

A Proposed Geotechnical GIS for Lunar Exploration



Leon Croukamp
Council for Geoscience
South Africa

South African Space Agency

- The South African Space Agency was formed a little over a year ago and the Bill was ratified by Parliament on 7 December 2007
- This make SA probably the newest kid on the block
- One small telecomms satellite had been launched in collaboration with Europe
- Second small comms satellite being constructed and launch vehicle in design stage
- New Geodesy site in development with LLR, SLR, VLBI and other geodetic co-located instruments – part of SKA, SALT and meerKAT

IAC, 2011, Cape Town, SA

- Funding from DTI and DST
- Coastal City with “interesting” weather
- 200 + vineyards: Cabs, Merlot, Chardonnay, etc
- Excellent “Method de Cap Classique” champagne....
- Unbelievable scenery
- Whale-watching time
- “Shark-Diving” for the less faint-hearted – beats bungee-jumping any day !

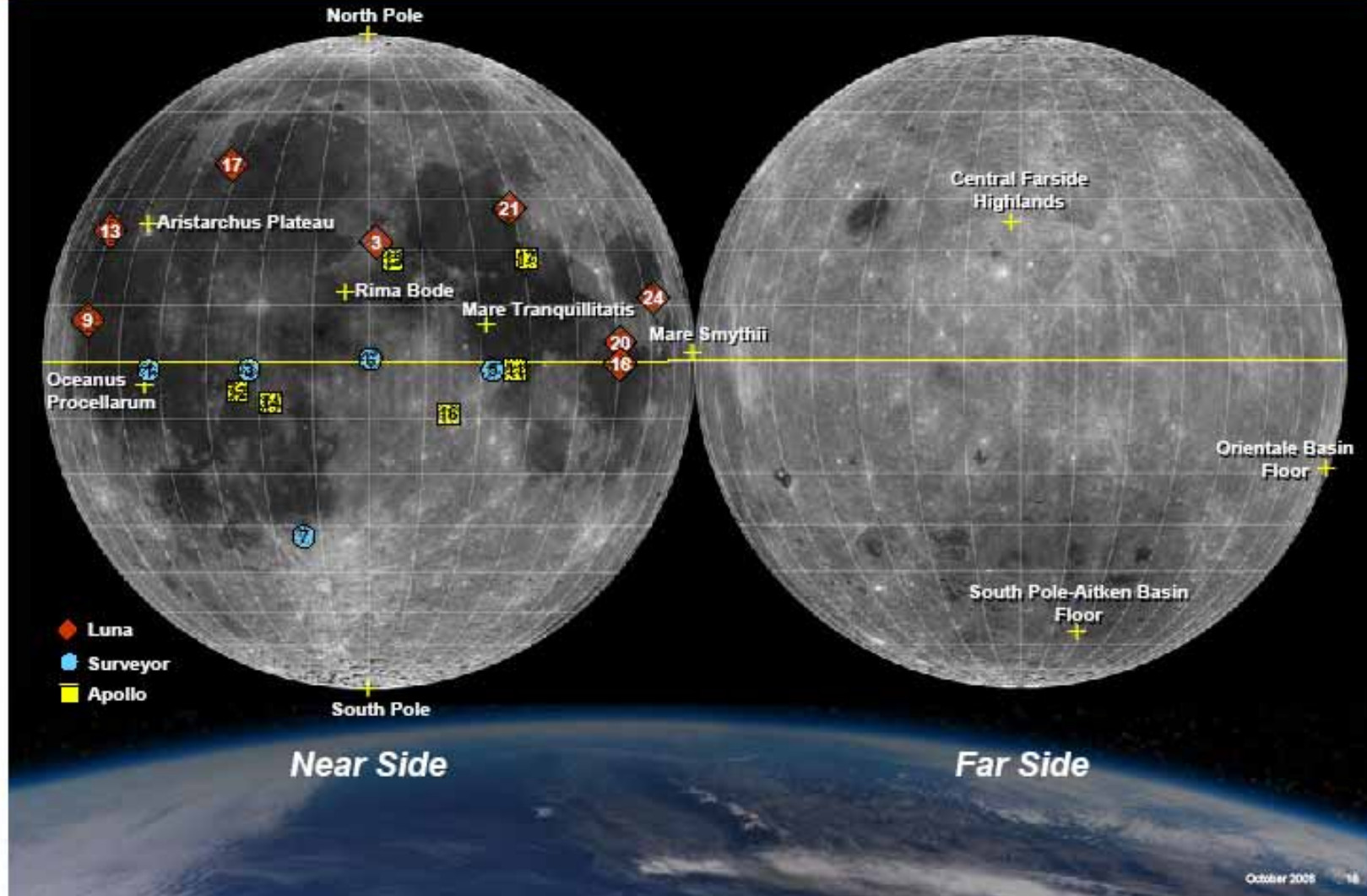
Data Collection & Integration



- Vast amounts of data had already been collected and more in the process of collection.
- Individual datasets can be analysed for optimal research of one aspect
- Integrating all datasets into one GIS can help in optimising target generation, assessment and best possible route of travel



High Priority Lunar Exploration Sites

