# INFLATION PROCESSES AT THE McCARTYS LAVA FLOW FIELD, NEW MEXICO, WITH APPLICATION TO IDENTIFYING INFLATED LAVA FLOWS ON PLANETARY SURFACES

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Abstract 2120

**Introduction:** Inflation has been recognized as a significant process during the emplacement of basaltic lava flows on shallow regional slopes [1-4]. As part of NASA PGG grant NNX09AD88G, we have been studying inflation features and flow textures on the McCartys lava flow located near Grants, NM, a well-preserved compound flow field that extends ~47 km from the vent (Fig. 1) [5-7], and which is ~3000 yr old [8]. The McCartys flow is an excellent analog to planetary flows (e.g., on Mars) for four reasons: the pre-existing surface was extremely flat, the areal extent of the flow field is large, the relief generated by inflation is large and ubiquitous, and flow supply likely persisted for months to perhaps years.

**Results:** We have made significant progress in unraveling the history of the McCartys flow field.

*Inflation plateaus.* Precision topography, obtained from Differential GPS surveys [9], show that inflation plateaus [1] within the flow field have remarkably uniform heights on their upper surfaces. Contact relations between inflation components reveals that individual plateaus can have very complex planforms (Fig. 2). We have fully mapped only the southernmost plateau, but the lighter grey-scale reflectance of plateau areas (in satellite imaging) suggests that large areas around the vent likely include extensive inflation plateaus ('P?' in Fig. 1). Lava-rise pits [1] are common on the upper surface of the inflated plateaus, and blades of squeeze-out lava from the molten interior of inflated components are present in the walls of some pits and marginal cracks. Fractured tumuli, surrounded by small lobes, are common adjacent to inflated plateaus, comprising a texture distinct from the plateau surface [10]. Contact mapping requires close examination in the field, due to the presence of numerous flow lobes and toes surrounding the inflated plateaus.

*Terraced margins.* DGPS profiles across several margins at McCartys reveal topographic terracing resulting from effusion at break-out fractures in the margin of adjacent inflated lobes, or toes from the terrace itself (Fig. 3) [11]. Terracing may be a helpful indicator of inflated flows on other planets.

*Flow textures.* Many distinctive textures are present on the surface of inflated flow components, and some textures give good indications of flow direction for 'pioneer' lobes emplaced prior to inflation [12]. Textures and the topography of the flow indicate that continuous fluid pathways existed to the distal reaches of the flow field; our conclusion is that fluid pressure governed the emplacement dynamics, as opposed to solely gravity-driven forces, a mechanism that relates closely to pahoehoe toe emplacment [13-15].

*Low-altitude aerial photography.* Weight-shifting ultralights have proven to be an excellent platform from which to obtain low-altitude oblique and vertical photography of inflated features on the McCartys flow field (Figs. 4 & 5). Low-altitude vertical photography provides stereo that documents relief down to sub-meter scale [17].

**Discussion:** Lessons learned from studies at the McCartys flow field were crucial to the interpretation of inflated lava features on the Moon [10], and should prove useful for on-going assessments of inflated lava flows on Mars [e.g., 16], as well as other planetary bodies. Continued analysis of mapped textures on the surface of inflated flows and modeling of inflation mechanisms will improve our ability to interpret inflation features that are indentified on other planets.

**Future Plans:** A follow-up proposal is currently under review with NASA PGG, which would include additional field studies at the McCartys flow, as well as field investigation of the large inflation plateaus present on the distal portion of the Carey lava flow, in the Craters of the Moon region in central Idaho [18]. We intend to submit one or more manuscripts to summarize the results derived from our work at the McCartys flow field, which should provide a basis for future field and modeling investigations of lava flow inflation.

