

**GEOLOGIC MAP OF CALLISTO;** K. C. Bender and R. Greeley, Department of Geology, Arizona State University, Tempe, Arizona 85287-1404, J. W. Rice, Jr., Department of Geography, Arizona State University, Tempe, Arizona 85287, D. E. Wilhelms, Hyde St., San Francisco, CA 94109

A 1:15M scale photogeologic map of Callisto, the second largest and outermost Galilean satellite of Jupiter, has been completed (Figure 1). Callisto's density of  $1.86 \text{ g/cm}^3$  suggests a high proportion of water-ice to silicates. The satellite's geology is surprisingly simple for a body 4840 km in diameter. Most of it is mapped as an apparently uniform geologic unit (ctu) on which only 128 craters >60 km across and seven multi-ring features are superposed. This paucity of large craters is very unlike the crater size-frequency distribution on the terrestrial planets, and may reflect impacts by comets and not asteroids [1].

Each of the two largest multi-ring features, the younger [2] ~1100 km Valhalla and the ~700 km Asgard, possess an inner palimpsest (units vi, ai), which probably represents the relaxed transient impact crater, and an outer concentric deposit (units vo, ao), which probably consists of ejecta. These Valhalla and Asgard Formations are less densely cratered than the cratered terrain (unit ctu) [3]. Structural symbols trace ring arcs surrounding these deposits and five smaller rings features that lack mappable deposits. Isolated light plains interpreted as palimpsests (unit lp) probably mark additional impact sites. Some crater chains (catenae) may have been created by the impact of disrupted comets like Shoemaker-Levy 9 [4], and others by the secondary impact of ejecta from a visible or nearly vanished (palimpsest) impact site.

The only unit considered endogenic forms small, elongate, smooth patches (unit sp), light toned at the bases of some scarps NE of Valhalla and dark toned within the cratered terrain (unit ctu). Water or slurry probably rose in response to disruption of the crust by the Valhalla impact [3,5,6,7].

The map probably portrays a generally ancient surface. Impacts are thought to have created Valhalla and Asgard about 4 b.y. ago [2], and the same is probably true of the isolated palimpsests (unit lp) and most of the craters (units c1 and c2). Only rayed craters (unit c3) and possibly the smooth plains are likely to have formed during the last 3 billion years.

This map has been used to aid in planning the Galileo imaging targets for Callisto. Within the constraints of the selected tour and the sharing of resources among various instruments, the following targets are candidates for imaging by the Galileo SSI: a) Valhalla, at high resolution (~50 m/pxl); b) Asgard, at moderate (1 km/pxl) and high (~100 m/pxl) resolutions; c) Adlinda and the ring feature NW of it at moderate (1 km/pxl) resolution; d) a scarp NE of Valhalla with smooth plains material at high (~100 m/pxl) resolution; e) a number of sites within the cratered terrain at high resolution; f) filling Voyager gaps (at Voyager or better resolutions) at 300°W longitude, SW of Valhalla, and portions of the South Pole.

**References:** [1] Chapman, C.R. and McKinnon W.B.(1986) in *Satellites*, Burns, J.A. and Matthews, M.S. eds, Univ. Ariz. Press, 548. [2] Passey, Q.R.(1982) Ph.D. Diss., Caltech, 89. [3] Remsberg, A.R.(1981) *LPSC Absts, XII*, 874. [4] Melosh, H.J. and P. Schenk (1993) *Nature*, 365 (in press), 735. [5] Melosh, H.J.(1982) *JGR*, 87, 1880. [6] Stooke, P.J.(1990) *LPSC Absts, XX*, 568. [7] Schenk, P.(1992) *EOS*, 73, 179.

## DESCRIPTION OF MAP UNITS

### Plains Materials

- (sp) Smooth plains- small mostly elongate patches. Light and dark albedo and lower crater frequency than surrounding terrain. *Interpretation:* Ice extruded from interior
- (lp) Light plains- elliptical or circular patches. Higher albedo and usually lower crater frequency than surrounding terrain. *Interpretation:* palimpsests originating by the viscous relaxation of a transient impact crater
- (ctu) Cratered terrain, undivided-most heavily cratered unit. Average albedo 0.2. *Interpretation:* ancient crustal materials, consisting of ice and rock/dust, brecciated by extensive impact cratering

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Valhalla Formation

- (vi) Inner facies- bright elliptical patch lacking structure. *Interpretation:* palimpsest like those of unit lp
- (vo) Outer facies- multiple discontinuous concentric ridges. Lower crater frequency than on surrounding terrain. *Interpretation:* impact ejecta blanket

Asgard Formation

- (ai) Inner facies- bright elliptical patch. A few arcuate structures at margin. *Interpretation:* palimpsest like those of unit lp
- (ao) Outer facies- multiple discontinuous inward-facing concentric scarps. Lower crater frequency than on surrounding terrain. *Interpretation:* impact ejecta blanket

Crater Materials

Craters >60 km in diameter mapped. *Interpretation:* formed by impact, degree of degradation approximates relative age (c1 oldest to c3 youngest)

- (c3) Class three- includes crater floor, complete rim and all visible ejecta
- (c2) Class two- includes crater floor and complete rim
- (c1) Class one- includes crater floor and all visible rim
- (cc) Crater catena- includes floors and rims of craters aligned in linear chains

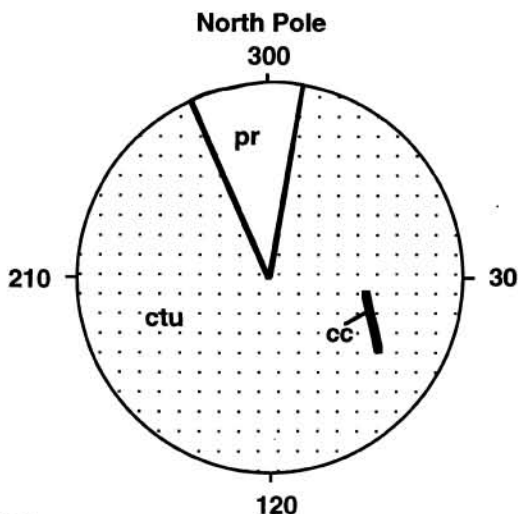


FIGURE 1  
Sketch map of Callisto Geologic Map

