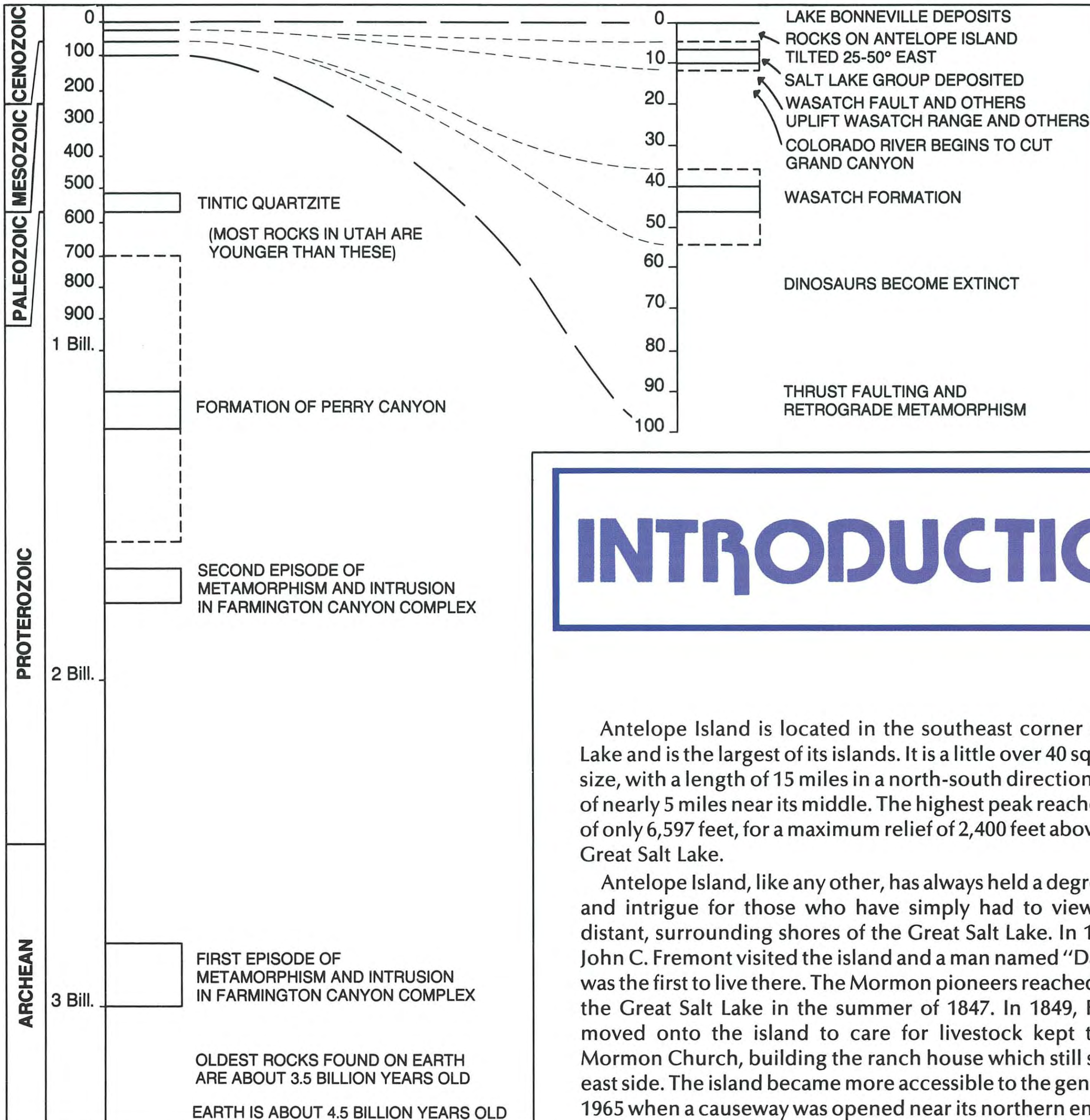
Geology & Antelope Island State Park, Utah

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
UTAH GEOLOGICAL AND MINERAL SURVEY
in cooperation with
Division of Parks and Recreation



INTRODUCTION

Antelope Island is located in the southeast corner of Great Salt Lake and is the largest of its islands. It is a little over 40 square miles in size, with a length of 15 miles in a north-south direction, and a width of nearly 5 miles near its middle. The highest peak reaches an altitude of only 6,597 feet, for a maximum relief of 2,400 feet above the level of Great Salt Lake.

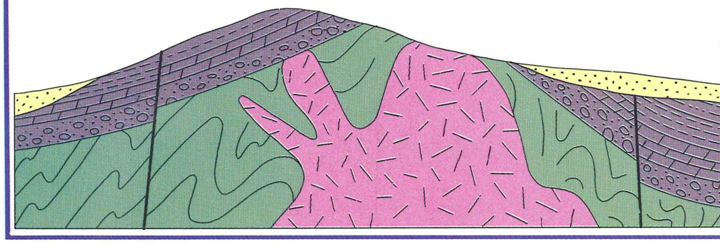
Antelope Island, like any other, has always held a degree of mystery and intrigue for those who have simply had to view it from the distant, surrounding shores of the Great Salt Lake. In 1845, Captain John C. Fremont visited the island and a man named "Daddy" Stump was the first to live there. The Mormon pioneers reached the valley of the Great Salt Lake in the summer of 1847. In 1849, Fielding Garr moved onto the island to care for livestock kept there by the Mormon Church, building the ranch house which still stands on the east side. The island became more accessible to the general public in 1965 when a causeway was opened near its northern end. The entire island is now under ownership of the State of Utah and is a jewel in the State Park system. Considering how close it is to a populated area, it remains relatively untouched.

The island is noted for its wildlife as well as for its geology. In addition to its famous herd of buffalo, mule deer, coyote, badger, and bobcats have been observed. It is regularly visited by flocks of migrating birds and is the habitat for several species of eagles, hawks, falcons, and owls, including the rare peregrine falcon.

Although several geologic expeditions visited the island while investigating the western United States in the 1800s, the first serious geologic investigation did not occur until Willard Larsen of the University of Utah provided the first geologic map in 1957. In 1987 the Utah Geological and Mineral Survey, in cooperation with the Utah Division of Parks and Recreation, geologically remapped the island and studied its mineral and water resources, and its geologic hazards.

STATE OF UTAH, Norman H. Bangerter, Governor. GEOLOGY AND ANTELOPE ISLAND STATE PARK, UTAH is published by the UTAH GEOLOGICAL AND MINERAL SURVEY, 606 Black Hawk Way, Salt Lake City, Utah 84108, (801) 581-6831. The Utah Geological and Mineral Survey, Genevieve Atwood, Director, is a division of the UTAH STATE DEPARTMENT OF NATURAL RESOURCES, Dee C. Hansen, Executive Director. This pamphlet was published in cooperation with the DIVISION OF PARKS AND RECREATION, J. A. Miller, Director and ANTELOPE ISLAND STATE PARK, M. A. Larsson, Superintendent. Text and photographs by H. H. Doelling, G. C. Willis, M. E. Jensen, F. D. Davis, J. W. Gwynn, W. F. Case, S. Hecker, G. Atwood, and R. H. Klauk, 1988.

Designed & Produced by Julia Vigil and Patti Frampton-Carter. Illustrations by Kent Brown.