**References:** [1] Walker G.P.L. (1991) Bull. Volc., 53, 546-558. [2] Hon K. et al. (1994) Geol. Soc. Am. Bull., 106, 351-370. [3] Self S. et al. (1996) Geophys. Res. Lett., 23(19), 2689-2692. [4] Self S. et al. (1998) Ann. Rev. Earth Planet. Sci., 26, 81-110. [5] Laighlin A.W. et al. (1972) Geol. Soc. Am. Bull., 83, 1543-1552. [6] Theilig E. (1990) in Volcanoes of North America (C.A. Wood and J. Kienle, Eds.), pp. 303-305, Cambridge Univ. Pr. [7] Crumpler L.S. et al. (2007) in The Geology of Mars (M. Chapman, Ed.), pp. 95-125, Cambridge Univ. Pr. [8] Laughlin A.W. et al. (1994) Geology, 22, 135-138. [9] Zimbelman J. R. et al. (2010) LPS XLI, Abs. 1826. [10] Garry W.B. et al. (2012) JGR 117, E00H31, 10.1029/2011JE003981. [11] Zimbelman J. R. et al. (2012) LPS XLIII, Abs. 1831. [12] Bleacher J.E. (2012) Geol. Soc. Am. Ann. Mtg, Abs. 19-8. [13] Glaze L. S. and Baloga S. M. (2013) LPS LXIV (this volume). [14] Glaze L. S. and Baloga S. M. (in review) JVGR. [15] Hamilton C. W. et al. (in review) Bull. Volc. [16] McCarthy M. L. and Zimbelman J. R. (2013) LPS XLIV, Abs. 1153. [17] Zimbelman J. R. et al. (2012) Geol. Soc. Am. Ann. Mtg., Abs. 38-2. [18] Garry W. B. and Zimbelman J.R. (2012) Geol. Soc. Am. Ann. Mtg., Abs. 38-1.

