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A tectono-stratigraphic map of the Greater Antilles

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Geologic maps of the Caribbean Basin generally display rock units according to their age and lithology (e.g. Late Cretaceous limestone). Few geologic maps display rock units according to their tectono-stratigraphic setting (e.g. North American platform carbonates). A preliminary 1:1,000,000 scale tectono-stratigraphic map for the Greater Antilles provides an easier-to-interpret map of the northern margin of the Caribbean Plate. Conference participants are invited to offer suggestions for improvement to both the map and the legend. Contributions will be incorporated and, at the next conference, an updated map will be presented for further review and revision. Plans are to extend this effort to the entire Caribbean Basin.

[Up]

Two-stage Neogene model for the Panama-Colombia collision

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GPS data (e.g. Trenkamp et al. 2002) show that Panama and the Sierra Baudó are converging with South America faster (40 mm/a) than the Caribbean Plate is converging with South America (20 mm/a). Thus the tectonic escape model invoked by Wadge & Burke (1983), Mann & Corrigan (1990), and Pindell (1993), wherein slices of Panama are being backthrust to the northwest onto the Caribbean Plate, is not currently operating, although it may have done so earlier in the collision (Middle to Late Miocene). I interpret Panama to be moving relatively east with respect to South America faster than the Caribbean Plate because the base of the Panama "block" is partially coupled to the north-dipping Nazca Plate which moves east relative to South America at > 60 mm/a, 3 times faster than does the Caribbean Plate. Panama is now overthrusting Caribbean crust on Panama's northeastern flank, and not its northwest flank as earlier models had presumed. Thus, I deduce that there should be E-W sinistral shear zones crossing Costa Rica/Panama that account for this late eastward displacement. Inspection of radar imagery shows that indeed there are variably developed topographic lineaments precisely where differences in GPS motions predict them to be, although seismicity along these zones rarely exceeds the magnitude 4 threshold witnessed by global networks. Here I employ the term reflects evolved arc activity that is synchronous with the major CLIP event. It must, therefore, be exotic with respect to the CLIP and the Nicoya Terrane.

To the SE of the S-Nicoya fault line, Turonian-Santonian (~90-85 Ma) oceanic plateaus resting on an unknown basement must represent actual outcrops of the trailing edge of the CLIP. These include the SE corner of the Herradura Promontory (Costa Rica) and the Azuero Plateau cropping out in Coiba, Sona and Azuero (Panama).

Late Campanian to Paleocene arcs rest on the oceanic plateaus (see Buchs et al. this conference), and are in their early stages geochemically influenced by their basement: The *Golfito Complex* (Costa Rica) and the *Azuero Arc* (Panama), possibly also the *San Blas Complex* (Panama) and the Serrania de Baudo (W-Colombia).

Igneous rocks with plateau and/or seamount affinities that are of late Cretaceous to Eocene age occur outboard of the fore-mentioned units and are exotic with respect to the CLIP. They became accreted during the Early Tertiary: The *Tulin Group* (Herradura), Quepos, The *Osa Igneous Complex*, Burica, the Osa Mélange (Costa Rica/Panama), and the *Azuero Accretionary Complex* (Panama).

The CLIP formation (~90-85 Ma) on an unknown pacific oceanic crust triggered a new, E-dipping subduction zone and Campanian-Maastrichtian (~80-70 Ma) initiation of proto-arcs on its trailing edge (see Buchs et al. this conference).

[Up]

Late Cretaceous subduction initiation on the southern margin of the Caribbean plateau: One Great arc of the Caribbean (?)

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The stratigraphic, magmatic and structural evolution of Aruba, Curaçao and Bonaire, along with some new U-Pb zircon geochronological results suggests an alternative model for the Late Cretaceous tectonic evolution of the southern Caribbean. Aruba and Curaçao contain a mafic complex long interpreted as representing exposures of the Caribbean Plateau intruded by ca 89-86 Ma arc related plutons and dikes, whereas the oldest rocks on Bonaire are a volcanic arc sequence that predates plateau formation and the arc plutonic activity on Aruba and Curaçao. In light of these new data, the Late Cretaceous arc polarity reversal model for the Caribbean due to aborted subduction of the buoyant plateau needs revision. We suggest that Late Cretaceous subduction initiation along the southern boundary of the plateau generated a Late Cretaceous arc constructed solely on a basement of Caribbean Plateau crust and that this arc is distinct from the Early to Late Cretaceous arc of the Greater Antilles. The tectonic analysis presented here for Aruba, Curaçao and Bonaire when combined with published data on other late Cretaceous terranes of northwestern South America and the southern Caribbean suggest a geodynamic model involving three separate but temporally overlapping arc systems.

