

VOLCANIC HISTORY OF THE DERCETO-KALLISTOS-UBASTET LIP, LADA TERRA, VENUS; L. M. MacLellan¹ and R. E. Ernst^{1,2}, ¹Department of Earth Sciences, Carleton University, Ottawa, ON, Canada (laurrenmaclellan@cmail.carleton.ca, richard.ernst@ernstgeosciences.com), ² Faculty of Geology and Geography, Tomsk State University, Tomsk, Russia.

Introduction: Detailed mapping using SAR images (100 m/pixel) of a 1,920,000 km² area in northern Lada Terra, Venus, has revealed the geological history of the herein-labelled Derceto-Kallistos-Ubastet large igneous province (LIP) (Figure 1). This magmatic event includes volcanic/tectonic features: Derceto Corona, previously known as Ammavaru Caldera, an elliptical-shaped corona [5] atop a regional volcanic uplift that is 960 km across, Kallistos Vallis a lava channel system [1], flows on the eastern flank herein termed Eastern Stage 1 [5], Ubastet Fluctus (flow field), along with other newly recognized flow stages. Each volcanic stage was mapped in detail and its source magma chamber was identified.

These multiple volcanic stages are integrated into a single magmatic event which we term a LIP, in comparison with the class of voluminous ($\geq 100,000$ km³) intraplate mafic magmatic events recognized on Earth and also interpreted for Venus and other planetary bodies [2-4]. The volcanic stages of the Derceto-Kallistos-Ubastet LIP are outlined below in order of inferred age (oldest to youngest), followed by preliminary insights into the overall volcanic plumbing system.

Eastern Stage (ES): The eastern flank of the Derceto Corona regional uplift is covered by a fanning distribution of lava flows (176,840 km²) with intermediate radar backscatter labelled ES-1. The source is a set of parenthesis-shaped irregular features likely marking nested collapse above a shallow magma chamber.

ES-2 begins on the lower flanks of the uplift as multiple lobate radar-bright flows, that are fed from individual NNW-trending grabens (overlying dykes). The total area is 61,600 km² and the average area for a single flow is 690 km². Both ES-1 and -2 flows head downslope and breach the Vaidilute Rupes (ridge system) and continue on the eastern side.

Western Stage (WS): WS-1 is a radar-bright flow (23,350 km²) fed from a single circumferential fracture belonging to the outer portion of the elliptical-shaped Derceto corona. The flow begins by spreading downslope to the NW and then swings 180 degrees to head SW along the older Hanghepiwi Chasma.

WS-2 begins as a channelized flow (14,370 km², with intermediate radar backscatter) originating from the curved end of a NW-trending graben and fans out to the west of Derceto Corona. WS-3 comprises individual radar-bright flows superimposed on WS-2 that are fed from a NW-trending grabens (dyke swarm).

Northern Stage (NS): NS-1 is fed from NNW-trending bifurcating irregular grabens (dyke swarm). NS-1 consists of a radar-bright flow covering 23,350 km² and locally covered by NS-2 flows (14,370 km²) having intermediate radar backscatter. The source for NS-2 is unknown. NS-2 is crosscut by the NS-3 flow field (14,370 km², radar-bright) which fans northward downslope from one NW-trending graben (part of the same dyke swarm that feeds WS-2).

Great Dyke Stage (GDS): A feature resembling a dyke-like layered intrusion “Great Dyke” has a maximum width of 5 km and 90 km length, and is part of a NE-trending graben system (dyke swarm). Both the GDS-1 (3240 km²) and younger GDS-2 (470 km²) flows have dark-intermediate radar backscatter and are fed from the northern half of the Great Dyke. The GDS-3 flow system (1450 km², radar-dark) is fed from the southern part of the Great Dyke. GDS-3 extends 200 km eastward starting as a channelized flow that transitions into a flow field. Age relationship of GDS-3 with respect to GDS-1 and -2 flows is unknown.

Kallistos-Ubastet Stage (KUS): The 900 km long Kallistos Vallis system begins as a collapsed magma chamber and flows downslope as an anastomosing channel system (KUS-1), feeding three flow fields (KUS-2, 28120 km², radar-bright; KUS-3, 9250 km², radar-dark; KUS-4, 108,810 km², radar-bright). It then follows along the western margin of Vaidilute Rupes before breaching this ridge at the same place as both ES-1 and -2 flows. It then spreads to the east of the ridge as a major flow field, Ubastet Fluctus (KUS-4).

Discussion: We infer a magmatic history beginning with Derceto Corona (and its associated circumferential graben system), followed by the WS flows. ES flows were deemed younger than WS flows based on the observation that NW-trending grabens that feed WS flows are flooded by ES flows. The three KUS flows are next in the history, as they overprint the ES flows. GDS flows are younger than NS flows, but their age relationship with the other flow stages is unknown.