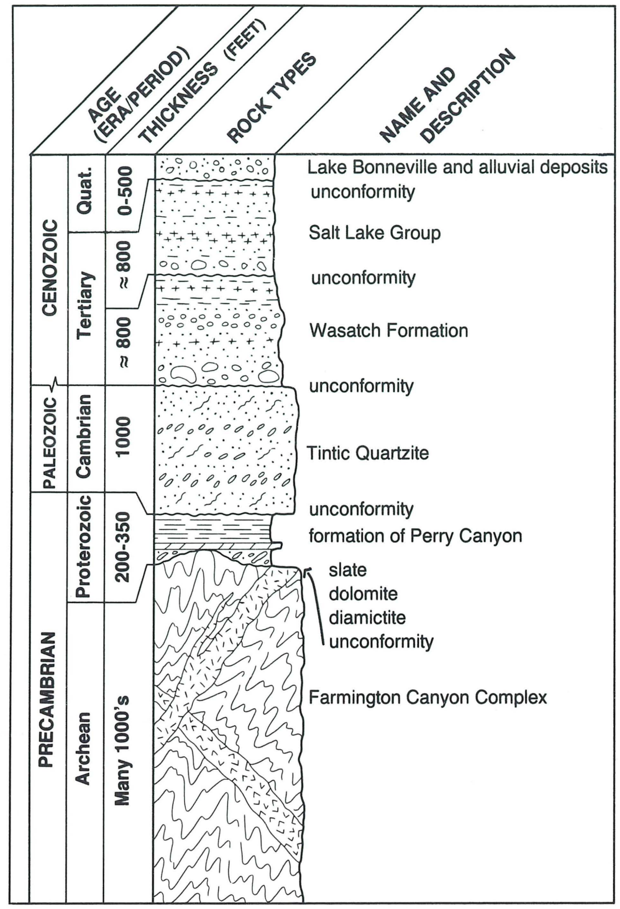


THE GEOLOGIC RECORD

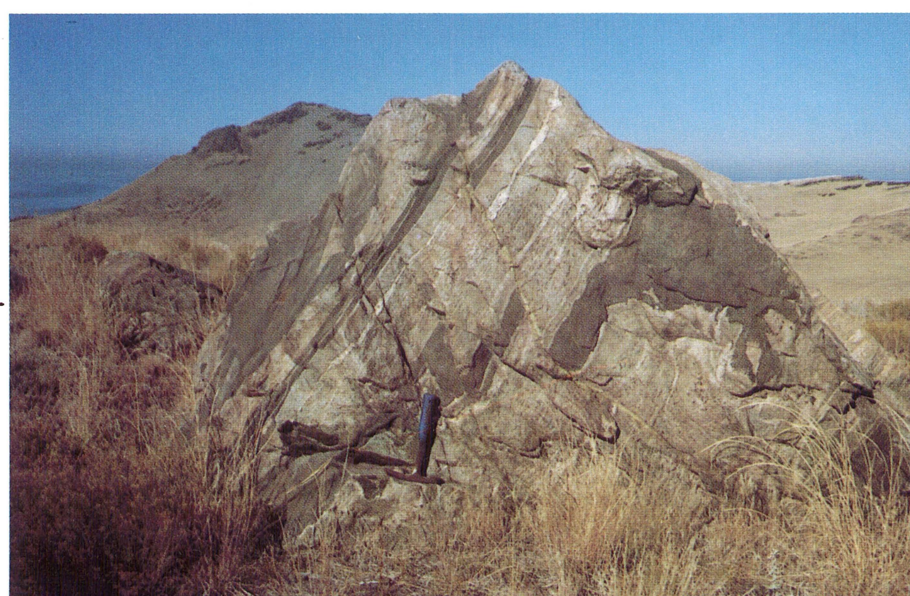
ROCKS AND TIME

As in most of our state and national parks, the geology provides the foundation for Antelope Island as a park. The geology determines the locations of mountains and valleys, while the rocks and minerals greatly influence what plants will grow. The geology controls the collection and distribution of ground water, and the location and size of springs. Indeed, the rocks of Antelope Island also reveal a long history of complex geologic processes.

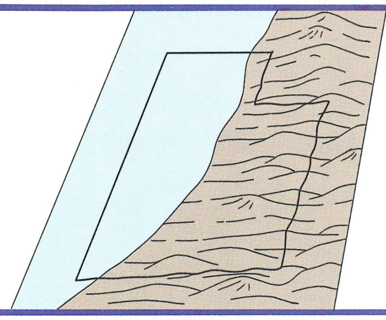
Rocks of Antelope Island include some of the oldest and youngest rocks in Utah, as well as representatives of the three major types: igneous, sedimentary, and metamorphic. On Antelope Island the rocks preserve with excellent detail five relatively short periods of geologic time, while other time periods are unrepresented in the rock record. The reason that there are no rocks from certain time periods is simply that the area was elevated above sea level on several occasions and the rocks either were never deposited or were eroded away. The erosional surfaces that represent large breaks in the geologic record are called unconformities. Geologists know little about the geologic events represented by the older unconformities, while nearby areas provide information about the younger ones.



Upper Right:
Stratigraphic column showing an idealized sequence of the rocks found on Antelope Island.



Outcrop of the Farmington Canyon Complex. The dark banding formed 1.7-3.0 billion years ago while the faults that cut it are probably less than 100 million years old.



CONTINENTS & OCEANS

3.5 billion to 100 million years ago

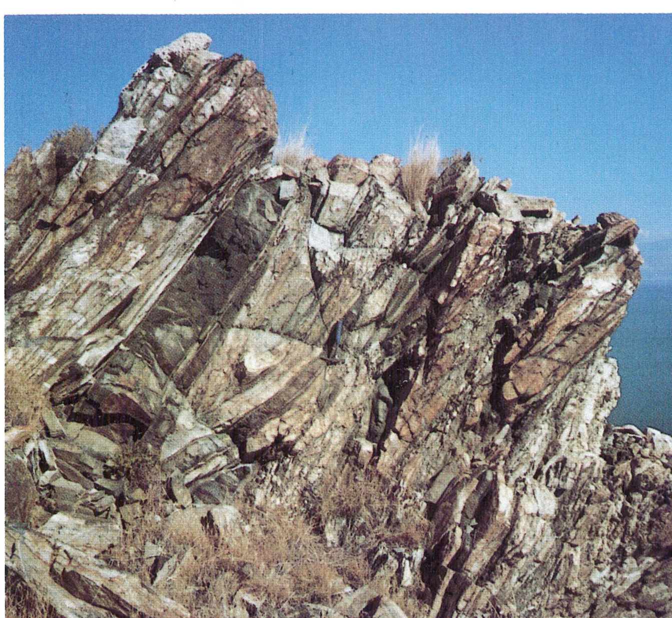
The oldest rocks of Antelope Island are only slightly younger than the oldest rocks found anywhere on earth. They represent the earliest preserved history of the earth—a time when the cores of the major continents were still forming. Mountain-building processes, occurring along the margins of the "proto-continents," along with deep burial, heated, deformed, and metamorphosed the rocks. Intense metamorphism, caused by at least two episodes of mountain building, is preserved almost everywhere in the rocks of the Farmington Canyon Complex.

The age of the next younger rocks, the formation of Perry Canyon, is only roughly known. They were deposited during a period of only a few million or tens of millions of years and were deposited sometime between 1.6 to 0.7 billion years ago. What happened in the time between the formation of the older rocks and these is poorly understood. However, the Perry Canyon rocks are only slightly metamorphosed, indicating that no high-grade metamorphism has occurred since their deposition.

The Tintic Quartzite, which overlies the formation of Perry Canyon, was deposited on another major unconformity representing several hundred million years. Numerous and diverse geologic events occurred during the hiatus, only the last of which was a period of erosion that erased the record. The rock record in other areas indicates that a great thickness of rocks is missing that once covered the formation of Perry Canyon on Antelope Island. Also, prior to the deposition of the Tintic Quartzite, an ocean encroached upon the western margin of the North American continent. It persisted until less than 200 million years ago and at times extended far east of Utah. Tens of thousands of feet of rock were deposited in and around the margins of this ancestral Pacific Ocean, including the Tintic Quartzite. Most of these rocks have been eroded from Antelope Island, however, and the Wasatch Formation contains some of the erosional detritus. Boulders and cobbles in the Wasatch Formation contain fossils of corals, brachiopods, crinoids, and other ocean-dwelling organisms.

Although mountain-building activities were present in other parts of the world from 1.6 billion to 100 million years ago, Utah geology was relatively passive. About 100 million years ago that began to change.

Intricate folding in the Farmington Canyon Complex.



The diamictite and dolomite beds of the formation of Perry Canyon.

METAMORPHISM

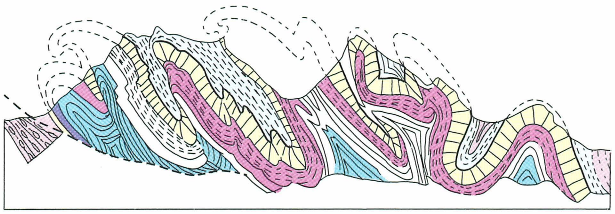
Migmatite gneiss, a common high-grade metamorphic rock in the Farmington Canyon Complex.

