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Structural interpretation of Santiago Island (Cape Verde) based on remote sensing techniques

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Santiago Island is one of the ten islands of Cape Verde Archipelago. This archipelago is located on the central Atlantic Ocean at about 10º to 16ºN, 22º to 24ºW, and belongs to a major group of Atlantic islands, the Macaronesian Islands, which includes Azores, Madeira and Canary islands.

The Cape Verde islands are rooted on an uplifted domain of oceanic crust (Cape Verde Swell) and are associated to intra-plate volcanic processes, which started about 60 Ma ago and still proceed nowadays.

The tectonic setting of Cape Verde Archipelago is complex and several interpretations were published. However, geographic, geologic, tectonic and geomorphological regional evidences points to the interference of: (1) MAR transformation faults, (2) important uplifting processes and (3) regional main NW-SE and NNE-SSW tectonic structures.

Santiago Island is the biggest island of the Archipelago (991 km^2) and is elongated NNW-SSE. The volcanic stratigraphy includes: (1) an older Volcanic Complex associated to proto-insular and submarine volcanism and (2) a sequence of volcanic formations and complexes dominated by subaerial volcanic events. Basaltic volcanics predominate, which are represented by lava-flows, pyroclast deposits, volcanic dikes and necks. Phonolithic and trachytic rocks outcrops less extensively. There are strong evidences of important uplift events during the island geotectonic evolution.

The above described volcanic stratigraphy was established from the available geological maps. However, structural data lack in most of the cases. With the purpose of recognize the structural lineaments and to contribute for a better understanding of the genesis and evolution of this island, remote sensing techniques were applied to data from sensors operating in the optical spectrum (ASTER). The studied image, level 1B, collected during the dry season (02-04-03), was geometrically corrected on the basis of the available topographic data and georeferenced to U.T.M. projection system with datum WGS-84. A digital elevation model of the island, with a pixel of 10 m, was build from topography and used in the lineament analysis. For this purpose directional filters were applied on the optical data as well as on the elevation data. The lineaments were traced automatically and by visual inspection; the Geomatica software (v10.1), from PCI, was used in both cases.

A dense lineament network was interpreted, dominated by N10-30ºE, N45-65ºE, E-W, N50-70ºW and N15-35ºW directions. The N10-30ºE and N45-55ºE systems control the main morphostructural features, and seems to be the focus of the main volcanic eruptions. In the first case, 5 different units were identified.

Combining lineament data, DEM and geological data it can be concluded that the main structural lineaments played as strike-slip faults (sinistral and dextral) or as dip-slip faults (normal and reverse), revealing a complex tectonic evolution. In some cases, especially for normal faults, the vertical displacement could reach some dozens of meters.

The identified lineaments and interpreted structural pattern of Santiago island is clearly compatible with the regional tectonic alignments and processes. However, more data acquisition, particularly field recognition, and structural interpretation are required and are presently under progress.

The methodology used in this work seems to be a quick and an efficient way to allow the recognition of probable structural lineaments, particularly in areas where tectonic studies were not made or the field access or the outcrops are limited.