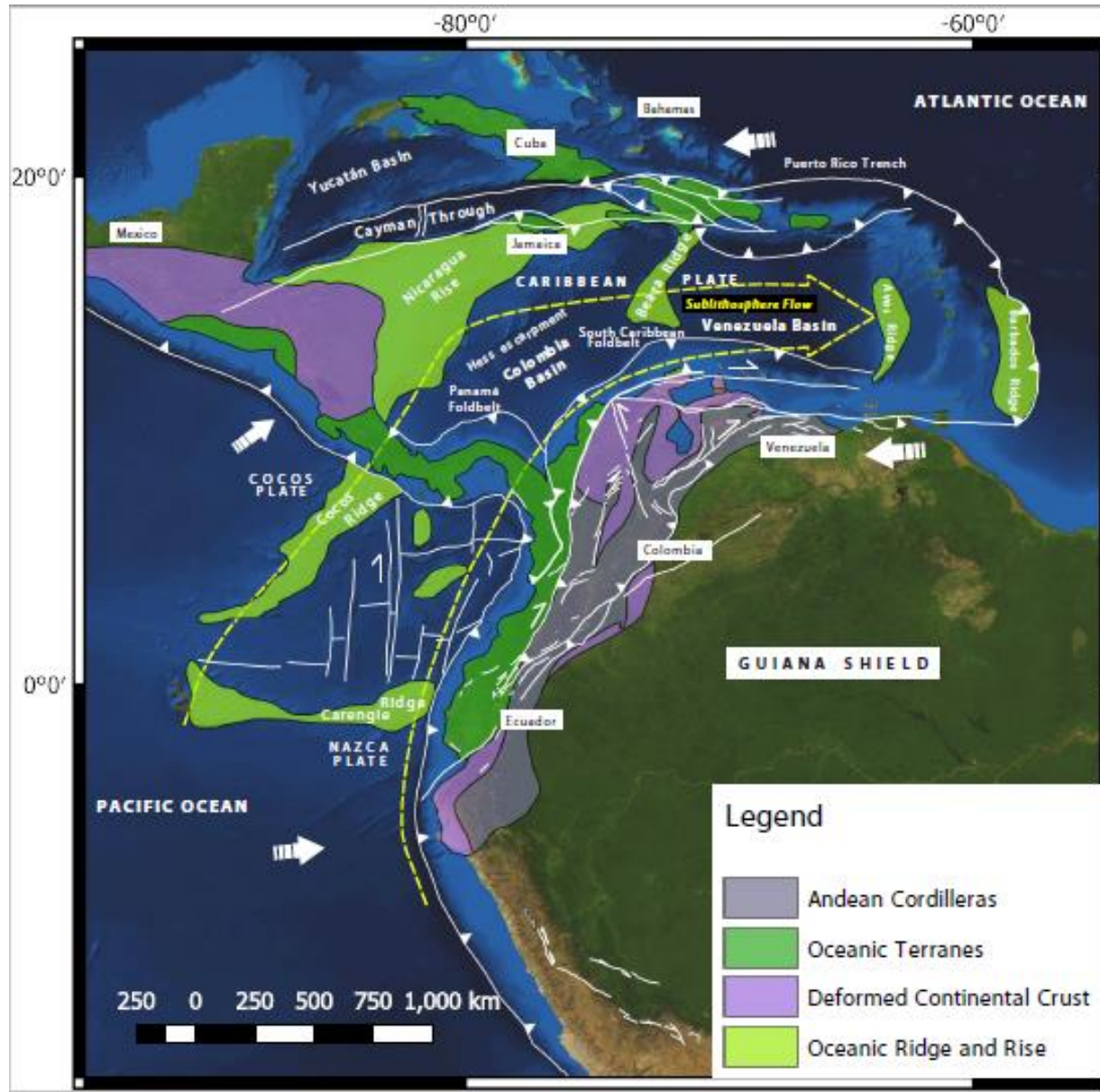


Structural framework and regional significance of a Northandean Cretaceous subduction cycle.

