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Pleistocene sector collapses in the Aeolian Islands: tsunami hazard implications

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The sector collapse of island volcanoes poses serious hazard in terms of tsunami-genetic submarine landslides. In our work we identified four main sector collapses occurred between 87 and 15 ka at Salina, Lipari and Vulcano islands (Aeolian Islands, Southern Tyrrhenian Sea) by merging volcanological, geomorphological and structural information with altimetric and bathymetric data. The Rivi-Capo collapse (Salina) was connected to a NE-SW striking structural discontinuity, i.e. the Rivi-Capo dyke and fault system, along which post-eruptive hydrothermal activity developed. Hence, the collapse of the northern sector of the edifice may have been due to the weakening effect of hydrothermalism. In this respect, it is worth noting that hydrothermal activity was responsible for the small landslide that affected the Fossa Cone in 1988 and produced a tsunami with a Sieberg-Ambraseys intensity 2. The Porri (Salina) and Chirica (Lipari) collapses do not appear to be related to hydrothermalism. The steep Porri volcano is affected by NE-SW striking faults, and Chirica developed along a WNW-ESE structural discontinuity. As a result, the Porri and Chirica collapses could be related to the destabilization of the edifice by faulting. At Vulcano, the 14-15 ka Fossa Caldera represents a pull-apart structure related to the main NNW-SSE striking strike-slip faults of the central Aeolians, and its formation is not related to eruptive activity either. Structural and tomography data are consistent with a vertical, piston-like collapse geometry. However, the eastern sector of the Fossa Caldera is occupied by a NE-SW oriented, large, submarine valley, whose occurrence calls for a lateral collapse. We propose that the northeastern, ancestral boundary of the Fossa Caldera slided into the sea, and hence the present-day depression originated from a

vertical collapse followed by a lateral sliding of its northeastern sector.

From new integrated DEM data we calculated volumes, maximum runout (L) and vertical drop (H) of the material remobilized by the Rivi-Capo, Porri, Chirica and Fossa Caldera collapses. The on-land missing volumes of the Salina, Lipari and Vulcano collapses are between 0.7 and 4.5 km^3. The offshore volumes of the hummocky terrains are between 0.034 and 0.9 km^3. For Rivi-Capo and Porri, the accumulated material is significantly lower than the missing material. However, the offshore collapsed sectors of Rivi-Capo and Porri are affected by two late Pleistocene abrasion platforms. As a consequence, these significant erosional phases may have destroyed the near-offshore accumulated material. The obtained H/L ratios are between 0.19 and 0.27, and these values are in the range of those of subaerial volcanic landslides (H/L=0.2-0.4). We note that the inception of the collapses occurred subaerially and most were emplaced under the sea.

Future catastrophic landslides involving the calculated $10^{-2}$to 1 km^3 volumes may trigger destructive tsunamis much larger than that occurred at Stromboli in 2002. The 2002 Stromboli collapse, involving volumes one to two orders of magnitude lower, produced a tsunami with a Sieberg-Ambraseys intensity 5. As a consequence, tsunami hazard related to possible future sector collapses similar to those described in our study must be seriously assessed in the Aeolian Islands.