Apart from WS-1 flow (linked to the main caldera collapse on the summit), most of the other flow stages are linked to magma chambers on the upper flanks of the volcanic uplift. In each case it is inferred that the flow stages represent multiple cycles of filling and emptying of the source magma chamber.

References: [1] Baker, V.R. et al. (1992) *Journal of Geophysical Research* 97, 13,421-13,444. [2] Ernst, R.E. (2014) *Cambridge U. Press*. [3] Hansen, V.L.

(2007) *Chemical Geology* 241, 354-374. [4] Head, J.W. and Coffin, M.F. (1997) *AGU Geophysical Monograph* 100, 411-438. [5] Lancaster, M.G. *et al.* (1995) *Icarus* 118, 69-86.

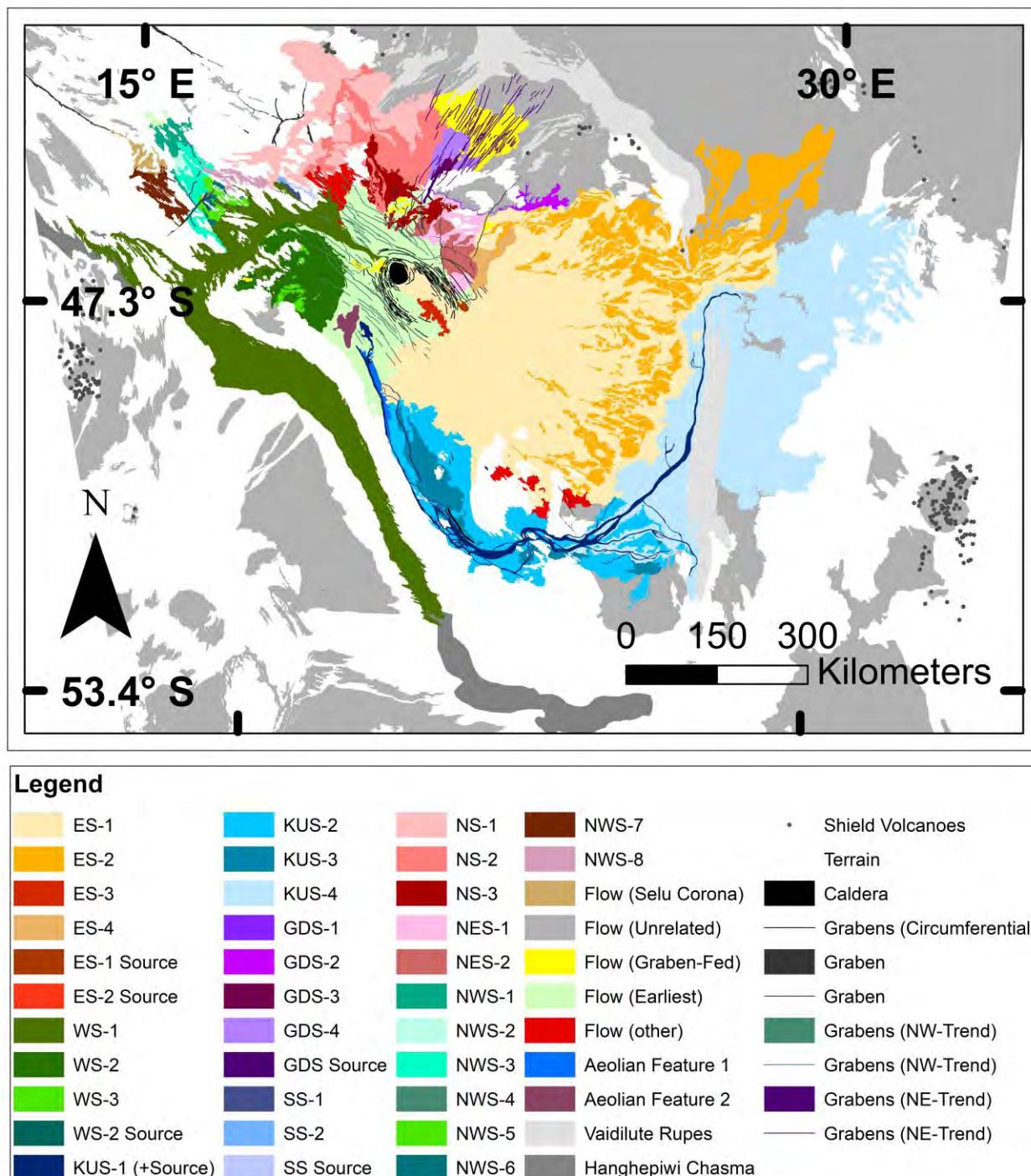


Figure 1: Detailed mapping of all volcanic features and structural elements that form the Derceto-Kallistos-Ubaste large igneous province (LIP). Additional stages of flows and their sources were included on this map, but were not discussed in the abstract: North-Eastern Stage (NES), North-Western Stage (NWS) and Sill Stage (SS).