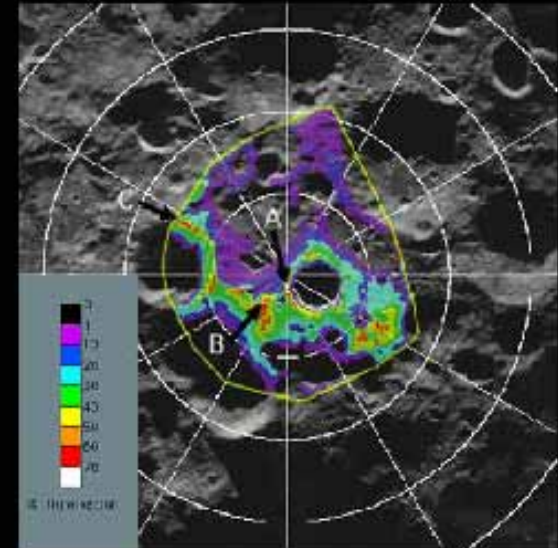




Possible South Pole Outpost



- ◆ **The lunar South Pole is a likely candidate for outpost site**
- ◆ **Elevated quantities of hydrogen, possibly water ice (e.g., Shackleton Crater)**
- ◆ **Several areas with greater than 80% sunlight and less extreme temperatures**
- ◆ **Incremental deployment of systems – one mission at a time**
 - Power system
 - Communications/navigation
 - Habitat
 - Rovers
 - Etc.



Lunar Geotech experiments



- Stem auger
- Failure of equipment (David Scott)
- Rock samples
- Bearing capacity (depth of LEM footpads)
- Mobility – photos, walking, Lunar Rover
- Selene television data

Existing data

- Lunar Orbiter
- Clementine
- LPI data
- USGS geological maps
- Selene
- Chandraan ?




Questions to be answered

- What do we know ?
- What do we need to know ?
- What can be determined from Earth ?
- Is earth-base observatio with current technology still viable ?
- What can be determined on the moon or near-surface observation ?

Principles of GIS

- Different layers of data
- Mostly “intelligent” data (each polygon contains several attributes with values)
- Raster images
- “Intelligent” Raster images (each square contains values for attributes)
- Stack, merge, union data sets
- Pose “questions” to datasets (Boolean, etc)

