VENUS MESOLAND HEAT TRANSFER PROCESSES AS RECORDED AT INARI CORONA. V. L. Hansen[1] and S. B. Mahoney[1], [1]Department of Earth and Environmental Sciences, University of Minnesota Duluth, 1114 Kirby Drive, Duluth, MN 55812, USA (vhansen@d.umn.edu; mahon230@d.umn.edu).

Introduction: Venus' heat budget is similar to Earth, yet Venus' heat transfer processes remain a mystery. The broad linear mesolands, marked by fracture zone terrain and associated coronae and chasmata, are hypsometrically similar to Earth's divergent boundaries, and represent a likely location of major global heat transfer [1-3]. Geologic relations documented at Inari Corona [4] provide new evidence for heat transfer mechanisms.

Why Inari Corona?: Western Aphrodite's mesolands host some of the largest coronae within the fracture zone terrain [2,3]. The mesoland's elevation is consistent with the occurrence of thin lithosphere [1], which is in turn consistent with the formation of tectonomagmatic features characterized by subsurface, versus surface, magmatism [5]. The relative size of these coronae is likely due to the broad width of thin lithosphere across such an expansive region.

Inari is similar in size to coronae Cere, Miralaidji, and Atahensik to the E. Inari, like these large coronae, sits at high elevation, but differs in its relative isolation and location within the fracture zone terrain immediately south of crustal plateaus Thetis and Ovda Regio. Structural lineaments extend relatively uninterrupted by adjacent features given Inari's isolated location. The general paucity of blanketing deposits across Inari reveals the nature of tectonic structures that characterize these huge features.

Inari Corona: Inari Corona asymmetrically straddles the E-trending mesoland fracture zone terrain between Thetis Regio (NE) and Artemis Chasma (SE). Regional topography slopes down to the S from ~4 km above MPR, Mean Planetary Radius, (Thetis) to ~1 km above MPR. Inari defines an off-center corona with a huge footprint with poorly defined outer limits. Its asymmetric geologic features are skewed extending >1000 km from the center to the S, ~400 km to the N, and >500 km to the E and W.

We divide Inari into three concentric geologic domains. Inari center consists of a central high surrounded by a moat-like basin and an outer concentric ridge. Outward from the ridge the mid-flank domain, developed the across the regional slope, is skewed southward; the distal flank occupies the southernmost reaches extending to lowest elevations. The mid-flank domain includes grossly concentric, nested ridges and basins offset to the S and SW that interrupt the regional slope. All three domains include radial and concentric tectonic lineaments. Geomorphic (ridges and basins) and tectonic (radial and concentric) structures define Inari as a coherent feature (>1.5 million km^2) greater than twice the size of Texas.

Inari's center (~71,000 km^2), free of obvious surface deposits except for thin cover in the moat-like basin, displays pervasively developed closely-spaced lineaments, pit chains and wide flat-floored troughs ($\leq$5 km wide, 5-50 km long). All lineaments intersect, with a range of orientations. Scalloped boundaries and rounded terminations attest to the troughs' pit chain origins. Troughs and trough fill cut, and are cut by, lineaments.

The mid-flank domain includes radar-rough and -smooth regions; intensely closely-spaced radial lineaments define rough areas whereas smooth regions host surface deposits that variably mask the lineament fabric. Boundaries of the smooth surfaces are typically extremely gradational and poorly defined, except within basins. Continuation of lineament fabrics on either side of the smooth areas indicates that the relatively thin cover dominantly postdates lineament fabric formation. However, individual (parallel) lineaments locally cut deposits, indicating continued lineament formation. In general surface deposits along the slopes lack evidence of flow (lobate margins, channels and levees).

Radial structures characterize the mid-flank domain, except the SW flank, which hosts concentric basins filled with thick deposits decorated with flow features. Radial structures include the lineament fabric, and parallel pit chains and wide troughs. These structures are similar to those of Inari center, except the lineaments define regionally extensive patterns >200 km long. The lineaments display an evolution from fractures, to pit chains, to troughs, with some lineaments preserving evidence of the transition along lineament trend. Although pit chains are difficult to robustly resolve given that they likely occur down to the radar data effective resolution [6], the spacing of both pit chains and troughs appears consistent across much of the mid-flank domain.

Concentric lineament fabrics (folds, fractures, faults) decorate ridges that form the downslope limit to the basins (SW flank). Concentric lineaments (fractures, faults and pit chains) also occur elsewhere within the mid-flank domain, locally more closely clustered, elsewhere more spaced.