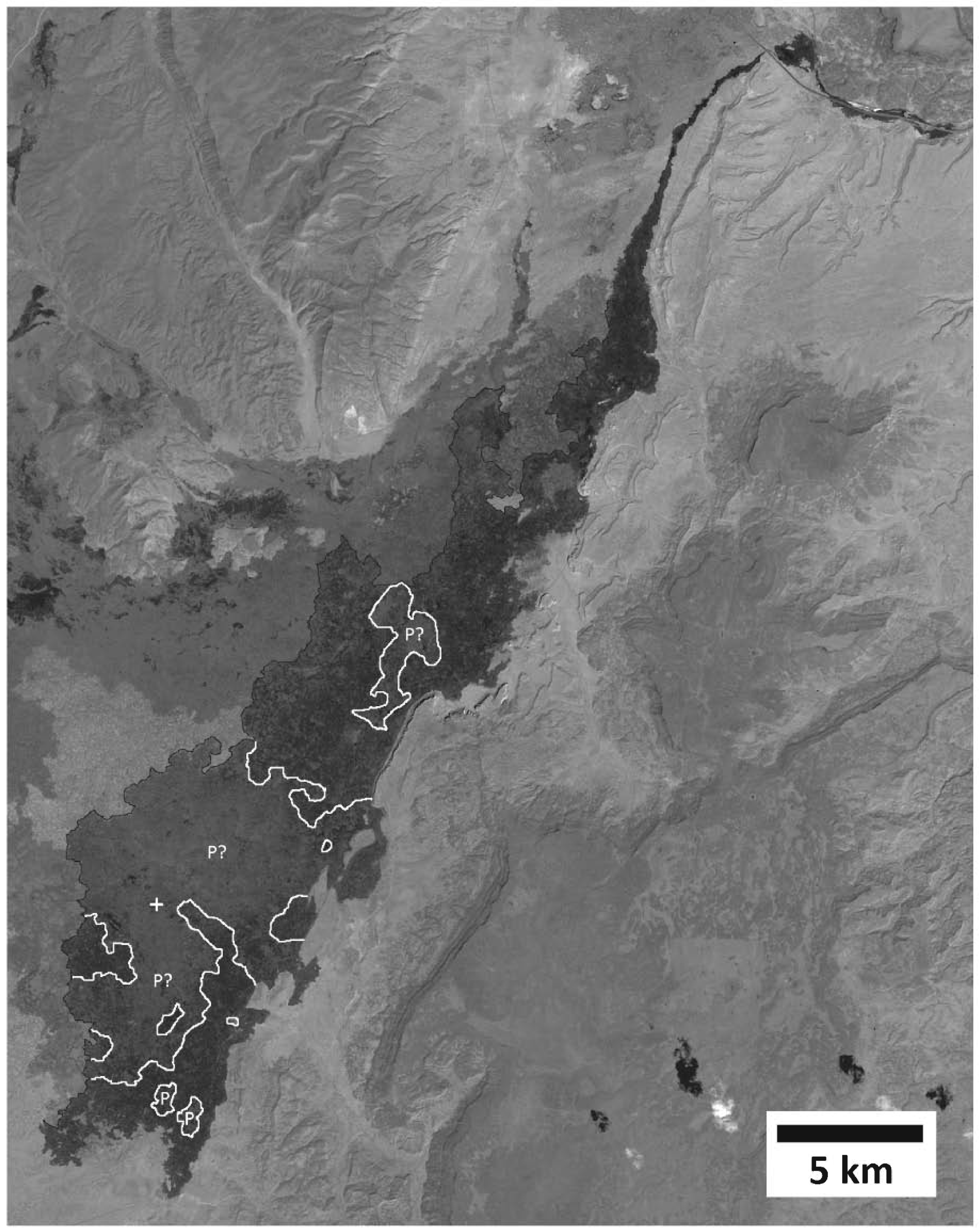


**Figure 1**. Portion of Landsat Thematic Mapper image L71034036, band 4 (4/14/00). The McCartys lava flow field is superposed on earlier Zuni-Bandera lavas. White lines indicate possible inflation plateaus (see text); white cross indicates the vent for the flow field.

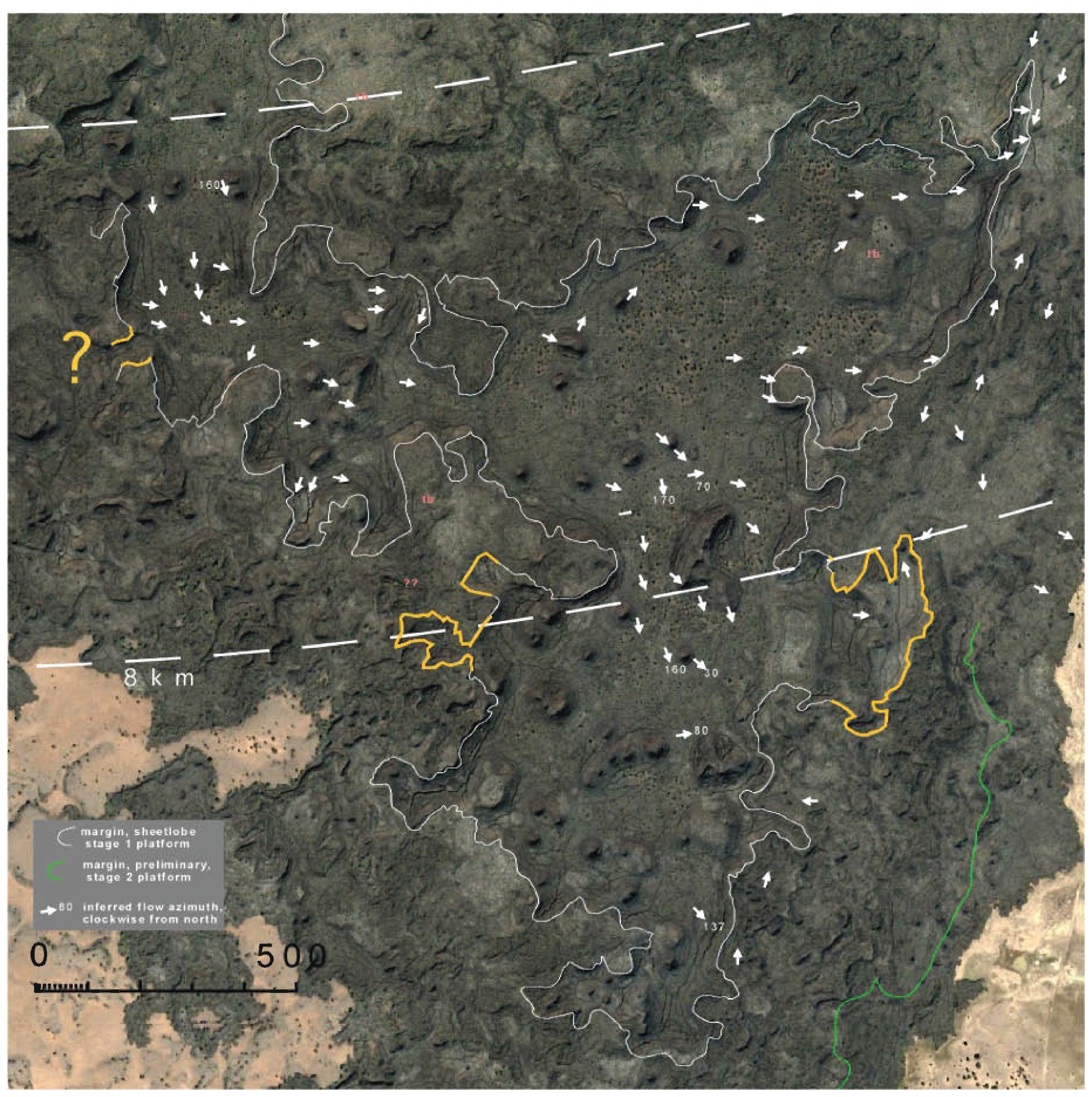


**Figure 2**. 2011 version of Lava Falls plateau map, the southernmost plateau in Fig. 1. White line: confident contact. Yellow line: inferred contact. Green line: contact between emplacement zones. Arrows: initial flow direction measured on lobe surfaces (preceding inflation). Compiled on Google Earth base by LSC.

