

to be localized along a reflected deep-seated fault. Local control of uranium in the Todilto limestone north of Grants, New Mexico, is exercised by fractures and associated small folds and wrinkles in the limestone rather than by sedimentary features. Many additional examples are added when it is argued that the curved fractures bordering ore "rolls" pre-dated mineralization and thus restricted the distribution of ore.

Although flexures and faults in many places control or influence primary ore distribution, joints do not. This is probably because joints are not through-going structures, but are restricted to brittle beds within the sedimentary pile, being absent from most of the numerous intercalated mudstones.

Perhaps the best example of *areal* tectonic control on the Plateau is shown in the Big Indian Wash-Lisbon Valley uranium district. Here, all ore bodies are elongated approximately parallel with the strike of the beds along the Lisbon Valley anticline, and all except one occur in the elevation interval 6,200-6,700 feet above sea-level. The single exception, which is about 5,840 feet above sea-level, lies along the Lisbon Valley fault in the southern part of the district. A general anticlinal control appears also to exist in the Uruvan Mineral Belt.

On the regional scale, the peripheral distribution of most Plateau ore deposits about laccolithic mountains, plus a suggested zonal relationship between copper and uranium around the La Sal laccoliths, suggests that the intrusives may have both a structural and a petrogenic relationship to mineralization.

Still broader structures appear to limit the occurrence and distribution of uranium in the Colorado Plateau. Significant deposits are not known to occur throughout the Plateau; rather they are restricted to the northwest-trending San Juan segment (as named by Vincent C. Kelley), which contains all the laccoliths. This structural segment is bounded by the Uncompahgre lineament on the northeast and by the Zuni lineament on the southwest.

22. JAMES GILLULY, U. S. Geological Survey, Denver  
Summary and Recapitulation of Tectonic Papers

Brief review of the papers which were presented and synthesis of the ideas expressed.

23. JOHN DE LA MONTAGNE, Colorado School of Mines, Golden  
Episodes in Tertiary Tectonic History of Saratoga-North Park Area, Wyoming and Colorado

A synclinal area between the Medicine Bow and Park ranges demonstrates several principles in the tectonic history of the southern Rocky Mountains. The area is of interest because: (1) it illustrates the episodic nature of tectonic events in this region; (2) the succession of fossiliferous Tertiary sediments are unusually complete and provide excellent clues to the timing and nature of these events; and (3) several structural elements in this area have trends independent of the regional structural patterns. Early Tertiary phases of tectonic activity were compressional in origin, but late Tertiary phases were both compressional and tensional.

An early Tertiary compressional phase produced the bold outlines of the present ranges and basins and induced erosion of all sediments from the structurally elevated areas. Débris which formed the Paleocene Coalmont and equivalent formations filled the basins and overlapped the truncated edges of older formations. North Park basin continued to sink following this deposition.

A second compressional episode involved Paleocene sediments in the movements, and culminated with extensive faulting during Eocene time. Although most of these thrusts parallel range flanks, the Independence fault which forms the north boundary of North Park basin displays evidence for movement of over 4 miles in a direction transverse to previous structural trends. The position of this fault within a complex zone between two regions possessing opposite structural asymmetry may explain, in part, its diverse trend.

Normal faults, warps, and folds affecting late Miocene rocks, and probably concurrent with regional uplift, distinctly modified the geologic regime during a third tectonic episode. Horsts rose 800 feet along range flanks as adjacent wedges of late Miocene rocks were downfaulted and preserved in linear troughs. The North Park syncline formed athwart the axis of North Park basin and transected some pre-existent north-trending range flank structures. These late Tertiary movements should be stressed because they emphasize the probability that similar movements modified adjacent areas where late Tertiary sedimentary sequences are either less complete or absent.