GEOLOGY OF THE CAPITOL REEF AREA, WAYNE AND GARFIELD COUNTIES, UTAH

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Trace Elements Investigations Report 724

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ABSTRACT

The Capitol Reef area includes about 900 square miles in western Wayne and north-central Garfield Counties, Utah. It is along the border between the High Plateaus and the Canyon Lands sections of the Colorado Plateau province. Capitol Reef National Monument is in the eastern part of the area.

Sedimentary rocks exposed in the area range from the Coconino sandstone of Permian age to the Flagstaff limestone of early Tertiary age and have an aggregate thickness of more than 10,000 feet. The Coconino sandstone, more than 800 feet thick, consists of sandstone crossbedded on a large scale. The overlying Kaibab limestone also of Permian age is 250 to 350 feet thick and includes beds of siltstone, limestone, dolomite, crossbedded sandstone, and chert nodules and layers.

The Triassic system consists of the Moenkopi and Chinle formations and the Wingate sandstone. The Moenkopi formation is mapped as two units: 1) the lower unit comprises basal beds of siltstone and upper beds of the Sinbad limestone member containing limestone, dolomitic limestone, dolomite, and calcareous sandstone and 2) the upper unit

consists of a lower part of chiefly sandstone and siltstone and an upper part of chiefly siltstone. The thickness of the Moenkopi ranges from about 760 to about 970 feet. The Chinle formation is mapped as three members and ranges in thickness from about 440 to 540 feet. Chiefly medium- to coarse-grained crossbedded sandstone that contains claystone beds and lenses, silicified and carbonized logs and carbonized plant remains composes the basal Shinarump member. The Shinarump member is a nearly continuous unit in about the western three-quarters of the area of its exposure and is discontinuous in the eastern one-quarter. The middle member of the Chinle consists of variegated bentonitic claystone, siltstone, and clayey sandstone, and some conglomeratic sandstone at the top. The upper member consists of variegated siltstone and lenticular beds of sandstone and limestone. Both the upper and middle members contain silicified logs. A pronounced erosional unconformity is at the contact between the Moenkopi and Chinle formations, and locally basal beds of the Shinarump have filled channels cut into the Moenkopi. The Wingate sandstone is a very fine grained sandstone crossbedded on a large scale and is from 320 to 370 feet thick.

Above the Wingate is the Kayenta formation of Jurassic(?) age; it is about 350 feet thick. It consists of lenticular beds of crossbedded sandstone, siltstone, and clay-pebble conglomerate. The Navajo sandstone of Jurassic and Jurassic(?) age is chiefly fine-grained sandstone that is crossbedded on a large scale and ranges from 800 to 1,100

feet in thickness. Formations of the San Rafael group of Jurassic age include the Carmel formation, the Entrada sandstone, and the Curtis and Summerville formations. The Carmel formation increases in thickness from east to west across the area--from about 300 feet to almost 1,000 feet. It consists of limestone, sandstone, claystone and siltstone, and gypsum; the percentage of limestone increases to the west. The Entrada sandstone, 475 to 780 feet thick, is reddish-brown thin- to thick-bedded sandstone and some siltstone. It is uniform lithologically over the area except in the southeast where it contains more massive crossbedded sandstone. The Curtis formation of grayish-green thin- to thick-bedded sandstone and some siltstone has a maximum thickness of 80 feet and is lacking in the southeastern part and probably in the western part of the mapped area. Uniformly reddish-brown thin-bedded siltstone and mudstone compose the Summerville formation that is about 200 feet thick. The Morrison formation of Jurassic age is composed of two members, the lower Salt Wash member and the upper Brushy Basin member. Lenticular beds of conglomeratic sandstone, siliceous-pebble conglomerate, and siltstone and claystone compose the Salt Wash; this member ranges from 30 to 236 feet in thickness. Variegated claystone and conglomeratic sandstone lenses compose the Brushy Basin; this member ranges from 160 to 225 feet in thickness.

Rocks of Cretaceous age include the Dakota sandstone, the Mancos shale, and the Mesaverde formation. The Dakota is lacking in places, has a maximum thickness of 50 feet, and is composed of sandstone and

conglomeratic sandstone. The Mancos consists of five members--in ascending order, the Tununk shale, the Ferron sandstone, the Blue Gate shale, the Emery sandstone, and the Masuk--with a total thickness of more than 3,000 feet. The Mesaverde formation consists of about 300 feet of sandstone and thin interbeds of shale.

Sedimentary rocks of Tertiary age rest with angular unconformity on the older units in the northwestern part of the area. These Tertiary beds are nonmarine limestone, tuff, tuffaceous sandstone, and conglomerate of the Flagstaff limestone. Their thickness cannot be measured in this area, but it is estimated to be more than 500 feet.

Igneous rocks and associated tuffaceous sedimentary rocks of Tertiary age cover about 100 square miles of the mapped area. Lavas of chiefly porphyritic andesite and some andesite scoria constitute the bulk of the igneous rocks. Dikes and sills crop out particularly in the northeastern part of the area. Tuffaceous sedimentary rocks are interbedded with the lava flows and in places form a greater percentage of the stratigraphic section than do the lavas.

