EVALUATION OF THE CLUSTER OF ANEMONE TYPE VOLCANOES LOCATED SOUTH OF ATLA REGIO, VENUS. F. Najib[1], H. El Bilali[2,3], R.E. Ernst[2,3] , J.W. Head[4], N. Youbi[1] [1]Department of Geology, Faculty of Sciences-Semlalia, Cadi Ayyad University, Marrakesh, Morocco; najibfatimaezzahrae@gmail.com, [2]Department of Earth Sciences, Carleton University, Ottawa, Ontario, Canada; hafidaelbilali@cunet.carleton.ca; richard.ernst@ernstgeosciences.com, [3]Faculty of Geology and Geography, Tomsk State University, Tomsk, Russia, [4]Department of Earth, Environmental and Planetary Sciences, Brown University, Providence, RI, USA

Introduction: Intermediate volcanoes on Venus are defined as volcanic centres between 20-100 km in diameter [1]. A subclass of these, informally known as the 'anemone type', were studied by [1]. They are characterized by petal like lava flows and radiating radar-bright patterns, and they are typically 30 and 40 km diameter [2]. They are unevenly distributed globally, and a strong concentration is located in an area south of Atla Regio. An association with fissure eruptions is noted in [1]. Herein we wish to consider in more detail the relationship between anemones and potential feeder dykes.

We focus on the cluster south of Atla Regio (Fig. 1). There are three main trends of graben-fissure systems in the region (N-trending blue set, NE-trending red set, and NW-trending green set). We interpret each of these sets to overlie dyke swarms, as has been suggested for similar graben-fissure systems across Venus (e.g. [3-4]).

As shown in Figure 2 it appears that the anemones are associated with all three dyke swarms. In Fig. 2A, the elongate axis of the central trough-like feature is parallel to the N-trending blue swarm. In Fig. 2B, the central trough-like feature is parallel to the NE-trending red swarm. In Fig. 2C the anemone type feature in the lower left of the image is associated with a NE-trending portion of the red swarm. In the central part of Fig. 2C there is a NNE-trending graben which probably belongs to the NW-trending green swarm. In Fig. 2D the central depression is not elongated, but the only visible graben in the vicinity belong to the NE-trending red swarm. In Fig. 2E the central trough is N-trending and is parallel to the blue swarm. In summary, we have two anemones inferred to belong to the N-trending blue swarm (Figs. 2A and E), and three inferred to belong to the NE-trending red swarm (Figs. 2B, 2C lower left of image and Fig 2D). We have one with a NNE-trend that is most consistent with the NW-trending green swarm (Fig 2C, centre of image).

Implications: Our analysis supports the suggestion from [1] that anemone are "related to regional patterns of extension and dike emplacement". However, the observation that they are associated with all three trends of regional dyke swarms provides additional constraints on the origin of this anemone cluster. The unusual appearance of the anemone flows, small with a petal-like appearance is very distinctly different from longer and more extensive flows associated with volcanic Mons [5]. Closer examination (Fig. 2) reveals the importance of regional lava flows in partially flooding both the periphery and interiors of anemone.

These small edifices and short flow features may be related to low-effusion rate, low-volume, supply-limited or cooling-limited flows formed during dyke emplacement events [7-9]. Another possible model is suggested in Fig. 3 in which anemone are spawned off regional dykes in areas of local vertical anomalous flow. This has been proposed as an origin for small intrusions such as those of British Tertiary province of the North Atlantic LIP [9].

Small volume flows could also be due to non-mafic compositions. For instance, alkaline magmatism and associated carbonatites are low volume and are frequently associated with Large Igneous Provinces (LIPs) [6], and can be inferred to reflect an unusual composition in the underlying lithospheric mantle source area (e.g. the Maimecha-Koyui alkaline province of the Siberian Traps LIP). However, the association of this anemone cluster with all three trends of regional dyke swarms would be seem inconsistent with a link to an underlying unusual lithospheric mantle source, particularly given that these regional dykes are likely laterally emplaced.

Research is continuing to explore the apparent genetic link between the anemone occurrences and regional dyke swarms [10].