Metamorphism, or the alteration of rocks by heat and pressure, has played an important role in the history of all but the youngest rocks on Antelope Island. Metamorphism can affect sedimentary, igneous, or previously metamorphosed rocks and can be intense enough to produce new minerals and rock types. For example, sandstone is metamorphosed to form quartzite, and limestone will become marble. The mineral muscovite (white mica) converts to minerals stable at higher pressures and temperatures, such as feldspar or sillimanite.

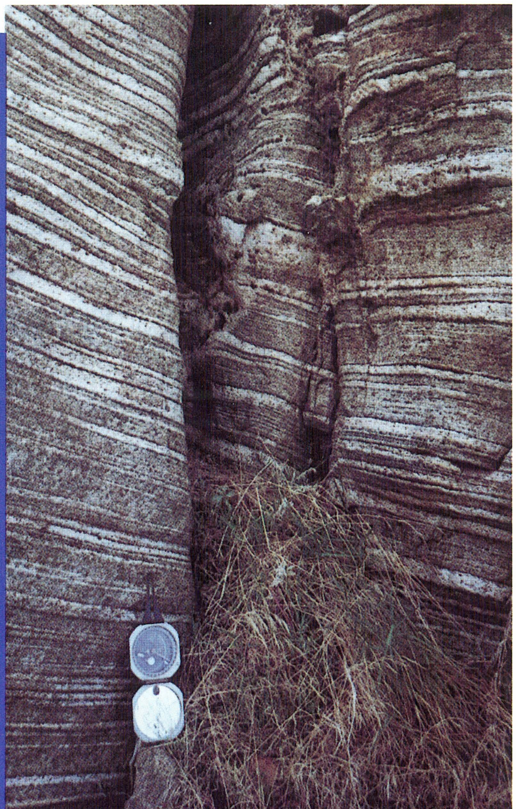
During more intense metamorphism the rocks may deform like warm plastic and can even partially melt. Metamorphism tends to cause the contained minerals in the rock to align, segregate, or clump, forming bands or "layers" and other unique textures and fabrics. The high pressures cause rocks to fold, fault, and "flow" to create complex swirls, contortions, and other patterns. Many of these patterns are spectacularly displayed on Antelope Island. Melted rock "intrudes" along zones of weakness, forming dikes and sills.

At least three episodes of metamorphism are recognized on Antelope Island. The oldest occurred 3.0 to 2.8 billion years ago. The second left its mark on the first about 1.7 billion years ago. Both were events of very high temperatures and pressures, and rocks were severely deformed, altered, and partially melted. The third event occurred during a mountain-building episode about 100 million years ago. This metamorphism was not as intense and most of the characteristics of the previously metamorphosed rocks were unaffected. However, there was enough heat and pressure to stretch pebbles and to convert some of the more easily altered minerals in the Farmington Canyon Complex. The dark green color evident on many of the rocks is due to the mineral chlorite, a product of low-grade metamorphism.

Amphibolite granite dikes formed by high-grade metamorphism.



ARCHEAN ROCKS

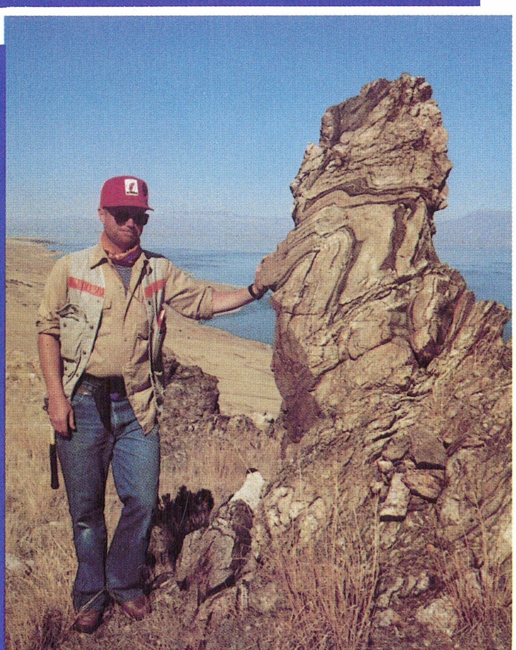


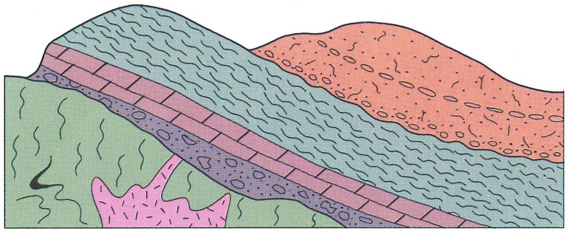
Archean rocks are so named because they are very old, more than 2.5 billion years old, and are so old that we can no longer tell how they were originally formed. They have undergone a long history of deep burial and were subjected to varied chemical and thermal conditions. On Antelope Island these rocks are collectively known as the Farmington Canyon Complex.

These rocks are exposed on the southern two-thirds of Antelope Island and most are classified as gneiss. A gneiss is a coarse-grained, irregularly banded metamorphic rock. There are banded gneisses, granite gneisses (pink or salmon-colored), amphibolite gneisses (dark), and quartz gneisses (almost white or translucent) on the island . The dominant minerals making up these rocks are feldspar, quartz, hornblende, and magnetite. Mica, garnet, and hematite are also locally common.

Some of the rocks were subjected to compressional forces, which folded or contorted them (photo-lower left), while others were submitted to shearing forces which "smeared" or granulated the rocks into finer grained equivalents called schists and phyllonites. These underwent chemical changes as well. One chemical change, called "chloritization," has imparted a strong green color to some of the rocks.

Other rocks were partially melted by the heat deep beneath the surface of the earth. They cooled very slowly so that the mineral crystals which developed were allowed to "grow" to very large sizes. On Antelope Island these rocks have a granular and very light-colored appearance and are called pegmatites. Fragments of unmelted rocks sometimes remain within the pegmatites (photo-lower right).





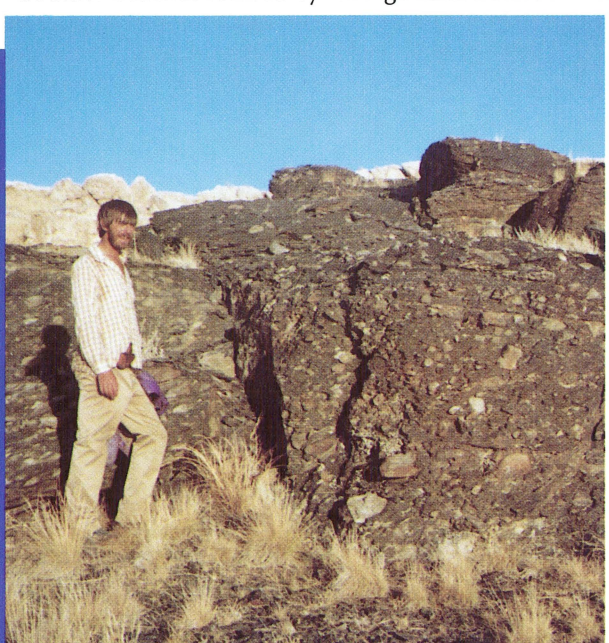
PROTEROZOIC & CAMBRIAN ROCKS

Folded layers of dolomite.

The rocks immediately overlying the Farmington Canyon Complex on Antelope Island were deposited sometime between 1600 and 700 million years ago. They are assigned to the formation of Perry Canyon and are divisible into three parts. The lowermost part is diamictite, a rock which consists of poorly sorted pebbles, cobbles, and boulders mixed in a dark matrix of sand and granules. Many geologists believe that this diamictite is till from an extensive glacier deposited in an ocean that covered parts of this region in Proterozoic time. The thickness of the diamictite ranges from 0 to 140 feet on Antelope Island.

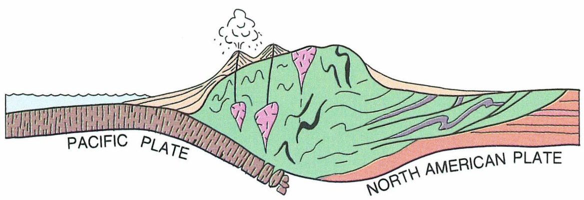
Covering the diamictite is a distinctive layer of light tan to pink dolomite about 25 feet thick. The dolomite is especially easy to recognize on the east part of Elephant Head where it forms light-colored cliffs and ledges. More than 200 feet of gray, purple, brown, green, and red slate are found above the dolomite. Slate has a good platy cleavage and is formed by the metamorphism of fine-grained sedimentary rocks, such as shale or mudstone.