The distal flanks generally display more widely-spaced radial lineaments. Local regions of penetrative radial lineament fabric occur to the SE; here, lineaments parallel Artemis-radial lineaments and thus provenance of individual lineaments is unclear. The SW distal flank includes extensive radial lobate flows that extend >600 km from the lowest concentric ridge within the mid-flank region. These extensive flows differ from thin cover deposits in that they bury pre-existing structures and preserve flow features. To the W and NW radial lineaments interact with fracture zone lineaments resulting in ambiguous provenance. These regions, most similar to the mid-flank domain, lack the distal-flank domain, perhaps due to high elevation. Lineament fabrics and parallel pit chains and troughs (that again define a regular wider-spacing), are locally covered, and cut regionally extensive thin deposits with diffuse boundaries.

Inari Evolution: Several characteristic features provide clues to Inari's evolution: central Inari tectonic fabrics, pit chains and wide troughs; penetrative (radial) fabrics and parallel pit chains and wide troughs; thin regionally extensive mid-flank cover deposits; and distal flanks flows.

Geologic relations in central Inari record progressive tectonism, formation of extensive pit chains and wide troughs indicative of subsurface magmatic stoping [2,7], and a notable lack of volcanic deposits. Inari center is dominated by subsurface processes.

Both subsurface and surface processes are recorded within the mid-flank domain. Radial fabrics and parallel pit chains and troughs indicate a lack of lava flows, and evidence of subsurface processes. Characteristics of the extensive surface deposits belie a lava flow origin: a lack of flow features; extremely diffuse boundaries; and blanketing, rather than burying, pre-existing structures. A local area along the SE mid-flank preserves additional clues for the origin of the blanketing deposits (M5 of [4]). A distinctive surface layer of similar thickness along an arc-shaped slope (25 km-wide and >400 km-long) forms a blanket-layer remnant. This deposit is cut by wide, periodically-spaced, parallel, down-slope erosion troughs. Earlier formed fractures are visible within the trough floors. Collectively, these characteristics defy a lava flow origin. An air fall origin for the layer would require a post-deposition erosion agent and mechanism to form the parallel periodic erosion troughs. However, the layer characteristics and the periodic erosion troughs might be expected via pyroclastic surge with both layer deposition and local erosion occurring synchronous with emplacement [8]. We propose that these extensive mid-flank deposits represent pyroclastic flow material that emerged from radial/concentric lineaments.

The distal-flank domain hosts radial lineaments and extensive surface flow deposits with well-developed flow features (SW flank).

The picture of Inari evolution that emerges varies in space and time, with operative magmatic processes related to elevation and magma buoyancy, and thermal/mechanical evolution of the lithosphere. Radial fracturing occurs through time, with each dike fusing the lithosphere, which is then refractured; repeated cycles form the characteristic tectonic fabric. Also with time and resulting heat transfer, the temperature difference between the subsurface mantle and surface lithosphere layer decreases, and dikes reach shallower crustal levels, resulting in pit chain development, and ultimately stoping troughs. Subsurface processes (i.e. magmatic stoping) dominate the highest elevations including Inari's center and mid-flank domain. Surface flows (lava?) are mostly limited to the distal-flank domain, where dikes intersect the surface. At intermediate elevation, mamga might rise due to lower density resulting from dissolved gasses. If/when such magma reaches the local surface, presumably via radial and/or concentric fractures, it might form huge density-driven pyroclastic flows blanketing extensive down-slope regions.

Implications for Thermal Evolution: Inari's huge quasi-circular footprint represents the surface expression of a magmatic/thermal diapir. Given Inari's location within the broad mesoland, the local lithosphere is relatively thin, similar to the highest regions within terrestrial divergent boundaries [1]. Unlike Earth however, Venus' thermally supported linear regions are not capable of splitting into distinct lithospheric plates that diverge and form new lithosphere. Thus Venus' thermally supported mesoland develops *in situ* over time. Conduction and intrusion-related advection dominate heat transfer processes. Such processes occur via dikes (at depth) expressed as surface fractures. With time, some fractures evolve into pit chains and/or wide troughs. However new fractures continue to form. Within the fracture zone terrain, lineament suites (fractures, pit chains, troughs) parallel the regional trend of broad linear mesolands. The parallel nature of these suites frustrate efforts to document evolution of the fracture zone terrain.

Inari preserves a more accessible record of fracture zone processes due to its domical character (and resulting development of radial and concentric lineaments), and its high elevation location, and thus the preponderance of subsurface versus surface processes. Inari, and the fracture zone terrain in general, is likely long lived (100's of millions of years—similar to terrestrial divergent plate boundaries) and records contemporary heat transfer processes. Similar heat transfer processes likely occur across the mesoland south of Aphrodite Terra eastward to Atla Regio. The lower elevation of the Atla-Beta-Themis coronae-chasmata mesolands exhibits extensive surface flows, blocking a view of subsurface processes.

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