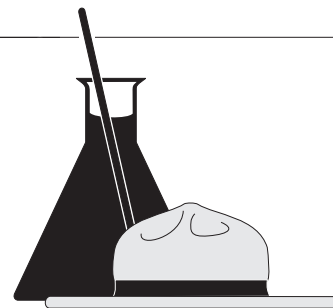




A CLOSE LOOK AT THE ROCK ART OF AMISTAD NATIONAL RECREATION AREA, TEXAS

Pictograph paint and accretion analysis techniques improve cultural reconstructions and the interplay of preservation and deterioration processes

By WARNA KALUARACHCHI, JOSEPH H. LABADIE, AND JON RUSS

MOST NATIONAL PARK SYSTEM UNITS IN THE WESTERN United States have a variety of Native American cultural sites. Many parks have prehistoric or historic sacred paintings, known to archeologists as pictographs

(petroglyphs are made by incising or scratching designs into rock surfaces). Although pictographs represent an important component of many early societies, the scientific study of these artifacts has been fraught with frustration due primarily to the inability to affiliate the art with the cultures that produced it. This will soon change with the recent developments in techniques for analyzing prehistoric paints. Samples of paint so small as to not compromise the artifact can now be collected and analyzed to determine the age and chemical composition. A completely new source of archeological information is now at hand that will begin to allow these important artifacts to be integrated into cultural reconstructions.

In most cases rock surfaces that contain prehistoric paints are not static; instead they are active biogeochemical systems. The result of this activity is the formation of rock accretions. These natural accretions often cover the prehistoric paints, sometimes protecting them, but also causing them to appear faded. Be-

cause the processes that form the accretion may affect the paint materials, accurate and reliable analyses of the paints require that we understand the relationship between the paint components and the natural rock substrate-accretion system. This information is also particularly important for developing informed



Figure 1. Large, multicolored, Pecos River style pictographs such as this shaman scene number in the thousands at Amistad National Recreation Area and are a testament to a period of highest cultural activity 3,000–4,200 years ago. Scientists are now using new radiocarbon paint dating and accretion analysis techniques to date the art and assess the processes of deterioration.

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conservation strategies.

This paper presents recent research on the prehistoric rock paints and the natural accretion from sites in and adjacent to the Amistad National Recreation area in southwest Texas. The aim of this study is to characterize the accretion, determine how it formed, and establish the relationship between the ancient paints and the natural rock crust.

THE AMISTAD NRA PICTOGRAPHS

Located in southwest Texas and northern Coahuila, Mexico, Amistad International Reservoir was created in 1969 by damming the Pecos, Devils, and Rio Grande rivers. The region surrounding the intersection of these three major rivers, the Lower Pecos region, contains one of the longest continuous records of human occupation in North America (Turpin 1982). Over 9,000 years ago hunter-gatherers began inhabiting the numerous rock shelters along the steep limestone cliffs that dominate the region. Archeological research prior to the construction of the Amistad Dam firmly established the existence of literally thousands of prehistoric pictograph and archeological sites.

Archeologists have defined four major prehistoric rock art styles, each with temporal and cultural implications. The oldest and most common style, the Pecos River style, generally features large (up to 4 m or 13.1 ft), multicolored anthropomorphic figures in multiple panels, which can cover more than 30 m (98.4 ft) of rockshelter wall (fig. 1, page 1). The first New World pictograph to be directly dated was a Pecos River style pictograph located in Seminole Canyon Historical State Park (Russ et al., 1990). Using a new technique, researchers extracted and radiocarbon dated organic carbon incorporated in the ancient paint. Three Pecos River style pictographs have now been dated with the results ranging from 3,000 to 4,200 years B.P. (Russ et al., 1992). These ages correspond to a period when cultural activity in the area was at a maximum (Turpin 1991).

