THE GEOLOGIC STORY OF THE ZION NATIONAL PARK AREA

BY
Dr. Herbert Alberding
Former Ranger-Naturalist
Zion National Park
Springdale, Utah 84767

PART I
Sedimentation

The geologic story of the Zion National Park area begins with sedimentation and ends with uplift and erosion. The oldest formation exposed in the area is the Permian Kaibab limestone which is the youngest formation along the rim of the Grand Canyon. Thus, where the Grand Canyon story ends, the geologic history as exposed at Zion begins and continues through younger and younger strata to the north to the Eocene Wasatch formation at Cedar Breaks National Monument and Bryce Canyon National Park. In the Grand Canyon, the Archeozoic Vishnu schist is overlain in places by 12,000 feet of the Proterozoic Unkar and Chuar groups. Above this is 3,500 feet of Paleozoic strata that may be assumed to underlie Zion and with a thickness possibly twice as great as at the Grand Canyon. Thicknesses of Mesozoic and Cenozoic strata above the Kaibab limestone in the Zion - Bryce area total approximately 9,000 feet of which the uppermost 3,300 feet has been stripped off at Zion. Originally, however, there must have been a total of at least 16,000 feet of Paleozoic, Mesozoic and Ceneozoic sediment deposited in the area. This sediment was laid down in a basin that was actively sinking and whose upper depositional surface was usually either slightly above or below sea level. Environmental conditions of sedimentation ranged from marine to coastal flood plains and river flood plains and channels. This would change to lakes and swamps and desert dunes for great lengths of time. Some volcanic ash was also contributed. Sources of sediments deposited were from adjacent highlands. Deposition was not continuous but was marked by numerous unconformities representing breaks in the stratigraphic sequence due to nondeposition or deposition followed by erosion.

Within the confines of Zion National Park, the oldest rock exposed is the Triassic Moenkopi formation which totals approximately 1,800 feet in thickness and consists of sandstones and shales along with limestones (the Virgin limestone) in the lower part of the formation and gypsum (the Schnabkaib member), deposited in the sea and on coastal and river flood plains. Unconformably overlying the Moenkopi is the widespread Shinarump conglomerate that averages 100 feet in thickness in the Park. This formation consists of coarse sand and pebbles of hard quartz rocks transported by rivers from highlands in

what is now central Arizona. Much petrified wood from logs washed in with the pebbles is found in the formation. Overlying the Shinarump conglomerate is the Triassic Chinle formation which is about 350 feet thick in the area. The formation is composed of shales and gypsum and volcanic ash deposited by rivers and in lakes. This is the bright-colored variegated formation of the Petrified Forest National Park and Painted Desert in Arizona. Much petrified wood is also found in the Chinle formation within Zion National Park. Unconformably overlying the Chinle formation is the red Moenave formation which is divided into two members. The upper member, or Springdale sandstone, is a river deposit 75 to 150 feet thick in Zion. The lower member, or Dinosaur Canyon sandstone, is 140 to 375 feet thick in the Park and is a river and lake deposit containing fossil fish. Overlying the Moenave is the red Kayenta formation consisting of 200 feet of river sandstones and shales. Dinosaur footprints preserved within the Kayenta formation have been found up the Left Fork of North Creek in Zion Park. The next formation going up in stratigraphic sequence is the most famous of all, and is the one that forms the spectacular cliffs within Zion, namely, the Navajo sandstone. This formation, which reaches its maximum thickness of 2,200 feet in the Park, consists almost entirely of desert dunes. Foreset beds of the ancient dunes are truncated by topset beds resulting in cross-bedding and the fantastic patterns on the sandstone surfaces as now exposed. Approximately 98% of the formation consists of quartz grains that are rounded and pitted from the wind action. The source area was from highlands to the west in what is now central Nevada. Cementing materials are calcium carbonate and iron oxide which give the red color to the lower part of the formation (the upper part as now exposed is white from lack of iron oxide which was either never deposited or has been leached out). Deposition of the sand occurred during the Jurassic and lasted for perhaps 10 million years.

Following the deposition of the Navajo sandstone, the seas again encroached over the land and 200 to 300 feet of the Carmel limestone was laid down. This was followed by the deposition of 2,800 feet of more dune sands, river deposits, swamp accumulations and marine beds through the remainder of the Jurassic and the Cretaceous. These younger post-Carmel Mesozoic formations, and the 500 feet of Eocene Wasatch formation at Cedar Breaks and Bryce Canyon, have now been eroded off the area within Zion. Younger basalt flows are quite common in the area and many were extruded along the Hurricane Fault. Volcanic cones within the borders of the Park retain their form and thus are fairly recent.

PART II
Uplift and Erosion

Beginning about 13 million years ago, at the close of the Miocene, uplift of the entire Colorado Plateau was resumed and accompanying the