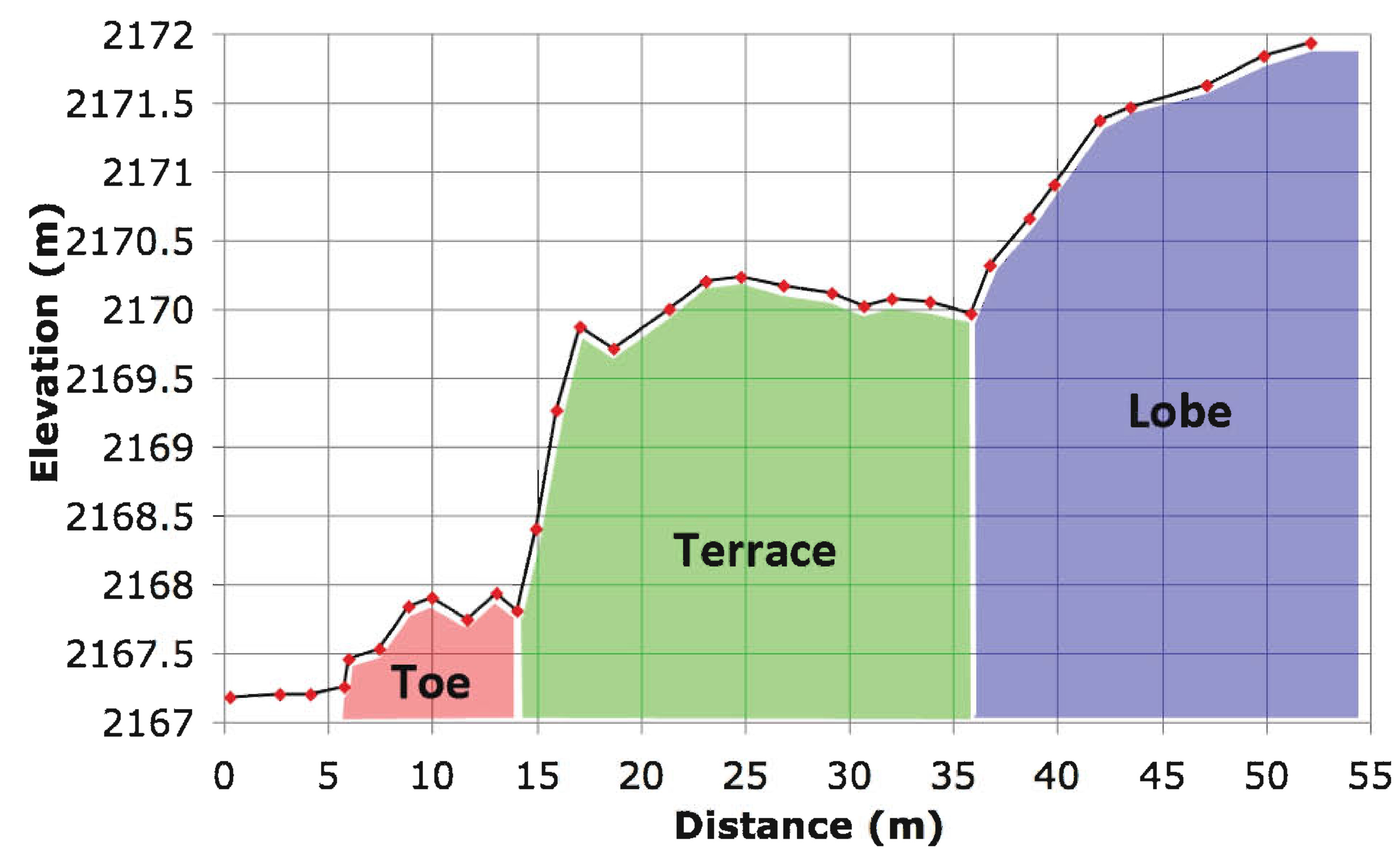


**Figure 3**. DGPS profile (3/30/11) of a McCartys margin displaying terracing, generated by sequenced emplacement followed by inflation, first from lobe to terrace, then from terrace to toe.

