USING GIS (GEOGRAPHIC INFORMATION SYSTEM) TECHNOLOGY TO ASSESS THE RESOURCE POTENTIAL OF LUNAR PYROCLASTIC DEPOSITS

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INTRODUCTION

Analyses of the lunar pyroclastic deposits can help address two major science theme strategies put forth by LExSWG: to better understand the formation of the Earth-Moon system, and the thermal and magmatic evolution of the Moon (LExSWG, 1992). To better visualize the interrelationships and assess the resource potential of the lunar pyroclastic sites, I have combined data collected from a variety of sources to generate a series of computer-based geographic information systems (GIS) for the major lunar pyroclastic sites; *Lunar Pyroclastic GIS*. An example of one data package is discussed here for the Taurus Littrow/Apollo 17 region of Mare Serenitatis.

What is a GIS?

A GIS is a computer system capable of capturing, storing, analyzing and displaying geographically referenced information in two or more dimensions (Fig. 1). A GIS package acts as both a data collator and spatial analyzing system, allowing one to easily query the entire set of spatially-registered data (e.g., local topography, sample sites, Apollo EVA 'roadmaps', photography at various resolutions and spectral ranges, telescopic spectra, sample chemistry, soil color and other available data). Each type of data is stored as a separate, 'transparent' data layer, allowing a wide variety of spatial analyses. This greatly enhances our ability to identify and further investigate underlying relationships and trends which may otherwise be difficult to recognize. Once completed, one can easily answer such queries as: How do the size and location(s) of the source vent(s) compare to the size of the deposit? How does the composition/spectra vary within a deposit? How does one deposit compare to another? Often, when all available data are included in a GIS, relationships that were never before envisioned become apparent. The potential of a GIS is only limited by the data available and one's imagination. Several computer programs were used to create and compile these GIS packages including ArcInfo, ArcView and Dimple.

Lunar Pyroclastic Deposits

Explosive volcanic, or pyroclastic, materials are unique phases in the lunar soils and are important as they hold clues to the history of lunar volcanism. Pyroclastic glasses, among the most primitive of lunar rocks, directly sample depths as great as 400 km (Delano, 1986). Earth-based telescopic studies have provided most of our information concerning lunar pyroclastic deposits. Combined with the returned lunar sample studies, recent telescopic data, and analyses of lunar photography, researchers continue to gather new information on the nature and origin of these explosive volcanic materials (Coombs, 1995; Coombs and Hawke, 1995). Based on their unique spectral signatures, two major classes and five subclasses of these deposits have been identified. Regional deposits are more numerous, extensive, thicker, and widely distributed than previously thought, leading us to suggest that they may exhibit distinct compositional variations and that they would provide ideal resource materials for a lunar base (e.g., Coombs, 1988; Hawke et al., 1989; Coombs and Hawke, 1995). Returned sample studies and the recently collected Galileo and Clementine data also corroborate these findings (e.g., Greeley et al., 1993; McEwen et al., 1994).

Example: Taurus-Littrow/Apollo 17

Located in the southeastern portion of Mare Serenitatis, the Taurus Littrow dark mantle deposit covers more than 4,000 sq. km. and varies in thickness from 10 to 30 m. This deposit is uniformly fine-grained and friable, offering a feedstock which reacts rapidly and can be used with little or no processing. Laboratory analyses of iron-rich samples represented by the orange glasses collected at this site yielded the highest percentage of oxygen of any lunar sample supporting its potential as an excellent resource material (e.g., Allen et al., 1994; Allen and McKay, 1995). Such a pyroclastic deposit could be a prime candidate for a future lunar oxygen plant, particularly with the high FeO abundance.

Coombs C.R.: Lunar Pyroclastic GIS

To further determine the potential of this resource deposit, a GIS was generated to facilitate data analysis and comparison. Data layers in this GIS package inlcude Apollo, Lunar Orbiter, and Ranger photographs and the more recent multispectral images, topographic, geologic and EVA maps, UV-VIS, near-IR and multispectral reflectance, 3.8- and 70-cm radar data and returned sample laboratory analyses as well as soil color and mophometric data. Although still in its infancy, the Taurus-Littrow GIS has permitted better visualization of the relationship(s) between deposit extent, sample locations and compositional variation. When completed, the Lunar Pyroclastic GIS will permit comparisons between the different pyroclastic deposits and expedite their evaluation as a potential resource.

References

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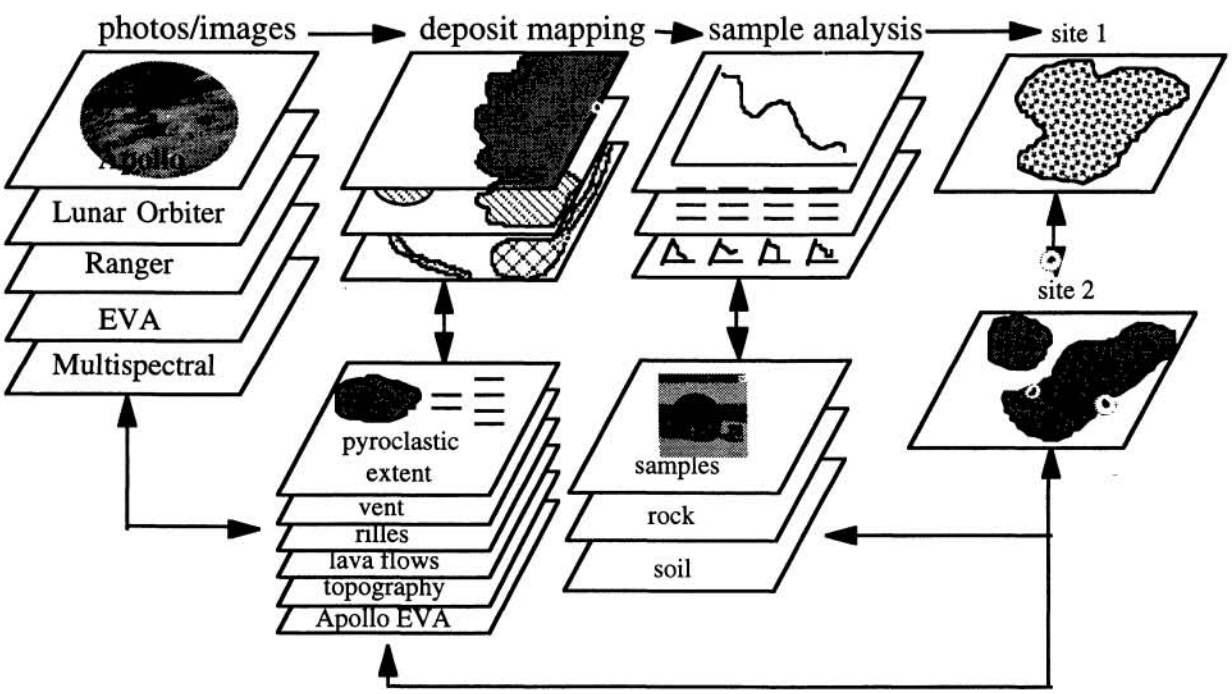

Figure 1: A schematic of a geographic information system (GIS) for a lunar pyroclastic deposit. Transparent data layers are user defined and may be combined in a variety of ways to provide the best assessment and visualization possibilities for a particular query.