THE NW MARGIN OF SOUTH AMERICA IN JURASSIC TIME: SOUTHERN EFFECTS OF THE OPENING OF THE GULF OF MEXICO AND PROTO-CARIBBEAN TECTONICS

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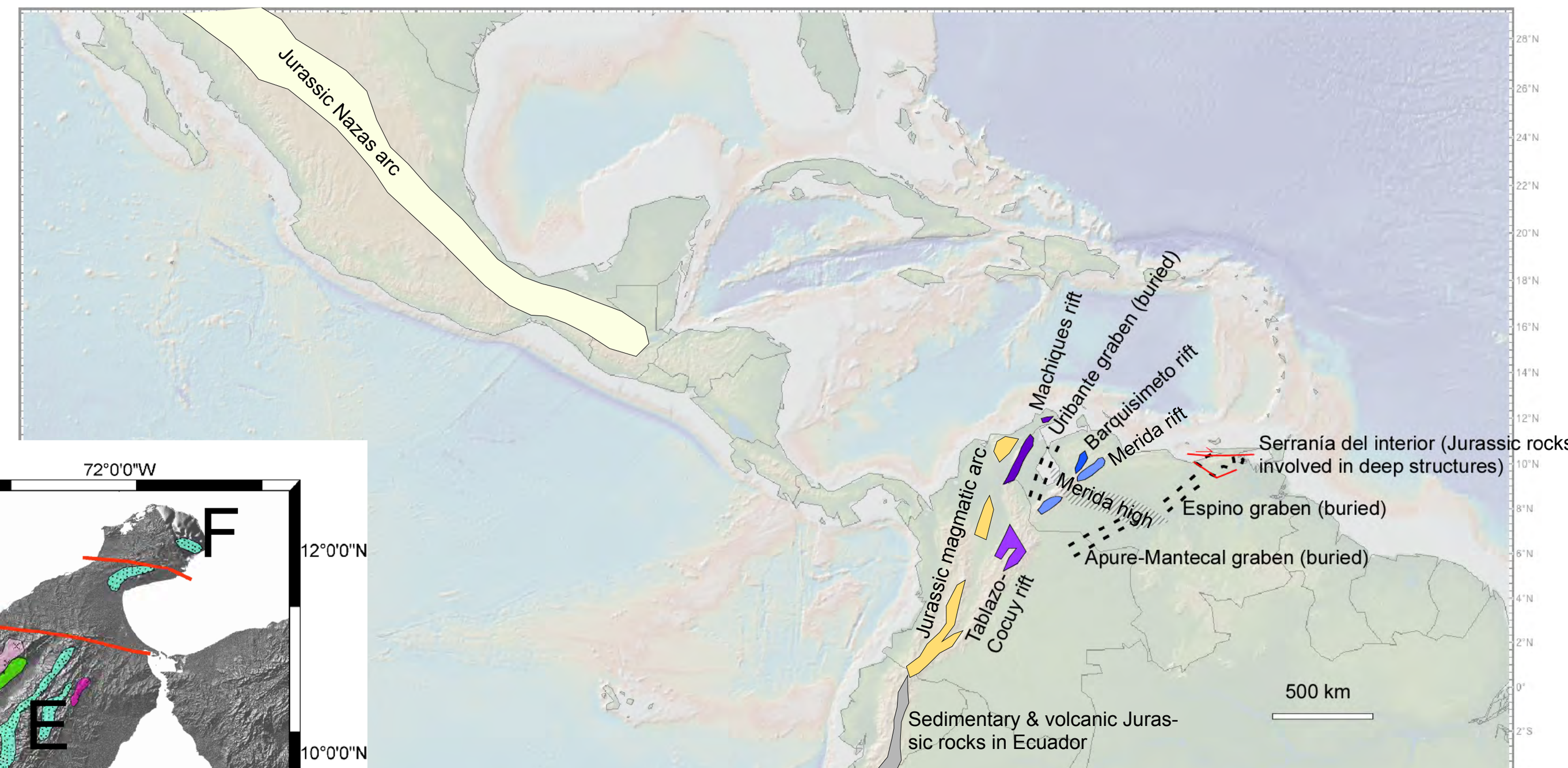
ABSTRACT

The northernmost record of Jurassic rocks includes, from west to east, the Santa Marta massif (3 in location map), Santander massif (C), Perija Range (E) - Cosinas Range (F), Merida Andes - Barquisimeto (D), and in the subsurface three grabens: Uribante (beneath the Maracaibo lake) and Apure-Mantecal and Espino grabens (beneath the Venezuela Llanos basin). Paleomagnetic data in the Santa Marta massif indicate a southern paleo-latitudinal position in Middle Jurassic time and northern equatorial position in Aptian time. In contrast, paleomagnetic data in the Perija-Cosinas and Merida Andes indicate that Jurassic and Lower Cretaceous strata accumulated in northern paleo-latitudes, with slightly higher latitudes in middle Jurassic time and equatorial latitudes in Early Cretaceous time. After restoration of the Cosinas-Perija ranges, due to 40 to 90º of clockwise rotation, all the ranges and subsurface basins shows a fan-like geometry of an extensional system, with a north-striking Perija-Cosinas system, changing gradually to northeast-striking in the Uribante and Merida Andes and more eastward for the Apure-Mantecal and Espino grabens system in the subsurface.

