Evidence for subaerial development of the Caribbean oceanic plateau in the Late Cretaceous and palaeo-environmental implications

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Accreted oceanic sequences exposed in the Western Cordillera of Colombia provide the first unequivocal evidence for an emergent volcanic phase of the Caribbean oceanic plateau in the Late Cretaceous (~90 Ma). This phase is documented by fallout tuffs with accretionary and armoured lapilli, which are interbedded with lahar deposits that host rounded clasts of basalt (Figures 1 and 2). These sequences record phreatomagmatic eruptions coeval to subaerial erosion on an oceanic island. Their origin is constrained by their whole-rock and clinopyroxene geochemical signatures that are similar to those of submarine lavas and intrusive igneous rocks that form most of the Caribbean plateau (Figure 1a). These results, which include the first known occurrence of lahar deposits on top of an oceanic plateau, complement previous in situ lithostratigraphic observations from the Ontong Java plateau and Shatsky rise. They suggest that syn-volcanic emergence of oceanic plateaus was a common process in the Pacific during the Mesozoic, which could have led to rapid releases of large volume of magmatic gases and aerosols in the atmosphere. In addition, we show that the emergence of the Caribbean plateau in the Late Cretaceous occurred in a complex tectonic setting associated with its migration from the Pacific to its present inter-American location. An arc-derived tuff bed within the studied subaerial plateau sequences (this study) and regional geological constraints (Wright and Wyld, 2011; Rodríguez and Arango, 2013; Weber et al. 2015; Jaramillo et al., 2017) show that this migration involved interaction with subduction zones at least ~20 m.yr. before collision of the plateau with South America and arc initiation on the southwestern edge of the Caribbean Plate (Figure 3). This tectonic evolution and the formation of island(s) on top of the Caribbean plateau suggest that the inter-American seaway became largely obstructed ca. 90 Ma. We propose that this significantly reduced the flow of Pacific oxygenated bottom waters into the juvenile Atlantic, and so promoted anoxia in the Atlantic basin in the Turonian-Coniacian (OAE-3 event). This also suggests that strings of islands have existed across the inter-American seaway since the Late Cretaceous, and this likely facilitated inter-American migration of terrestrial organisms in the Cretaceous-Palaeogene.

References

Figure 1. Field relations and lithologies. A) Lobate and pillowed lavas in tectonic contact with the studied volcaniclastic deposits. B) Faulted sequence of layered ash tuff. C) Intercalated lahar and ash to lapilli fallout deposits with abundant accretionary lapilli; this locality includes green tuff DB15-065 from the matrix of a lahar deposit and lapilli tuff DB15-066 with accretionary lapilli (Figure 2a). D) Layered tuffs with accretionary lapilli from the upper part of (C). E) Thin lahar deposit including well rounded amygdalar basalt cobbles from the lower part of (C). F) Juvenile (amoeboid) basalt clast from a lahar deposit in (C).
Figure 2. Thin section images of coarse lapilli tuffs from the volcaniclastic deposits. A) Tuff DB15-066 with. The white arrow points at an armoured lapilli. B) Graded tuff DB15-068 with deformed accretionary lapilli. C) Tuff DB15-080 with large accretionary lapilli.

Figure 3. Tectonic model of the inter-American seaway in the Late Cretaceous (modified from Pindell and Kennan, 2009, with key elements of Wright and Wyld, 2011 and Jaramillo et al., 2017 for the southern Caribbean and northern South America). Possible land exposures are shown in green. GA: Greater Antilles arc; A: Aruba Island part of the Colombian-Leeward Antilles arc (Wright and Wyld, 2011); Q: Quebradagrande complex.