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Hydrology and Earth System Sciences Discussions

Interactive comment on "Hydrogeological settings of a volcanic island (San Cristóbal, Galapagos) from joint interpretation of airborne electromagnetics and geomorphological observations" *by* A. Pryet et al.

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We are thankful to the reviewer for his comments and corrections. We agree with the proposed changes in language, they will be taken into account to improve the manuscript. Two main comments arise in this review: a first regarding the relation between faults, fissures and dykes, a second regarding the nature of the central low resistivity channel interpreted as a dyke-impounded aquifer.

1 Fissures, Faults and Dykes

In the discussion paper (l. 11-14, p. 9665) we state that "*antithetic normal faults intruded by dykes are the evidence of a NNW-SSE* [extensional] *tectonic stress*". The reviewer puts this assertion into question: "*there is no way to tell if they are normal or reverse*", and "[He does] *not know of a single locality in Galapagos where dikes are observed to intrude faults, nor where fissures are on-line with a fault*".

It is beyond the scope of this paper to conclude on the exact nature of faults and their interactions with dykes on San Cristóbal Island. Due to the difficulty of access and paucity of outcrops, we acknowledge that our assertions can hardly be demonstrated. These lines will be rewritten with a more careful wording. Nevertheless, observations at the northwest of the area of interest give support to our assertions.

Faults scarps (Figs. 1 and 2 in the discussion paper and Fig. 1 in this comment) align with the main axis of the southwestern shield (WSW-ENE), which suggests that a same tectonic stress is likely to be at the origin of the two. This tectonic stress must have been *extensional* to allow volcanic activity and the construction of volcanic cones that can be identified close to and along the scarps. As a result, dykes may locally coincide with normal faults on San Cristóbal Island.

2 Central low resistivity channel

The terms *scarp* and *offset* used in Section 3.2.4 (l. 18-22, p. 9670) are misleading and will be changed in a revised version of this manuscript. The *scarps* refered to are an effect of the resistivity contrast on the geophysical imagery visualized through the extraction of high resistivity cells in the 3D model. They do not refer to *fault scarps* in the subsurface or their expression at the surface.

As detailed in the conceptuel model (Fig. 7 in the manuscript), the central low resistivity channel is thought to be *dyke-impounded*, not necessarily *fault-bounded*. The occurrence of subvertical dykes accounts for the observed contrasts in resistivity. Additionally, eruptive cones at the surface align with the boundaries of the low resistivity channel, which support the presence of dykes.

3 Other comments

3.1 Potential contrasts between the windward and leeward sides of the island

In the discussion paper (l. 18, p. 9668), we state that "*The only difference that can be expected between the two sides* [of the island] *is a higher amount of volcanic ash blown by the trade-winds to the north. But these materials are easily weathered and would reduce resistivity in the north, contrary to what is observed.*"

We agree with the reviewer that there is no "*direct evidence*" of this phenomena, but it is proposed here as a hypothesis of a difference between the two sides, which in any case is later discarded for the purpose of explaining the observed difference.

During its constructive phase, several differences may have arisen between the leeward and windward sides of the edifice. But to our knowledge, the only difference that can be *a priori expected* between these two sides is the effect of trade winds conveying light ashes to the northwest.

3.2 High-level groundwater and low permeability layers

The reviewer brings following comment on Section 3.2.3: "*it seems odd to me that the word aquiclude is not used in this section. It seems that the key to the hydrology of*

these permeable rocks is to have bedrock that is a barrier to flow."

We agree with the second assertion: the key issue in the hydrology of young basaltic islands is the high permeability of rocks. The occurrence of impervious paleo-soil layers probably accounts for the existence of perched aquifer on San Cristóbal (l. 13, p. 9670).

Impervious layer and *poorly permeable layer* are synonymous of *aquiclude*, but to our knowledge, the former are more common in the literature.

3.3 Springs and streams

After the reviewer's own observations, numerous streams dry in extreme dry years (1981). We will mention this in the revised manuscript.

Besides, we will reword the sentence regarding the mapping of springs and avoid the use of the term "GPS Campaign".

Note: We agree with the other minor comments that are not mentioned in this document. They will be taken into account for the revised version of this manuscript.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 9661, 2012.

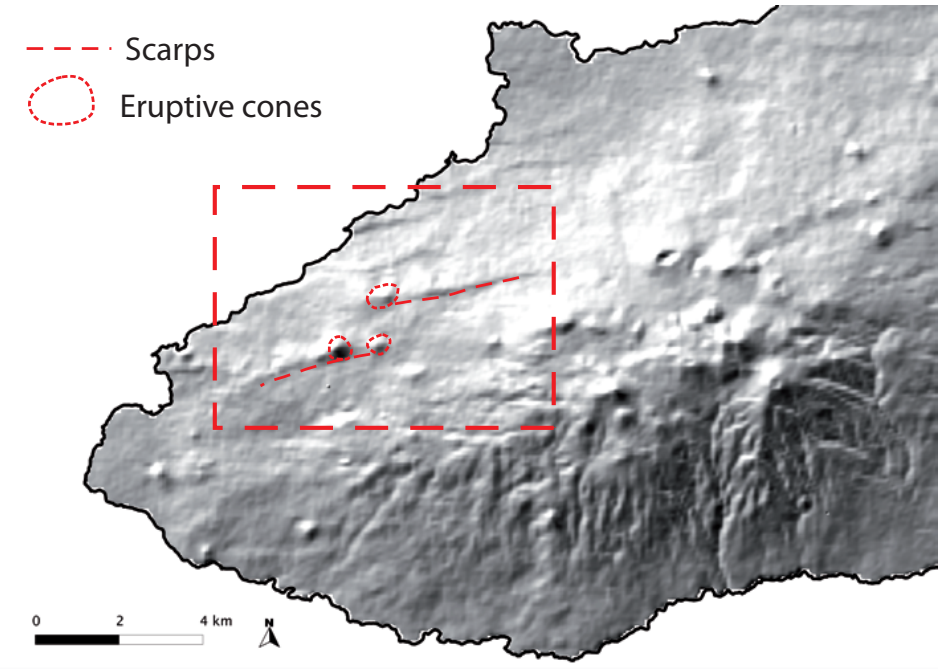

Fig. 1. The shaded relief map from the SRTM DEM reveals scarps offsetting vertically the topography. They align with eruptive cones at the northwest, which suggests the presence of intruding magma.