Andreas Kammer, Michael Avila, Universidad Nacional de Colombia

Motivation



At its western border the Northern Andes contain an accreted oceanic terrane, for which an allochthonous southern intraplate origin has been proposed. Provenance analysis and U-Pb age data increasingly point to a tectonic evolution close to a continental margin.

The tectonic setting close to and its connection with the Central American land bridge suggests a possible relation to a mantle flow guided by the subducting slab and its eastward escape into the little confined Caribbean realm.

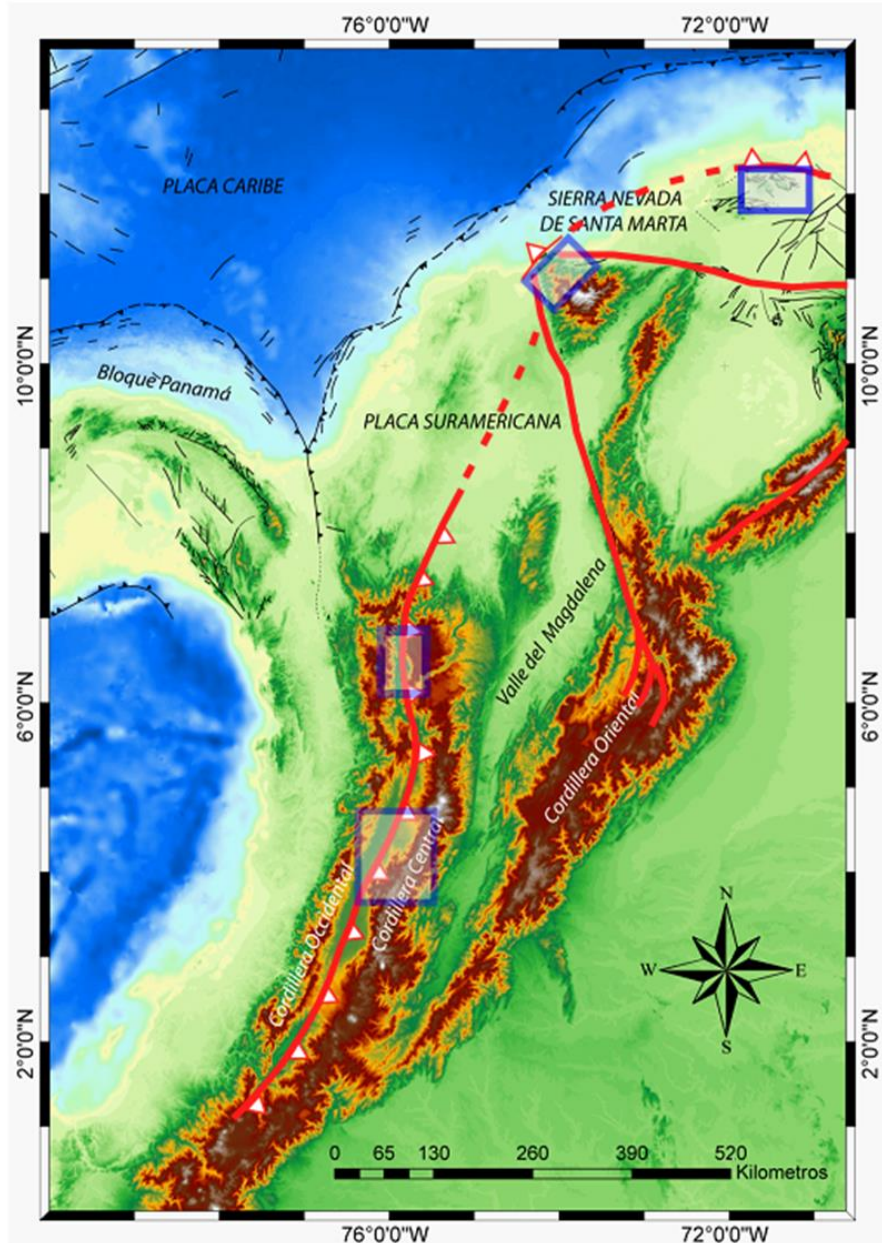
Do similar relations hold for a Cretaceous subduction cycle, which shows a proper tectonic setting and timeframe within the Northandean terrane?

