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RECONNAISSANCE OF THE HOT SPRINGS MOUNTAINS AND ADJACENT AREAS, CHURCHILL COUNTY, NEVADA

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GEOLOGIC RECONNAISSANCE OF THE HOT SPRINGS MOUNTAINS AND ADJACENT AREAS, CHURCHILL COUNTY, NEVADA

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ABSTRACT

A geological reconnaissance of the Hot Spring Mountains and adjacent areas, which include parts of the Brady-Hazen and the Stillwater-Soda Lake Known Geothermal Resource Areas (KGRA's), resulted in a reinterpretation of the nature and location of some Basin and Range faults. This reconnaissance took place during June-December 1975. In addition, the late Cenozoic stratigraphy has been modified, chiefly on the basis of radiometric dates of volcanic rocks by U.S. Geological Survey personnel and others.

The Hot Springs Mountains are in the western part of the Basin and Range province, which is characterized by east-west crustal extension and associated normal faulting. In the surrounding Trinity, West Humboldt, Stillwater, and Desert Mountains, Cenozoic rocks overlie "basement" rocks of Paleozoic and Mesozoic age. A similar relation is inferred in the Hot Springs Mountains. Folding and faulting have taken place from the late Tertiary to the present.

INTRODUCTION

This geologic reconnaissance of the Hot Springs Mountains, Nevada, was done to improve knowledge of the structure and stratigraphy in the Brady-Hazen and Stillwater KGRA's. None of the area was mapped in detail, nor were earlier stratigraphic classifications changed substantially. However, the general structural pattern, particularly the location and nature of some of the Basin and Range faults, has been reinterpreted. In addition, several radiometric dates for volcanic rocks obtained during the past several years have permitted modification of the Tertiary stratigraphy and have provided information about the age of the latest igneous events in an area of promising geothermal potential. Information in this report is being used in the interpretation of geohydrololgic and heat-flow data from test wells drilled as a part of a study of the geothermal hydrology of the western Carson Desert and Brady's Hot Spring areas by the U.S. Geological Survey.

The writer spent 6 weeks in the field during June-December 1975. Mapping was done with the aid of vertical aerial photographs at a scale of 1:48,000. Contacts, faults, and other features were checked by means of vehicle and foot traverses. The geologic mapping was compiled at a scale of 1:62,500 on the Two Tips, Soda Lake, Desert Peak, and Fireball Ridge 15-minute topgraphic quadrangles of the U.S. Geological Survey. The work was done under the general supervision of Franklin H. Olmsted. Richard Burzinski of Sacramento State University aided in field work during June and July of 1975.

PREVIOUS WORK

King (1978) conducted reconnaissance geologic studies in the area of the present study and defined the Truckee Formation. Axelrod (1956) described the Chloropagus flora, and assigned the enclosing volcanic and sedimentary rocks to his Chloropagus Formation and overlying Desert Peak Formation. He also revised the description of the Truckee Formation. Anctil and others (1960) mapped geology for the Southern Pacific Company in the Brady's Hot Springs area, the northwestern part of the area in this report. Morrison (1964) described the geology of Lake Lahontan sediments underlying much of the lowlands of western Nevada and adjoining parts of California. Schilling (1965) compiled isotopic age determinations for Nevada, including one sample from Axelrod's Chloropagus type locality. Wahl (1965) interpreted gravity data from the Carson Sink area. Moore (1969) compiled a geologic map of Lyon, Douglas, and Ormsby Counties at 1:125,000 scale. An aeromagnetic map, compiled at 1:125,000 scale, was published by U.S. Geological Survey (1972), and Willden and Speed (1974) compiled a geological map of Churchill County at a scale of 1:125,000. Stanley and others (1976) compiled an aeromagnetic map of the Stillwater-Soda Lake KGRA and provided a Bouguer anomaly map of the Carson Sink area.

GEOGRAPHIC SETTING

The area mapped is in west-central Nevada, mostly in Churchill County. It is bounded on the northwest by Interstate Highway 80, on the east by U.S. Highway 95, and on the south by U.S. Alternate Highway 95. Fallon, near the southeast corner of the area, is 100 km east of Reno.

Several unpaved roads provide access to most of the area (pl. 1). Railroad tracks of the Southern Pacific Co., which parallel the southeast edge of the Hot Springs Mountains, may be crossed by vehicles only near Hazen and Parran. Vehicle access from Interstate Highway 80 is possible only at the Hot Springs exit, at Brady's Hot Springs.

The Hot Springs Mountains rise about 500 m above the Carson Sink to the east, reaching a maximum altitude of 1,635 m at Desert Peak (pl. 1). Carson Sink forms the sump for the Carson River, which rises on the east slope of the Sierra Nevada; at times it also receives overflow from the Humboldt Sink, the terminus for the Humboldt River. Low but prominent tuff rings southwest of Carson Sink form Upsal Hogback and enclose the Soda Lakes.

