USING BOUNDARY-BASED MAPS TO ILLUSTRATE THE PALIMPSEST EFFECT OF EARLY IMPACTS ON LUNAR SURFACE FORMATION.

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Purpose: We are applying the Constant Scale Natural Boundary (CSNB) approach [1,2,3] to mapping the Moon to provide additional insight on its surface formation processes.

Constant Scale Natural Boundary Mapping: The Constant Scale Natural Boundary (CSNB) mapping method produces maps that are markedly different from those produced by more traditional methods. Whereas traditional maps can be expressed as outward-expanding formulae with well-defined central features and relatively poorly defined edges [4,5], CSNB maps begin with well-defined boundaries.

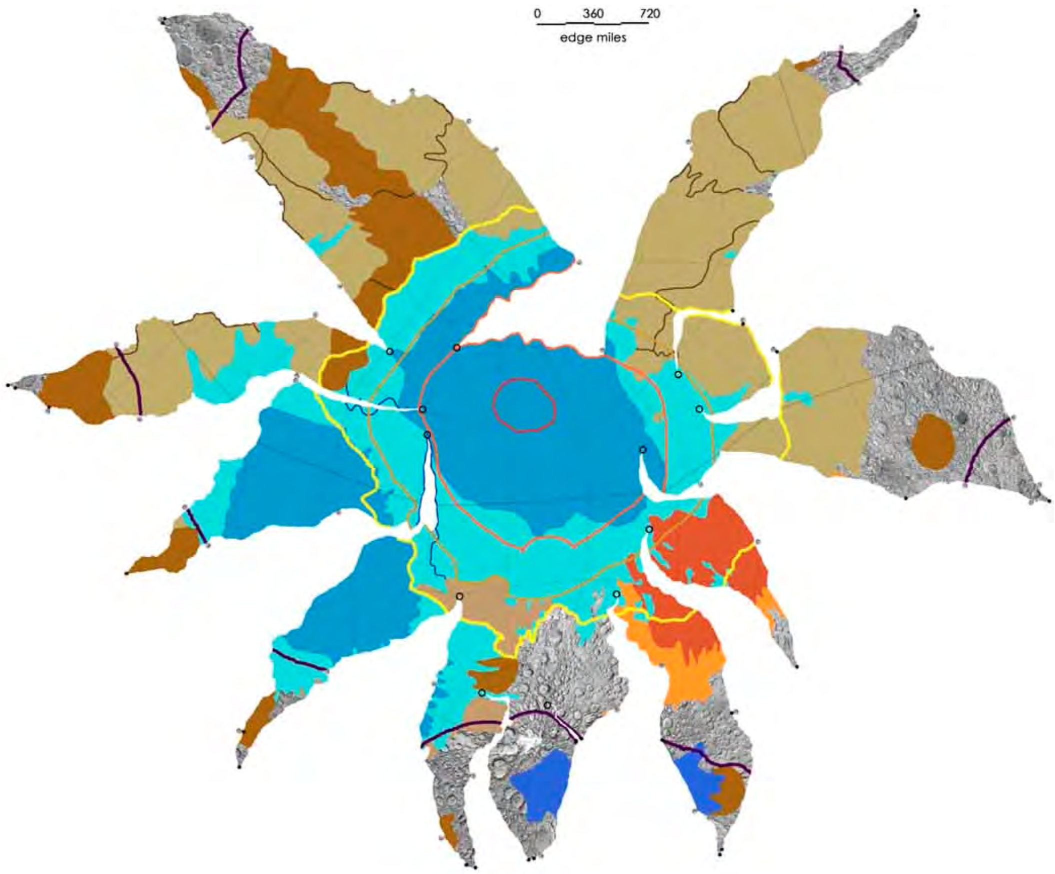
For a given body and timeframe, internal (tectonic), external (impact), or combined processes may dominate in shaping global high (ridge) or low (trough) relief surface features, which act as constant-scale boundaries or 'edges' in this approach. On an entirely impact-dominated surfaces, we would anticipate that morphological boundaries would represent radial and concentric features formed during crater formation, whereas on tectonically-driven surfaces, such boundaries would be associated with surface expression of tectonic plates or cells. When surface modification processes occur on a rapid timescale, such mapping techniques will give insight on processes shaping the most recent events. On the Moon, chiefly shaped by external processes, the impact-driven resurfacing rate has slowed down historically due to the decrease in size and frequency of bombardment. Although we can certainly observe the effect of later events which have overlapped spatially on earlier events, how much palimpsest-like influence do the larger magnitude earliest events still exert?