The Tintic Quartzite was deposited about 570 to 540 million years ago in a beach or shallow marine environment. It forms the pale-orange outcrops and rounded ridges on the northern third of Antelope Island. Tintic Quartzite is pale orange to light-gray quartzite with abundant layers of pebble conglomerate. Many of the pebbles were elongated or stretched as the quartzite was deformed under high pressure and temperature. Boulders and cobbles of the Tintic Quartzite are present in the boulder beaches formed by Ice-Age Lake Bonneville on many parts of the island.



Diamictite containing cobbles of gneiss, amphibole and quartzite.

Platy weathering slate.

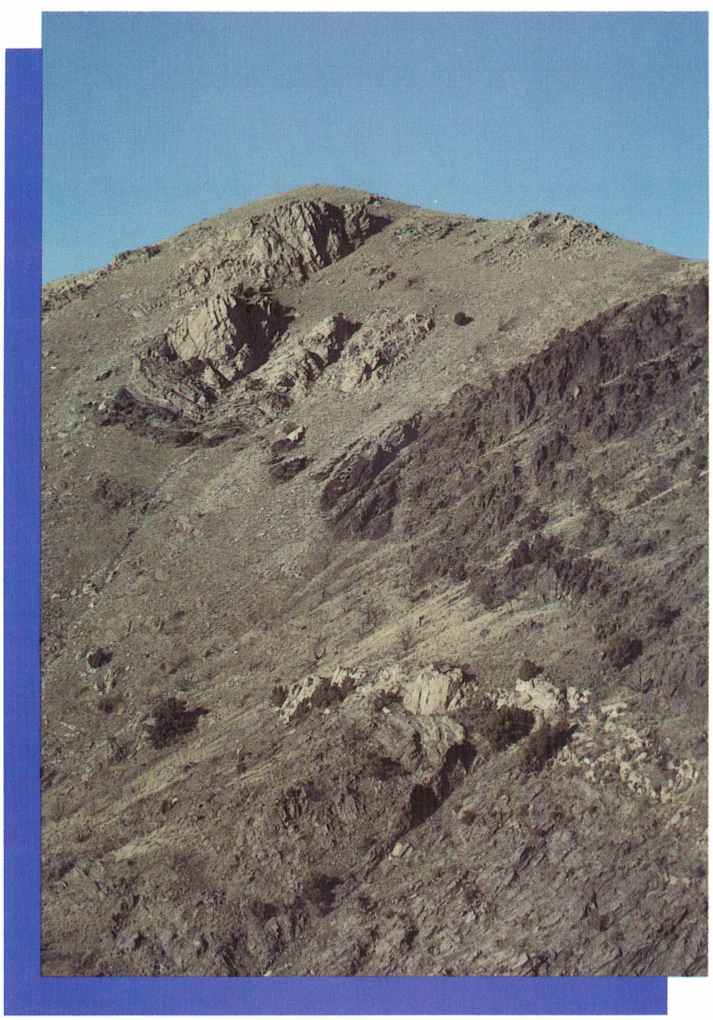


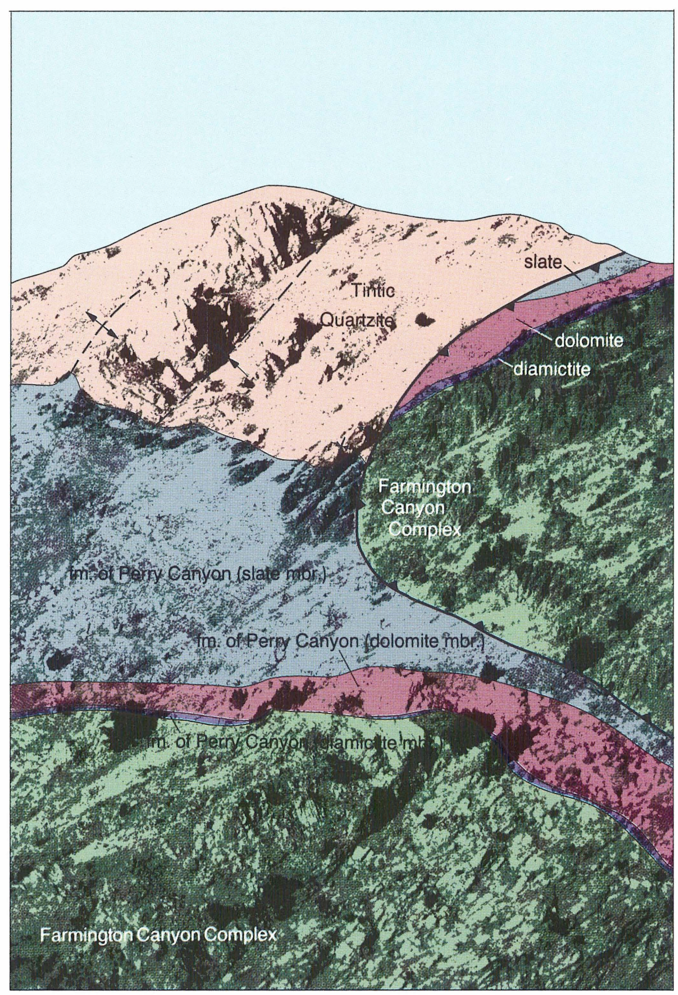
BUILDING MOUNTAINS

Through geologic history the continental and oceanic plates of the earth's crust have collided with and even ridden over each other, causing faulting, earthquakes, metamorphism, volcanic activity, and mountain building. Roughly 100 to 150 million years ago the North American continental plate collided with the Pacific oceanic plate and the ensuing deformation produced major thrust faults that affected much of western North America. Thrust faults are sub-horizontal faults along which large "sheets" of rock many miles across are transported distances of a hundred miles or more. The older rocks of Antelope Island originally formed 50 to 75 miles farther west and were transported to their present positions along one or more such faults. During their transport they were faulted, intensely sheared, and subjected to low-grade metamorphism. Other thrust faults, located above the presently exposed rocks of the island, were later removed by erosion.

The transported thrust sheets were folded and stacked, creating high mountains from which thousands of feet of rock were later eroded. The Wasatch Formation, exposed on the east side of Antelope Island, represents the erosional detritus of one of these ancestral mountain ranges.

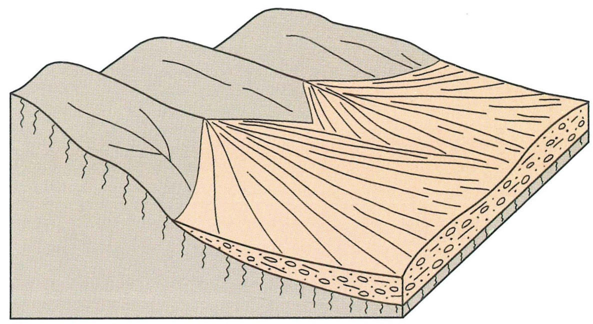
A view near the highest part of Antelope Island. The rock names, faults, and folds are shown on the diagram to the right.





TERTIARY ROCKS

The earliest of the Tertiary (Cenozoic Era) rocks deposited on Antelope Island are known as the Wasatch Group and consist of gray and red conglomerate and minor reddish-orange silt, sand, and clay. These rocks were deposited at the front of a mountain range as coalescing alluvial fans, 60 to 45 million years ago. Rocks from this ancient mountain range are now incorporated as the limestone, dolomite, and quartzite boulders and cobbles in the conglomerate.

