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Transient magmatic control in a tectonic domain: the central Aeolian volcanic arc (South Italy)

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The background stress field in volcanic areas may be overprinted by that produced by transient magmatic intrusions, generating local faulting. These events are rarely monitored and thus not fully understood, generating debate about the role of magma and tectonics in any geodynamic setting. Here we carried out a field structural analysis on the NNW-SSE strike-slip system of the central Aeolian Arc, Italy (Lipari and Vulcano islands) with ages constrained by stratigraphy to better capture the tectonic and magmatic evolution at the local and regional scales. We consider both islands as a single magmatic system and define 5 principal stratigraphic units based on magmatic and tectonic activity. We collected >500 measurements of faults, extension fractures and dikes at 40 sites, mostly NNE-SSW to NNW-SSE oriented with a dominant NS orientation. These structures are governed quasi exclusively by pure dip-slip motion, consistent with an E-W extension direction, with minor dextral and sinistral slip, the latter being mostly related to old deposits (>50 ka). We further reconstructed the evolution of the Vulcano-Lipari system during the last $\sim$20 ka and find that it consists of an overall half-graben-like structure, with faults with predominant eastward dips. Field evidence suggests that faulting occurs often in temporal and spatial relation with magmatic events, suggesting that most of the observable deformation derived from transient magmatic activity, rather than from steady regional tectonics. To explain the dominant magmatic and episodic extension in a tectonic dominant domain, we propose a model where the regional N-S trending maximum horizontal stress, responsible for strike-slip activity, locally rotates to vertical in response to transient pressurization of the magmatic system and magma rise below Lipari and Vulcano. This has possibly generated the propagation of N-S trending dikes in the past 1 ka along a 10 km long by 1 km wide crustal corridor, with important implications for volcanic hazard assessment.