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Comment

Comment on "The distribution of basaltic volcanism on Tenerife, Canary Islands: Implications on the origin and dynamics of the rift systems" by A. Geyer and J. Martí. Tectonophysics 483 (2010) 310–326

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In their article, Geyer and Martí (2010) propose that the evolution and origin of the volcanic islands which constitute the Canarian archipelago are strongly controlled by regional tectonic "Atlantic" and "African" structures. In their Fig. 1a they sketch the geometry of the Iberian and Moroccan microplates and the respective boundary zones with respect to Africa (Nubia) and Eurasia (Mantovani et al., 2007). Dashed lines indicating presumed plate boundaries cross the Canarian archipelago, which will therefore be located along a lithospheric fracture, the boundary between the Moroccan and African (Nubia) microplates. This regional fracture extends from the Atlas to the Atlantis fracture zone, coinciding in parts with the propagating fracture postulated by Anguita and Hernán (1975). In Fig. 1b of Geyer and Martí (2010), dashed lines indicate the orientation of the most evident tectonic structures visible on the ocean floor. As we show in this comment, all of these mapped "faults" are artifacts.

Two main models were proposed in 1975 to account for the origin and structural evolution of the Canary Islands. Anguita and Hernán (1975) associated the Canarian magmatism to a propagating fracture from the Atlas. This model is based upon structures that cut through the lithosphere to be the cause of, and the control for, the location of the volcanism. Alternatively, Carracedo (1975) postulated an upwelling mantle plume (cf. Morgan, 1971), a feature largely independent of the lithosphere.

Abundant literature has been published thereafter supporting the hot spot model (Carracedo, 1979, 1994, 1996, 1999; Schmincke, 1982; Holik et al., 1991; Hoernle et al., 1991; Hoernle and Schmincke, 1993; Carracedo et al., 1998; Guillou et al., 1996, 2004; Geldmacher et al., 2001, 2005). Moreover, the propagating fracture model has severe difficulties in being unable to account for the large volumes of magma required to develop the Canary volcanic province (McKenzie and Bickle, 1988; White and McKenzie, 1989). Being aware of this weakness, Anguita and Hernán (2000) accepted the existence of an upwelling mantle plume under the Canary Islands, with a fracture system associated to the Atlas Mountains, which facilitated and directed the ascent of magmas. Although local seismicity has been detected around the Canaries (such as in 1989), no evidence has been found to prove the existence of any major fault connecting the Atlas with the Canaries in any detailed geophysical studies of the area (Martínez and Buitrago, 2002) or around the Canarian archipelago (Funck et al., 1996; Urgeles et al., 1998; Watts, 1994; Watts et al., 1997; Krastel et al., 2001; Krastel and Schmincke, 2002).

Particularly high resolution data evidence is provided by Krastel and Schmincke (2002). This data points against the existence of a major fault zone in the channel between Gran Canaria and Tenerife, formerly postulated by Mezcua et al. (1992) following an original hypothesis by Dash and Bosshard (1969), to explain the occurrence of a magnitude 5.2 earthquake in this area that was followed by a large number of aftershocks. Krastel and Schmincke (2002) interpreted seismic, sidescan sonar, bathymetric multibeam, as well as dredge sample and ODP (Ocean Drilling Program) drill core data obtained from this channel, and could not identify a major fault or fault system in the area. They interpreted the seismicity to be related to a cluster of volcanic cones scattered in the area being younger than the 830 ka submarine Güímar debris avalanche deposit (Carracedo et al., in press). Already Krastel and Schmincke (2002) attributed this volcanic cluster to be a result of post-collapse Güímar volcanism (cf. Manconi et al., 2009) and alerted the reader clearly in their Fig. 3 that the strong linear features that trend mainly in a SW–NE direction are artifacts reflect that the ship tracks during multi-beam data acquisition.

