Orogrande Turquoise

Virgil Lueth

Virgil Lueth, Ph.D. spoke on the two diverse occurrences of turquoise in the Orogrande Mining District and presented explanations regarding the different geologic and chemical mechanisms that determined the genesis of the turquoise. Dr. Lueth has been a geologist for twenty years and is currently a Mineralogist/Economic Geologist and Curator of the Mineral Museum at the New Mexico Bureau of Mines, a division of the New Mexico Institute of Mining and Technology in Socorro.

The Orogrande Mining District lies in Otero County in the Jarilla Mountains of south-central New Mexico. Igneous intrusions interrupted the sedimentary limestone bedding and introduced many types of minerals as it pushed upward to form the Jarilla Mountains. These volcanic events left a granite core and broke the limestone beds into islands surrounded by regions of magma.

Copper, lead, gold, and iron in significant amounts were discovered, and the commercial production of these minerals took place between the late 1800's to the 1930's. Production peaked between 1912 to 1920 and declined after 1920 until 1953. One six-ounce gold nugget was found at the turn of the century after much of the copper ore had been extracted and initiated another mine rush.

Turquoise is a hydrated phosphate of copper and aluminum with a chemical composition of:

Cu+2Al6(PO4)4(OH)8.4H2O

Museum specimens and pre-historic artifacts from the turquoise workings were unearthed from Orogrande, as well as from Cerrillos, Hachita, and the Burro Mountains. Around 1899, the turquoise mined from the Orogrande sites was then the finest U.S. domestic quality known. The early 1980's marked the last years of turquoise production from Orogrande's Iron Mask mine.

The surface features that distinguish the two host sources of the turquoise at Orogrande, the DeMueles mine, and the Iron Mask mine, differ both geologically and chemically. The turquoise from these two sites also shows a distinctly different physical character from each deposit. The individual features of these two deposits suggest a completely different manner of turquoise formation and origin.

The turquoise from the DeMueles mine occurs as veinlets in clay in altered granite. The low ph (below 3) of the water that percolated downward during the weathering of the deposit contained enough acidity to turn the granite into kaolinite and limonite (iron oxide). This conversion is known as acid sulfate alteration. The presence of jarosite (a potassium-iron sulfate) also indicates a high acid content in the water. The turquoise precipitated in the fractures of the less altered granite with the kaolinite, jarosite, and limonite as vein fillings and nodules in veins.

The turquoise from the DeMueles mine tends to be thin but hard, due to silica from the quartz monzonite. The DeMueles mine is considered to be an example of the classic environment for turquoise formation. The potassium contained in the water allowed this source of turquoise to be age-dated by the Ar-Ar method, and a date of ten million years was established.

In contrast, the turquoise from the Iron Mask mine developed as nuggets in a light-colored, phosphatic shale that had been geologically altered by intrusive dikes. The presence of cuprous pyrite, hematite, and chalcopyrite indicates a hydrothermal origin for the copper from magmatic fluids. These copper-bearing minerals were weathered, and the turquoise formed from downward percolation of acid groundwater that leached phosphorus from the shale. The turquoise then precipitated amid gypsum and halite. Much of the turquoise is chalky and lighter in color. This source of turquoise is considered to have been formed in a very unusual manner.

Two models for the origin of the Orogrande turquoise have been presented, and both types show weathering-related processes. At the DeMueles mine, the weathering of pyrite and chalcopyrite in the quartz monzonite led to the formation of acid waters that provided a source for copper. Percolating acid waters altered the feldspar to kaolinite and dissolved some aluminum. The same acid waters weathered apatite as a source for phorphorus. The mineral solutions concentrated along rock fractures, where the turquoise precipitated.

A completely different weathering model is proposed for the turquoise deposits at the Iron Mask mine. Pyrite replacement deposits occur in and above the host phosphatic shale. The oxidation of the pyrite deposits led to the formation of acid sulfate waters, which percolated along rock fractures and through the shale. Turquoise precipitated in fractures and along bedding planes in the shale. The abundance of gypsum is an artifact of the acid sulfate alteration. The presence of jarosite is also a product of pyrite oxidation.