



## Lime Kilns

### Introduction

There are six lime kilns in Saguaro National Park (SNP), four in the Rincon Mountain District (RMD) and two at Tucson Mountain District (TMD). Lime was an important building material for any developing community. Many lime kilns were constructed in the mountains around Tucson and as the town grew in the 19<sup>th</sup> Century so did the demand for lime. Lime kilns were usually built near the source of limestone, but may also have been built near the construction site.

The earliest use of lime dates to present-day Turkey between 7,000 and 14,000 years ago, and many ancient civilizations used it to create mortar to hold stones together. The Romans, however, took lime a step further, mixing it with various other ingredients to create an early version of cement.<sup>1</sup>

### Quicklime Production

A lime kiln is used to produce quicklime through the calcination of limestone (calcium carbonate). This reaction takes place at 900 °C but a temperature around 1000 °C is usually used to make the reaction precede quickly.<sup>2</sup> Quicklime was used to make plaster and mortar for building construction. By adding sand to the mix, bonding between the sand and the lime results in a hardened product (either mortar or cement) that keeps its shape over time. Another lime-based product was whitewash, which was quicklime that had been saturated with water, and then mixed with glue. After processing, products derived from limestone have the unique ability to return to their original chemical form. The lime cycle consists of first burning of limestone to form quicklime. Hydrated lime can then be produced by adding water to the quicklime. At this point, carbon dioxide in the atmosphere or from industrial processes reacts with hydrated lime to convert it back to limestone. This cycle is called the lime cycle.

Limestone is a naturally occurring and abundant sedimentary rock consisting of high levels of calcium and/or magnesium carbonate, and/or dolomite (calcium and magnesium carbonate), along with small amounts of other minerals.



A recent photograph of Sus Lime Kiln #2.

### Types of Lime Kilns

There are two basic types of lime kilns; flare kilns and draw or running kilns. The lime kilns at SNP are flare kilns. The two types of kilns have similar construction, generally a broad chimney, often set into the side of a hill. The kiln is loaded from the top (the hill side) and fired from the bottom, from where the lime is also removed. Flare kilns are loaded with a single charge of limestone. First a vault of limestone blocks is built over the furnace, above which the rest of the limestone is stacked. The fire is lit and kept stoked for several days until all the limestone has been calcined. The kiln is then unloaded, the lime sent to the slaking pits, and the process repeated with the next batch of limestone. To determine the correct temperature in the kiln is an art rather than a science, and it depends on the limestone size as well as type of kiln and type of fuel used. The kiln operator must experiment to determine the exact temperature for the particular size limestone that is being used.<sup>2</sup>

According to a local rancher and lime kiln user, Frank Escalante, a kiln needed to be fired for 4 days and 4 nights to make a batch of lime, each firing took from between 10 to 15 cords of wood.<sup>2</sup>

### Lime kilns at Saguaro National Park

The lime kilns at SNP were probably built during the last quarter of the 19th century and provided quicklime for construction activities in Tucson, specifically for use in plaster, mortar, and white-wash. Tradition states that the first kilns were operated in the Rincon Mountain District to supply lime in the construction of Ft. Lowell in 1873.<sup>3</sup>

Local lime was being produced for Ft. Lowell and Tucson by 1882, but only in small quantities and on an as needed

basis.<sup>3</sup> Two of the kilns ceased production in 1920. The kilns were closed by court order "on complaint of ranchers in the area because of the cutting of mesquite and Palo Verde trees was depleting the bean crop on which stockmen depended to feed cattle." Little is known of the third and fourth kilns at RMD or of the two kilns at TMD but it is likely they were built and operated at approximately the same time. All six lime kilns were built into the side of drainages (see schematic of flare kiln).

