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Lava penetrating water: submarine lava flows around the coasts of Pico Island, Azores

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Bathymetry data collected with a multibeam echo-sounder around Pico Island, Azores (Portugal) reveal a remarkable series of lava flows on the island's shelf with a variety of pristine structures that suggest how lava behaves on entering water. Many flows are dendritic in plan-view, some with channels and tumuli. Dendritic geometries are interpreted to arise from flow fronts repeatedly arrested by enhanced cooling and magma pressure subsequently causing new breakouts. Cascades of elongated flow fingers also occur, with individual fingers of comparable diameters to the largest known megapillows. Some flows have wide transverse clefts, in cases separating flows into segments, which are interpreted as caused by their upper surfaces having solidified, while their still-fluid cores allowed the surfaces to extend. A number of flows moved onto the

shelf as large bodies, stopped, and then sourced smaller lobes forming the dendritic patterns. This two-stage evolution and the tumuli (which lie on a low gradient immediately below a steep near-shore gradient) suggest that, after initial emplacement and development of a crust by cooling, some flows pressurized. Once movements ceased and viscous stresses dissipated, magmastatic pressure developed from the weight of flow interiors passing over cliffs and near-shore gradients. One group of flows traverses the island's submarine slope, so direct supply of lava to the slopes is possible, although volumetrically how important it is to the island's internal composition is difficult to tell from these data.

Based on observed strong surf erosion of historical flows, these delicate structures probably could not have survived passage through a moving sea level unmodified by erosion so they are unlikely to be pre-Holocene subaerial flows. They were are interpreted to have formed in the Holocene from flows penetrating sea level or possibly some from near-shore tube openings or vents. Such flows and abundant clastic deposits are ephemeral features that become remobilized by surf during times of lower sea level. The shelves of active volcanic islands are therefore active geologically and are far from being simple products of erosional truncation as was once envisaged.