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Frontal accretionary wedge structure from seismic reflection imaging in the Lesser Antilles, Guadeloupe-Antigua sector

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The Lesser Antilles Subduction Zone (LASZ), forming the plate boundary between North and South American plates and the Caribbean plate, has not produced any recent large instrumentally recorded thrust earthquake. The 1843 earthquake event (~M_w 8.5) located offshore Guadeloupe is possibly subduction thrust related. Previous studies in the north-central LASZ based on active source seismic data have examined the overall configuration of the forearc domain, especially the geometry of the backstop and effect of subducted oceanic ridges. However, the detailed architecture of the accretionary wedge is still poorly known, as are wedge structures like splay faults that may host slip during future megathrust ruptures. In this study, we use selected re-processed deep multichannel seismic (MCS) profiles from the SISMANTILLES surveys (2001, 2007) and higher-resolution MCS profiles from the CASEIS survey (2016) complemented by a bathymetric data compilation. Analysis of this combined dataset yields a more comprehensive characterization of the accretionary wedge offshore Guadeloupe and reveals features that had not been previously described in this area.

The time-domain seismic data processing sequences was performed on selected MCS profiles from the SISMANTILLES surveys (profiles H, I and K) to mitigate the strong background noises and the ringy effect from the single-bubble air-gun source. The reprocessed images clearly show the presence of arcward-dipping splay faults extending from décollement to the seafloor. The most prominent one roughly delineates a boundary between the more topographically elevated inner wedge and the less-elevated frontal domain of the accretionary wedge. We estimate an along-strike (N-S) extent of ~168 km for the identified splay faults, between 16°12'N and 17°21'N; their northward continuation is then disturbed by the subducting Barracuda Ridge. In the vicinity of the northern flank of the Barracuda Ridge, landward of the deformation front, we observe a duplex-type structure above the décollement. Its geometry is reminiscent of the initial stage of the development of underplating duplexes as observed in analog models. We suggest that the evolution of such underplating basal duplex may result from the increase in friction due to the subduction of Barracuda Ridge and the increase in sedimentary loading on its northern flank. This observation highlights the complex role played by the Barracuda Ridge on the shaping and

deformation of the frontal prism.