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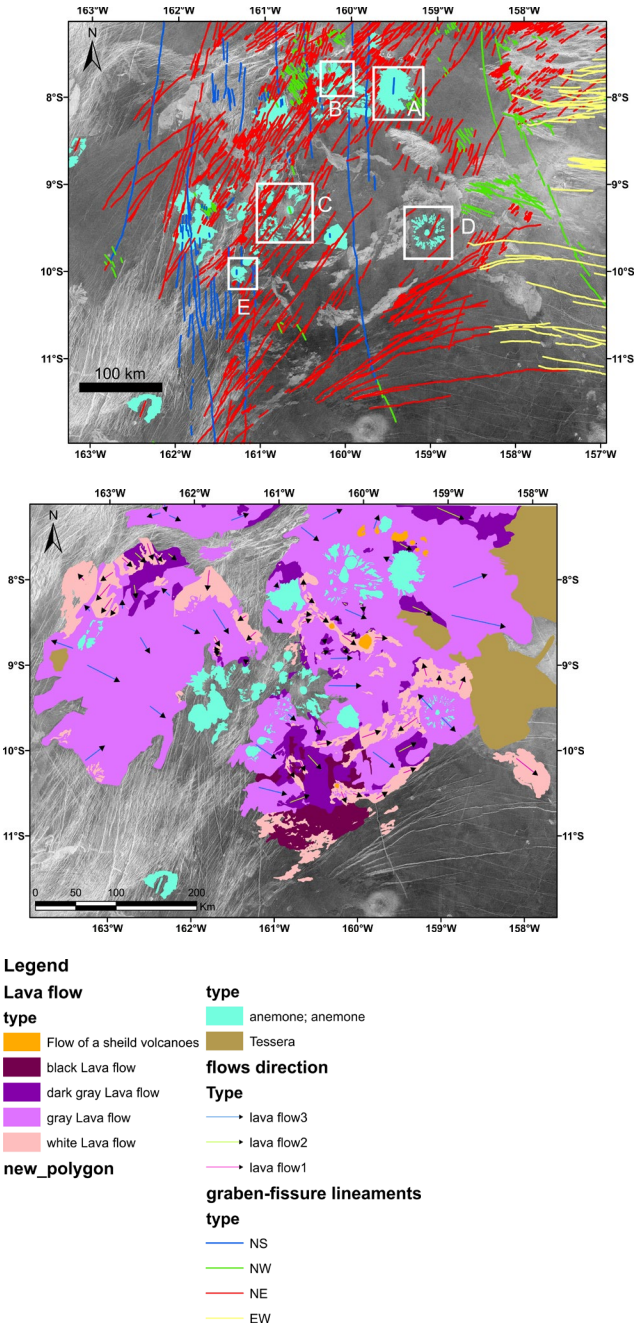

Figure 1. *a) Regional graben systems (N-trending blue, NE-trending red, NW-trending green and E-W tending yellow) and location of anemone (in green). White boxes indicate specific anemone illustrated in Figure 2. b) Regional lava flows which partially flood the individual anemone. Arrow indicate flow directions inferred from topography. c)Legend. Background for parts A and B are from Magellan SAR image from Cycle 1.*

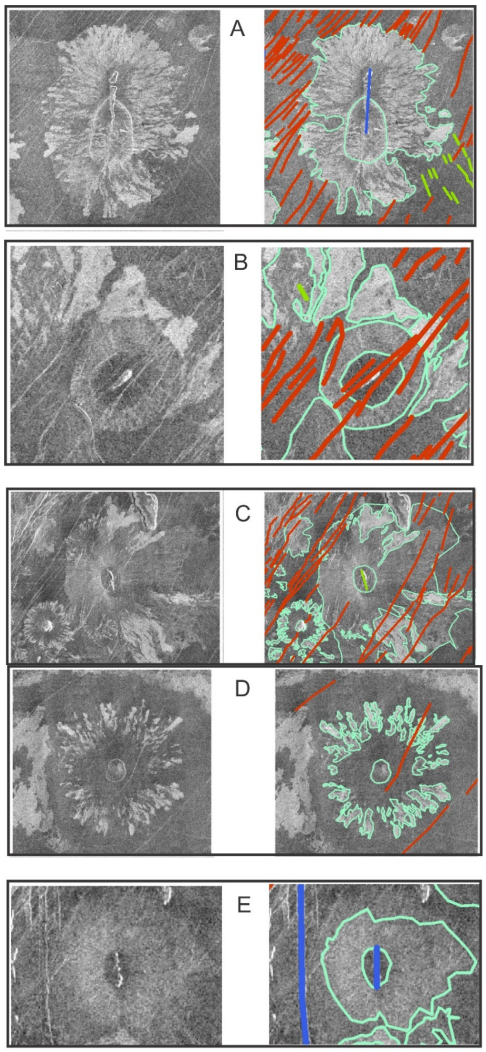

Figure 2*: Examples of anemone-like features located in Figure 1 (Magellan Cycle 1 SAR images). The right side of each pair of images shows the associated outlines of anemone flows (greenish-blue) and three trends of any associated graben (blue, red and/or green).*

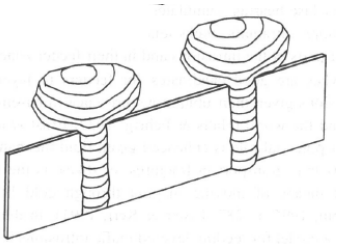

Figure 3*: Regional-scale dolerite dyke feeding local intrusion. Given the association of anemone with the main regional graben sets (Fig. 1), is it possible that they are being spawned off regional dykes? This diagram is from [10].*