Relation between Fluid Migration and the Deep Crustal Structure at the Lesser Antilles Island arc.

Klingelhoefer, F. [1], Marcaillou, B. [2,*], Laurencin, M. [3], Boucard, M. [4], Laigle, M. [2], Lebrun, J.-F. [4], Schenini, L. [2], Graindorge, D. [3], Evain, M. [1], Biari, Y. [1], Lucazeau, F. [5], Rolandone, F. [6], Kopp, H. [7, 8]

[1] Géosciences Marines, IFREMER, Centre de Brest, Plouzané, France (ORCID-id 0000-0001-5838-0577)
[2] Geoazur, Université Côte d'Azur, CNRS, IRD, Observatoire de la Côte d'Azur, Nice, France
[3] UMR LGO, University of Western Brittany, Brest, France
[4] UMR5243 Geosciences Montpellier, Antilles University, Pointe-à-Pitre, France
[5] Sorbonne Université, CNRS-INSU, Institut des Sciences de la Terre, Paris
[6] Institut de Physique du Globe, Paris, France
[7] GEOMAR, Kiel, Germany, 8 Christian-Albrechts University, Kiel, Germany

The Lesser Antilles subduction zone is an endmember subduction where old Atlantic oceanic crust (80-100 Ma), formed at the slow-spreading Mid-Atlantic Ridge, is being subducted beneath the Caribbean Plate at a low rate (20 mm/yr). While devastating earthquakes have occurred in the Central Lesser Antilles and in the Greater Antilles, in between, the Northern Lesser Antilles (Montserrat-Virgin Island) subduction have produced very few earthquakes with Mw>5. Here we present a 210 km long trench normal wide-angle seismic model recorded during ANTITHESIS cruise. In contrast with previously published seismic velocity models from the Central Antilles, the velocity structure for the subducting plate suggests that the basement mostly consists of serpentinized mantle rocks, offshore of the Northern Antilles. The mechanical properties and fluid content of this material differ possibly influencing the tectonic deformation, the amount and composition of migrating fluids as well as the seismogenic behavior. Velocity heterogeneities at depth in the upper plate correspond with numerous deep-rooted faults, including the N100-120°-trending Tintamarre normal fault system observed in Multichannel seismic lines. These velocity heterogeneities are thus likely to be related to fault-driven migration of fluids originating from compaction and dewatering of subducting sediment and/or fluids originating from the ultramafic basement rocks deserpentinization. Thus, seismic and bathymetry data reveal vigorous fluid migration through the Northern Lesser Antilles margin, possibly related to deep deserpentinization reactions of ultramafic rocks constituting, at least a portion of the subducting Atlantic crust.

Mots-Clés : Wide-angle seismic, subduction, Antilles