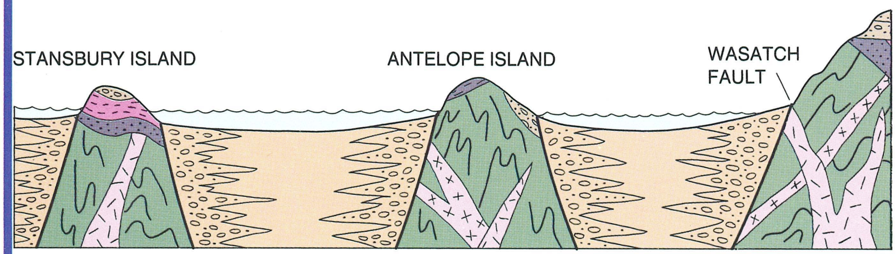


Younger Tertiary rocks also present on Antelope Island were deposited between 19 and 1.6 million years ago. These are called the Salt Lake Group of rocks and consist of tuffaceous sandstone, volcanic tuffs, white to gray conglomerate, friable sandstone, and multi-colored bentonitic clay. The large amount of volcanic material in these rocks testifies that much volcanic activity occurred in northern Utah during that time.

Tertiary rocks crop out only on the east side of Antelope Island south of Sea Gull Point and on the extreme northern tip of Ladyfinger Point. After their deposition they were covered by Lake Bonneville sediments but were bared during the excavation of the huge pits for gravel used in the construction of I-80 in the late 1970s. These Tertiary rocks were originally laid down in nearly flat positions but are now tilted 20 to 45 degrees to the east, indicating continued faulting and mountain-building activity.

Red conglomerate from a Tertiary age alluvial fan (Wasatch Group).

Landsat image of Antelope Island and the Great Salt Lake taken in June of 1975. The colors are altered (especially green to red) to enhance particular ground features. The differences in both the depth and salinity of the lake show up as slight differences in color. A subtle difference is noticeable between the north and south areas of the lake separated by the Southern Pacific Railroad causeway. The north arm is generally saltier than the south arm.



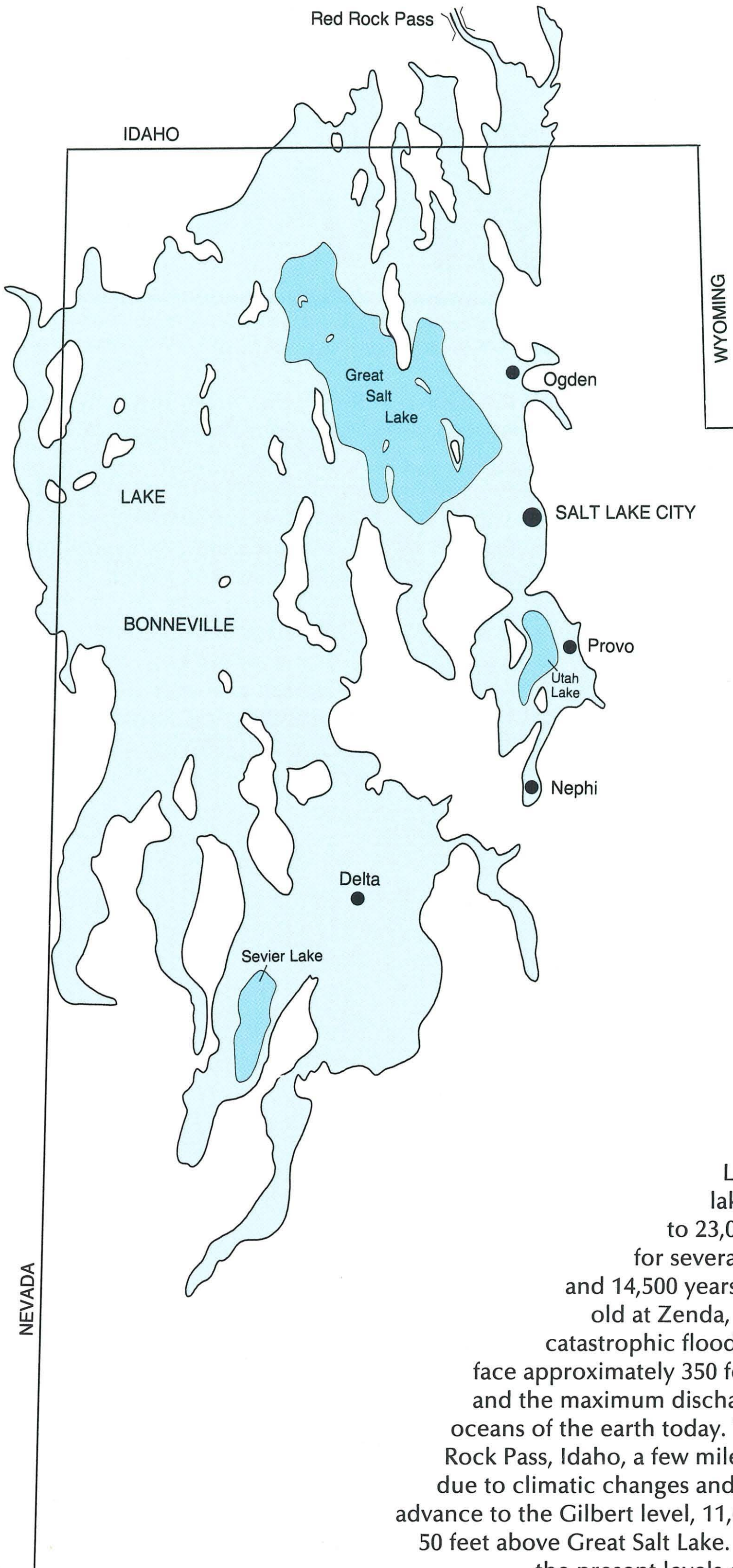
BASINS & RANGES

About 10 million years ago a new phase of mountain-building activity commenced which continues to the present. It is caused by east-west extension of the North American continental plate in the area between the Wasatch Range to the east and the Sierra Nevada of California to the west. The "stretching" resulted in the formation of north-south-trending mountain ranges bounded by steeply dipping faults, such as the Wasatch fault, and separated by deep basins. Antelope Island is bounded by one or more such faults. The basins rapidly fill with material eroded from the adjacent highlands, forming wide valleys with no external drainage. The Salt Lake Group of rocks, which unconformably overlie the Wasatch Formation, represents earlier deposition into these intermontane basins. At times large lakes, such as Lake Bonneville, fill the basins, while at other times only salty playas exist. Sediments deposited by Lake Bonneville mantle Antelope Island to an elevation of about 5,300 feet.

Geology is just as active on and around Antelope Island today as it ever was. The faults bounding the island move periodically, elevating and tilting the island relative to the adjacent basins. Rocks of the Salt Lake Group have been tilted as much as 45 degrees in just the last few million years. Rivers, streams, and washes, as well as occasional volcanic eruptions, continue to fill the surrounding basins, some of which now contain more than 13,000 feet of detritus. Erosion, primarily from rain, melting snow, and springs, is imperceptibly, but constantly, altering the face of the island.

The backbone of Antelope Island. The strandline of the Bonneville level of Ice Age Lake Bonneville and recent erosion are quite evident.

