FINAL REPORT
NASA Grant 3684
Lava Flow Dynamics

Principal Investigator: G. Jeffrey Taylor, University of Hawai'i

This grant originally had four major tasks, all of which were addressed to varying extents during the course of the research:

- Measure the fractal dimensions of lava flows as a function of topography, substrate, and rheology.
- The nature of lava tube systems and their relation to flow fields.
- A quantitative assessment of lava flow dynamics in light of the fractal nature of lava flow margins.
- Development and application of a new remote sensing tool based on fractal properties.

During the course of the research, the project expanded to include the projects listed below. This work was also funded in part by the National Science Foundation through a graduate fellowship to Rachel Friedman.

- A comparison of what we can learn from remote sensing studies of lava flow morphology and from studies of samples of lava flows.
- Study of a terrestrial analog of the nakhlites, one of the groups of meteorites from Mars.
- Study of the textures of Hawaiian basalts as an aid in understanding the dynamics (flow rates, inflation rates, thermal history) of flow interiors.

In addition, during the first year an educational task was included. This entailed development and writing of a teacher's guide and activity set to accompany the lunar sample disk when it is sent to schools. This resulted in publication of **EP-306**, referenced below.

Publications

Publications in refereed journals

Bruno, B. C., Taylor, G. J., Rowland, S. K. and Baloga, S.M. (1994) Quantifying the effect of rheology on lava-flow margins using fractal geometry. *Bull. Volc.*, **56**, 193-206.

Bruno, B. C. and Taylor, G. J. (1995) Morphologic identification of Venusian lavas. *Geophys. Res. Lett.* **22**, 1897-1900.

Bruno, B. C., Baloga, S. M., and Taylor, G. J. (1996) Modeling gravity-driven flows on an inclined plane. *J. Geophys. Res* **101**, 11,565-11,577.

Educational publication

Taylor, G.J., Martel, L.V. and Bays, B. (1994) *Exploring the Moon: A Teacher's Guide with*

Activities, **NASA EP-306**, 148 p.

Abstracts and extended abstracts

Taylor, G. J. (1992) Fractal properties of lava tube systems. *EOS* **73**, 648.

Bruno, B. C. and Taylor, G. J. (1992) Effect of rheology on plan-view shapes of lava flows. *EOS* **73**, 648.

Bruno, B. C., Taylor, G. J., and Lopes-Gautier, R. M. C. (1993) Quantifying the effect of rheology on plan-view shapes of lava flows. *Lunar and Planetary Science XXIV*, 207-208.

Lopes-Gautier, R., Bruno, B. C., Taylor, G. J., and Kilburn, C. R. J. (1993) Martian lavas: three complementary remote sensing techniques to derive flow properties. . *Lunar and Planetary Science XXIV,* 899-900.

Bruno, B. C., Taylor, G. J., Rowland, S. K., and Baloga, S. M. (1993) Flow margins: indicators of underlying fluid dynamics processes? *IAVCEI Abstracts*, 13.

Taylor, G. J. and Bruno, B. C. (1993) Fractal properties of lava flows: Clues to eruption rates, emplacement mechanisms, and rheology. *Geol. Soc. Amer. Annual Meeting*, A-343.

Bruno, B. C., Baloga, S. M., Taylor, G. J., and Tatsumura, M. J. (1994) Lava flow rheology: A comparison of data and theory. *Lunar and Planetary Science XXV*, 189-190.

Taylor, G. J., Bruno, B. C., and Self, S. (1994) Slow emplacement of flood basalts: evidence from fractal properties of lava flows. *Lunar and Planetary Science XXV*, 1383-1384.

Friedman, R. C., McCoy, T. J., and Taylor, G. J. (1994) Constraints on the physical details of nakhlite formation. *Lunar and Planetary Science XXV*, 391-392.

Bruno, B. C. and Taylor, G. J. (1995) Morphologic identification of venusian lavas: implications for emplacement of long lava flows. *Lunar and Planetary Science XXVI*, 185-186.

Coombs, C. R., Taylor, G. J., and Rowland, S. K. (1995) The formation and evolution of lava tubes. *Lunar and Planetary Science XXVI*, 279-280.

Friedman, R. C., Taylor, G. J., and Treiman, A. H. (1995) Processes in thick lava flows: nakhlites (Mars) and Theo's flow (Ontario, Earth). *Lunar and Planetary Science XXVI*, 429-430.

Lopes-Gautier, R., Bruno, B. C., Taylor, G. J., and Kilburn, C. (1995) Lava flows on Alba Patera: analysis of flow properties using three complementary models. *Lunar and Planetary Science XXVI*, 861-862.

Lopes-Gautier, R., Bruno, B. C., Taylor, G. J., Smythe, W., and Kilburn, C. (1996) Analysis of Martian lava flows using three complementary models. *Lunar and Planetary Science XXVII*, 771-772.

Future publications

NASA Grant 3684 will be acknowledged in future publications now in preparation. These will deal with Theo's flow (the martian meteorite analog), Hawaiian basalts, lava tube formation, and computer modeling of lava flows with explicit attention paid to the shapes of the margins. Although other support contributed to these studies, NASA support was essential.

Inventions

No inventions were created during the course of this work.