The deposits of Quaternary age consist of a variety of types of deposits: pediment gravel, bouldery deposits of diverse materials of more than one origin, till, outwash gravel, terrace gravel, landslide deposits, colluvial sand and gravel, rock glaciers, alluvial fan deposits, and alluvium. The pediment gravels are dated as

pre-Wisconsin chiefly on their topographic positions. They are higher than early Wisconsin deposits in places, and the area underwent considerable erosion between the cutting of the pediments and deposition of the gravels and the deposition of the Wisconsin stage till. Bouldery deposits contain many boulders chiefly derived from the lavas exposed on the tops of Boulder and Thousand Lake Mountains and contain fragments and irregular blocks as much as 100 feet long that can be identified as being derived from formations of Tertiary, Cretaceous, and Jurassic age. These bouldery deposits probably include chiefly till, as well as landslide deposits, and small remnants of pediment gravel. The topographic form of these deposits is different from that of the other Quaternary deposits and does not indicate their manner of origin. The bouldery deposits are considered to be chiefly pre-Wisconsin although in a few places some Recent deposits are included in the same map unit.

Till forming three moraines was deposited from glacial ice that formed on the top of Boulder Mountain--northeastern part of the Aquarius Plateau--and flowed down valleys on the mountain sides. Outwash gravel extends beyond the margins of some of the moraines. Because of their lack of weathering and erosion these deposits are correlated with the Wisconsin stage of the Great Lakes region and with the Bull Lake and Pinedale stages of the Rocky Mountain region. Terrace gravel along the Fremont River is considered to be early Wisconsin. Extensive landslide deposits are on the flanks of Boulder and Thousand Lake Mountains. Most of the landsliding probably took place during the Wisconsin stage, but some movement has occurred recently.

The Recent deposits include rock glaciers, alluvium, alluvial fan deposits, and colluvial sand and gravel.

Structurally the Capitol Reef area is in a marginal belt between large basins and upwarps on the east and generally north-trending normal faults--the High Plateau faults--on the west. Principal structural features are the northwest-trending Waterpocket Fold near the eastern edge of the area, the northwest-trending Teasdale anticline through the central part of the area, the northwest-trending Teasdale fault on the southwest side of the Teasdale anticline, and the north-trending Thousand Lake fault in the western part of the area. The total structural relief between the crest of the Teasdale anticline and the trough of the Henry Mountains structural basin east of the Waterpocket Fold is more than 7,800 feet. The deformation that formed the main folds and the northwest-trending faults preceded the deposition of the Flagstaff limestone and probably occurred between the middle and latter parts of the Paleocene epoch. Movement along the Thousand Lake fault may have started also before deposition of the Flagstaff but from local evidence postdates the lavas tentatively assigned to the Miocene. In at least one place movement along this fault is later than the deposition of early Wisconsin terrace gravels.

Abnormal radioactivity or uranium minerals are widespread areally and stratigraphically in the Capitol Reef area, but no economically important uranium deposits had been found through 1955.

Uraniferous rock occurs in the Moenkopi formation, all three members of the Chinle formation, the Curtis formation, and the Salt Wash member of the Morrison formation. Most of the uranium is in the Shinarump member of the Chinle formation and the Salt Wash member of the Morrison formation.

Uranium deposits or uraniferous rock in the Shinarump member have four principal associations: (1) the deposits are most common in the area of discontinuous Shinarump; (2) they are most concentrated in beds where strata of the Shinarump filled channels cut into the underlying Moenkopi formation; (3) they are associated with or are in the vicinity of carbonaceous material; and (4) they are associated with claystone or clayey beds.

The known uranium deposits in the Salt Wash member occur in conglomeratic sandstone lenses at or near the top of the member. These deposits consist of carnotite and uraniferous material disseminated in conglomeratic sandstone and locally concentrated in pockets containing abundant carbonized plant fragments.

Geochemical studies were concerned principally with altered or bleached mudstone adjacent to the Shinarump member, adjacent to a dike, and adjacent to joints in the Moenkopi formation. Increase and decrease of certain metals in the bleached beds near the Shinarump relative to the unbleached red beds suggest that the fluid that bleached and chemically altered the mudstone was probably an acid

and mildly reducing solution. Alteration of red beds probably by hydrothermal solutions near the dike and by ground water along joints caused little or no chemical change.

The close association of uranium minerals with reducing carbonaceous material suggests that the original precipitation of the minerals was due to chemical reduction caused in part at least by the organic material. The amount of original carbonaceous material may have been much greater than that now seen in the rocks. An original abundance of carbonaceous material may have been great enough to serve as a reductant for precipitation of considerable amounts of uranium minerals.

Several copper prospects and two manganese prospects are in the mapped area. The Teasdale, Fruita, and Thousand Lake anticlines have ample closure for oil and gas accumulation, but a well drilled on the Teasdale anticline failed to produce any oil or gas.