PLANETARY SURFACE ANALOGS IN THE DRY VALLEYS, SOUTH VICTORIA LAND, ANTARCTICA. Everett K. Gibson, Jr., Geochemistry Branch, NASA-JSC, Houston, TX.

Field studies in the Dry Valleys of Antarctica have shown the presence of numerous surface features and processes operating which are analogous to those observed on other planetary bodies--namely, Mars and the icy satellites of Jupiter. The environment of the Dry Valleys have been recognized as very unique since their discovery during the International Geophysical Year (1956-1957), and only reconnaissance studies were carried out at that time (1). Since then, extensive studies have been carried out in the valleys. The Dry Valleys are the Earth's coldest and driest desert and were previously believed to have implications for the Mars biological program (2). The Dry Valley system of southern Victoria Land comprises an area of several thousand square kilometers that is blocked by the Transantarctic Mountains from the flow of glaciers from the polar plateau (Fig. 1) The mean annual air temperature is -20 to -25°C, although the surface may reach temperatures of 10°C for short periods of time in the late summer (3). The ground is underlain by permafrost which is found at depths from a few centimeters to over a meter, depending on the elevation, proximity to lakes and glacial melt, valley orientation, and other factors determining the overall degree of desiccation of the location. During the summer months, diurnal cycles of freezing-thawing occur, depending upon the amount of radiation the area receives. The meager annual precipitation is in the form of snowfall (mean of 15 gm/cm^2/yr) (2). No rainfall has ever been recorded or observed in the Dry Valleys. Because of the low relative humidity of the valleys, the snow sublimes without visibly wetting the ground. The low relative humidity is caused by the katabatic winds that blow from the polar plateau down the valleys. Surfaces are covered with ventifacts and wind-sculptured pebbles, rocks, and ridges, which attest to the strength of the winds.

Evidence exists that the Dry Valleys have been drying out for thousands of years (4). Numerous saline ponds and lakes are present throughout the region and are believed to be fed by glacial meltwater. These bodies have no drainage and water-loss is by evaporation or sublimation. Lakes and ponds are generally frozen year-round except for melting around their edges and inlets during late summer. The only exception is Don Juan Pond in the South Fork, Wright Valley, which remains unfrozen because of its high salt content (5). Salt crusts are found throughout the Dry Valley system. The most common ions are sodium, calcium, magnesium, chloride, sulfate, and nitrate (6).

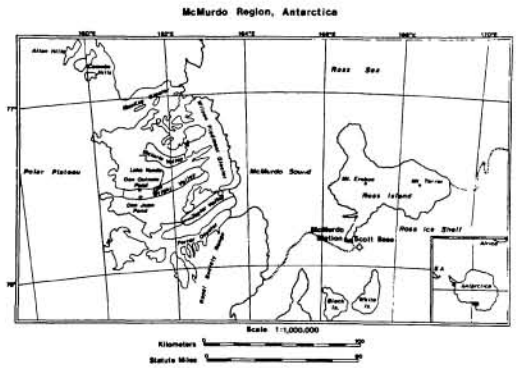

Fig. 1. Dry Valley region of Antarctica.

Viking data from Mars and Voyager photographs of Europa show features of planetary surfaces which are similar to those observed in the Dry Valleys. The flanks of Don Juan Pond are similar in appearance to the Viking 2 landing site (Figs. 2 and 3) (7,8). A boulder field with evaporite regions between the rocks is present at each location. However, the source of the rocks are different in the two cases. At the Viking 2 site the boulders represent ejecta from Mie Crater (8), whereas at Don Juan Pond they result from mass-wasting from the surrounding valley walls. Duricrust as seen by Viking has been observed in the Dry Valleys and a typical example is shown in Figure 4. The Dry Valley duri-

Fig. 2. Don Juan Pond, Wright Valley, Antarctica.

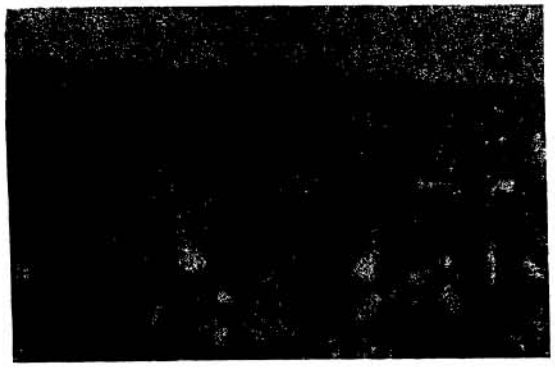

Fig. 3. Viking 2 landing site, Mars.

crust is only 1 to 5 mm thick and results from the cementation of surface soil layers by salts which have been deposited by percolating water as it moves toward the surface prior to evaporation. Salts remain after evaporation and act as a sealant to the tops of the soils. Aeolian action produces the abrasion and removal of the salts at the edges of the duricrust. Often, beneath the surfaces, larger salt deposits are present (Fig. 5) as seen from trenches dug near evaporite ponds (6).