Envisaged data Layers

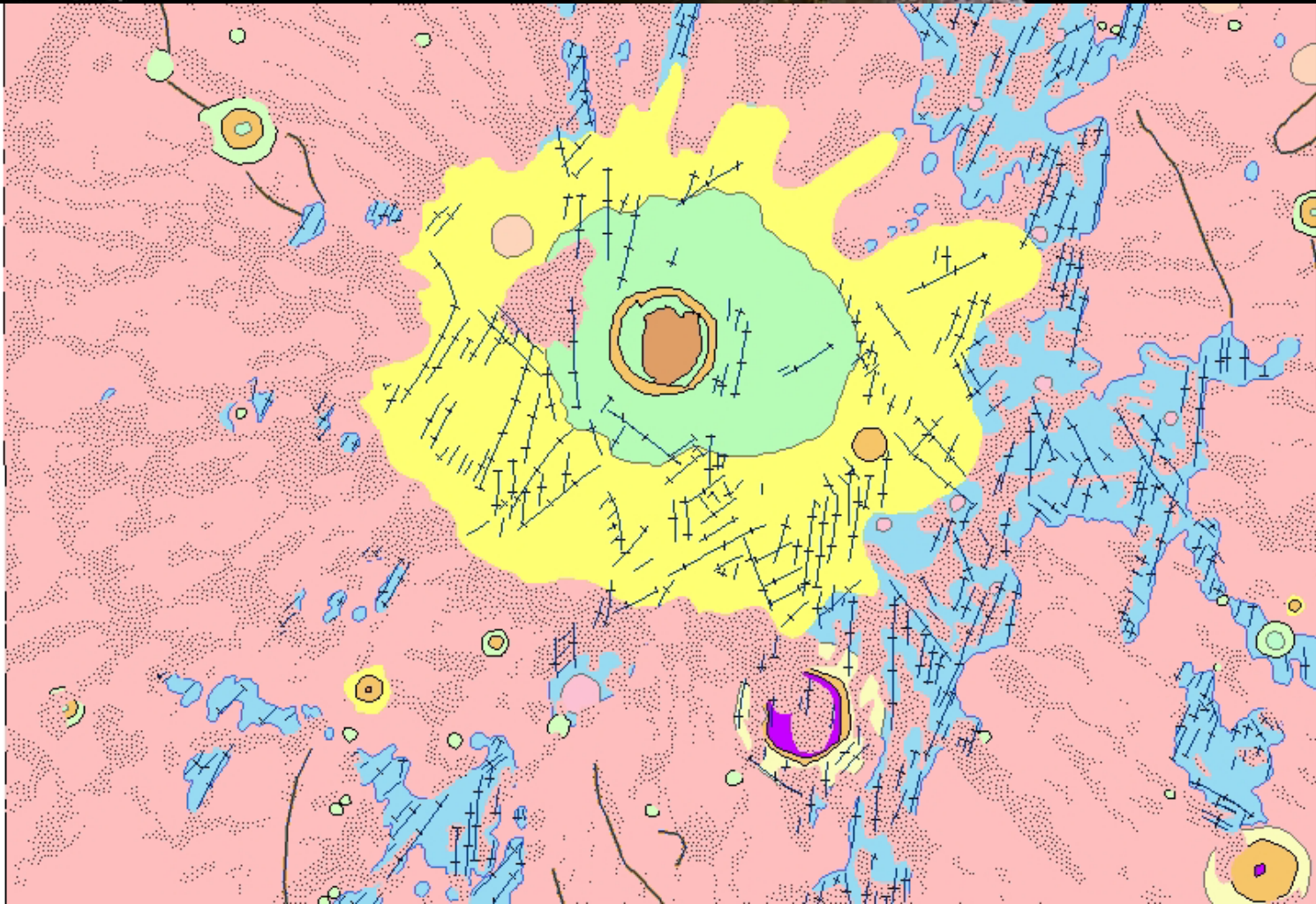
- Surface roughness (Boulder size, Ray areas, etc)
 - Geology
 - Geotechnical properties
 - Perpetual shadow ice ?
 - Slope angle
 - Slope aspect
 - Mineralogy
 - He3 abundance
 - Manoeuvrability
 - Fuel/energy cost
 - etc
- 

