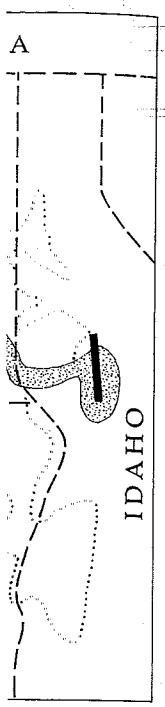

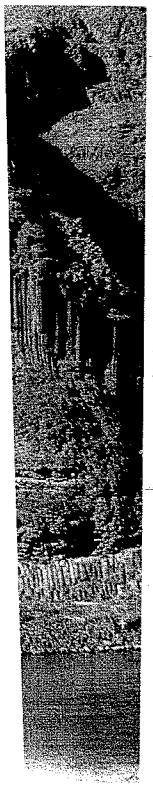

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7.1 A typical basalt lava

Before looking at the physics underlying the flow of lava, let us review briefly what happens to a lava of modest scale, traced from source to toe. For a technical account of an individual flow, Lipman and Banks's description of a 1984 Mauna Loa flow is ideal.[4]

When it first emerges from below ground, a basalt lava is at a temperature of about 1200°C. It glows fiercely reddish yellow; noticeably redder than the colour of molten iron poured from a furnace. At this temperature, the molten rock is at its least viscous, so it flows downslope in a fiery torrent, splashing boisterously over minor obstacles, and cascading over larger obstacles in glowing fire-falls. Flow rates as high as 60 kilometres per hour were observed when the Nyiragongo lava lake was breached in 1977. Although the term 'rivers of fire' inevitably springs to the lips of narrators of volcano films, closer observation shows that the lava flows more like thick cream than water: an expression of its greater viscosity.

Fierce surface radiance quickly cools the flowing lava. Its glow fades to a less intense cherry red, while its viscosity increases to something more like molasses. As the viscosity increases, the lava flows more smoothly, slowing to the speed of a run, and then of a fast walk. Black streaks and blobs of chilled solid lava appear on the surface. (These dark streaks may *appear* black against the brighter background, but are themselves still very hot, and would probably appear red-hot against a dark background.) Initially, these streaks are no more substantial than flecks of foam on a boisterous mountain stream, soon engulfed once more in the main mass. As the lava cools further, more chilled material remains on the surface, agglomerating together to form progressively larger rafts which eventually cover the surface, hot lava itself glowing dully red only through cracks and fissures. At this temperature, the lava is extremely viscous, like sticky treacle. Its stickiness can make it difficult to extract the pole that volcanologists, obeying some irresistible atavistic urge, feel obliged to poke into it, if they can get near enough.

As cooling progresses, a rubbly surface layer of solidified lava blocks accumulates, carried on top of the moving lava like rock on a quarry conveyor belt. Solid lumps of lava also pile up in front of the advancing front of the flow. In the higher, hotter parts, the lava continually advances over this solid material, rolling over it like a caterpillar tractor. In its lower, colder parts the lava may resemble a static heap of slag from the outside, but mobile lava is still arriving deep within it and pushing forward. So the front of the flow is unstable, and there is a constant gentle clatter of small chunks of lava falling forward. Every now and then a larger mass breaks off, toppling forward in a glowing cascade, leaving a sullen red scar, quickly fading, to mark the place on the flow that it fell from. Where such a flow encounters trees, it usually pushes them over, rather than flowing round them.

In this way, the toe of the flow slowly advances, clattering and rattling forward like a shuffling slag heap. Barely perceptible movement of perhaps a few metres an hour continues until the supply dies away at source, and the flow becomes still and silent. In a matter of hours, the surface will be cool enough for geologists to swarm over it without harm, except for scorched boots and singed back sides. Deeper down, the interior mass cools much more slowly, so that for days afterwards the core may still be red hot; its glow visible through cracks and fissures. Rubbly lava is a remarkably effective insulator—in 1938 a couple of Russian geologists hopped on a raft of chilled lava on a moving flow from the Klyuchevskaya volcano in Kamchatka. They were carried along on the gently moving conveyor belt at about one and a half kilometres an hour while they made measurements of the viscosity of the lava, and eventually hopped off again, none the worse for wear, although the surface temperature of their raft was 300°C, and that of the flow interior many hundreds of degrees higher.

7.1.1 The 1783 Skaftár fires (Laki) fissure eruption

Of the innumerable lavas which have been erupted in modern times, the 200-year-old Laki

Volcanoes: A Planetary Perspective by Peter Francis
Clarendon Press, 1993, 443 pp.