Abstract

The Late Eocene Nanchititla mafic dyke swarm consists of over one hundred vertical and parallel dyke segments emplaced in southern Mexico. Here, we present a geological and physical description of the dyke swarm, and discuss the emplacement mechanism at the regional and local scale. The host-rock is a continental sedimentary sequence interbedded with volcanic rocks at different levels. Measurements of the apparent Young’s modulus and Uniaxial Compressive Strength (UCS) made with a Schmidt hammer at different levels of the host-rock sequence yielded values from 5 to 45 GPa and from 20 to 90 MPa, respectively. The stratified host rock is mechanically heterogeneous, composed of soft (siltstone) to strong (volcanic breccia) materials. This mechanical contrast has a local effect in the emplacement of dykes inducing sill formation, non-planar morphologies of the dyke walls, en echelon dyke segments, finger-like intrusions, and plastic deformation in some part of the host rock. The weaker siltstone-bearing sequences allowed heterogeneous interaction with the magmatic fluid; whereas stiffer sequences produced fractures parallel to dykes and brecciation. The general trend of the swarm indicates a NNE-SSW orientation of the minimum compressive stress during dyke emplacement, and the parallelism of the dykes with respect to strike-slip faults suggests that the left-lateral deformation regime prevailing in southern Mexico during the early Cenozoic might have influenced its general orientation. We propose that the Nanchititla mafic dyke swarm was emplaced by overpressure of the magma at a shallow crustal level, during the early stages of a non-coaxial transtensional deformation episode in southern Mexico.

Keywords

Dyke swarm, tectonic regime, apparent Young’s modulus, mechanical stratigraphy, Sierra Madre del Sur, Mexico.