Geology of the Rincon Mountains

General Setting of the Rincon Mountains

The Rincon Mountains are one of many relatively small ranges that dot the southwestern U.S. belonging to the Basin and Range Province. These ranges are the result of block faulting which occurred 10-25 million years ago (MYA) and are separated by basins filled with thousands of feet of alluvial sediment derived from the erosion of these mountains. The Rincon Mountains are a highly eroded mass of bedrock referred to as a metamorphic core complex, one of several that extend from northern Mexico into southern Canada. The highest peak in the Rincons is Mica Mountain. It is 8666' in elevation and supports Ponderosa Pine and spruce vegetation. Several trails lead to its summit, including one along Tanque Verde Ridge, the portion of the Rincons visible from park headquarters.

The Building Blocks

Before we begin to look at the origin of the Rincon Mountains, it is important to look briefly at the rocks which make up the mountains and at the theory of plate tectonics, which holds the key to understanding the origin of the rocks and structures which make up the Earth's crust. Rocks of the three major classes, igneous, sedimentary, and metamorphic, are found within the park. The igneous rocks include coarse grained intrusive rocks, such as granite, and extrusive lava flows and intrusive basalt dikes which cooled much more rapidly. Sedimentary rocks are formed from the consolidation of sediment derived from weathering and erosion of preexisting rocks and deposited in layers by streams, wind or in the shallow waters of the ocean. The most common of these rocks include sandstone, shale and limestone. Metamorphic rocks form deep within the earth when heat, pressure, and chemical fluids alter preexisting rocks. These include slate, marble, gneiss, and schist. Specific examples of these major rock types will be discussed in the following sections as they help to explain the geologic history of the Rincon Mountains.

The theory of plate tectonics states that the crust is made up of many plates, some of which are thousands of miles in diameter and up to sixty miles thick. These plates are in constant motion, breaking apart along the mid-ocean ridges, as molten material (magma) wells up beneath them, and coming together along the margins of certain continents.

Where these plates meet, one of three things may happen. If one plate, usually the oceanic plate, is denser than the others, it will descend (subduct) under the other plate and a trench will form at that point. As the oceanic plate continues to descend deeper, the rocks become plastic and then molten, leading to the formation of a chain of volcanoes as the less dense magma rises to the surface. Such is the case today as the Pacific Plate subducts under the North American Plate or Asian Plate. If neither plate is dense enough to subduct, the plates may collide and push up very high mountains such as the Himalayas, or slide past one another forming shear zones such as the San Andreas Fault Complex.

How it Came to Be*

*Much of the information in this section comes from articles and field trip itineraries of Dr. George H. Davis.

The oldest rocks found in the park are dark gray metamorphic rocks, known as the Pinal Schist, which represent the original crust in southern Arizona. These rocks are approximately 1.7 billion years old and belong to an era of geologic time known as the Precambrian. They formed during a plate collision at that time which altered preexisting sediments and volcanic rocks to schist and other metamorphic rocks. Also present are 1.4 billion year old granites, which, although altered, form much of the Tanque Verde Ridge.

There is little evidence of what happened over the next few million years as the region was subjected to extensive erosion. Approximately 600 MYA, at the beginning of the Paleozoic Era, gentle rises and falls of the crust occurred. This led to the

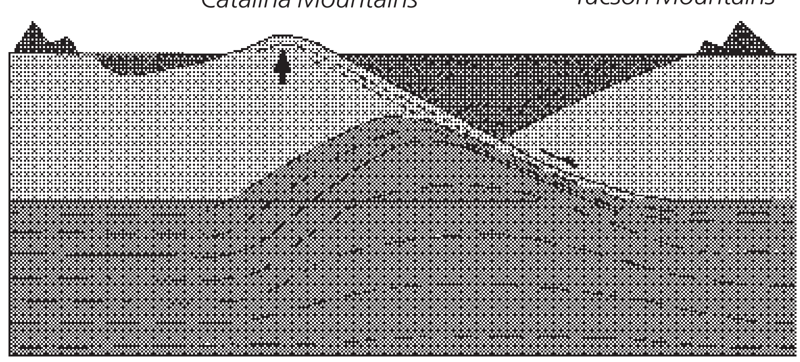
How it Came to Be Continued*

encroachment of shallow seas and the deposition of sedimentary rocks, mostly limestones, sandstones, and shales, separated by extensive periods of erosion. The limestones are exposed in several places within the park, those near Lime Kiln Falls were at one time mined and used to make hydrated lime for mortar.

During the early part of the Mesozoic Era, continual uplift of the region led to the erosion of exposed rocks by streams. These sediments were deposited as floodplains in the shallow waters of intermontane basins.

Late in the Mesozoic Era, as the ancient Pacific Plate continued to descend (subduct) under the North American Plate, extensive volcanic activity and mountain building occurred in the area. This event is known as the Laramide Orogeny. Although not present in the Rincon Mountains, these volcanic rocks form a majority of the rocks which compose the Tucson Mountains to the west. During and following this volcanic period, masses of granite were implaced 5 to 8 miles below the surface and slowly cooled.

Then, approximately 20-30 MYA, the Earth's Crust in this region was stretched and sheared in a northeast to southwest direction. As arching continued, a huge slab of rock broke loose and slid to the northwest along a special type of fault known as a detachment fault. This movement took place over thousands of years shattering the rocks along the fault zone. These shattered but cohesive rocks are called cataclasites and are exposed in several places along the Cactus Forest Loop Drive, but can best be seen exposed in the hillside as you look north from Lime Falls. Above the fault, forming the upper plate are Paleozoic limestones, whereas below the cataclasite forming the lower plate, are stretched, highly altered granites, which form a type of metamorphic rock called mylonite. These mylonites form the impressive Tanque Verde Ridge seen to the east of the loop drive. Other highly deformed lower plate rocks can be seen as strikingly banded rocks along the Catalina Highway to Mt. Lemmon. This metamorphic rock is the Catalina Gneiss.



The Last Stages

Following the detachment of the upper plate rocks, which incidentally is responsible for the location of the Tucson Mountains (before detachment they were located further east of the present Rincon Mountains), stresses relaxed. The entire southwestern portion of the United States became stretched as the Pacific Plate began to pull away from and shear past the North American Plate, between 10-20 MYA. The extension of this area produced block faulting, where many blocks separated from other blocks along steep normal faults producing the basins which today surround the Rincon Mountains and other similar ranges in the southwest.

At one time valley floors may have been as much as eight to ten thousand feet below the mountain crests, but today relief is much reduced as alluvial (stream) deposits of gravel, sand and mud have filled the basins to their present levels.

What does the future hold for the region? Erosion will continue to reduce the relief of the mountains, which may lead to renewed uplift of the mountain fault block and potential future earthquakes. A major earthquake has not occurred in the Tucson region since the 1880's, but could happen at any time. However, such events will most likely be few and far between over the next few thousand years!