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(Accompanied by summary pamphlet)

PRELIMINARY GEOLOGIC MAP OF THE NORTH-CENTRAL SAN BERNARDINO MOUNTAINS, CALIFORNIA

By

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METHODS

This geologic map was compiled from a number of published and unpublished sources. The distribution of crystalline rocks of the Proterozoic Baldwin Gneiss is from unpublished U.S. Geological Survey (USGS) mapping by J.C. Matti, C.M. Conway, F.K. Miller, J.P. Calzia, and C.R. Wrucke. The distribution and geologic structure of Proterozoic and early Paleozoic metasedimentary rocks mainly is from unpublished mapping by J.C. Matti, F.K. Miller, J.P. Calzia, and C.R. Wrucke and by H.J. Brown (Pluess-Stauffer, Inc.); in the east part of the map area, relations among late Proterozoic rocks are adapted from unpublished mapping by P.L. Ehlig and students of California State University, Los Angeles. The distribution and structure of Paleozoic metasedimentary carbonate rocks is from unpublished geologic mapping by H.J. Brown (Pluess-Stauffer, Inc.) and unpublished USGS mapping by J.C. Matti, J.P. Calzia, and C.R. Wrucke. The distribution and structure of Mesozoic plutonic rocks is from MacColl (1964), Smith (1982), and Cameron (1981) modified by unpublished USGS mapping by F.K. Miller and J.C. Matti. The distribution and structure of Tertiary and Quaternary sedimentary materials is from unpublished USGS geologic mapping by J.C. Matti. Previous geologic mapping by Gillou (1953), Richmond (1960), Dibblee (1964, 1967), Tyler (1975, 1979), Cameron (1981), and Sadler (1981, 1982a-m) guided our mapping investigations, and locally the geologic map was modified from these studies.

Plutonic rock classification.--Plutonic rocks and their deformed equivalents are classified in accordance with the International Union of Geological Sciences Subcommission on the Systematics of Igneous Rocks (1973; Streckeisen, 1976).

Aerial photography.--Several aerial-photography series were used for this investigation. The primary source materials are 1:24,000-scale color photography flown for the U.S. Geological Survey in May and June, 1975 by I.K. Curtiss, Inc. Other source materials include: (1) 1:20,000-scale black-and-white photographs, vintage 1953 (ASCS, symbol AXM and AXL); (2) 1:30,000-scale black-and-white photographs, vintage 1966 (U.S. Geological Survey, symbol GS-VBNS).

ACKNOWLEDGMENTS

We gratefully acknowledge the limestone-mining community of the Lucerne Valley Mining District for its cooperation throughout the course of this investigation. Four companies currently operating in the district allowed us to conduct geologic studies on leased and patented claims under their control, and company personnel not only spent considerable time sharing with us their understanding of carbonate rocks in the San Bernardino Mountains region but also provided us with proprietary maps and documents that clarified the geologic setting of these rocks. We thank Pluess-Stauffer (California) Inc. for providing us with proprietary geologic mapping by Howard J. Brown in the San Bernardino Mountains region; this detailed mapping, modified and generalized by us, provides the basis for our interpretation of carbonate-rock stratigraphy and structure throughout much of the map area. We thank Douglas C. Shumway and Michael Gantenbein of Mitsubishi Cement Corporation for arranging geochemical analyses of carbonate-rock samples, and Shumway for serving as an invaluable liason between the U.S. Geological Survey and the mining community. Harold D. Kennedy and Phil Van Alstine of Specialty Minerals, Inc. (formerly Pfizer, Inc.) shared a proprietary detailed geologic map of the Furnace Canyon area, and graciously allowed a group of private- and public-sector geologists to examine the stratigraphy and structure of carbonate rocks under company management. Luther Lynn of Partin Limestone Products (Riverside Cement Company) facilitated company approval for us to map and study carbonate rocks under their management.

We gratefully acknowledge P.L. Ehlig of California State University, Los Angeles, for providing us with unpublished mapping by him and by his students in the east part of the map area where late Proterozoic metasedimentary rocks and the Baldwin Gneiss crop extensively. Also, we thank P.M. Sadler of the University of California, Riverside, who discussed with us many aspects of the geologic structure and stratigraphy of the San Bernardino Mountains. The map and summary pamphlet benefitted from a thorough review by M.D. Carr.

