Geophysical Research Abstracts
Vol. 13, EGU2011-13408, 2011
EGU General Assembly 2011

Geomorphologic evidences of an extensional NW-SE fault zone in the central sector of Gran Canaria (Canary Islands, Spain)

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Gran Canaria is a volcanic island with more than 14.5 Ma, which are recognized remains of several overlapping volcanic edifices: a basaltic shield volcano, a collapsed caldera of rhyolite-trachyte-phonolite composition, a stratovolcano alternating basic and acid emissions, and basanitic-basaltic fissure eruptions. These reliefs are partially covered by a recent alkaline volcanism which developed cinder cones and phreatomagmatic calderas.

Tectonics of Gran Canaria Island has been widely discussed because of the particular distribution of volcanism. The oldest formations are mainly located in the southwest, while the most recent being in the northeast.

Traditionally, the existence of a hotspot under the Canary archipelago has assumed. Recently, some volcanologists have proposed some tectonic activity to explain the structure and evolution of the archipelago.

Our study provides several geomorphologic observations that support the hypothesis of a NW-SE fracture zone that crosses the Gran Canaria Island from side to side:

1. The lineation map. It was derived from satellite image and shows a high density of morphological structures with a main NW-SE trend in the central zone of the island. At the northern sector of the island, some of these lineations are the dikes related to basanitic-basaltic fissure eruptions. At the southern sector of the island, some of the lineations are the dikes related to the rhyolitic-trachytic-phonolitic stage.
2. The elliptical shape of the collapsed caldera of rhyolite-trachyte-phonolite composition. Collapsed calderas are usually circular but if a fracture influences its formation, it takes an elliptical geometry with the fracture as the main axis. The elliptical shape of the collapsed caldera of the basic-acid stratovolcano is elongated following a NW-SE trend and also agrees with the main trend noticed by two negative gravity anomalies detected inside the caldera, which have been interpreted as filled calderas by the collapsed materials.
3. The alignment of a dozen of phonolitic domes related to the basic-acid stratovolcano which marks the supposed fault zone at the central part of the island.
4. The high density of lineations (fractures and dikes) that are in the two main canyons of the island (Tirajana, La Aldea), both with a NW-SE trend.
5. The large number of gravitational landslides recognized in the main canyons of the island (Tirajana, La Aldea).
6. The existence of small sharp elbows in the drainage system with a main NW-SE trend in both the northern and southern sector of the island. These bends define a bayonet-shape path.
7. The existence of anomalous hills that link the headwaters of the canyons following a main NW-SE trend.
8. The efficiency of erosion in the canyons which are aligned following the NW-SE trend. All of them have been developed a strong incision in the rocky substratum more than one occasion, as they have undergone several restorations of the channel by the accumulation of intracanyon lavas.
9. The evidence of some vertical island instability. An ancient coastal guidance level located above current sea level has been recognized in the northern sector of the island. By contrast, in the southern sector there are no signs of collapse: the alluvial fans and old marine abrasion platforms are located to the current sea level.

All of these geomorphologic observations support the hypothesis of an uncoupling of the Gran Canaria Island into two parts following an extensional NW-SE fault zone located at the central part of the island.