One of the most striking features present in the Dry Valleys which may be analogous to the icy surfaces of satellites is the ice-covered lakes and ice shelf near the entrances of the Dry Valleys. The fracture patterns, grooves, and individual ice units are similar in appearance to features observed on Europa (9). Lake Vanda, Wright Valley, is permanently frozen and has an ice cover of approximately 3 meters. The surface of the lake is fractured and grooved (Fig. 6). The edges of the lake show evidence where the ice has moved onto the shore because of expansion. The surface fractures have served as traps for sand grains. Because the sand grain's heat absorbing properties, the ice has melted around the sand grains and the winds evaporate the water. Thus, the crack is enlarged and the process is repeated numerous times resulting in fractures up to 1 to 10 cm in width, up to 0.5 meters in depth, and up to several hundred meters in length. Another unusual ice formation is found on the Ross Ice Shelf's edge where the old ice has become trapped by the new ice. The old ice blocks with their unusual angular shapes are surrounded by the new ice (Fig. 7). The features are analogous to situations which may have operated on the low density icy satellites. It is very clear that the Dry Valleys of Antarctica represent one of the best terrestrial laboratories in which to study certain planetary surface processes.

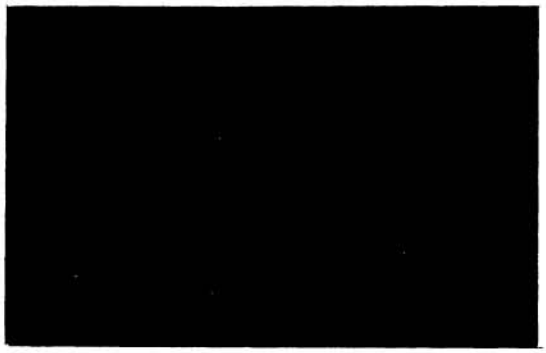

Fig. 4. Duricrust, Don Quixote Pond, North Fork, Wright Valley, Antarctica.

Fig. 5. Soil trench, Wright Valley. Note salt-rich layer below surface.

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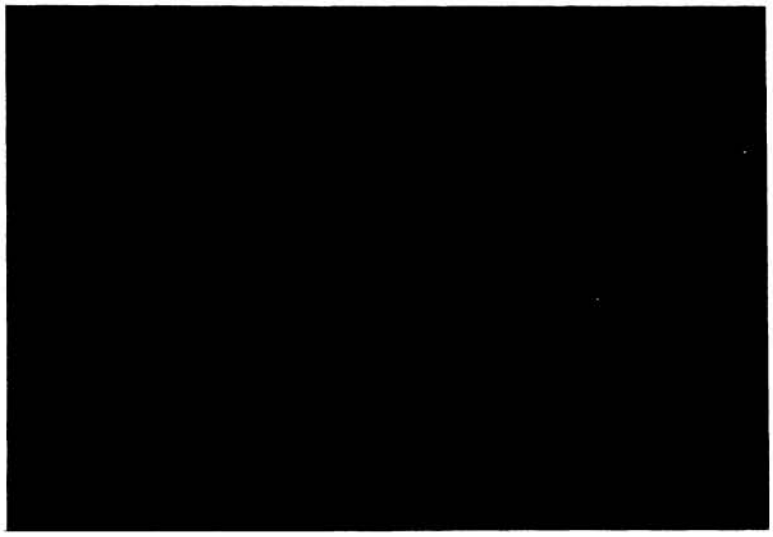

Fig. 6. Frozen surface of Lake Vanda, Wright Valley. Note fractures. Edge of lake at top and bottom of photo. New ice appears dark in color, new ice light. View from helicopter--1000 ft. elevation.

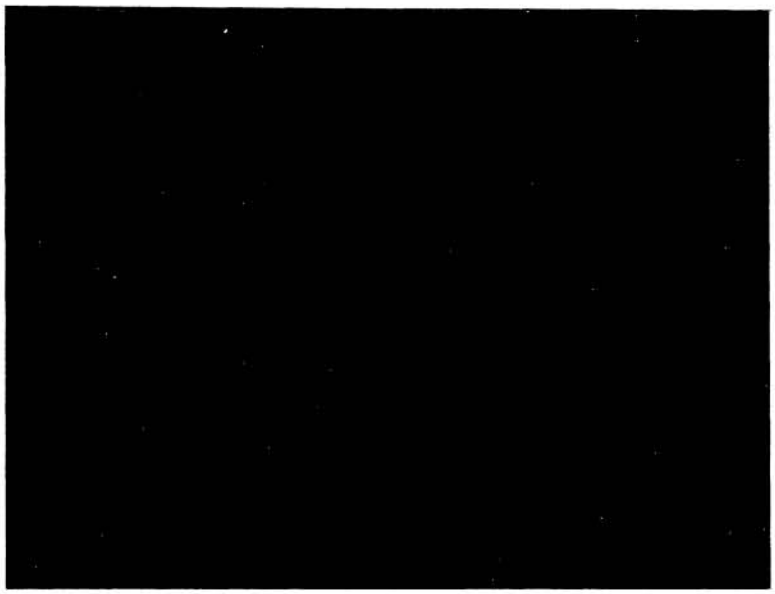

Fig. 7. Old ice trapped by newly formed ice at entrance to Taylor Valley, Antarctica. View from helicopter--1000 ft. elevation.