Habitation

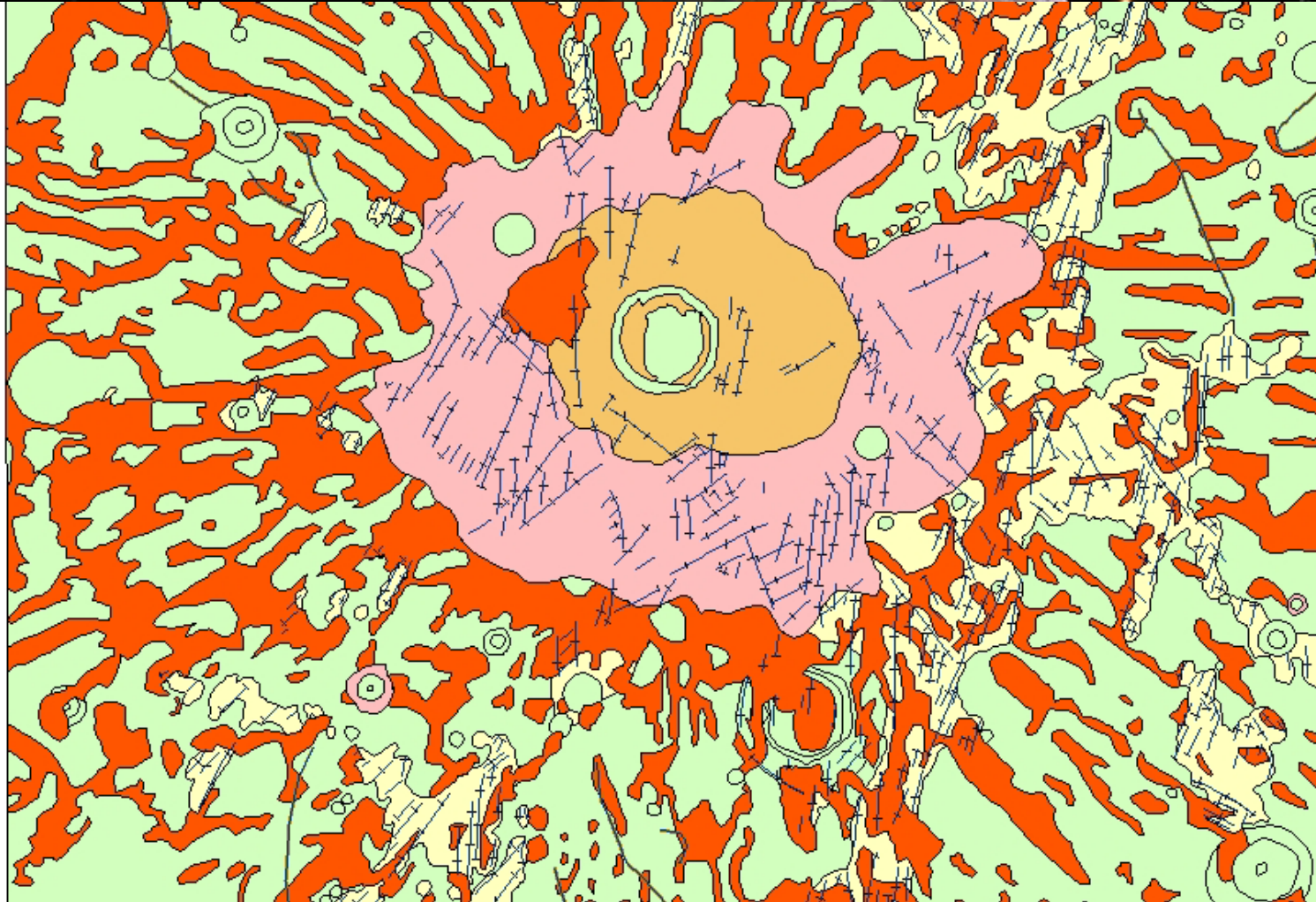


- Excavatibility
- Bearing capacity
- Air tightness
- Construction materials
- Material needed from Earth
- Lunar fabricated materials
- Distance/Fuel/cost of delivery
- etc

