminary geologic map of the Luning SW Quadrangle, Mineral and Nye Counties, Nevada: U.S. Geological Survey Open-File Report 78-917, scale 1:48,000.

Ekren, E. B., Hinrichs, E. N., and Dixon, G. L., 1972, Geologic map of The Wall Quadrangle, Nye County, Nevada: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-719, scale 1:48,000.

Ekren, E. B., Hinrichs, E. N., Quinlivan, W. D., and Hoover, D. L., 1973, Geologic map of the Moores Station Quadrangle, Nye County, Nevada: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-756, scale 1:48,000.

Ekren, E. B., Orkild, P. P., Sargent, K. R., and Dixon, G. L., 1977, Geologic map of Tertiary rocks, Lincoln County, Nevada: U.S. Geological Survey Miscellaneous Investigations Series Map I-1041, scale 1:250,000.

Ekren, E. B., Rogers, C. L., Anderson, R. E., and Botinelly, Theodore, 1967, Geologic map of the Belted Peak Quadrangle, Nye County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-606, scale 1:62,500.

Ekren, E. B., Rogers, C. L., and Dixon, G. L., 1973, Geologic and Bouguer gravity map of the Reveille Quadrangle, Nye County, Nevada: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-806, scale 1:48,000.

Ekren, E. B., and Sargent, K. A., 1965, Geologic map of the Skull Mountain Quadrangle, Nye County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-387, scale 1:24,000.

Erickson, R. L., and Marsh, S. P., 1974a, Geologic map of the Iron Point Quadrangle, Humboldt County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-1175, scale 1:24,000.

_____1974b, Geologic map of the Golconda Quadrangle, Humboldt County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-1174, scale 1:24,000.

Ferguson, H. G., and Cathcart, S. H., 1954, Geologic map of the Round Mountain Quadrangle, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-40, scale 1:125,000.

Ferguson, H. G., Muller, S. W., and Cathcart, S. H., 1953, Geologic map of the Coaldale Quadrangle, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-23, scale 1:125,000.

_____1954, Geology of the Mina Quadrangle, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-45, scale 1:125,000.

Ferguson, H. G., Muller, S. W., and Roberts, F. J., 1951, Geology of the Winnemucca Quadrangle: U.S. Geological Survey Geologic Quadrangle Map GQ-11, scale 1:125,000.

Gardner, J. N., Eddy, A. C., Goff, F. E., and Grafft, K. S., 1980, Reconnaissance geologic map of the northern Kawich and northern Reveille Ranges, Nye County, Nevada: Los Alamos, New Mexico, Los Alamos Scientific Laboratory LA-8390 Map UC-51, scale 1:62,500.

Gilbert, C. M., and Reynolds, M. W., 1973, Character and chronology of basin development, western margin of the Basin and Range province: Geological Society of America Bulletin, v. 84, no. 8, p. 2489-2510.

Gilluly, James, 1967, Geologic map of the Winnemucca Quadrangle, Humboldt and Pershing Counties, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-656, scale 1:62,500.

Gilluly, James, and Masursky, Harold, 1965, Geology of the Cortez Quadrangle, Nevada, with a section on Gravity and aeromagnetic surveys, by D. R. Mabey: U.S. Geological Survey Bulletin 1175, 117 p.

Granger, A. E., Bell, M. M., Simmons, G. C., and Lee, Florence, 1957, Geology and mineral resources of Elko County, Nevada: Nevada Bureau of Mines Bulletin 54, 190 p.

Greene, R. C., 1976, Volcanic rocks of the McDermitt caldera, Nevada-Oregon: U.S. Geological Survey Open-File Report 76-753, 80 p.

Hinrichs, E. N., Krushensky, R. D., and Luft, S. J., 1967, Geologic map of the Ammonia Tanks Quadrangle, Nye County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-638, scale 1:24,000.

Hope, R. A., and Coats, R. R., 1976, Preliminary geologic map of Elko County, Nevada: U.S. Geological Survey Open-File Report 76-779, scale 1:100,000.