Our geologic-mapping studies in the north-central San Bernardino Mountains were funded by three U.S. Geological Survey programs: (1) the National Geologic Mapping Program, (2) the Strategic and Critical Minerals Program, and (3) the National Mineral Resource Assessment Program.

EXPLANATION

CONTACT

FAULT--Dotted where concealed. Arrows show direction of movement. Bar and ball on downdropped block

THRUST FAULT--Dotted where concealed. Sawteeth on upper plate. Mainly older-over-younger geometry, but includes younger-over-older geometry where fold-breaking thrusts emplace younger rocks of one fold limb against older rocks of another fold limb

AXIAL TRACE OF FOLD

Anticline

Upright

Overturned

Syncline

Upright

Overturned

LANDSLIDE--Arrows indicate direction of movement. Includes the Blackhawk landslide of Woodford and Harris (1928) and Shreve (1968) in the vicinity of Blackhawk Mountain

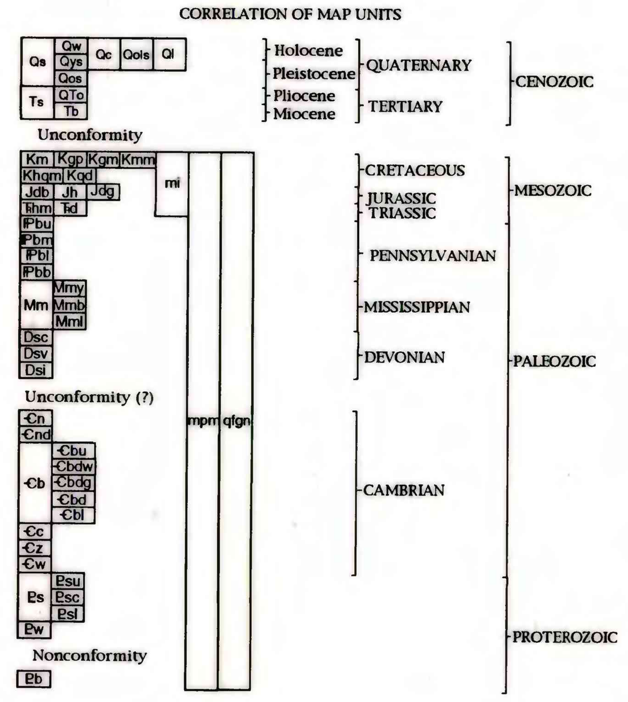
CARBONATE BRECCIA SHEET--Catastrophic landslide breccia consisting mainly of shattered carbonate-rock debris ranging from cobble- and boulder-size rubble to large blocks of carbonate rock with original stratigraphy intact; interlayered with and overrides Old Woman Sandstone. In the vicinity of Blackhawk Mountain, Shreve (1968) included these deposits within his Cushenberry Formation; locally includes rocks mapped by Sadler (1981, 1982d-f) as marble cataclasite

