Life in the Atacama Project Workshop

Geology Ground-Truth Report
July 28-30, 2003

*NASA Ames, **UCN
Site Selection Timeline

- November 2002: ASTEP Selection
- March 4-10, 2003: Ground-Truth Team in Chile
  - Edmond Grin (NASA ARC)
  - Nathalie Cabrol (NASA ARC)
  - Hans Winkle (UCN)
- March 28, 2003: Ground-Truth Report to Technology Team
- April 2003: First Rover Field Campaign
Activities associated to Ground-Truth and Site Selection

- Selection among a variety of possible sites (4)
- Acquire GPS Data for Digital Elevation Model
- Characterize the site for:
  - Geology
  - Habitats and Life
  - Trafficability Potential
- Establish topographic profile (science & trafficability)
- Report for Technology and Field Science Team
## Contribution to the DEM Model

<table>
<thead>
<tr>
<th>Lmk No.</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Elevation (ft)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20°53'053S</td>
<td>70°02'656W</td>
<td>2154</td>
<td>Main Mine Road Junction</td>
</tr>
<tr>
<td>2</td>
<td>20°54'762S</td>
<td>70°01'122W</td>
<td>2170</td>
<td>Road facing ridge</td>
</tr>
<tr>
<td>3</td>
<td>20°54'976S</td>
<td>70°00'641W</td>
<td>2294</td>
<td>Topographic Marker on top of butte</td>
</tr>
<tr>
<td>4</td>
<td>20°56'271S</td>
<td>70°01'063W</td>
<td>2242</td>
<td>Road junction to small mine (salinas Muffeler)</td>
</tr>
<tr>
<td>5</td>
<td>20°56'966S</td>
<td>70°00'805W</td>
<td>2145</td>
<td>Dark rectangle</td>
</tr>
<tr>
<td>6</td>
<td>20°57'382S</td>
<td>70°01'223W</td>
<td>2287</td>
<td>Primary landing site</td>
</tr>
<tr>
<td>7</td>
<td>20°57'381S</td>
<td>70°01'243W</td>
<td>2300</td>
<td>Base of &quot;Pampa Nevada&quot; Butte</td>
</tr>
<tr>
<td>8</td>
<td>21°13'938S</td>
<td>70°01'122W</td>
<td>2170</td>
<td>South Salar Grande</td>
</tr>
</tbody>
</table>
DEM: Topographic Context for Science

8/24/2003 Life in the Atacama
Support Trafficability Assessment (rock distribution and smaller-scale topography)
Landing Site Location

Site needed to combine following criteria:

• Be on the Eastearn side of Coastal Range and allow a South/North (→) transect by the rover;
• Allow rover traverses for both science and technology
• Show geological and biological diversity to allow calibration of science instruments;
• Allow life and habitats characterization;
• Include the potential for genuine discoveries about life in the Atacama Desert.

So...
Landing Site Location
Site Location

- General: West Salar Grande de Atacama, Chile;
- “Humid Zone” of Atacama. Fog region
- Specific: Transition between Coastal Range and Salar Grande;
- 50 km south of Iquique, North Chile;
- Site Location:
  Lat: 20°57’382S
  Long: 70°01’223W
  Elevation: 750 m
- Name: “Pampa Nevada” (after a nearby mountain name)
Views from “Landing Site”: Pampa Nevada
Geological Setting, General:

• Landing site at transition between Coastal Range and Salar Grande;

• Contact between Cretaceous volcanic material and Jurassic marine sedimentary butte.

• Layering in Pampa Nevada is tilted (~35°) showing the tectonic push from the West;

• Massive salt is extruding in place both in the volcanic and sedimentary material. At landing site, not commonly associated with crystallized gypsum whereas this association is extremely common in the salar.
Geological Setting, General (cont.)

- Alluvial fan material is in general fine-grained, mud-like and cover by a thin crust of gypsum. It is light tone, made of small (~5 cm) polygons;
- Volcanic material is made of lava, lava filling -- quartz pellets-- and pyroclasts.

Structure

- A main fault cuts through Pampa Nevada.
- Large faults cuts through Salar Grande
- Several smaller systems run N/S and NE/SW
### Sketch Stratigraphy (large temporal-scale)

Salar: 160 m deep salt deposit, 50 x 8 km Pull-Apart basin. 1.1 km vertical displacement in past 28 Myr.

<table>
<thead>
<tr>
<th>Time (BP)</th>
<th>Layer</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 1M</td>
<td>AFd</td>
<td>• Salar Grande and Massive salt outcrops</td>
</tr>
<tr>
<td>~28M</td>
<td>MSo</td>
<td>• Alluvial Fan deposits</td>
</tr>
<tr>
<td>~100M</td>
<td>CVd</td>
<td>• Cretaceous Volc. Dep.</td>
</tr>
<tr>
<td>~150M</td>
<td>JMd</td>
<td>• Older Jurassic Marine Sediment.</td>
</tr>
</tbody>
</table>

Tectonic is active. Sets of fault are relatively recent and cut through Salar Grande.
Site Morphology

- **Desert pavement**: gravelly to blocky material of volcanic andesitic origin. Contains angular clasts (brownish to red); Round orange quartz pellets corresponding to lava gas holes filling material. Quartz seems to be coated by an orange (chalcedoine) material.
Site Morphology

- **Hill Material:** light color, sedimentary in origin. Pampa Nevada limestone. Other: Metamorphic.
Site Morphology

- **White salt areas:** associated with hard, cemented grey material. Salt (halite, ahydrite, gypsum) at the contact with limestone at Pampa Nevada is covered with a thin 5mm layer of green material that penetrates salt. The color can vary from bright green to brownd-red or yellowish. These tones occur only near Pampa Nevada. Massive salt deposits are often accompanied by crystallized gypsum. Typical area: Salar Grande.