Hotz, P. E., and Willden, Ronald, 1964, Geology and mineral deposits of the Osgood Mountains Quadrangle, Humboldt County, Nevada: U.S. Geological Survey Professional Paper 431, 128 p.

Johnson, M. G., 1977, Geology and mineral deposits of Pershing County, Nevada: Nevada Bureau of Mines and Geology Bulletin 89, 115 p.

Kistler, R. W., 1968, Potassium-argon ages of volcanic rocks in Nye and Esmeralda Counties, Nevada, in Eckel, E. B., ed., Nevada Test Site: Geological Society of America Memoir 110, p. 251-262.

Kleinhampl, F. J., Davis, W. E., Silberman, M. L., Chesterman, C. W., Chapman, R. H., and Gray, C. H., Jr., 1975, Aeromagnetic and limited gravity studies and generalized geology of the Bodie Hills region, Nevada and California: U.S. Geological Survey Bulletin 1384, 38 p.

Knopf, Adolph, 1918, Geology and ore deposits of the Yerington district, Nevada: U.S. Geological Survey Professional Paper 114, 68 p.

Krauskopf, K. B., 1971, Geologic map of the Mt. Barcroft Quadrangle, Esmeralda and Mono Counties, California and Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-960, scale 1:62,500.

Lipman, P. W., Quinlivan, W. D., Carr, W. J., and Anderson, R. E., 1966, Geologic map of the Thirsty Canyon SE Quadrangle, Nye County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-489, scale 1:24,000.

Longwell, C. R., 1963, Reconnaissance geology between Lake Mead and Davis Dam, Arizona-Nevada: U.S. Geological Survey Professional Paper 374-E, p. E1-E51.

Luedke, R. G., and Smith, R. L., 1981, Map showing distribution, composition, and age of late Cenozoic volcanic centers in California and Nevada: U.S. Geological Survey Miscellaneous Investigatiion Series Map I-1091-C, scale 1:1,000,000, 2 sheets.

MacJannet, G. S., 1957, Geology of the Pyramid Lake-Red Rock Canyon area, Washoe County, Nevada: Los Angeles, California, University of California, unpublished M. A. thesis.

Marvin, R. F., Mehnert, H. H., and McKee, E. H., 1973, A summary of radiometric ages of Tertiary volcanic rocks in Nevada and eastern California - Part III, southeastern Nevada: Isochron/West, no. 6, p 1-29.

McKay, E. J., and Williams, W. P., 1964, Geology of the Jackass Flats Quadrangle, Nye County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-368, scale 1:24,000.

McKee, E. H., 1968, Geologic map of the Spencer Hot Springs Quadrangle, Lander County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-770, scale 1:62,500.

_____1982, Geologic map of the Sugarloaf roadless area, Nevada: U.S. Geological Survey Miscellaneous Field Studies Map MF-1400-A, scale 1:62,500.

McKee, E. H., Diggles, M. F., Donahoe, J. L., and Elliot, G. S., 1982, Geologic map of the White Mountains wilderness and roadless areas, Esmeralda, Inyo, Mineral, and Mono Counties, California and Nevada: U.S. Geological Survey Miscellaneous Field Studies Map MF-1361-A, scale 1:62,500.

McKee, E. H., and Nelson, C. A., 1967, Geologic map of the Soldier Pass Quadrangle, Esmeralda, Inyo, and Mono Counties, California and Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-654, scale 1:62,500.

Merriam, J. C., 1910, Tertiary mammal beds of Virgin Valley and Thousand Creek in northwestern Nevada--Part 1, Geologic history: Berkeley, University of California, Department of Geological Sciences Bulletin, v. 6, no. 2, p. 21-53.

Moore, J. G., 1969, Geology and mineral deposits of Lyon, Douglas, and Ormsby Counties, Nevada, with a section on Industrial minerals, by N. L. Archbold: Nevada Bureau of Mines and Geology Bulletin 75, 45 p.

Morrison, R. B., 1964, Lake Lahontan--Geology of southern Carson Desert, Nevada: U.S. Geological Survey Professional Paper 401, 156 p.

