Eruption Dynamics and Flow Morphology During the 2005 Sierra Negra Eruption, Galapagos Islands

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Overview of the 2005 Eruption

In 2005, a eruption occurred at Sierra Negra, Galapagos Islands. The eruption was documented by numerous observers, including scientists, tourists, and local residents. A variety of morphological features were observed, including a variety of lava types, such as pahoehoe, a’a, and toothpaste lavas. The eruption lasted for several days, resulting in the formation of new lava flows and the deposition of tephra.

Morphologic Types

SN06 17. The crater of the eruption flows with a smoothly flowing 'a'a lava, but also regions of Louisville where the lava poured out, allowing the flow to spread四处 (Fig. 13).

SN06 10 and 11. Overflow from the main channel consists mostly of smooth pillow lava with a layer of 'a'a lava (Fig. 12). All were emplaced within a day or two after each other. Often the end of the morphotypic formation of a discrete flow.

SN06 15. Lava collected from the immediate caldera floor has a morphology that overgrows the crystallinity of the sample, which may be due to the amount of pahoehoe lava in the foreground (Fig. 12). The transition between the Ovid flow and the caldera floor is gradual and almost continuous (Fig. 13).

SN06 16 and 17. Toothpaste lava was observed from a crack in the southern toe of the intrusion flow (Fig. 15). This is the only location where this morphological type has been observed.

Microscopy Textures & Morphology

Lava samples collected from the eruption provide evidence of a variety of textures and morphologies. The Ovid flow has a range of morphological types and crystallinity spanning from 0% to 100% (Fig. 20). In contrast, the caldera floor has a higher crystallinity, ranging from 0% to 100% (Fig. 21). Toothpaste lava has a high crystallinity, which is one of the controlling factors in a lava's morphology at Sierra Negra.

Petrology of Erupted Material

The lavas of the 2005 eruption are related by fractional crystallization of plagioclase, olivine, and clinopyroxene (Fig. 22). This relationship allows for the identification of the eruptive order of the lavas whose origins are otherwise unknown.

Relationship of Chemical Variations to Eruption Chronology

Chemical analysis of tephra collected during the eruption define two distinct groups: early and later volcanic deposits (Fig. 23). The chemical analyses allow for the identification of the eruptive order of the lavas whose origins are otherwise unknown.

SN06 07 through 14. Thick toothpaste lava was observed from the southern toe of the caldera floor flow (Fig. 12). This is the only location where this morphological type has been observed.

Figure 6. A morphological playground: the Ovid flow.

Figure 7. Overflows from the main channel.

Figure 8. Breakouts from the caldera floor flow.

Figure 9. Satellite imagery shows hotter activity in the northern part of the caldera.

Figure 10. Clastogenic flow with vent in upper left corner.

Figure 11. Intracaldera 'a'a is remarkably uniform.

Figure 12. Toothpaste lava from the southern toe of the caldera floor flow.

Figure 13. Sample site for SN06 17 (A-C).

Figure 14. Samples localities along the Ovid flow (a.). Close up view of SN06 14 A-C.

Figure 15. The different morphological types of 2005 lava and tephra are compositionally distinct.

Figure 16. Petrolergetic field of the Ovid flow.

Figure 17. The distinction between earlier and later lava.

Figure 18. Slowly cooled lava. Clinopyroxene frequently overgrows the crystallinity of each lava.

Figure 19. The petrology of erupted material.

Figure 20. Super-imposed timeline of the compositional data.

Figure 21. Chemical compositions of the Ovid flow.

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Figure 23. Average crystallinities for 20 of the 2005 samples. Clastogenic rocks do not contain enough crystallinity to be used in the crystallinity measurements.

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Figure 27. Imbricated microlites and higher crystallinities are present in the toothpaste lava.

Figure 28. Toothpaste lava has a high crystallinity, which is one of the controlling factors in a lava's morphology at Sierra Negra.

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