Figure: Present mantle flow as proposed by Alvarez, 2001.

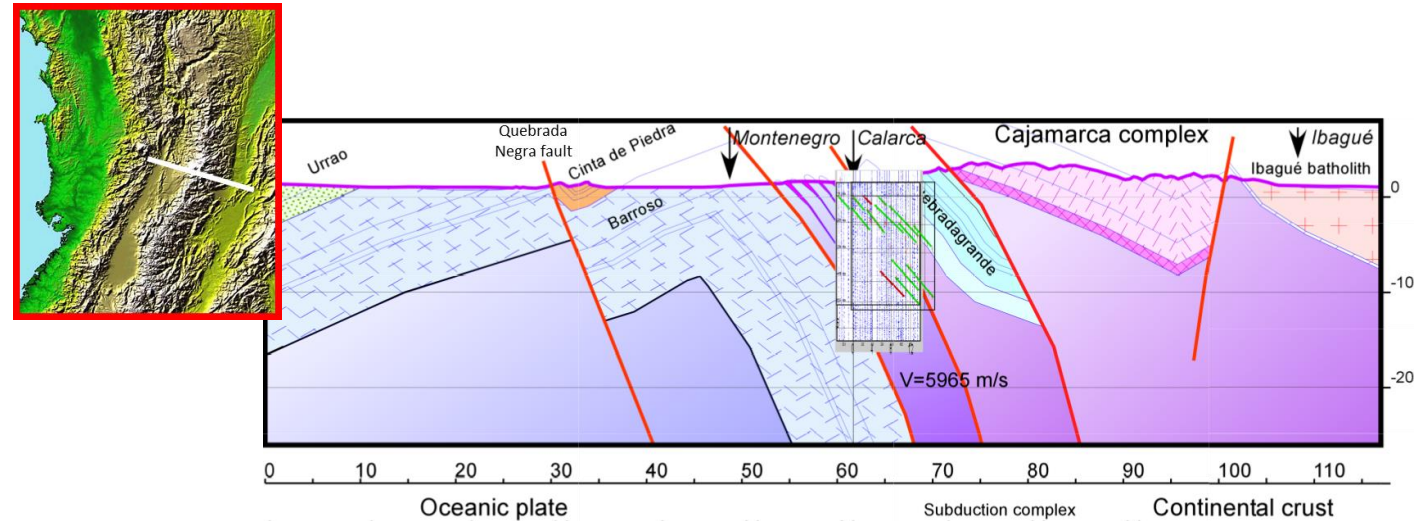
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Location and structural setting



A continuous suture limits the pre-Cretaceous continental margin against the oceanic western terrane. Up to the Sierra Nevada Block in the north, this suture and an adjacent eastern subduction complex faces to the west (left-hand figure).