A NPS rock art deterioration study (Labadie 1990) established that many national recreation area pictographs are deteriorating, due primarily to natural causes. However, vandals have intention-

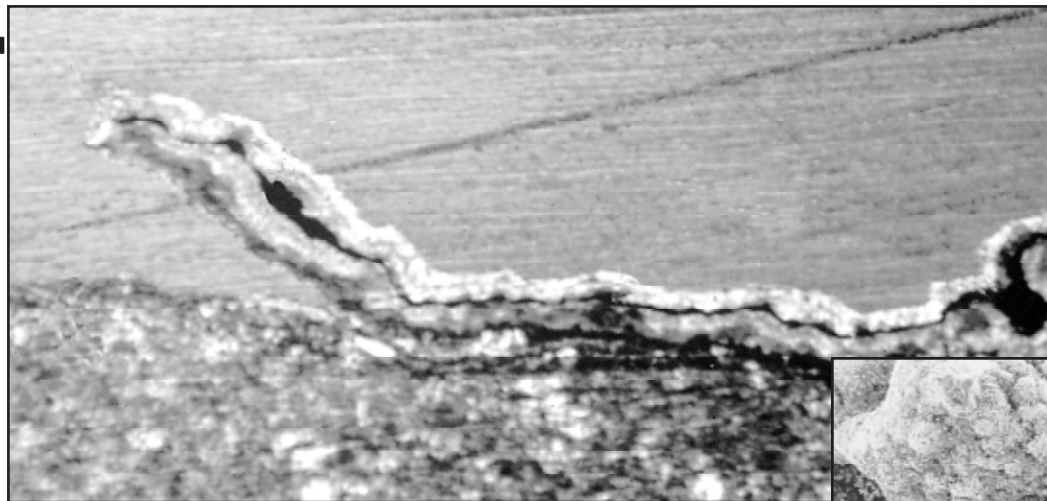


Figure 2 (above). The pictograph study technique involves examining paint encapsulated within a rare mineral accretion that serves both to protect and obscure the art. An optical photomicrograph of a thin-sectioned paint sample reveals the ancient paint, just 0.1 mm thick, encapsulated within a thicker layer of natural accretion.

Figures 3 (right). Scanning electron microscope image shows the surface of the rock accretion. Features indicate past lichen activity as the likely source of the whewellite-rich accretion. Although a nuisance to viewing the pictographs, the accretions pose less of a threat to the panels than freeze-thaw cycles or vandalism.



ally destroyed some sites by carving, scratching, pecking, spray painting, and using the paintings for target practice. Early photographers in the region often used water or kerosene to enhance the contrasts in the pictographs, not knowing the long-term effect of repeated dousing with liquids. Still others have been damaged by modern campfires or are submerged under the waters of Amistad International Reservoir.

THE NATURAL ROCK ACCRETION

To the naked eye, most of the pictographic paints appear to be on the surface of the limestone rock. In actuality, the paints are covered with a thin veneer of natural accretion. In many of the samples that we have studied the accretion occurs both above and below the paint layer, thus encapsulating the ancient paints (fig. 2). The primary substance in this accretion is *whewellite* (Russ et al. 1994), a calcium oxalate mineral (human urinary tract stones are also composed of calcium oxalate). Although whewellite is generally regarded as rare in geological environments, it has recently been discovered in rock accretions in Australia, Italy,

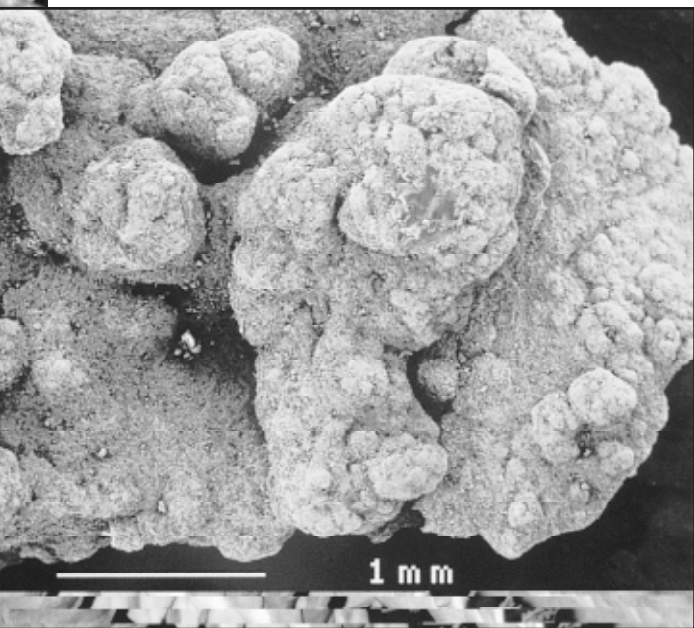
California, and now Texas. The origin of whewellite in rock accretions is not fully understood.