ICE AGE



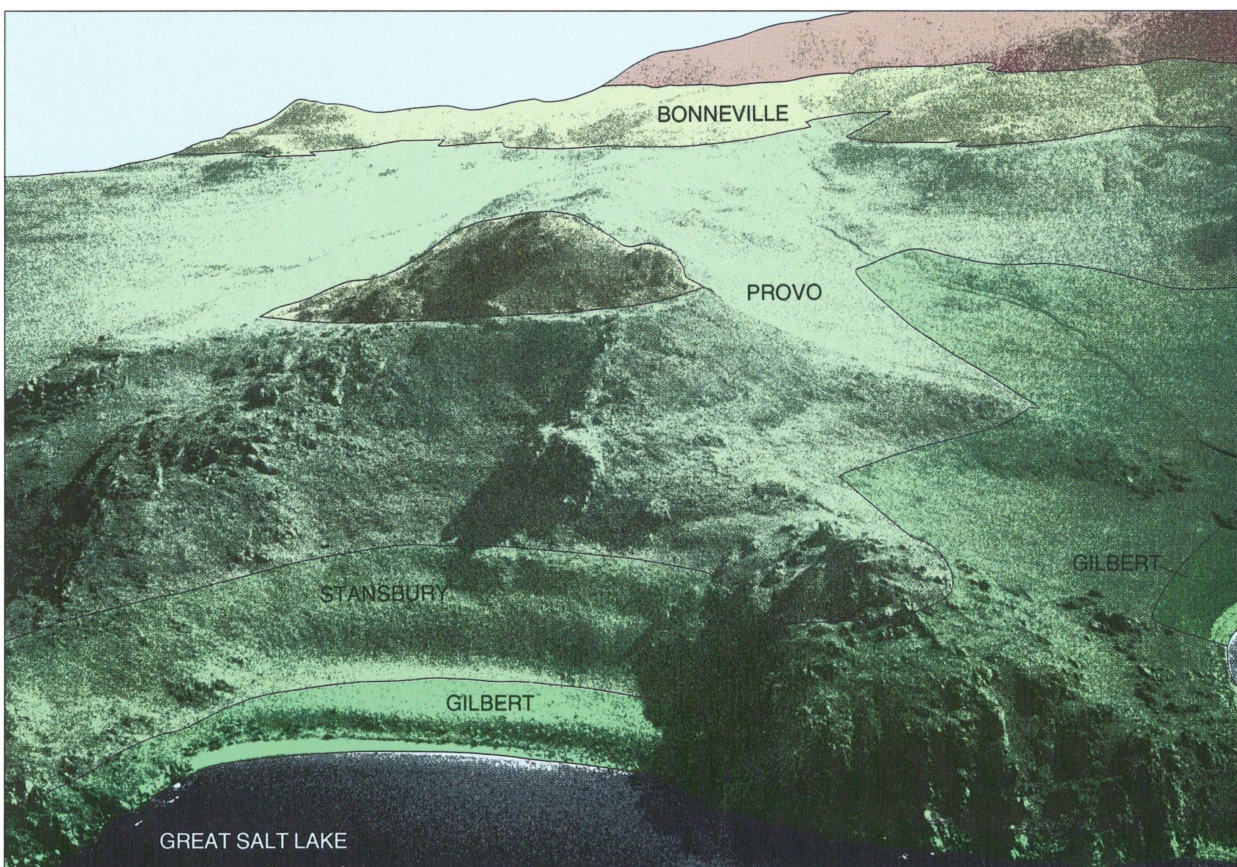
During the last ice age, while glaciers advanced and retreated in the higher peaks in Utah, the basins of northwestern Utah were covered by ridges deposited by energetic waves. Sand and gravel beach deposits of Lake Bonneville are found more than 1,000 feet above the present Great Salt Lake shoreline. The shorelines record a history of Lake Bonneville lasting several thousands of years. Lake Bonneville expanded gradually from a small saline lake about 30,000 years ago to the Stansbury level 20,000 to 23,000 years ago. The water surface fluctuated at this level for several thousand years, and then rose almost 700 feet 16,000 and 14,500 years ago. The Bonneville level was maintained at a threshold at Zenda, Idaho until 13,500 years ago when a breach released a catastrophic flood into the Snake River Plain and lowered the water surface approximately 350 feet to the Provo level. The flood lasted several months and the maximum discharge exceeded the total fresh water flowing into all the oceans of the earth today. The Provo-level lake stabilized with a threshold at Red Rock Pass, Idaho, a few miles south of Zenda. Evaporation exceeded precipitation due to climatic changes and the lake nearly dried up 13,000 years ago. A minor readvance to the Gilbert level, 11,000 to 10,000 years ago, raised the water surface about 50 feet above Great Salt Lake. Lake levels have oscillated and gradually decreased to the present levels of Great Salt Lake, a saline remnant of Lake Bonneville.

LAKE BONNEVILLE

The most conspicuous reminders of Lake Bonneville are its shorelines, wonderfully etched on the Antelope Island mountainsides. During the Ice Age it was the largest lake in the western United States, covering more than 20,000 square miles. In comparison it was almost the size of Lake Michigan.

A crustal rebound followed the disappearance of the 1000-foot deep lake so that the shorelines on Antelope Island are now higher than found along the Wasatch Range to the east. For reference, the highest Bonneville shoreline is approximately 5,240 feet above sea level on Antelope Island, 50 feet above the same shoreline in the Wasatch Range.

The bones of mammoth and other large mammals have been discovered in Lake Bonneville gravels on the mainland indicating that they frequented its environs. It is hard to imagine that such vast changes in climate and scenery could occur in only 15,000 years.



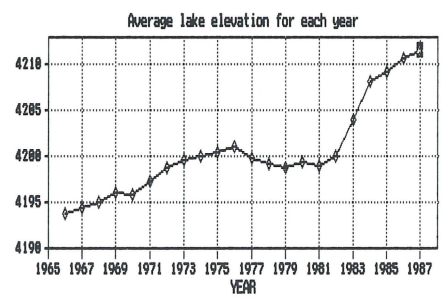
GREAT SALT LAKE

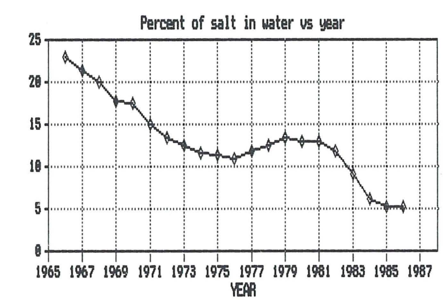
A strange spiralling current under a cloudy sky.

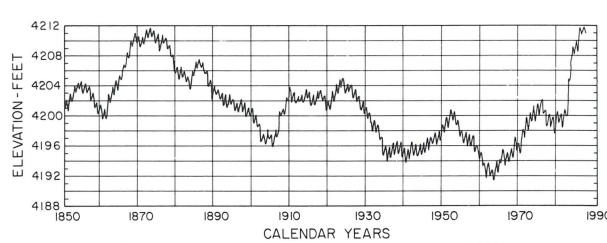
The Great Salt Lake is a shallow body of water and its size and depth vary greatly with the rates of evaporation and precipitation. When the lake level is low many of its islands become connected to mainland by land bridges, including Antelope Island. From 1850 until the present (1988), the level of the Great Salt Lake has fluctuated over a range of more than 20 feet (4191 to 4212 feet above sea level). During this time its area has changed from 970 to 2,280 square miles, making it the largest lake in the United States after the Great Lakes.

Within the salty waters of Great Salt Lake are 5 major elements or ions. These include sodium (Na), magnesium (Mg), potassium (K), chlorine (Cl), and sulfate (SO4). Calcium, lithium, bromine, and boron are present in lesser quantities. The salinity of the lake rises and falls inversely with the level of the lake, from 5 to more than 25 percent. The waters surrounding Antelope Island are density stratified. The bottom third of the lake is a very dense, discolored, and hydrogen sulfide-laden brine. A zone of transition, 1-3 feet in thickness, separates it from a relatively clean, odor-free brine of a lesser density above it.

Contrary to general belief, a dozen species of bacteria, a variety of protozoa, and the brine shrimp (Artemia salina) thrive in the lake. Swarms of brine flies and a variety of aquatic insects also survive along its shorelines in certain seasons of the year. Industries pump its waters to evaporation ponds to extract valuable salts. Besides common salt, potassium sulfate (fertilizer), sodium sulfate (chemicals and medicine), magnesium metal, chlorine gas, and a highly concentrated magnesium chloride brine are or have been produced.







Surface elevation of Great Salt Lake, 1850 to present (1988).

Landsat photograph of the southern part of Great Salt Lake and the area immediately to the south showing major basins and ranges. Snowcover accentuates the drainage patterns of the higher ranges. Faults are usually present where the boundaries between the valleys and mountains are very sharp.

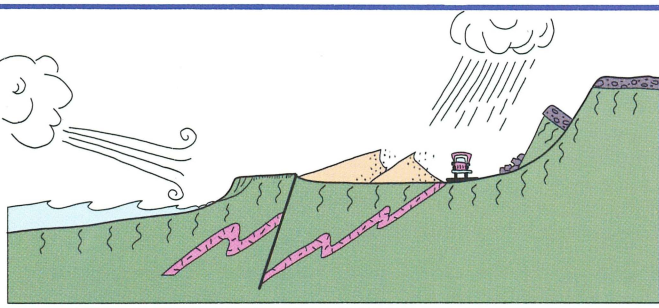
SHORELINE & BEACHES

Several beaches and lagoons constructed by succeeding rises of the lake over the past several thousand years are shown at the southern most tip of the island.