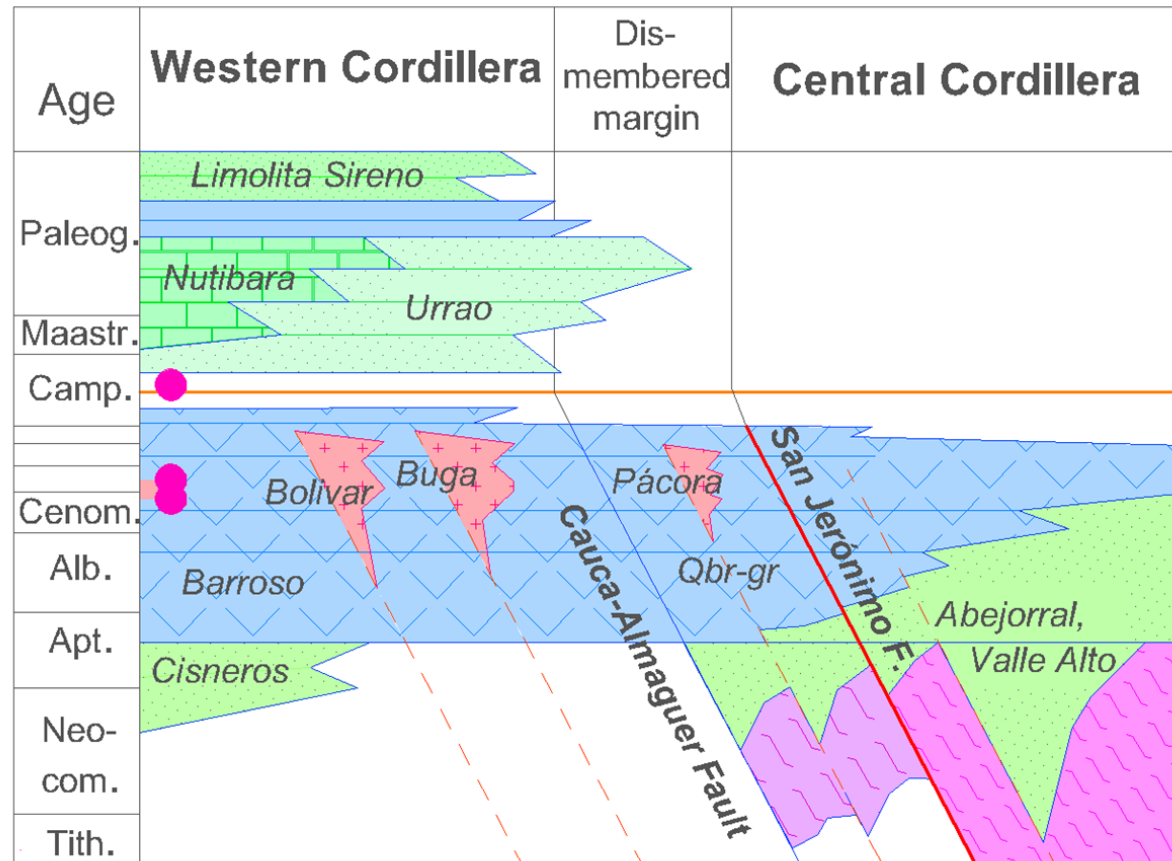


The proper subduction complex consists (A) of the bent plateau complex of the Western Cordillera, (B) strongly retrograded basement slices, which are interleaved with serpentinites and configure the Arquia complex, (C) a verticalized, basal volcanic sequence overlying the metamorphic basement of the Central Cordillera, and (D) the metamorphic basement of the Central Cordillera (Cajamarca Complex).

