Calder W. PATTERSON, Richard E ERNST and Claire SAMSON, 2016. Pit Chains Belonging to Radiating Graben-Fissure Systems on Venus: Model for Formation during Lateral Dyke Injection. *Acta Geologica Sinica* (English Edition), 90(supp. 1): 143 -144.

Pit Chains Belonging to Radiating Graben-Fissure Systems on Venus: Model for Formation during Lateral Dyke Injection

Calder W. PATTERSON, Richard E ERNST* and Claire SAMSON

Department of Earth Sciences, Carleton University, Ottawa, K1S 5B6, Canada

Pits are circular to elliptical, steep-sided, flat-bottomed depressions interpreted to form from collapse into a cavity. They occur on Earth, Venus and Mars and range in diameter from ~100 m to several kilometres (e.g. Bleamaster and Hansen, 2001; Wyrick et al., 2010; Davey et al., 2013). Pit chains are linear successions of pits that can extend from hundreds of metres to tens of kilometres in length and contain varying numbers of pits.

Pit chains on Venus are typically aligned in the same direction as other adjacent linear features, primarily graben-fissure systems, which suggest that there is a causal relationship between pit chain formation and the presence of the dykes thought to typically underlie graben-fissure systems. The goal of the present study is to gather evidence to test this proposed genetic link, based on the surface expression of pits and pit chains. In this study we focus on pit chains related to radiating graben-fissure systems. In radiating graben-fissure systems dyke injection direction is laterally away from the system's centre (e.g. Grosfils and Head, 1994; Ernst et al., 2003, Studd et al., 2011), so any progressive changes in pit and pit chain properties moving outward from the central area could reflect changing conditions during lateral dyke propagation.

Using the 75 m resolution Magellan mission SAR images, 64 pit chains associated with radiating graben-fissure systems belonging to the Kono Mons (91.8˚W, 19.0˚N; diameter ~900 km) and Theia Mons (79.721˚W, 23.641˚N; diameter ~1150 km) radiating systems were mapped and characterized, and preliminary observations are summarized below (see also Patterson et al., 2016).

Preliminary observations from the two radiating systems considered (Kona Mons and Theia Mons), show a greater abundance of pit chains and also a maximum in pit diameter at similar relative distances (with respect to the systems' sizes) from their respective radiating centres. This is not observed in the pit spacing data, which exhibits a large variability. Systematic trends outward from the radiating centre are provisionally interpreted to be correlated with the propagation of underlying dykes. Additional mapping of pit chains in other radiating systems is required to validate this correlation.

Various general models of pit formation have been proposed including an association with underlying dykes (e.g. Wyrick and Ferrill, 2004; Smart et al., 2011). The present study develops a hypothesis that pits form during active lateral dyke propagation (Fig. 1). In order to create a pit, a cavity must be created in the subsurface for the overlying host rock to collapse into, which implies that the dyke must be propagating at shallow depths and the overlying host rock must be friable. Possible contributors to the friability of the host rock include the presence of vesicular basalt as well as pyroclastic deposits (e.g. Davey et al. 2013). Future models will incorporate the effect of regional domal uplift and how extension in the host rock might be a co-factor in the formation of pits during dyke propagation.

Stopping and starting of the dyke's propagation could be the result of the dyke's magma pressure being unable to overcome the tensile strength of the host rock. This may be due to changes in the magma supply, where a decrease in magma supply causes the dyke to halt and then advance again when magma supply resumes. Another possibility is that magma supply is continuous but the pressure is below that required for propagation; only when pressure builds sufficiently can the dyke advance before halting again as the pressure drops back to ambient levels. This is a cyclical process.

* Corresponding author. E-mail: Richard.Ernst@ErnstGeosciences.com

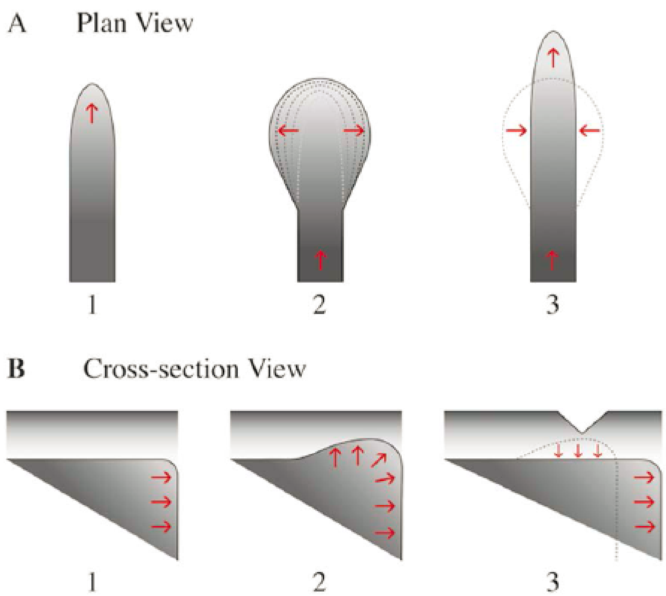

Fig. 1. Model of formation of a collapse pit above the leading edge of a laterally propagating dyke that has discontinuous movement. Each time forward movement (step 1) is stopped (step 2), then magma pressure builds up and the dyke width and vertical height increase (and potentially causes some fragmentation of the overlying rock). Then the tensile strength of the rock is exceeded and the dyke resumes forward propagation (step 3). At this point the vertical height decreases and a gap is produced into which the friable over-lying layer collapses forming a pit (large circle in A, downward triangle in B). Repetition of this process of stopping and starting of the laterally propagating dyke produces a pit chain.