Muller, S. W., Ferguson, H. G., and Roberts, R. J., 1951, Geology of Mount Tobin Quadrangle, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-7, 1:125,000.

Noble, D. C., and Christiansen, R. L., 1968, Geologic map of the southwestern quarter of the Black Mountain Quadrangle, Nye County, Nevada: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-562, scale 1:24,000.

Roberts, R. J., 1940, Quicksilver deposits of the Battle Creek district, Humboldt County, Nevada: U.S. Geological Survey Bulletin 922-A, 29 p.

_____1964, Stratigraphy and structure of the Antler Peak Quadrangle, Humboldt and Lander Counties, Nevada: U.S. Geological Survey Professional Paper 459-A, p. A1-A93.

Roberts, R. J., Montgomery, K. M., and Lehner, R. E., 1967, Geology and mineral resources of Eureka County, Nevada: Nevada Bureau of Mines Bulletin 64, 152 p.

Robinson, P. T., and Crowder, D. F., 1973, Geologic map of the Davis Mountain Quadrangle, Esmeralda and Mineral Counties, Nevada, and Mono County, California: U.S. Geological Survey Geologic Quadrangle Map GQ-1078, scale 1:62,500.

Robinson, P. T., Stewart, J. H., Moiola, R. J., and Albers, J. P., 1976, Geologic map of the Rhyolite Ridge Quadrangle, Esmeralda County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-1325, scale 1:62,500.

Rogers, C. L., Anderson, R. E., Ekren, E. B., and O'Connor, J. T., 1967, Geologic map of the Quartzite Mountain Quadrangle, Nye County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-672, scale 1:62,500.

Rogers, C. L., Ekren, E. B., Noble, D. C., and Weir, J. E., 1968, Geologic map of the northern half of the Black Mountain Quadrangle, Nye County, Nevada: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-545, scale 1:62,500.

Rose, R. L., 1969, Geology of parts of the Wadsworth and Churchill Butte Quadrangles, Nevada: Nevada Bureau of Mines Bulletin 71, 27 p.

Sargent, K. A., and Bedinger, M. S., 1984, Geologic and hydrologic characterization and evaluation to the Basin and Range province relative to the disposal of high-level radioactive waste--Part II, Geologic and hydrologic characterization: U.S. Geological Survey Circular 904-B, [in press].

Sargent, K. A., McKay, E. J., and Burchfiel, B. C., 1970, Geologic map of the Striped Hills Quadrangle, Nye County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-882, scale 1:24,000.

Sargent, K. A., and Stewart, J. H., 1971, Geologic map of the Specter Range NW Quadrangle, Nye County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-884, scale 1:24,000.

Scott, R. B., 1965, The Tertiary geology and ignimbrite petrology of the Grant Range, east-central Nevada: Houston, Texas, Rice University Ph.D. dissertation, 116 p.

Silberling, N. J., and Wallace, R. E., 1967, Geologic map of the Imlay Quadrangle, Pershing County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-666, scale 1:62,500.

Smith, J. F., Jr., and Ketner, K. B., 1978, Geologic map of the Carlin-Pinon Range area, Elko and Eureka Counties, Nevada: U.S. Geological Survey Miscellaneous Investigations Series Map I-1028, scale 1:62,500.

Smith, J. G., 1973, Geologic map of the Duffer Peak Quadrangle, Humboldt County, Nevada: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-606, scale 1:62,500.

Solomon, B. J., and Moore, S. W., 1982a, Geologic map and oil shale deposits of the Elko West Quadrangle, Elko County, Nevada: U.S. Geological Survey Miscellaneous Field Studies Map MF-1410, scale 1:24,000.

_____1982b, Geologic map and oil shale deposits of the Elko East Quadrangle, Elko County, Nevada: U.S. Geological Survey Miscellaneous Field Studies Map MF-1421, scale 1:24,000.

Spengler, R. W., Maldonado, Florian, Weir, J. E., Jr., Hanna, W. F., and Dixon, G. L., 1979, Inventory of granitic ashes in the State of Nevada: U.S. Geological Survey Open-File Report 79-235, 264 p.