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Chronostratigraphic chart



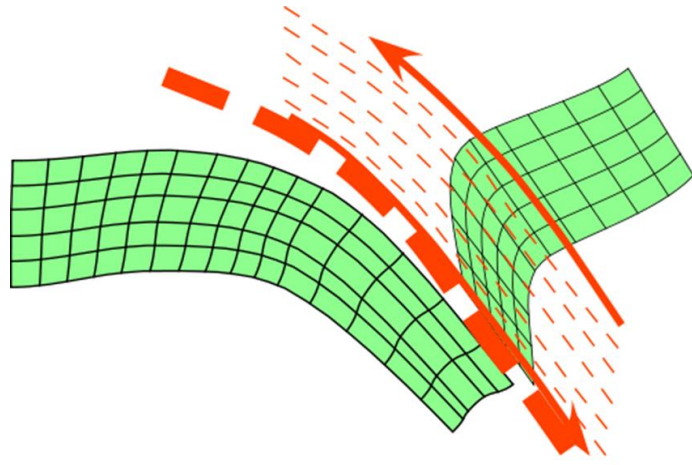
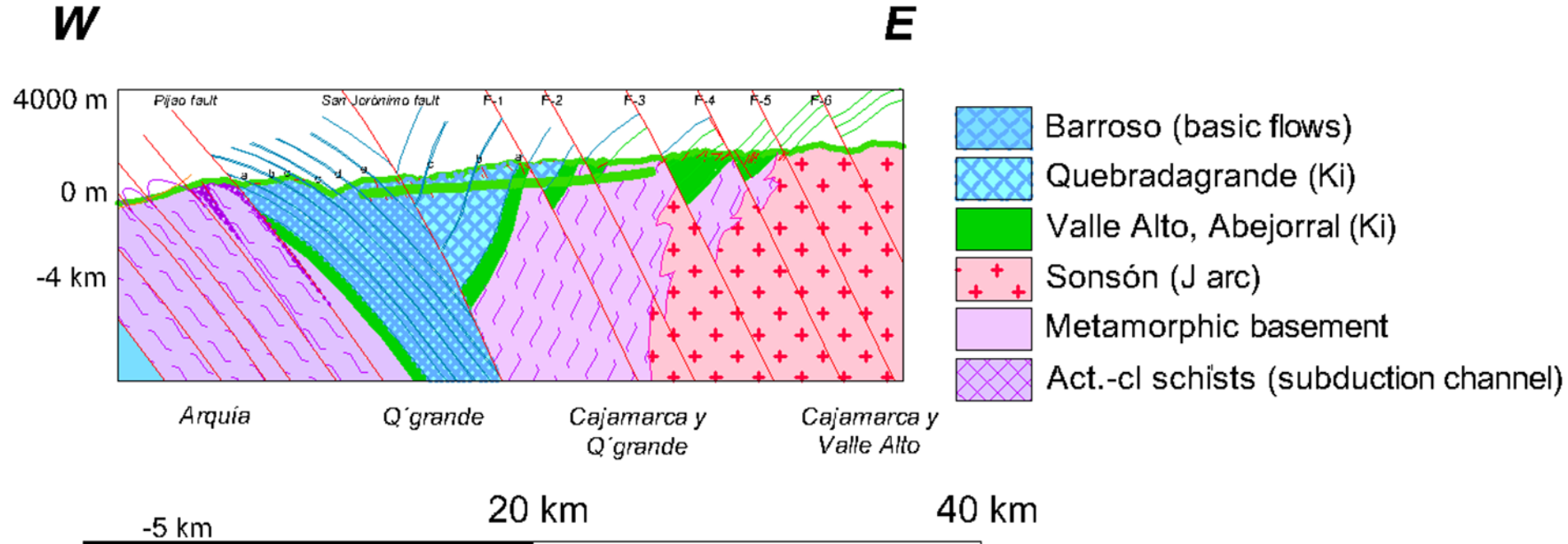
Based on the interpretative, but internally consistent stratigraphic chart (figure to the left), we highlight some common features for the Cretaceous depositional evolution of the forearc basins:

- A basal siliclastic Neocomian sequence overlies the metamorphic basement of both the subduction complex and the continental margin and forms the basin fill of half-grabens delimited by E-dipping faults.
- The volcanic-effusive sequences of an upper Cretaceous age (radiometric data < 100 Ma) set in regionally since the Albian.
- The volcanic-effusive sequences are intruded by mafic plutonic bodies, which have a geochemical arc affinity. Major bodies separate different volcanic-effusive units and have strongly mylonitized borders. We interpret them to have intruded major faults.
- The volcanic-effusive sequences extend up to the Campanian and are overlain by siliciclastic sequences sourced by continental arc and basic "plateau" material.

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Extensional tectonics at the continental margin