[Up]

The role of the Ibero-Armorican Arc development in the tectonic inversion of the South-Portuguese Zone (SW Iberian Massif, Variscan Orogeny)

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The SW Iberian Massif tells an important part of the history of the late Paleozoic tectonic evolution of northern Gondwana margin, and specially that of the Rheic

Ocean. The closure of the Rheic Ocean and consequent continental collision between Gondwana and Laurussia which ultimately led to the amalgamation of Pangea, gave rise to the European Variscan belt (Matte, 2001). The Variscan belt is linear but sinuous with kilometre-scale curvatures.

In Western Europe, the Ibero-Armorican Arc (Ribeiro et al., 1995) includes a fold and thrust belt affecting a foredeep basin in the outer arc (South Portuguese Zone- SPZ), and a fold and thrust belt affecting shallow water continental platform in the inner arc (Cantabrian Zone). These foreland basins are separated by an hinterland (Ossa-Morena Zone, Central-Iberian Zone and West Asturio-Leonese Zone) dominated by Mississipian/early Pennsylvanian high-grade to low-grade metamorphism, synorogenic plutonism and sedimentation, and heterogeneous deformation (Variscan orogeny).

The originally linear Variscan belt was the result of (1) an oblique-subduction process that culminated in the late Devonian (c. 370 Ma) and consequent crustal thickening with subsequent orogenic collapse during the Mississipian/early Pennsylvanian (Tournaisian to early Moscovian; c. 350-310 Ma) (Martinez-Catalan et al., 2007). The orocline formation occurred as a secondary structure in the middle-late Pennsylvanian (late Moscovian to late Gzhelian; c. 306-299 Ma) and was followed by significant late-post-Variscan magmatism (early Permian; c. 295 Ma) (Weill et al., 2010 and references therein).

The geology of SPZ, located in the outer arc, includes a Carboniferous foreland basin and a late Devonian basement characterized by shallow water siliciclastic sediments (Horta da Torre Formation, Represa Formation, PQ Formation and Tercenas Formation) (Oliveira et al., 1990). The Famennian rocks are overlained: (1) by a succession with Tournaisian-Visean felsic volcanism (Volcano-Sedimentary Complex), and late Visean (Mertola Formation) to Serpukovian-Bashkirian (Mira Formation) overlying turbidites, or (2) by a succession of Tournaisian (Bordalete Formation), Visean (Murração Formation) and middle Bashkirian age (Quebradas Formation) mud/carbonate rocks. Lower Bashkirian to late Moscovian (Brejeira Formation) turbidites commonlly rest conformably on Serpukovian-Bashkirian sediments but also unconformably overlie sediments with Tournaisian to Visean ages (Pereira et al., 1994).

As response to middle-late Pennsylvanian tectonic inversion, the overall structure of the SPZ is characterized by southwestward (present coordinates) vergent folding and thrust displacement (Silva et al., 1990). This complex contraction deformation obscured the importance of the Viséan syn-sedimentary gravitational collapse structures and extensional faults. In Mértola we recognized tectonic instability during the late Visean with deposition of thick turbiditic sequences coeval with large-scale slope mass wasting of the older platform margin. The Visean to Moscovian stratigraphy of Aljezur-Bordeira reveals significant lateral changes of sedimentary facies and the presence of unconformities suggesting that sedimentation was influenced by development of synsedimentary extensional faults. The regional folding and thrusting that characterizes the overall structure of the SPZ, with the same age of the Ibero-Armorican Arc development, clearly marks a tectonic inversion that postdated late Visean to late Moscovian deposition contemporaneous with the extensional collapse and significant up-lift and denudation of the Variscan linear orogen (Pereira et al., 2009).

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[Up]

Why 307? Absolute age (Ar-Ar and U-Pb) constrains on orocline development and related lithospheric delamination in the Iberian Armorican Arc

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The timeframe for the development of the Ibero-Armorican Arc (West European Variscan Belt), as a bend of a previously more linear orogenic belt, has recently been constrained paleomagnetically as an orocline in the Cantabrian Zone, northern Iberia (the core of the arc) (Weil et al, 2002, 2010). According to the known evidence, oroclinal generation took place in the uppermost Carboniferous-lowermost Permian, between about 310 and 295 Ma, and it is interpreted to have been ultimately caused by the self-subduction of the Pangean global Plate (Gutiérrez-Alonso et al., 2008). This plate-scale structure is bound to have had a profound effect on the lithosphere and consequently should be recognized in structures developed coevally with the orocline as a consequence of its origin.

One of the most striking features found in the West European Variscan Belt is a large strike-slip shear zone/fault system, characterized as "Late-Variscan", that runs parallel to broad structural trends around the Iberian Armorican Arc. Ar-40Ar ages in the fabric of 5 shear zones of this system, both dextral and sinestral, have yielded ages that, within error, cluster at 307 Ma, suggesting that their development took place within the time frame of oroclinal bending