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The influence of intra-arc deformation along the Sumatra Fault System, Indonesia, on the volcanic geothermal systems

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The Sumatra Fault System is a regional dextral strike-slip fault zone which coincides with the subduction-related volcanic arc along the island of Sumatra, Indonesia. Structural analysis indicates that irregularities, segmentations and bendings, along the fault system are the primary factor which leads to both transtensional and transpressional deformation along its strike. The transtensional deformation is mostly accommodated by dilational step-overs in form of pull-apart basins, while the transpressional deformation occurs in restraining bends or step-overs. At regional scale there is no clear spatial correlation between the occurrences of these structural features and volcanism (i.e. the location of volcanic edifices). Nevertheless, at local scale smaller intrusion and volcanic features, such as dykes, sills, or domes, are influenced by the fault framework.
Elevated heat flow due to crustal thinning within pull-apart basin are well documented in other transtensional settings such as in California. However this is not clearly observed in Sumatra as deduced from the size and temperature of geothermal systems inside the basins. Analysis of associated geothermal systems suggests that although the upflow zone of geothermal fluid circulation is strongly controlled by intrusions in relation with the volcanic edifices, its convective outflows and associated thermal hotspots may occur both in pull apart segments as well as restraining bends. It is observed that within pull-apart basin the outflow tends to be compartmented or confined around permeable structures. Based on our observation, we propose that in pull-apart settings the elevated topography, which envelops the depression, creates advection of cold meteoric water which then confines or even chops-off the convection of hydrothermal system. In contrast, outflow system in restraining bend tends to be relatively widespread in lateral sense due to absence of prominent topographic depression.