Antelope Island displays some of the most distinct exposures of shoreline features developed by the rise and fall of Great Salt Lake and its predecessor, Lake Bonneville. Because Great Salt Lake has no outlet variations in precipitation and stream runoff into the lake result in fluctuations of the lake's level. In historical time, the lowest lake level was measured in 1963 at 4191.35 feet above sea level. During the 1860s-1870s and 1980s, the lake level rose to approximately 4212 feet above sea level in response to wetter than average weather. These fluctuations are normal and have occurred several times in the last 10,000 years. The greatest fluctuation in the last 10,000 years resulted in a rise of the lake to a high of 4221 feet in response to cool, wet decades.

Early geologists and geographers recognized that shorelines and other lake features on Antelope Island could provide evidence to decipher past history of Great Salt Lake. Captain John C. Fremont noted that the shorelines around the lake were evidence of higher lake levels. In 1843, he rode his horse to Antelope Island across the submerged bar connecting the south end of the island to the mainland. G. K. Gilbert used Fremont's observation and later observations by stockmen using the same route to estimate the lake level before 1875. G. K. Gilbert's 1877(?) measurement of the shorelines on the east side of Antelope Island are the only available direct measurements of the highest levels of Great Salt Lake in the 1870s. These observations predate the first water-level gauge established on Great Salt Lake in 1875. More recently, geographers at the University of Utah used evidence from southern shorelines on Antelope Island to document a rise of the lake to 4217 feet possibly in the 1600s or 1700s A.D. Wave-tossed gravel mixed with modern debris (railroad ties, ping-pong balls, toys, etc.) can be found on virtually all beaches on the island. Beach shape, the exposure to storm waves, and coarseness of beach material affect the level of a particular shoreline created by the lake. Thus, at different locations around Antelope Island, the high shorelines of the 1980s vary in elevation by as much as 7 feet.

Shoreline features on Antelope Island document lake fluctuations. When the lake rises it creates new beaches where storm waves toss material onto storm lines or where storm waves undercut bluffs or erode beaches. The road leading to the causeway (taken in October, 1987) shows evidence of the destructive action of storm waves.

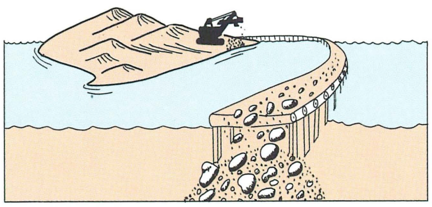


GEOLOGIC HAZARDS

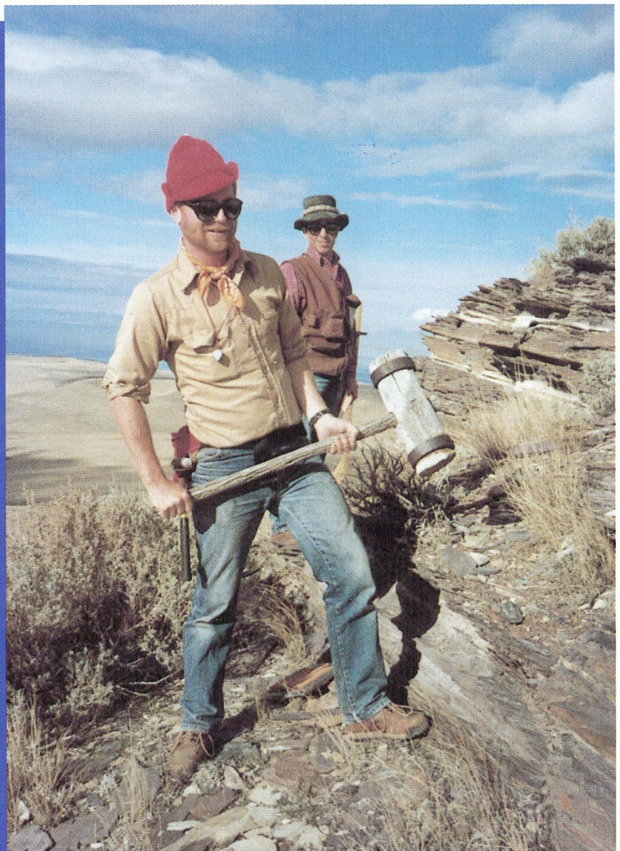
Unusually high precipitation in the early part of the 1980s caused Great Salt Lake to rise, destroying road access and flooding public beaches. It also caused the movement of many small landslides on steep, deeply weathered slopes. Though highlighted by the recent wet conditions, geologic hazards have had a long history on the island. Scars and deposits of ancient landslides, rockfalls, and debris flows can be seen in the modern landscape. On the north end of the island, sand dunes, thousands of years old, have migrated onto recently constructed roads. Unpaved roads on steep hillsides of loose material have also contributed to erosion hazards. Perhaps the greatest geologic hazard on Antelope Island, but the most difficult to appreciate, is ground shaking due to earthquakes. Major nearby faults, notably the Wasatch fault to the east and the East Great Salt Lake fault just offshore to the west, have been host to numerous large earthquakes in the geologic past and are expected to have more in the future. Strong ground shaking from such events could seriously damage or destroy man-made structures and at the same time trigger other hazards, such as landslides, rockfalls, and large waves in the Great Salt Lake.

Above: Failure of a slope in old lake gravels created this 500-foot wide slump-type landslide.

Below: Wave erosion during the high level of Great Salt Lake during the 1980s destroyed these concrete picnic facilities and cut back the shore to the roadway (pavement topped beach face).



ROCKS & MINERAL RESOURCES



Mallet used to split slate on Antelope Island in early days.

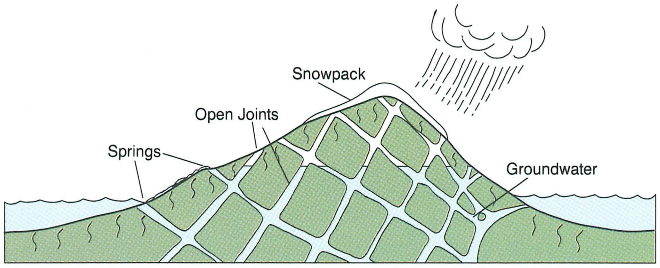
Sand, gravel, flag stone (slate), metals (copper and gold), and quartzite suitable for concrete aggregate are the chief resources of Antelope Island. Noteworthy deposits of oolitic calcium carbonate sand are abundant on the northern and western beaches of the island.

Sand and gravel deposits are present in many places around the perimeter of the island and are the most important resource. The pits around the island were opened to build road embankments for highways and causeways to the island. In 1979 and 1980 about 16 million cubic yards were excavated from alluvial fans and beach deposits on the southeastern side of the island for use in the construction of Interstate Highway 80 between Saltair and Salt Lake City. The material was loaded onto a 13-mile long conveyor belt, touted to be the longest in the world at the time. The irregularly shaped excavation area grew to approximately 2 square miles.

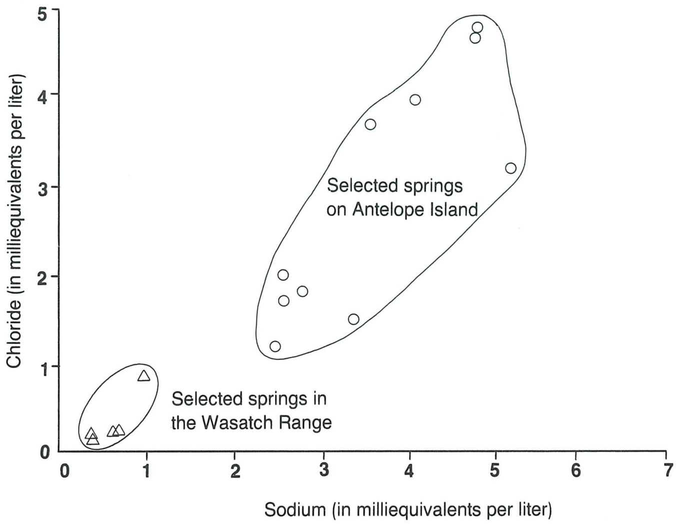
Small occurrences of metal-bearing minerals, such as chalcopyrite, chrysocolla, malachite, and limonite, have been discovered on Antelope Island disseminated in white quartz veins, especially in the central and high parts of the island. In early times a little slate was quarried for flagstone and crushed for roofing stone. Oolite sands mined elsewhere around the Great Salt Lake have been used for smelter flux. Other non-economic minerals present on Antelope Island include quartz, feldspar, hornblende, mica, red and brown garnet, staurolite, and sillimanite, which are of interest to mineralogists.