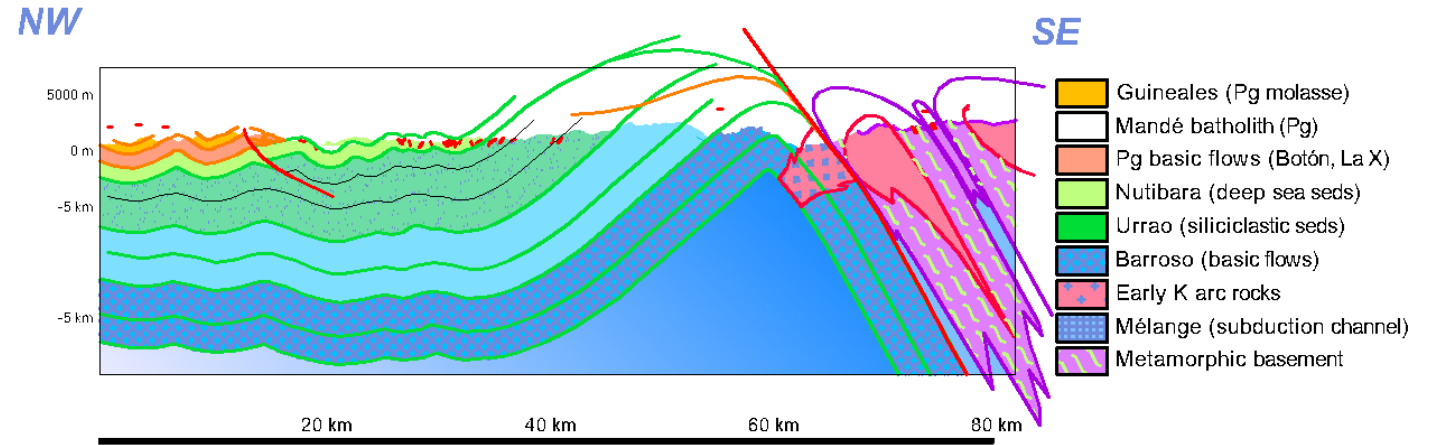
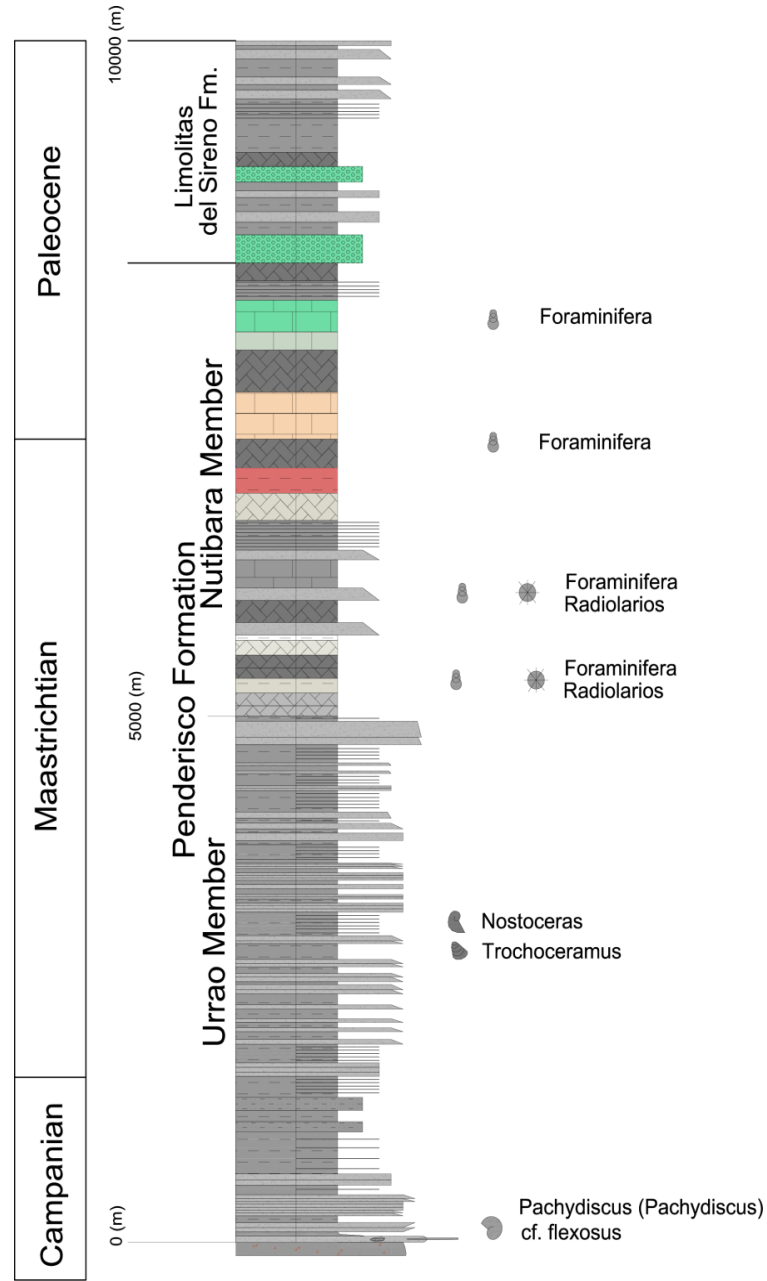


