

SHEET HYALOCLASTITE: DENSITY-CURRENT DEPOSITS OF QUENCH AND
BUBBLE-BURST FRAGMENTS FROM THIN, GLASSY SHEET LAVA FLOWS,
SEAMOUNT SIX, EASTERN PACIFIC OCEAN

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New observations with the submersible ALVIN and deep-tow camera show that bedded sheet-hyaloclastites are common deposits between 2024 and 1723 m depth on the upper flank of Seamount Six, located on the Cocos plate at 12°45'N, 102°35'W. The individual sheets are highly localized and of small areal extent (< 200 m²), though no vent sites were found. Several facies associations of hyaloclastite, with pillow talus, knobby fist-sized lava fragments and thin sheet lava (< 10 cm) underlying hyaloclastite, are identified. Recovered samples consist of angular, polyhedral sand-sized sideromelane shards and thin, bent, plate-like sideromelane fragments called Limu O'Pelee. Limu are solidified fragments of burst magma bubbles which formed by vaporization of water entrapped by lava. Analysis of lava and hyaloclastite shards including limu shows three geochemically distinct populations, depleted MORB (N1), more evolved NMORB (N2) and hawaiite (H) of diverse composition. In individual hyaloclastite samples, shards of two or three different types may occur in various proportions, though in samples of hyaloclastite associated with sheet lava the predominant shards are of the same geochemical type as the sheet lava.

Deposition of hyaloclastites occurred from lateral density currents formed by transformation from convective suspension settling. Grain size distribution, settling behaviour of different co-deposited shard types and sedimentary structures, together with pelagic ooze in the matrix and geochemically mixed shard populations, indicate some erosion, traction reworking and turbulence during transport.

Critical observations are that contorted sheet lava protrudes through hyaloclastite and that sheet lava flow vugs commonly contain pelagic ooze. Facies associations plus consideration of limu formation allow the establishment of a new, multi-component model of hyaloclastite formation. It is inferred that the formation of limu-bearing sheet hyaloclastite involves entrapment of pelagic sediment beneath or within lava. This leads to limu bubble formation and suppressed tephra jetting. Together with convectively rising water heated by the lava flow, these processes loft shards slightly into the water column, from which they settle singly or in vertical sediment gravity flows that are redirected to flow along the seafloor.

Keywords: hyaloclastite, seamount, sheet lava, sedimentary density current

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