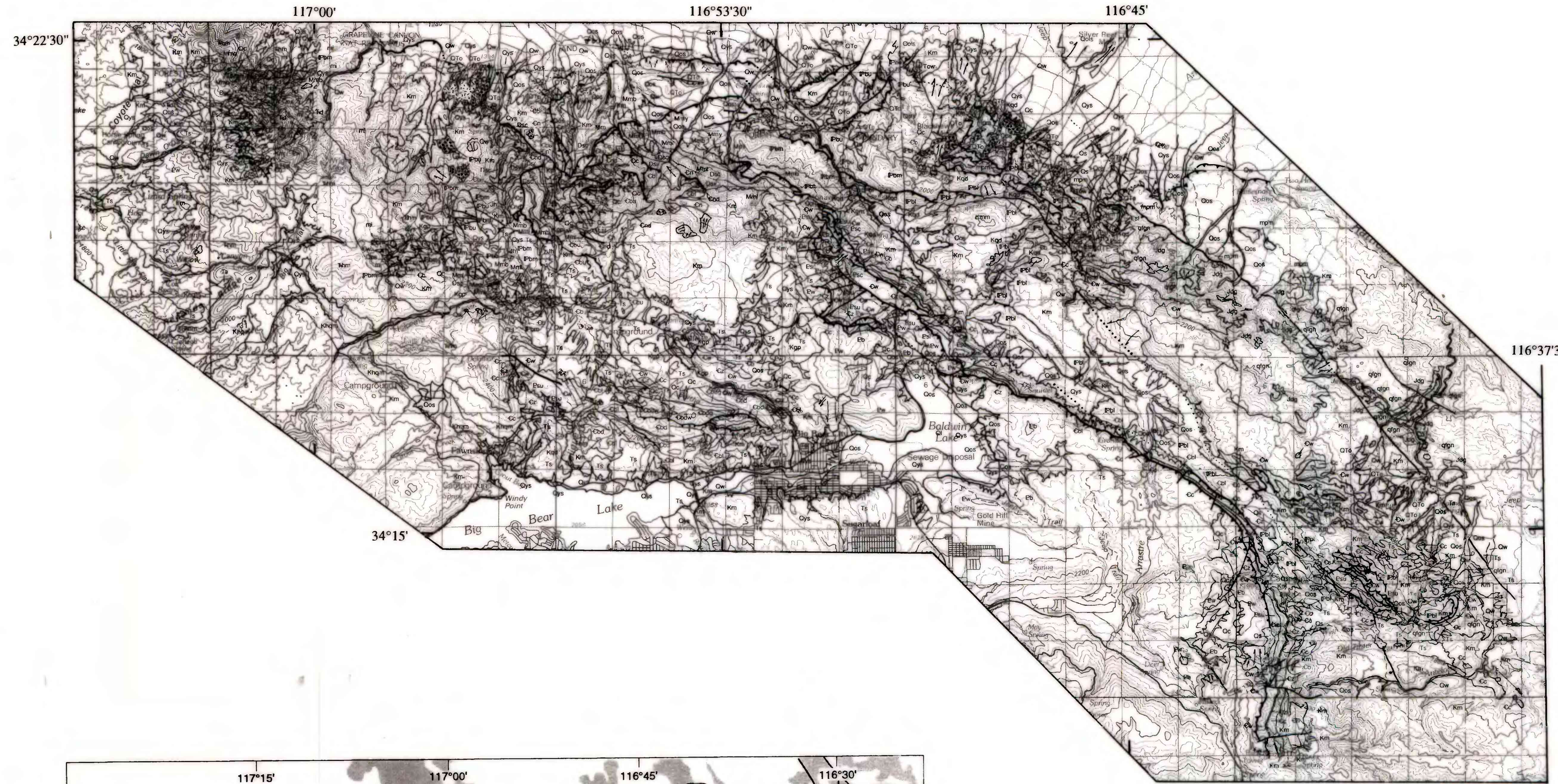
GRANITOID BRECCIA SHEET--Catastrophic landslide breccia consisting mainly of shattered blocks and pebble- to boulder-size clasts of granitoid debris; interlayered with and overrides Old Woman Sandstone. In the vicinity of Blackhawk Mountain, Shreve (1968) included these deposits within his Cushenberry Formation. Between Crystal Creek and Dry Creek mapped as granite cataclasite by Richmond (1960) and Sadler (1981, 1982f)