- The continental basement displays closely spaced faults, which delimit narrow half-grabens. Gravity flow deposits and rheomorphic volcanic flows attest to a synkinematic nature of the basin fills.
- In a crustal slice enclosed to the W by the Arquía Complex and to the E by the continental basement the polarity of the sequences becomes inverted (top faces E). This slice is limited in its hanging wall by a major fault which controlled the emplacement of mafic stocks and serpentinites, some 400 km long. We interpret this fault to have accommodated an incipient subduction (lower diagram).

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Flexural basin to the W of the subduction zone

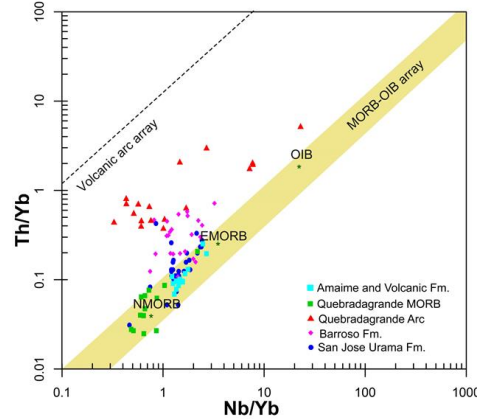


- Above the Campanian unconformity the Campanian to Paleogene siliciclastic sequences define a basement fill, which locally surpasses a thickness of 10.000 m. For this first-order basin we suggest a flexural origin caused by the blocking of the subduction of the oceanic plate and a subsequent buckling at a crustal scale.
- Regionally, the abandonment of this subduction zone is evidenced by the exhumation of the continental margin and its backarc basin, as evidenced by thermochronological data. This regional response may owe its origin to a break-off of the blocked slab.

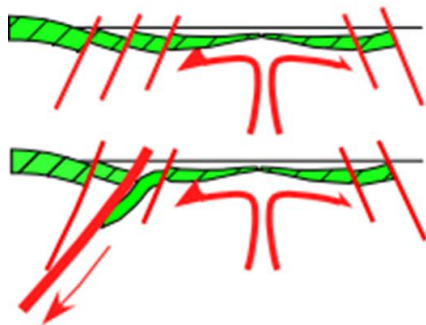
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A possible synthesis



Subduccion inducida por empuje transmitido desde una dorsal



In order to synthesize the multifaceted structural and stratigraphic relations, we emphasize some particular aspects of this Cretaceous subduction cycle.

- Subduction sets in concomitantly to the onset of the upper Cretaceous effusive-volcanic activity held responsible for the build-up of the plateau sequences of the Caribbean Large Igneous Province (CLIP).
- Subduction becomes abandoned as the igneous “plateau” activity ceases.
- The geochemical signature varies between N-MORB of the basal Quebradagrande sequence to E-MORB for extrusive flow units of stratigraphically upper “plateau” units. Volcanic sequences have an Island Arc affinity. A suprasubduction setting may be inferred from an enrichment of LRE and LIL elements.
- Early to Late Cretaceous siliciclastic to volcanic basins at the continental margin attest to ongoing extensional tectonics. Elongated batholiths and stocks of the plateau province (Western Cordillera) are tentatively associated to crustal scale normal faults.

Considering these characteristics, we propose for the emplacement of the basic units a forearc setting, presupposing the existence of an active margin at a western (or Pacific) border. In this scenario we consider the initiation of the failed subduction within the Quebradagrande complex and the successful subduction at the Romeral suture as a consequence of a plume-related effect in the forearc domain.

The mantle flow that gave rise to these extensional tectonics may be compared to experimentally produced edge (or toroidal) flows at the lateral termination of a large slab segment.