The limestone walls inside the rock shelters in and adjacent to the park are completely covered with the whewellite-rich rock crust. This accretion is typically less than 0.5 mm thick and imparts a yellow to brown color to the limestone. Gypsum, quartz, and clays are the other principal components in the accretion. The whewellite, gypsum, and quartz are sufficiently translucent that the pictographs are clearly seen. However, accretions with high concentrations of clays tend to obscure the pictographs, causing them to appear faded or to be completely blocked from view.

A MICROSCOPIC VIEW OF THE PAINTS AND ACCRETION

Using scanning electron microscopy (SEM), we analyzed samples of prehistoric paints and accretion from Amistad (fig. 3). The SEM allows us to image and analyze individual particles that are 0.5 μ (micron–1,000 μ = 1 mm). Presented here are some of the results of this study.

Lichen living on or near the surface of the limestone produced the whewellite. We observe whewellite structures that are strikingly similar to lichen (or fungi) features at the surface and within the accretion (fig. 3). High magnification of the accretion surface reveals structures that



resemble microcolonial fungi or lichen; below the surface the morphology of the whewellite is similar to lichen thalli. In essence, we are observing the fossilized remains of the lichen that produced the calcium oxalate (some lichen are known to produce this compound). Finally, radiocarbon dating of the whewellite confirms a biological origin and indicates that the mineral was produced periodically over the last 5,500 years (Russ et al. 1995).

The source of the gypsum is the limestone substrate. Water moving through pores in the limestone carries dissolved sulfate and calcium ions to the rock surface. Gypsum (calcium sulfate) precipitates as the ions reach the surface by a process known as efflorescence.

The clay and quartz are primarily from eolian (airborne) matter adhering to the rockshelter wall. These materials adhere to the shelter wall usually when they are moist from high humidity. The silicate materials are then incorporated within the accretion as it continues to form.

Some of the accretions have multiple lamellae, suggesting that it was produced by different mechanisms at different times. We are currently investigating relation-

ships between accretion processes and major shifts in the regional climate over the last 6,000 years.

The prehistoric paints are generally 30-100 μ (0.3-0.1 mm) below the surface of the accretion and are about 100 μ (0.1 mm) thick. Zolensky (1982) identified the principal pigments in the prehistoric paints as iron oxide minerals for red paints and manganese oxides for black paints. We not only observe a high incidence of iron and manganese in the paints, but also a significant clay component. Thus, the paints are composed mainly of a mixture of clay and oxide minerals.

CONCLUSIONS

The primary source of the accretion covering the park pictographs was lichen activity on the surface of the limestone inside the rock shelters. Very little evidence of oxalate-producing lichen exists currently in the shelters. The

primary growth of the accretion at this time is the gypsum efflorescence, indicating that water is moving through the substrate, paints, and accretion. The water should have little effect on the paint materials since paints are composed of highly insoluble clays and oxide minerals.

The current deterioration of the pictographs is not due to surface decay. In fact, the accretion may be the most important factor in how the pictographs have remained intact on the shelter walls over the last four millennia. Preserved within these natural materials, they are protected from attack by chemical and physical weathering agents. At this time, the crust is only a nuisance by causing the paintings to appear faded. Removing the accretion simply to make the paintings appear brighter will be unproductive since it may accelerate biological growth and dissolution processes on the exposed surfaces.

The major force in the deterioration of the pictographs is related to frost action within the limestone substrate (see Winkler 1975). The reality is that the rock art will not last forever. Forces beyond our control will eventually erase this phase of

human prehistory. The new methods for analyzing the ancient paints will revolutionize the study of prehistoric art, and increase our understanding of these enigmatic artifacts. With these studies our ability to preserve them will also improve.

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