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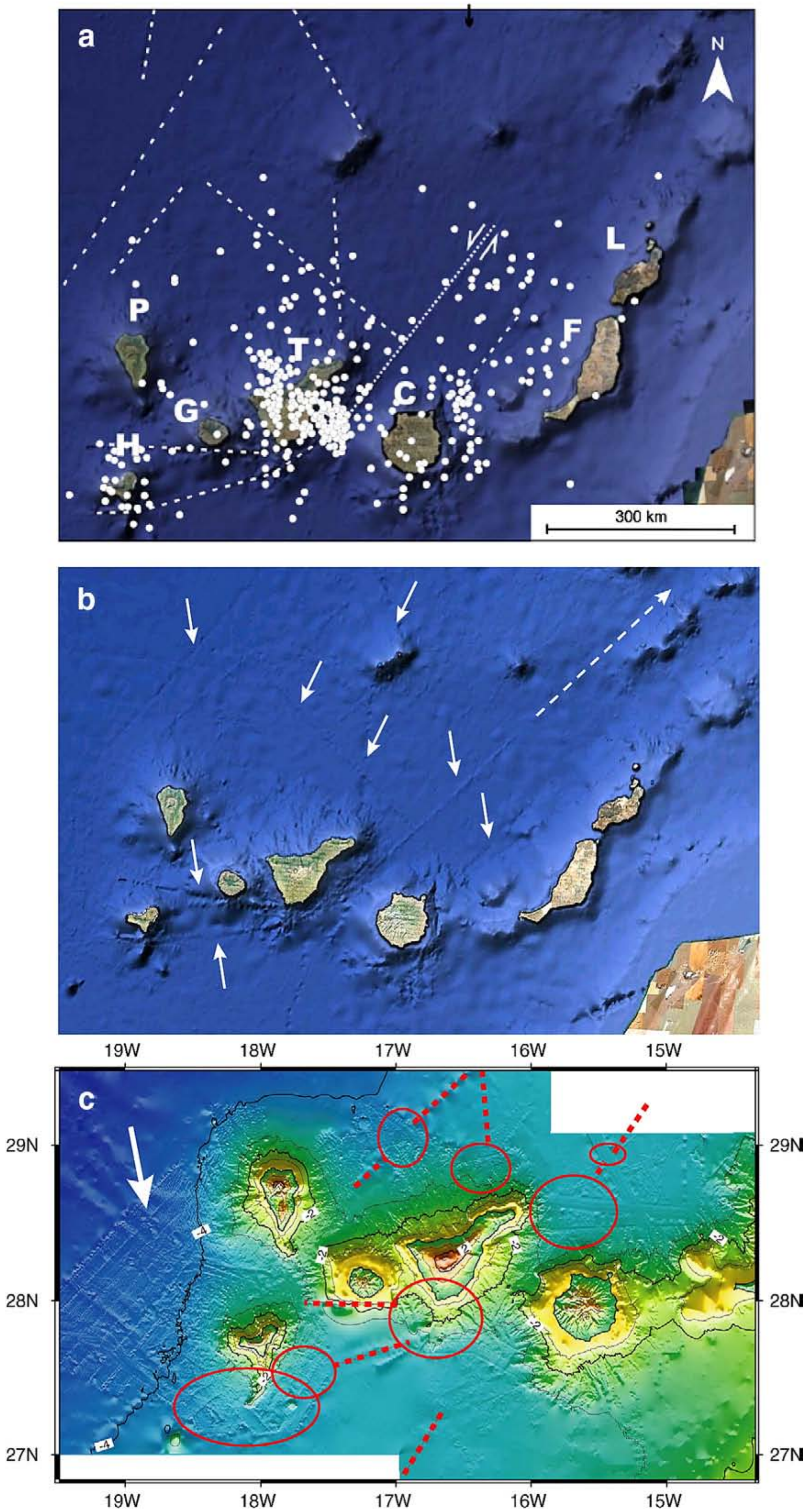

Fig. 1. a: Google Earth image of the Canarian Archipelago in Fig. 1 of Geyer and Martí (2010). Dashed lines indicate for these authors the orientation of the most evident tectonic structures visible on the ocean floor. Densely dotted line corresponds to the postulated sinistral transcurrent fault between Tenerife and Gran Canaria. b: Google Earth image with artifacts (arrows) due to ship track lines coinciding with the alleged faults of Geyer and Martí (2010). Prolongation of the alleged faults (dashed arrow) would be detached from the Atlas system. c: Compilation of multi-beam bathymetric data after Krastel et al. (2001) and Masson et al. (2002). Red dashed lines are the artifacts interpreted as faults by Geyer and Martí (2010). Circled areas depict high resolution data that reveal absence of the surface expression of the alleged "faults".

This latest paper (Geyer and Martí, 2010) challenges once more the origin of the islands and their rift zones. Our critisism is four-fold: 1.) Using a 2D-model for rift zones inherently ignores gravitational forces and variable intrusion depths that are long known to have major control on stress and strain distribution (e.g. Fiske and Jackson, 1972; Dieterich, 1988; McGuire and Pullen, 1989; Mitchell, 2001; Dieterich et al., 2003).

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2. Their paper fails to acknowledge recently published age dates that imply the N–S rift to have been active after 0.18 Ma (see Carracedo et al., 2007). 3.) The existence of a 3rd, weaker and often passive rift arm is well established for the Canaries as well as for Hawaii and is not a new concept (see Dieterich, 1988; Walter and Troll, 2003; Walter et al., 2005 and references therein). 4.) The most fundamental flaw of their work, however, is that Geyer and Martí (2010) base their rationale mainly on the existence of "crustal fractures" that apparently predate the formation of the Canaries, shown in their Fig. 1. It is easy to see that these fractures are, for most parts, artifacts. These "fractures" are ship lines or seams between different data sets of the Google Earth® data that Geyer and Marti used (Fig. 1a–b). These "prominent faults" disappear in regions where higher resolution data are available (e.g. Fig. 1c; Krastel and Schmincke, 2002). If the alleged faults had a surface expression in the ocean basins, then they should also cut the volcaniclastic aprons of the islands (e.g. the debris avalanche deposits of the Güímar landslide) and recent marine sediments, and they should be seismically active. However, the "faults" do not cut through apron deposits (Fig. 1c). Furthermore, Fig. 1b of Geyer and Martí (2010) shows that seismic events in and around the Canary Islands cluster around Tenerife and El Hierro, and between Gran Canaria and Fuerteventura, but not along the alleged "faults". Beyond these volcanic islands the seismicity declines, and disappears between Lanzarote and the Atlas continental margin.

Although we welcome the renewed discussion on the origin of Canary volcanism, Geyer and Martí (2010) based their model for the origin of the Canaries and the Canary rifts on "faults" that are obvious artifacts. Their model has therefore no geological basis and appears to be a *sophism*, i.e. an elaborate construct of argumentation that is founded on a wrong belief or assumption. We do not preclude the existence of faults in the ocean crust *per se*, but we would hope to see compelling evidence for these before they can be considered as major control on Canary volcanism.

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