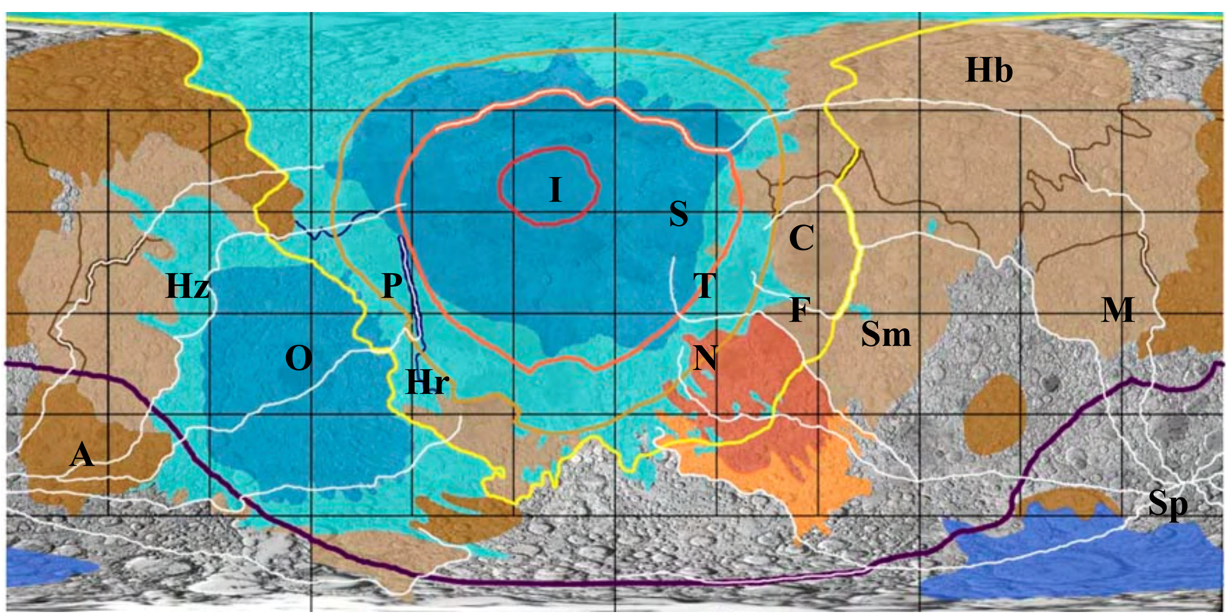
The Mother of all Impact Events: A number of workers [6,7,8,9,10] have proposed that much of the global-scale underlying structure of the nearside was shaped by a major impact event. The resulting impact feature, known as Gargantuan Basin, can still be seen as much of the continuous outline of western Oceanus Procellarum, as well as in the discontinuous mare and terra features which have patterns of distribution concentric and radial to the original basin [8]. The interior of such a basin would be anticipated to have a thinner crust, which could in fact explain the systematic (as a function of radial distance to impact center) changes in composition and age of the basalts (e.g., KREEP or Ti abundance) which subsequently erupted [11,12].

CSNB Map of the Moon: We have applied the CSNB approach to the Moon with Wilhelms earliest age multi-ring basin maps [9] superimposed on the most recent global photomosaic [13] as an underlying base map. The center of the Gargantuan basin is at the center of the map, and what is now known as the South Pole Aitken Basin, clearly antipodal to the big nearside basin, at the edge of the map. Boundaries are drawn ridges and troughs apparently radial and concentric to Gargantuan. Often these edges are reactivated and associated with later basin rings and radials, perhaps even more clearly among older materials on the farside. The thinner-crust nearside is dominated by more recent flood basalt flows. This projection allows the pattern in the global distribution of Nectarian and Imbrian deposits to be seen more clearly.

CSNB Implications for Planetary Modeling: The CSNB projection has now been used to produce global maps of bodies lying on a continuum between externally and internally driven control of surface morphology. For the Earth and Mars, representing the internally-driven end-member, ridge and trough boundaries are apparently associated with internal activity cells, thus CSNB maps allow greater understanding of, for example, the pattern of gravity and magnetic anomalies. For asteroids, representing the externally-driven end-member, irregular facet edges become boundaries of a 'splat' map and allow insight into the bombardment history. The Moon, typically mapped in an Earth-like projection, but more asteroid-like in terms of surface modification, is now 'splat' mapped to reveal the continuing influence of old, large impacts. Mapping Mars in the 'splat' fashion might also reveal the palimpsest-like influence of its proposed equivalent gargantuan basin [14].

References: [1] C.S. Clark (2002) LPS XXXIII, #1794; [2] C.S. Clark (submitted) Mars Informatics; [3] P.E. Clark and C.S. Clark (2005) LPS XXXVI, #1423; [4] Krantz (1999) American Scientist, 84, 436; [5] Stooke, http://www.ssc.uwo.ca/geography/ spacemap/contents.htm [6] Cadogan (1974) Nature, 250, 5465, 315-316; [7] Whitaker (1981) Proc LPSC 12A, 105-111; [8] Wilhelms (1982) NASA TM 85127, Reports of the Planetary Geology Program; [9] Wilhelms (1987) USGS Prof Paper 1348; [10] Wilhelms (2005) personal communication; [11] P.E. Clark (1985) Lun Plan Sci XVI, 137-138; [12] P.E. Clark and L.A. McFadden (2000) JGR Planets, 105,4291-4316; [13] Hamilton, http://www.solarviews.com/cap/moon/ moonmap.htm; [14] Wilhelms and Squyres (1984) Nature, 309, 138-140.





Blue Imbrian	I Imbrium S Serenitatus T Tranquillitatis N Nectaris F Fecunditatis	C Crisium Sm Smythii Hb Humboldtianum P Procellarum Hr Humorum	O Orientale H Hertzsprung M Mendeleev A Apollo Sp S. Pole/Aitken	Brown Nectarian