FAST COASTAL PROCESSES ON VOLCANIC SHORELINES: EXAMPLES FROM STROMBOLI, ITALY

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Abstract
Very fast coastal processes occur on volcanic coastlines, particularly in response to alternating constructive (eruptive activity) and destructive (erosion or collapse) stages. Rapid morphologic readjustment has been documented at Stromboli after the 30/12/2002 landslide and tsunami. Studies of historical coastal evolution of the island, reconstructed from maps and aerial photographs dating back to the past century, clearly indicated that coastal processes develop at high rates. Alternating coastal accretion and erosion stages have been recognized, in fact, for the main beaches of the island, where accretion is related to main stages of eruptive activity and to littoral drift processes redistributing sediment along the coasts.
Keywords : Aeolian Arc, Coastal Processes, Tyrrhenian Sea.

Stromboli is located at the NE end of the Aeolian Archipelago in the Southern Tyrrhenian Sea. It is known worldwide for its persistent, mainly mildly explosive, central volcanic activity spanning at least the last 2000 years. In historical times, volcanic activity has been mostly concentrated on one flank of the island (western), which supplies sediments for most of the northern beaches. Sciara del Fuoco, a horseshoe-shaped feature located in the western flank of the island, is in fact where most of the volcanic products/lavas of recent activity have been accumulated. It is a partially filled scar, formed in the last of a series of major flank collapses; its steep lateral walls extend well below sea level and act as a channelway to the sea for most of the eruptive products. Loose volcaniclastic materials (breccia, gravel and sand) are reworked gravitationally down the steep Sciara scree slope (>38°) to the sea shore. Small lava deltas, built when lava flows reached the sea during the last main historical eruptions (such as in 1930, 1954-55, 1967, 1975, 1985-86, 2002-2003), have invariably been almost completely eroded away by wave action within a few days or months after formation. As directly observed during the 2002-2003 eruption, the entrance of lava flows into the sea at the foot of Sciara del Fuoco, and the interaction with seawater there, directly produces large quantities of volcaniclastic deposits by quenching and fragmentation due to phreatic explosions. This caused, for instance, the initial filling of the slide scar created by the 30/12/2002 landslide event, at present almost completely obliterated.

The foot of the Sciara del Fuoco slope is exposed to westerly winds; from data on the marine climate, it is expected that nearshore waves and wind-generated currents induce a prevalent clockwise drift along the N half of the island. From Sciara del Fuoco, in fact, sands and gravel drift alongshore, due to this prevalent and most energetic wave climate approach, and reach beaches on the north and northeastern side of the island, where the sediment residence in the nearshore is promoted by the physiographic setting.

Evolution of the N and NE coastlines of Stromboli in the last 50 years has been traced in detail using historical maps and series of vertical aerial photographs, taken on average at decadal intervals [1]. There are evidences that the historical evolution of beaches at Stromboli can be related to the occurrence of volcanic activity. While cliffed tracts were relatively stable, in fact, beaches on the N and NE side of the island experienced alternating accretion and erosional stages linked, respectively, with the contemporary eruptions and with sediment redistribution and/or the washing out and loss of sediment to deeper waters.

In particular, in the northern and northeastern sector of the island, from a condition of prevailing coastal erosion at the end of the 1800s, beaches accreted until 1938 and during the period of 1967-1987 and were slowly but consistently eroded during the intervals 1938-1955 and 1987-2001. Periods of coastal accretion follow episodes of relatively intense volcanic activity, as recently observed after the 2002-2003 eruptive crisis. On the other hand, during stages of lowered eruptive activity (as, for instance, in the interval 1938-55 or 1987-2001), a diffused reduction in beach volume has been documented, possibly induced by washing out and loss of sediment to deeper waters under storm conditions, particularly where active canyons and gullies dissect the coastal sectors.

Complementary information from field studies and beach sediment analyses (granulometric data and rounding observation) also support the clockwise longshore drift model along the western, northern and north-eastern coasts of the island.

Reference

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