Large stain of copper bearing malachite on white quartz dike, central island.

Utah freeways benefited from Antelope Island gravel.



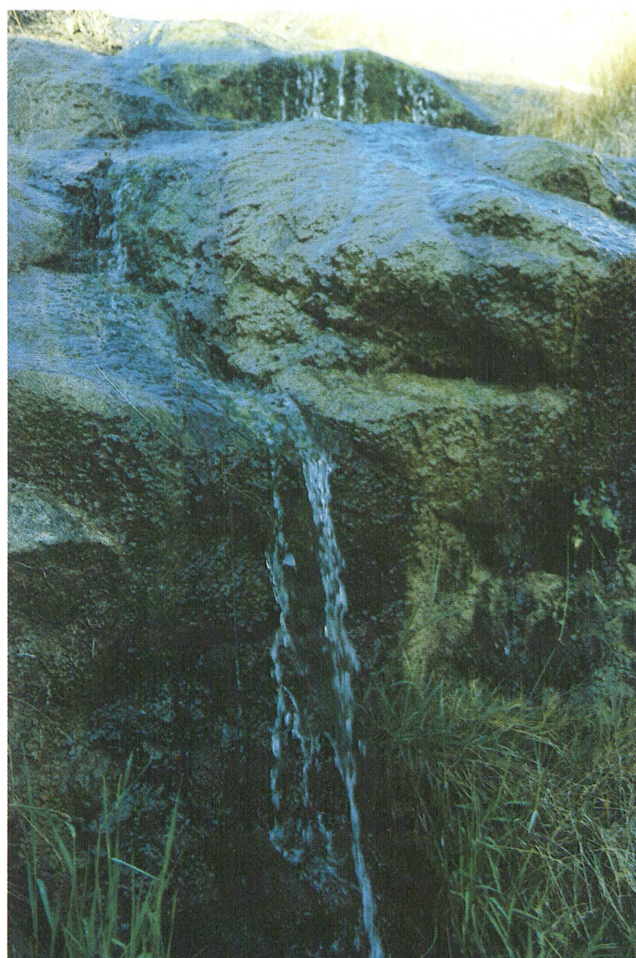
SPRINGS & GROUNDWATER



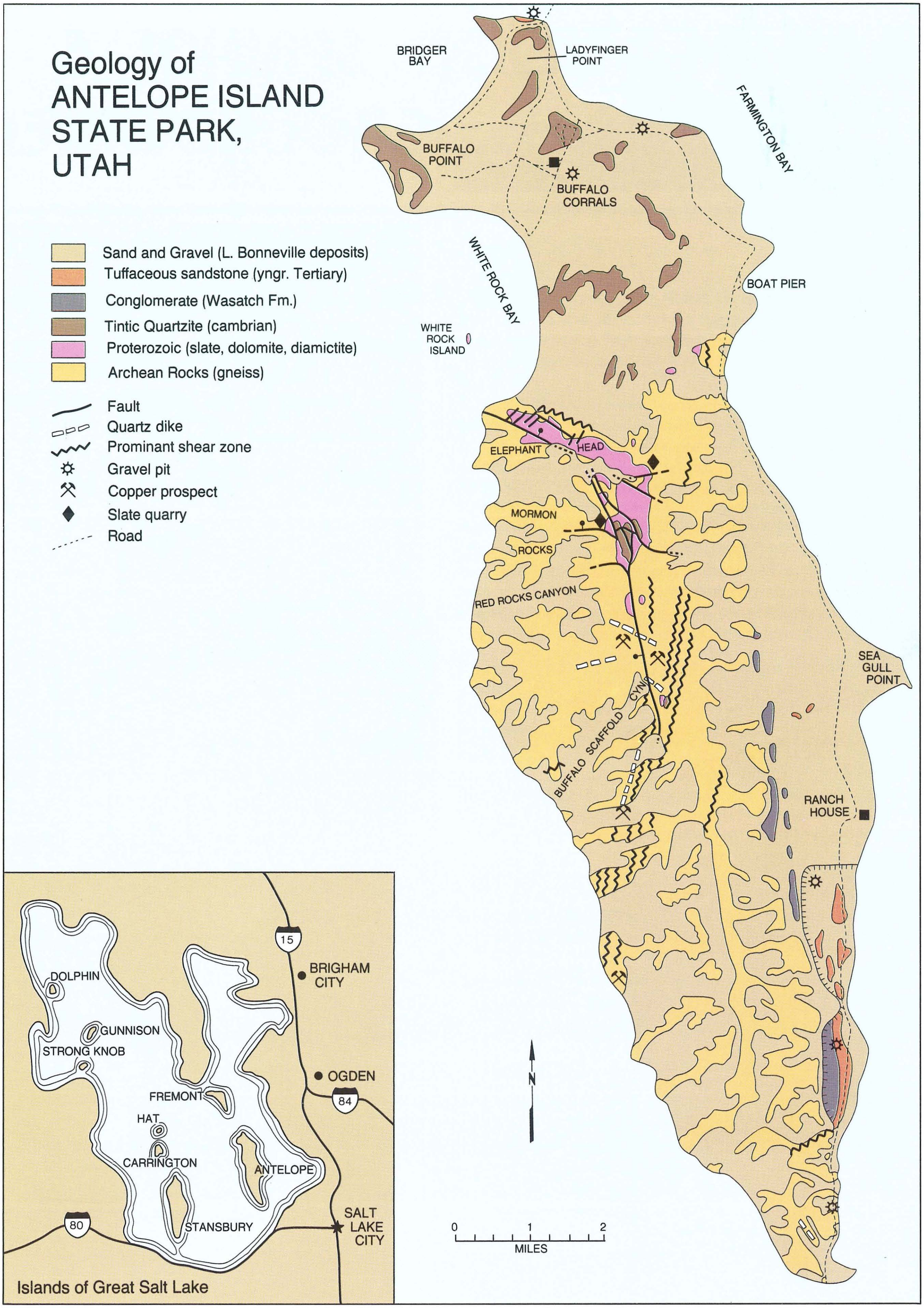
Plot of sodium versus chloride ion concentrations showing higher amounts in Antelope Island water.

Antelope Island has numerous springs that flow from rock and surficial deposits primarily on the east side of the island. Many of these ground-water discharge points are at low elevations around the periphery of the island and are submerged when the lake level is high. Other islands in Great Salt Lake have little or no ground water discharging at the surface.

Major springs are generally above an elevation of 4,400 feet on the east side of the island. These springs are thought to be locally recharged at higher elevations by rain and snow infiltrating lacustrine and alluvial deposits as well as highly fractured and jointed bedrock. The basic chemical quality of these springs is good. Comparison with water emanating from similar bedrock in the Wasatch Range shows that sodium and chloride ion concentrations are greater in the springwater of Antelope Island. This suggests that storms passing over Great Salt Lake and the Great Salt Lake Desert provide precipitation that recharges the springs with higher than normal concentrations of sodium and chlorine ions.



Blackburn spring on the southern end of Antelope Island.


Geology of
ANTELOPE ISLAND
STATE PARK,
UTAH
Sand and Gravel (L. Bonneville deposits)
Tuffaceous sandstone (yngr. Tertiary)
Conglomerate (Wasatch Fm.)
Tintic Quartzite (cambrian)
Proterozoic (slate, dolomite, diamictite)
Archean Rocks (gneiss)
Fault
Quartz dike
Prominant shear zone
Gravel pit
Copper prospect
Slate quarry
Road
BRIDGER BAY
LADYFINGER POINT
FARMINGTON BAY
BUFFALO POINT
BUFFALO CORRALS
WHITE ROCK BAY
WHITE ROCK ISLAND
BOAT PIER
ELEPHANT HEAD
MORMON ROCKS
RED ROCKS CANYON
BUFFALO SCAFFOLD CYN.
SEA GULL POINT
RANCH HOUSE
N
0 1 2
MILES
Islands of Great Salt Lake
DOLPHIN
GUNNISON
STRONG KNOB
FREMONT
HAT
CARRINGTON
ANTELOPE
STANSBURY
15
84
80
BRIGHAM CITY
OGDEN
SALT LAKE CITY