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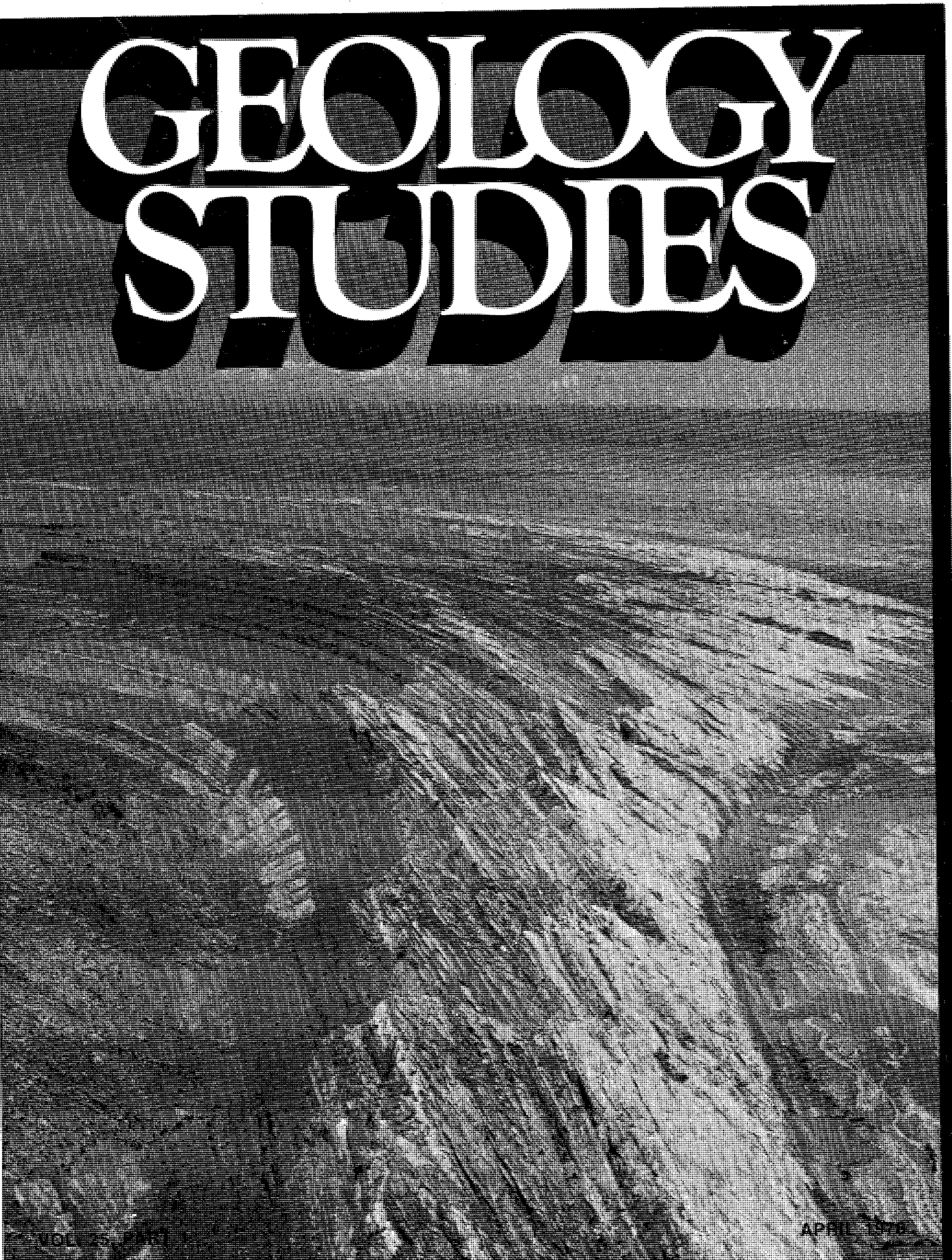
GEOLOGY STUDIES



VOL. 25, PART 1

APRIL 1978

BRIGHAM YOUNG UNIVERSITY GEOLOGY STUDIES

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Papers reviewing geology of field trip areas, 31st annual meeting, Rocky Mountain Section, Geological Society of America, April 28-29, 1978, at Brigham Young University, Provo, Utah.

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Cover: East flank of San Rafael Swell, Emery County, Utah; looking north. Photo by W. K. Hamblin.

A publication of the
Department of Geology
Brigham Young University
Provo, Utah 84602

Brigham Young University Geology Studies is published semiannually by the department. *Geology Studies* consists of graduate-student and staff research in the department and occasional papers from other contributors. *Studies for Students* supplements the regular issues and is intended as a series of short papers of general interest which may serve as guides to the geology of Utah for beginning students and laymen.

ISSN 0068-1016
Distributed April 1978
Price $5.00
(Subject to change without notice)
4-78 800 31295

Geology, Geochemistry, and Geophysics of the Roosevelt Hot Springs Thermal Area, Utah—A Summary

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The Roosevelt Hot Springs thermal area is a newly discovered geothermal power prospect. Seven production wells have been drilled with a maximum flow capability averaging 4.5 x 10^5 kg of combined vapor and liquid per hour at a bottom-hole temperature of 260°C.

The thermal area is located on the western margin of the Mineral Mountains, which consist dominantly of a Tertiary granitic pluton 32 km long by 8 km wide. Rhyolitic tuffs, flows, and domes cover about 25 km^2 of the crest and west side of the Mineral Mountains within 5 km of the thermal area. The rhyolitic volcanism occurred between 0.8 and 0.5 m.y. ago and constitutes a major Pleistocene thermal event believed to be significant to the evaluation of the Roosevelt thermal area. Thermal waters of the dry spring, a seep, and the deep reservoir are dilute (ionic strength 0.1 to 0.2) sodium chloride brines.

Spring deposits consist of siliceous sinter and minor sulfur. Alluvium is cemented by sinter and altered in varying degrees by hot, acid-sulfate water to opal and alunite at the surface, grading successively to alunite-kaolinite, alunite-kaolinite-montmorillonite, and muscovite-pyrite within 60 m of the surface. Observed alteration and water chemistry are consistent with a model in which hot aqueous solutions containing H_2S and sulfate convectively rise along major fractures. Hydrogen sulfide oxidizes to sulfate near the surface, decreasing the pH and causing alunite to form. Opal precipitates as the solutions cool. Kaolinite, muscovite, and K-feldspar are formed in sequence as the thermal water percolates downward and hydrogen ion and sulfate are consumed.

Minor earthquake activity occurs near the Roosevelt Hot Springs thermal area, Utah, whereas major swarms of earthquakes occur 30 km to the east-northeast near Cove Fort, Utah. Delayed P-wave travel times generated from the Cove Fort microearthquakes and observed west of the northern Mineral Mountains are suggestive of a low velocity zone under them; the vertical and lateral resolution of the data is inadequate to delineate the zone. Gravity and magnetic surveys are helpful in understanding the structure and depth of valley fill of the area of the northern Mineral Mountains; on the other hand, neither one has detected, in an obvious manner, an intrusive source of heat. Thermal gradient measurements that range up to 960°C/km in 30 m to 60 m deep holes outline a 6 km by 12 km area which we believe to be reasonably descriptive of the thermal field. Comparison of thermal gradient and resistivity data shows that they both outline anomalous zones along the system of faults that control the near-surface fluid flow. The source of both anomalies is interpreted to be the circulation of thermal water, which gives rise to the high heat flow. The lowered resistivity is thought to be due to the hot brine and the associated hydrothermal alteration. Magnetotelluric data are highly anomalous over the field, but we have yet to arrive at a means for quantitative interpretation of them.