Stewart, J. H., 1979, Geology map of the Miller Mountain and Columbus Quadrangles, Mineral and Esmeralda Counties, Nevada: U.S. Geological Survey Open-File Report 79-1145, scale 1:24,000.

_____1981a, Geology map of the Jacks Spring Quadrangle, Mineral County, Nevada: U.S. Geological Survey Open-File Report 81-368, scale 1:24,000.

_____1981b, Geology map of the Basalt Quadrangle, Mineral County, Nevada: U.S. Geological Survey Open-File Report 81-369, scale 1:24,000.

Stewart, J. H., and Carlson, J. E., compilers, 1978, Geologic map of Nevada: Prepared by U.S. Geological Survey in cooperation with Nevada Bureau of Mines and Geology, scale 1:500,000.

Stewart, J. H., and McKee, E. H., 1977, Geology and mineral deposits of Lander County, Nevada--Part 1, Geology: Nevada Bureau of Mines and Geology Bulletin 88, p. 1-59.

Stewart, J. H., Reynolds, M. W., and Johannesen, D. C., 1981, Geologic map of the Mount Grant Quadrangle, Lyon and Mineral Counties, Nevada, with Surficial geology by J. C. Dohrenwend: U.S. Geological Survey Miscellaneous Field Studies Map MF- 1278, scale 1:62,500.

Stewart, J. H., Robinson, P. T., Albers, J. P., and Crowder, D. F., 1974, Geologic map of the Piper Peak Quadrangle, Nevada-California: U.S. Geological Survey Geologic Quadrangle Map GQ-1186, scale 1:62,500.

☆US GOVERNMENT PRINTING OFFICE 1984—781 174

Thompson, G. A., 1956, Geology of the Virginia City Quadrangle, Nevada: U.S. Geological Survey Bulletin 1042-C, p. 45-77.

Thompson, G. A., and White, D. E., 1964, Regional geology of the Steamboat Springs area, Washoe County, Nevada: U.S. Geological Survey Professional Paper 458-A, p. A1-A52.

Vitaliano, C. J., 1963, Cenozoic geology of the Ione Quadrangle, Nye County, Nevada: U.S. Geological Survey Mineral Investigations Field Studies Map MF-225, scale 1:62,500.

Vitaliano, C. J., and Callaghan, Eugene, 1963, Geology of the Paradise Peak Quadrangle, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-250, scale 1:62,500.

Vitaliano, C. J., and Vitaliano, D. B., 1972, Cenozoic volcanic rocks in the southern Shoshone Mountains and Paradise Range, Nevada: Geological Society of America Bulletin, v. 83, no. 11, p. 3269-3280.

Volborth, Alexis, 1973, Geology of the granite complex of the Eldorado, Newberry, and northern Dead Mountains, Clark County, Nevada: Nevada Bureau of Mines and Geology Bulletin 80, 40 p.

Walker, G. W., and Repenning, C. A., 1965, Reconnsaissance geologic map of the Adel Quadrangle, Lake, Harney, and Malheur Counties, Oregon: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-446, scale 1:250,000.

Walker, G. W., and Swanson, D. A., 1969, Discussion of paper by H. E. Wheeler, and H. A. Coombs, "Late Cenozoic Mesa Basalt sheet in northwestern States": Bulletin of Volcanology, v. 32, no. 3, p. 581-585.

Wallace, R. E., Silberling, N. J., Irwin, W. P., and Tatlock, D. B., 1969, Geologic map of the Buffalo Mountain Quadrangle, Pershing County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-821, scale 1:62,500.

Wallace, R. E., Tatlock, D. B., Silberling, N. J., and Irwin, W. P., 1969, Geologic map of the Unionville Quadrangle, Pershing County, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-820, scale 1:62,500.

Willden, Ronald, 1963, General geology of the Jackson Mountains, Humboldt County, Nevada: U.S. Geological Survey Bulletin 1141-D, p. D1-D65.

Willden, Ronald, and Speed, R. C., 1974, Geology and mineral deposits of Churchill County, Nevada: Nevada Bureau of Mines and Geology Bulletin 83, 92 p.