ASSESSING A LARGE IGNEOUS PROVINCE (LIPS) CONTEXT FOR VOLCANISM AND TECTONICS ON VENUS. R. E. Ernst[1,2], K. L. Buchan[3], H. El Bilali[1] and J. W. Head[4], [1]Department of Earth Sciences, Carleton University, Ottawa, Ontario, Canada; richard.ernst@ernstgeosciences.com; [2]Faculty of Geology and Geography, Tomsk State University, Tomsk, Russia; [3]273 Fifth Ave., Ottawa, Canada; [4]Department of Earth, Environmental and Planetary Sciences, Brown University, Providence, Rhode Island, USA.

Introduction: Voluminous Venusian magmatism may be analogous to Large Igneous Provinces (LIPs) on Earth [1-3]. We consider implications of the terrestrial LIP paradigm for the Venus geological record:

Grouping magmatic units and tectonic aspects into LIPs: On Earth, each LIP event comprises multiple magmatic units (flows, dykes, sills, intrusions, magmatic underplate) and tectonic features (uplift, associated rifting). Different LIP events (with distinct ages) can spatially overlap. For Venus we are assessing strategies to similarly group units into discrete events, using stratigraphic relationships in the absence of an absolute geochronology.

Link to mantle plumes: For Venusian LIPs (by comparison with Earth), we assess evidence for a plume centre, a broader plume head region, and beyond-plume regions, each with distinctive magmatic and tectonic expression.

Graben-fissure systems as the surface expression of underlying dyke swarms: Do radiating and circumferential graben-fissure systems on Venus mark radiating and circumferential dyke swarms? Are Venusian coronae analogues to terrestrial circumferential dyke swarms [4].

Identifying magma reservoirs: On Earth, erosion and geophysical data reveal the distribution of magma reservoirs of LIP plumbing systems [4, 5]. On Venus (given the absence of erosion), we assess evidence for the presence of magma reservoirs in at least three ways: a) local uplifts, b) central depressions within coronae, which may indicate down-sag caldera collapse associated with expulsion of magma; and c) surface depressions which can be interpreted to mark roof collapse above sill-like and dyke-like layered intrusions [6].

Sources of lava flows: Terrestrial lava flows can be fed from fractures along the edge of a caldera, from lateral injection of dykes intersecting surface topography and from circumferential fractures [7].

Effect on climate: Terrestrial LIPs are responsible for dramatic climate change and mass extinctions [8]. The proposed Great Climate Transition on Venus, from habitable to present day hyper-warm with high CO2 [9-11] may be associated with stochastic overlap of multiple LIPs [12].

References:

[1] Head & Coffin 1997. In: AGU GM, 100, 411. [2] Hansen 2007 Chem. Geol., 241, 354. [3] Ernst 2014 Large Igneous Provinces. Cambridge U. Press; [4] Buchan & Ernst 2021 Gond. Res., in press; [5] Ernst et al. 2019 JVGR, 384, 75; [6] MacLellan et al. (2021) ESR, 220: 103619; [7] El Bilali et al. 2021 LPSC #2529; [8] Ernst et al. (ed.) 2021 AGU Geophys. Monograph 255; [9] Way et al. 2016 GRL. 43, 8376–8383; [10] Way & Del Genio 2020 JGR Planets, 125, e2019JE006276; [11] Khawja et al. 2020 Nat. Comm. 11, 5789; [12] Way et al. 2021 AGU Fall mtg.