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The Bouillante 3D Structural Model (French West Indies): a Tool for Geothermal Exploration Combining Onshore and Offshore Geological Knowledge

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The Bouillante area is located on the West side of the Guadeloupe Island (French West Indies); a region well known for geothermal resources. This sector is a key geodynamic area (e.g. Bouysse et al. 1988; Feuillet et al., 2002) at the junction of two regional fault systems: i) a major submarine N160°E strike-slip fault belonging to the normal-sinistral Montserrat-Bouillante-Les Saintes system, only detected offshore (Thinon et al., 2010), and ii) the western end of the interpretative ESE-WNW Bouillante-Capesterre normal fault which is probably a major fault of the E-W Marie-Galante graben system. At the junction, faults observed on the field mainly elongate along the E-W direction (Bouchot et al., 2010) whereas offshore structures interpreted from marine seismic lines shows a larger range of directions (Thinon et al., 2010).
To achieve a coherent structural interpretation of the zone, data and observations from the sea and from the ground were combined into a 3D structural model. Firstly, a Digital Elevation Model was created merging onshore and offshore data in a 50 m resolution 2D grid to cap the structural model. Then, a 15 km x 16 km zone was modelled down to 10 km vertical extension to interpret regional structures. Data are interpolated using the potential field method developed in BRGM and implemented in the 3D GeoModeller software (Calcagno et al, 2008).
Onshore, data consist in faults observed and measured during field work. Due to outcrops poor accessibility, these data are mainly located on the coast where sea erosion is intense. Inland, some structures are interpreted from previous works mainly based on topography (e.g. Feuillet et al, 2002). Offshore, location and dip of the faults are derived from the acoustic basement offset interpreted in 52 seismic profiles representing about 180 km long in total. To construct a coherent interpretation, E-W structures observed onshore were as much as possible a guide to interpret and to connect E-W structures offshore.
The final 3D interpretation highlights 3 clusters of coherent structures, mainly oriented E-W, elongating onshore and offshore. This distribution may be interpreted as westward E-W fault corridors, consistent with a major fault located on Bouillante city. On the other hand, the model highlights an offshore NE-SW direction that is not observed onshore so far, except at the Pointe Marsolle outcrop. Probably combining normal and strike slip movements, these faults could limit E-W fractured blocks as interpreted offshore Bouillante city. Another offshore family of faults, oriented NW-SE, is limited on the Montserrat-Bouillante-Les Saintes fault zone; such a direction is not observed onshore except possibly at the Colas bay.
As permeable zones, the fault clusters highlighted by the structural modelling are good candidates for preferential geothermal fluid circulation. Consequently, a particular attention will be paid to them for exploration purpose. Furthermore, places were E-W faults modelled only offshore would cross the coast will be interesting spots to investigate onshore. To go further, the 3D structural model needs to be filled with geological formations observed in the field and in the Bouillante boreholes for the upper part of the model. Deeper formations will be interpreted from deep penetration seismic profiles. The geometry of the 3D model will also be constrained by other geophysical methods such as MT. Then, the 3D model will be meshed to simulate flow and temperature distribution.

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* 3D GeoModeller is a commercial software developed by BRGM and Intrepid Geophysics. For further information visit: http://www.geomodeller.com.

Bouchot.V. et al., 2010, WGC-2010, 25-30/04/2010.
Bouysse P. et al., 1988, Marine Geology, 81, 261-287.
Calcagno P. et al., 2008, Phys. Earth Planet. Int., 171, 147–157.
Feuillet N. et al., 2002, J. Geophys. Res., 107(B12), 2331.
Thinon I. et al., 2010, Bull. Soc. géol. Fr., t. 181, N°1, 51-65.