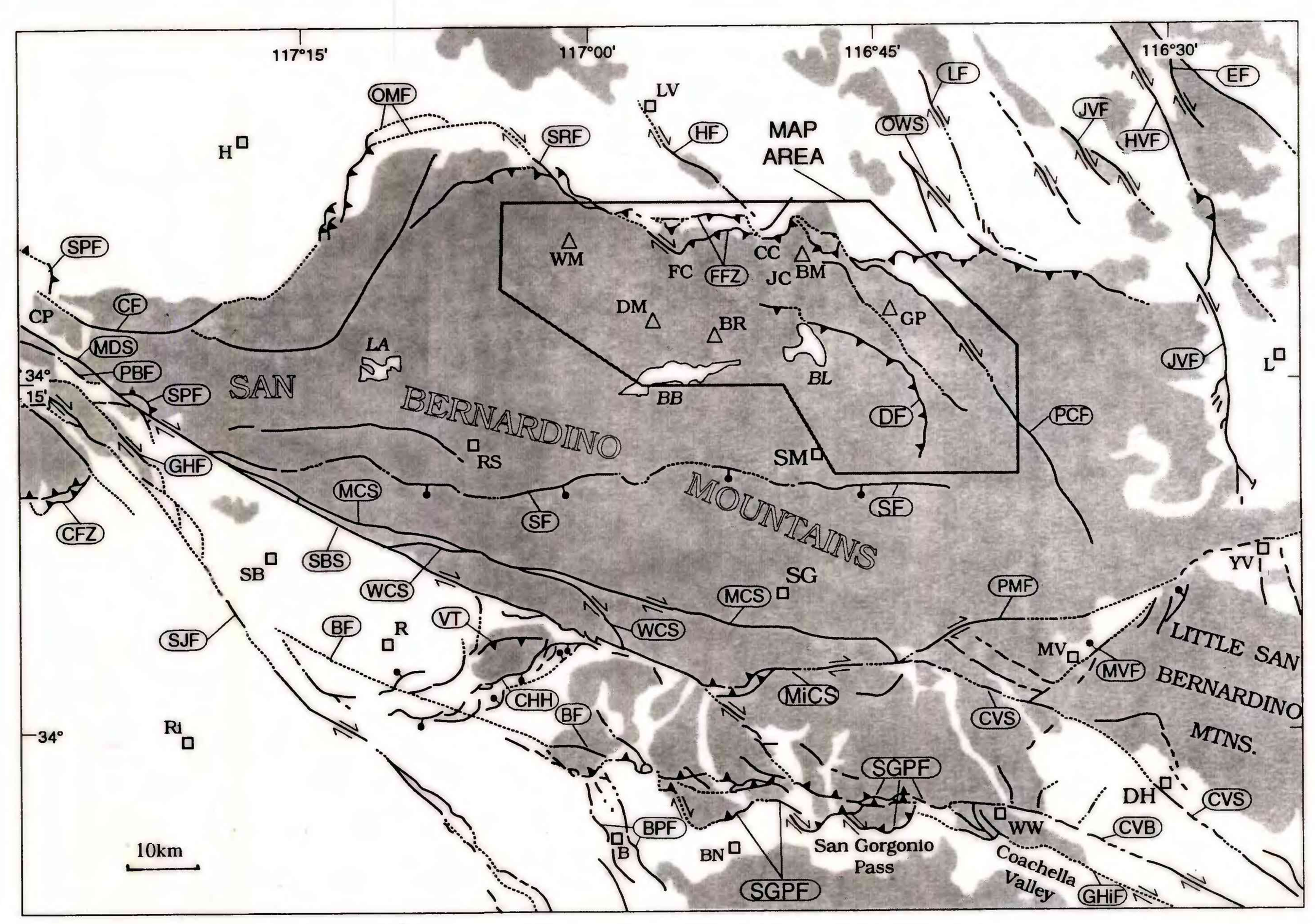
DESCRIPTION OF MAP UNITS

- **Qw** Deposits in active washes of streams and on active surfaces of alluvial fans (Holocene)
- **Ql** Lacustrine deposits of Baldwin Lake (Holocene and Pleistocene)
- **Qc** Colluvial deposits (Holocene and Pleistocene)--Includes active talus deposits and dissected older talus deposits
- **Qs** Undifferentiated surficial deposits (Holocene and Pleistocene)--Composite map unit consisting mainly of inactive deposits, but locally includes active deposits that cannot be differentiated at map scale. Where possible, divided into younger surficial deposits and older surficial deposits:
  - **Qys** Younger surficial deposits of alluvial fans and alluvial plains
  - **Qos** Older surficial deposits of alluvial fans and alluvial plains. Locally includes gravel assigned by Shreve (1968) to his Cushenberry Formation
- **Qols** Older landslide deposits (Pleistocene)
- **QTo** Old Woman Sandstone (Pliocene)
- **Tb** Basalt (Miocene?)
- **Ts** Undifferentiated sedimentary rocks (Miocene? to Pliocene?)
- **mpm** Mixed plutonic and metasedimentary rock (Mesozoic and older)
- **Kmi** Mixed igneous rocks (Cretaceous and older)
- **Kmm** Muscovite-bearing monzogranite (Cretaceous)
- **Km** Monzogranite (Cretaceous)
- **Kgp** Granite porphyry (Cretaceous)
- **Khqm** Hornblende quartz monzonite (Cretaceous)
- **Kqd** Quartz diorite (Cretaceous)
- **Kgm** Mylonitic granitoid rock (Cretaceous)
- **Jdb** Diorite of Bertha Peak (Jurassic)
- **Jdg** Diorite and gabbro (Jurassic?)
- **Jh** Hypabyssal dike rocks (Jurassic)
- **ŦRhm** Hornblende monzonite (Triassic)
- **ŦRd** Diorite (Triassic)
- **IPb** Bird Spring Formation (Pennsylvanian)
  - **IPbu** Upper member
  - **IPbm** Middle member
  - **IPbl** Lower member
  - **IPbb** Basal member
- **Mm** Monte Cristo Limestone (Mississippian)
  - **Mmy** Yellowpine Member
  - **Mmb** Bullion Member
  - **Mml** Lower Member
- **Ds** Sultan Limestone (Devonian)
  - **Dsc** Crystal Pass Member
  - **Dsv** Valentine Member
  - **Dsi** Ironside Member
- **Ꞓn** Nopah Formation (Cambrian)
  - **Ꞓnd** Dunderberg Shale Member
- **Ꞓb** Bonanza King Formation (Cambrian). In the Bertha Ridge and Furnace Canyon areas we recognize five informal members:
  - **Ꞓbu** Upper member
  - **Ꞓbdw** White dolomite member
  - **Ꞓbdg** Gray dolomite member
  - **Ꞓbd** Dolomite member
  - **Ꞓbl** Lower member
- **Ꞓc** Carrara Formation (Cambrian)
- **Ꞓz** Zabriskie Quartzite (Cambrian)
- **Ꞓw** Wood Canyon Formation (Cambrian)
- **Ps** Stirling Quartzite (Proterozoic)
  - **Psu** Upper quartzite member
  - **Psc** Carbonate member
  - **Psl** Lower quartzite member
- **Pw** Wildhorse Meadows Quartzite (Proterozoic)
- **qfgn** Quartzofeldspathic gneissose rock (Mesozoic? and [or] Paleozoic? and [or] Proterozoic?)
- **Pb** Baldwin Gneiss (Proterozoic)

CORRELATION OF MAP UNITS







Index map showing location of map area and localities referred to in summary pamphlet. B, Beaumont; BB, Big Bear Lake; BF, Banning fault; BL, Baldwin Lake; BM, Blackhawk Mtn.; BN, Banning; BPF, Beaumont Plain fault complex; BR, Bertha Ridge; CC, Cushenberry Canyon; CF, Cleghorn fault; CFZ, Cucamonga fault zone; CHH, Crafton Hills horst-and-graben complex; CP, Cajon Pass; CVB, Coachella Valley segment, Banning fault; CVS, Coachella Valley segment, San Andreas fault; DF, Doble fault; DH, Desert Hot Springs; DM, Delamar Mountain; EF, Emerson fault; FC, Furnace Canyon; FFZ, Furnace fault zone; GHF, Glen Helen fault; GHiF, Garnet Hill fault; GP, Granite Peaks; GPF, Granite Peak fault; H, Hesperia; HF, Helendale fault; HVF, Homestead Valley fault; JC, Jacoby Canyon; JVF, Johnson Valley fault; L, Landers; LA, Lake Arrowhead; LF, Lenwood fault; LV, Lucerne Valley; MCS, Mill Creek strand, San Andreas fault; MDS, Mojave Desert segment, San Andreas fault; MiCS, Mission Creek strand, San Andreas fault; MV, Morongo Valley; MVF, Morongo Valley fault; OMF, Ord Mountain fault zone; OWS, Old Woman Springs fault; PBF, Punchbowl fault; PCF, Pipes Canyon fault; PMF, Pinto Mountain fault; R, Redlands; Ri, Riverside; RS, Running Springs; SB, San Bernardino; SBS, San Bernardino strand, San Andreas fault; SF, Santa Ana fault; SG, San Gorgonio Mountain; SGPF, San Gorgonio Pass fault zone; SJF, San Jacinto fault; SM, Sugarloaf Mountain; SPF, Squaw Peak fault; SRF, Sky Hi Ranch fault; VT, Vincent thrust; WCS, Wilson Creek strand, San Andreas fault; WM, White Mountain; WW, Whitewater; YV, Yucca Valley.