Geology

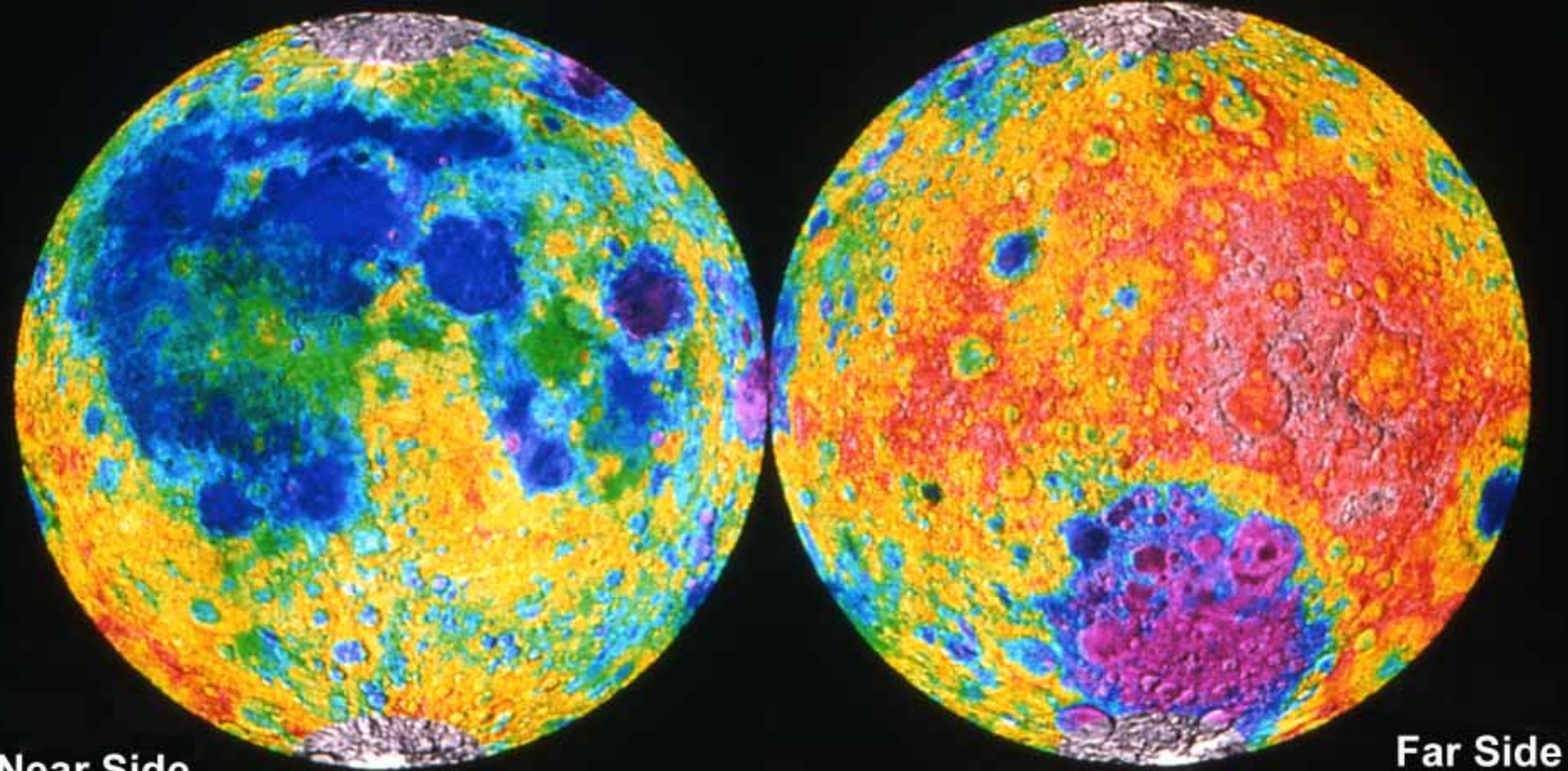


Surface Roughness (based on geological formation)



Clementine Topographic Map of the Moon

Equal-area projection



Near Side

Far Side

-8

-4

0

+4

+8

kilometers

GIS as Decision Making Tool

- Use of these data layers in combination or separately and posing different questions could help in the finding of new resources and also contribute to find the best (least-cost) route to these resources and places of exploration.
- In essence a manoeuvrability map will be the end result but also it would constitute a decision making tool determining the least-cost path once a mission objective is decided upon.
- This should be augmented from onboard visual instrumentation for on-the-spot- decision making in travel path

THANK YOU



Make every
second count



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