COUPLED VOLCANO EDIFICE- AND CONTINENTAL MARGIN DEFORMATION AND INSTABILITY AT MT ETNA, ITALY

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Abstract

Mt Etna's volcano edifice, known as Europe's largest volcano, reveals a large-scale instability at its eastern flank. In order to investigate the extension of this deformation and coherent instability, a new high-resolution 2D/3D reflection seismic dataset was acquired during research cruise M86/2. The dataset shows in high detail the deformation pattern at the submerged continental margin offshore Mt Etna. The limits of the continental margin's deformation were identified by transpressional and compressive tectonic structures. Based on the new dataset and available onshore data, we propose a coupled volcano edifice and continental margin deformation, leading to a large-scale on- and offshore instability.

Keywords: Geohazards, Ionian Sea, Tectonics, Volcanology

Mt Etna is Europe's largest volcano (3323 m a.s.l.), which was established on the eastern coast of Sicily ~500 ka ago. Gravitational instability on Mt Etna's volcano edifice was first described by Borgia et al. (1992). Due to a lack of marine geological and geophysical data, the extension of this instability in the direction of the submerged volcano flank and continental margin was only recently considered and investigated. Chiocci et al. (2011) presented the first multi-beam bathymetry map of the submerged continental margin offshore Mt Etna, showing a complex morphology that differs significantly from Sicily's continental margin not affected by the volcano buildup. Chiocci et al. (2011) proposed a large-scale continental margin instability, linked to an ancient large-scale slope failure. Based on 2D reflection seismic profiles, Argnani et al. (2013) presented deep and shallow seated extensional deformation patterns at the continental margin. Nevertheless, Argnani et al. (2013) did not observe any clear evidence for the limits of this deformation.

In order to investigate the deformation of the continental margin in detail, a high-resolution 2D/3D seismic dataset was acquired during research cruise M86/2 (December 2011 - January 2012).

The 2D seismic profiles reveal a complex tectonic setting, dominated by extensional faulting on the continental margin. The eastern limit of the deformation is characterised by two major N-S trending anticlines (Fig. 1), revealing syn-tectonic activity. The northern boundary of the deformed margin is marked by a stratigraphic disconformity at Riposto Ridge (Fig. 1). The southern boundary of the system is displayed by a positive flower structure, indicating a deep-seated transpressional fault. This fault system can be traced by a prominent morphological lineament from the continental margin towards the onshore observed southern fault system. A high-resolution 3D P-Cable seismic dataset reveals the deformation of the boundary between Valle di Archirafi and a prominent amphitheater-like structure (Fig. 1).

The data suggest a strong link between the tectonic system of the Timpe Fault System onshore and the head of the amphitheater-like structure offshore. As most of the faults are traceable to the seafloor, we suggest that this system is highly active. Furthermore, a domino-style fault system, dipping towards the headwall of the amphitheater, was identified. This implies high activity of this tectonically-controlled system. As tectonic lineaments and structures can be traced from the volcano edifice to the continental margin, we propose a coupled volcano edifice and continental margin instability.

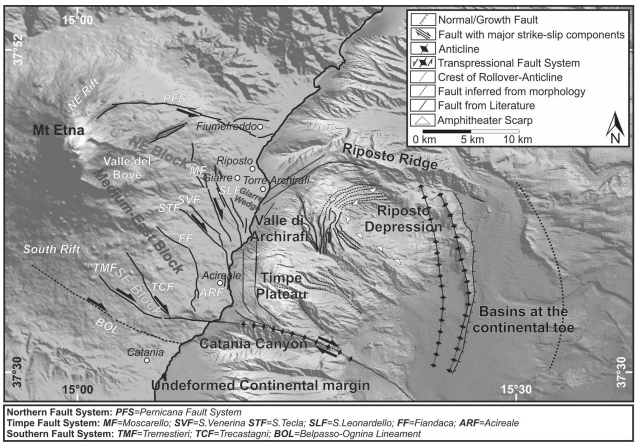

Fig. 1. New morpho-tectonic map of the onshore volcano edifice and the submerged continental margin.

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