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-----1982c, Geologic map of the Lucerne Valley 7.5' quadrangle: California Division of Mines and Geology Open File Report OFR 82-18 S.F., Plate C, scale 1:24,000.

-----1982d, Geologic map of the Big Bear City 7.5' quadrangle: California Division of Mines and Geology Open File Report OFR 82-18 S.F., Plate D, scale 1:24,000.

-----1982e, Geologic map of the Cougar Buttes 7.5' quadrangle: California Division of Mines and Geology Open File Report OFR 82-18 S.F., Plate E, scale 1:24,000.

-----1982f, Geologic map of the Fawnskin 7.5' quadrangle: California Division of Mines and Geology Open File Report OFR 82-18 S.F., Plate F, scale 1:24,000.

-----1982g, Geologic map of the Onyx Peak 7.5' quadrangle: California Division of Mines and Geology Open File Report OFR 82-18 S.F., Plate G, scale 1:24,000.

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-----1982i, Geologic map of the Rimrock 7.5' quadrangle: California Division of Mines and Geology Open File Report OFR 82-18 S.F., Plate I, scale 1:24,000.

-----1982j, Geologic map of the Fifteenmile Valley 7.5' quadrangle: California Division of Mines and Geology Open File Report OFR 82-18 S.F., Plate J, scale 1:24,000.

-----1982k, Geologic map of the Old Woman Springs 7.5' quadrangle: California Division of Mines and Geology Open File Report OFR 82-18 S.F., Plate K, scale 1:24,000.

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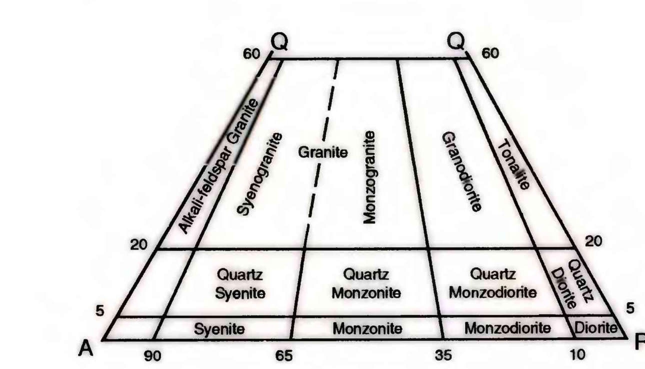
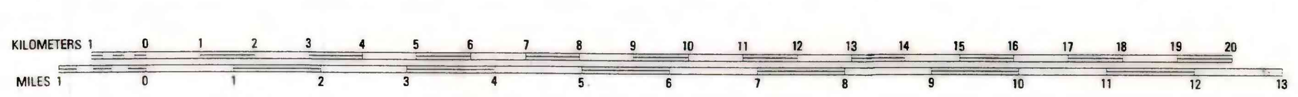


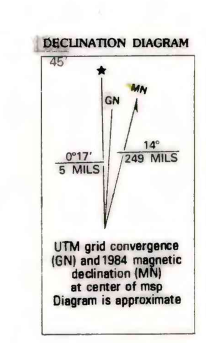
Classification of plutonic rock types (from Streckeisen, 1976). A, alkali feldspar; P, plagioclase feldspar; Q, quartz.

Base from U.S. Geological Survey
Big Bear Lake, (Advance sheet)
San Bernardino, 1982

Universal Transverse Mercator Projection



SCALE 1:100 000
1 CENTIMETER ON THE MAP REPRESENTS 1 KILOMETER ON THE GROUND
CONTOUR INTERVAL 50 METERS



UTM grid convergence (GN) and 1984 magnetic declination (MN) at center of map
Diagram is approximate

Geology mapped by: J.C. Matti (1981-82; 1991-92); H.J. Brown (1977-87); F.K. Miller (1974-77); C.R. Wrucke (1991); J.P. Calzia (1991); C.M. Conway (1991)