GENERAL GEOLOGIC FEATURES

The Hot Springs Mountains are in the western part of the Basin and Range province. In the Trinity, West Hummboldt, Stillwater, Truckee, Virginia Ranges, and Desert Mountains, Cenozoic rocks unconformably overlie "basement" rocks of Paleozoic And Mesozoic age. The same relation is inferred in the Hot Springs Mountains. Folding and faulting have taken place from late Tertiary to the present.

Present topography reflects the effects of faulting and of erosion on uplifited blocks, and the resulting burial of downthrown blocks. Lowland pediments have formed on soft sedimentary rocks (chiefly the Truckee Formation and the Desert Peak Formation of Axelrod, 1956), which are less resistant to erosion than adjacent volcanic rocks. Highlands are composed of more resistant volcanic rocks or siliceous shale. Because of the present-day aridity, wind and downslope gravity movements of material are most important in shaping the topography, although occasional intense rainstorms cause significant local fluvial erosion and deposition. Gravel bars and other beach features for Lake Lahontan are common below an elevation of 1,335 m. These features are described in detail by Morrison (1964).

ROCK UNITS

Rock units exposed and mapped within the area of study are described briefly and shown on plate 1. Determining the stratigraphy in the area is difficult because of complex faulting which causes repetition of beds and juxtaposes stratigraphically separate beds. Deposits of Pleistocene Lake Lahontan and Holocene wind-blown sand cover much of the lowlands from depths of a few centimeters to many meters and obscure relations between outcrops. Thus, many interpretations on plate 1 are tentative and may need revision when more information becomes available.

Because of the short field time allotted to this project, it was not possible to distinguish between the Desert Peak and Chloropagus Formations of Axelrod (1956). These formations are included in the older basalt and siliceous shale, both of Tertiary age, shown on plate 1. however, the descriptions in the explanation are based in part on Axelrod's measured sections in order to provide a more complete description of the stratigraphy.

STRUCTURE

The Hot Spring Mountains are in the western part of the Basin and Range province, which is characterized by east-west crustal extension and associated normal faulting.

The present topography of the Hot Springs Mountins has resulted chiefly from the effects of Quaternary movements on Basin and Range faults. Steeply dipping normal faults predominate. Strikes of the faults are generally northeast, although minor cross faulting is present. Fault-plane dips range fron about 30° to vertical. Folding and faulting occurred also during the Tertiary Period, as the Tertiary units are considerably more deformed than the Quaternary units.

In the area surrounding Desert Peak, strikes and dips of bedding differ widely from one exposure to the next, but blanketing wind-blown sand and alluvium prevent a clear interpretation of the apparently complex structure. Farther south, the structure of the Hot Springs Mountains is less complex. This part of the mountains is a gently westward-tilted block, bounded by faults having a northeast strike. Most of the exposed rocks are younger basalt (Tby on pl. 1), but the underlying Truckee Formation is exposed along the east margin of the mountains.

A cold salty spring in sec. 35, T. 22 N., R. 26 E. that rises in lake Lahontan deposits has been identified as discharge from a hydrothermal-convection system several kilometers to the northeast (W. R. Benoit, oral communication, 1979). The spring apparently lies near a concealed west-northwest-trending fault zone inferred from proprietary geophysical and test drilling data obtained by geothermal exploration companies. The inferred fault zone does not appear to be exposed, however, and its precise location and trend are not shown in plate 1.

SUMMARY OF GEOLOGIC HISTORY

On the basis of field relations, fossils described by Axelrod (1956), and several radiometric ages, the geologic history of the Hot Springs Mountains and adjacent areas is summarized briefly below.

1. Intrusion of diorite during the Jurassic Period.
2. Faulting and mineralization of the diorite.
3. Uplift and erosion of the diorite.
4. Eruption of rhyolitic tuffs and dacite during early Tertiary time.
5. Alternating deposition of the shales and basalts of the Chloropagus and Desert Peak Formations of Axelrod (1956) during the Miocene and Pliocene, in a warm, humid climate.
6. Silicification of the shales. Source of the silica is unknown.
7. Deposition of the Truckee Formation in the Pliocene in a warm, humid climate and a nonmarine enviroment.
8. Faulting, uplift, and erosion of the Truckee Formation, and the Desert Peak and Chloropagus Formations of Axelrod (1956).
9. Eruptions of basalts.
10. Eruption and deposition of welded tuff.
11. Resumption of faulting in Quaternary time.
12. Filling of Lake Lahontan at several times during the late Pleistocene, and deposition of lacustrine sediments.

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