## Rincon Mountain District

The *North Lime Kiln* was constructed with coursed adobe bricks and is round in plan-view. In 1976 this kiln was mostly intact and stood approximately 9.4' and was 9.2' in diameter and is estimated to have had a maximum height of between 10' and 11'.<sup>4</sup>

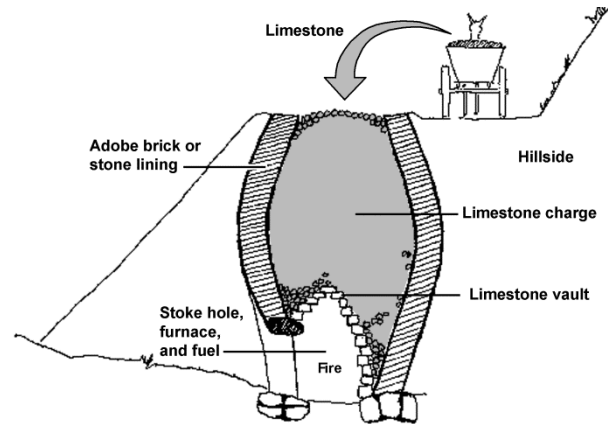
The *South Lime Kiln*'s construction is different than that of the North Lime Kiln in that it has a double wall; one of sun dried/fired adobe brick encased by a rock wall. Stone reported that South Lime Kiln had significantly deteriorated due to use and natural erosional processes and stood approximately 8.6' and was 8' in diameter; originally the kiln may have been 10' in height.<sup>4</sup> There are no intact structural remains along the east region of the kiln except for a small amount of brick along the base.

*Lime Kiln #3* is constructed of large granite boulders, smaller rock and lime mortar with some possible brick in the basal portion of the wall. It measures 9' across the top; a maximum height could not be taken due to the west region of the kiln being blown out. The kiln's maximum measurable height was 2', but this was only measured in an area that was intact. Lime debris that fused to the kiln's interior wall. The north and east regions of the kiln are intact while the south and west regions are severely impacted. A large hole exists at the bottom of the kiln in the west region facing out toward the drainage.

*Loma Alta Kiln* is located near Loma Alta on the edge of a hill above the junction of two washes. It is constructed of granite rock and unamended mortar. Its maximum height is 5'9" minimum height is 2'; and maximum wall thickness is 1'. The interior diameter of the kiln measure east-west is 9'7". The east region of the kiln is blown out toward the wash. It does not appear to have been used very often.

## Tucson Mountain District

The *Sus Lime Kiln* is located on a slope near a wash just west of the Sus Picnic Area. Small granite stones are used in some regions of the predominantly adobe brick walls. It measures 6.75' across; maximum height of 23"; minimum height of 4"; and wall thickness of 10". There is also a limestone debris pile located 45' northwest of the kiln.



**Schematic of a flare kiln. The TMD and RMD lime kilns appear to be this type of kiln.**

*Sus Lime Kiln #2* is a circular shaft of unshaped stone masonry with an interior diameter of 7' and a current maximum height of 3' (see photograph on previous page).

## Visiting the Lime Kilns

Remember, for both Districts there is no off trail hiking below 4500 feet! This means visiting the lime kilns is prohibited except for the two along the Cactus Forest Trail and the one along the Ruiz Trail in the Rincon Mountain District.

One should never attempt to climb or stand on the lime kilns or walk too close to the kilns. The tops and walls of the lime kilns are fragile and the park puts substantial effort into keeping the kilns in repair. Walking close to the kiln will exacerbate erosion of the embankment which will weaken the structural stability of the kiln.

<sup>1</sup> Kaller, Brian  
2013 Burning the Bones of the Earth: Lime Kilns.  
<http://www.lowtechmagazine.com/2013/09/lime-kilns.html>

<sup>2</sup> Moss, Jeremy and David Yubeta  
2006 The Preservation Treatment and Documentation of Historic Lime Kilns in Saguaro National Park, Tucson. MS on file at SAGU.

<sup>3</sup> Clemensen, A. Berle  
1987 Cattle, Copper, and cactus: The History of Saguaro National Monument. Historic Resource Study, National Park Service.

<sup>4</sup> Stone, Lyle M.  
1976 Description of Two Lime Kilns Located in Saguaro National Monument. MS on file at SAGU

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