**Figure 4.** Oblique low altitude photo of margin of a McCartys inflated plateau. Lava-rise pit in plateau surface is at center left. Margin relief, ~8 m. JRZ, 4/28/12.

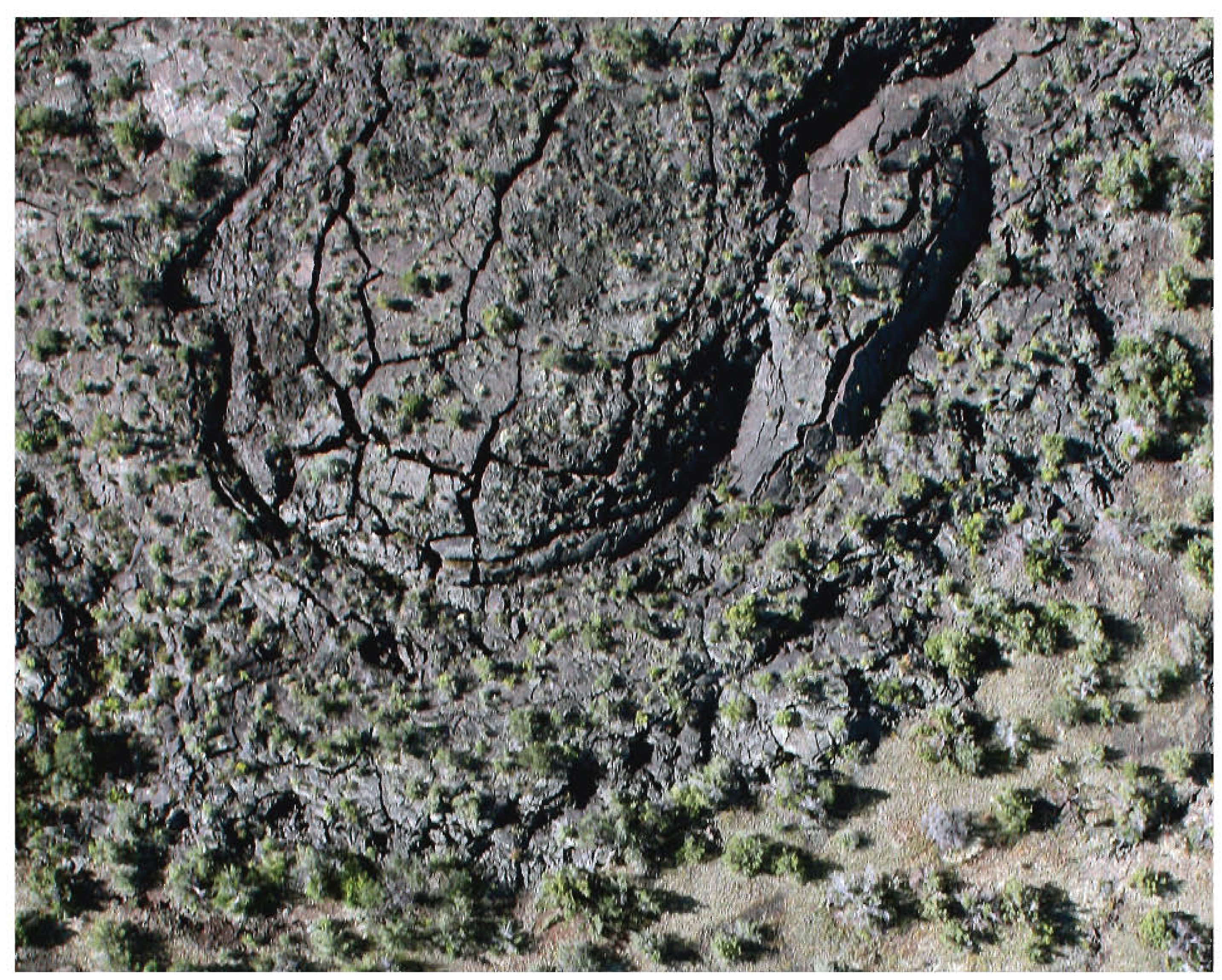

**Figure 5.** Vertical low altitude photo of terraced flow lobe margin, south of La Vieja on the eastern side of the McCartys flow field. Inflated plateau portion of lobe is ~30 m wide. JRZ, 9/22/12.