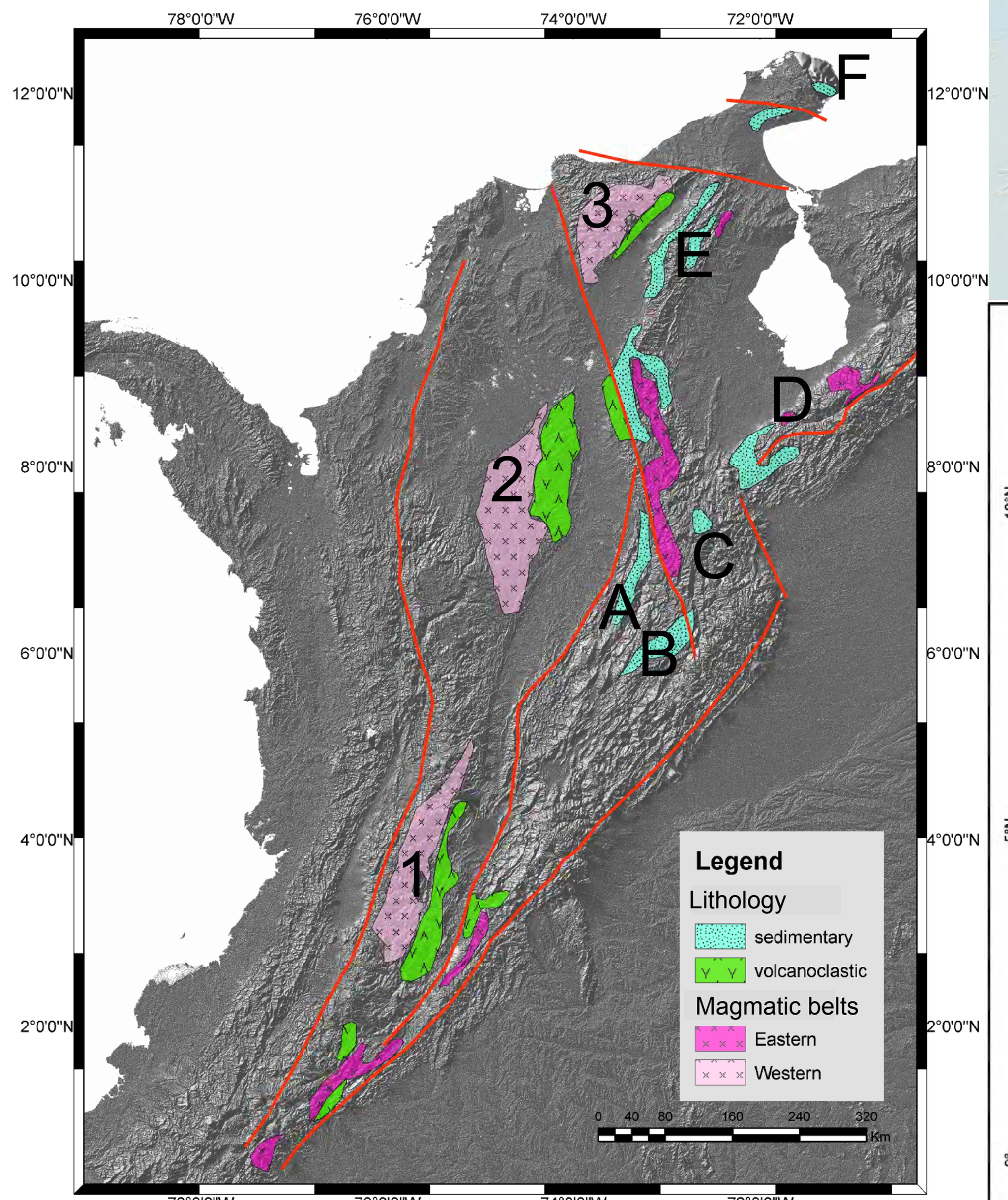
With exception of the Santa Marta massif, depositional systems in those ranges are very similar, with dominance of red volcaniclastic strata, epiclastic deposits and volcanic rocks, and localized presence of magmatic centers. Stratigraphic thickness may reach 7-9 kms in some areas, and abrupt changes in thickness occur across normal faults. All of these deposits accumulated in an extensional regime, with graben-axis trend changing from N-S to ENE, and all the systems ending toward the Santander massif. The restored configuration of the Lower-Middle Jurassic subduction zone in the pacific margin also changes in strike at the latitude of the Santander massif. The Jurassic extensional basins and associated magmatic arcs in the northernmost South America plate and amalgamated Mexican terranes were more dispersed, in contrast to the linear trend a subduction magmatic arc father south, where Santa Marta massif volcanic and intrusive rocks formed. The development of the proto-Caribbean plate that separated Mexican and Colombian terranes, the curved goemtry of the subducting plate, and the influence of the opening of the Gulf of Mexico, favored the formation of extensional basins along the NW corner of South America.

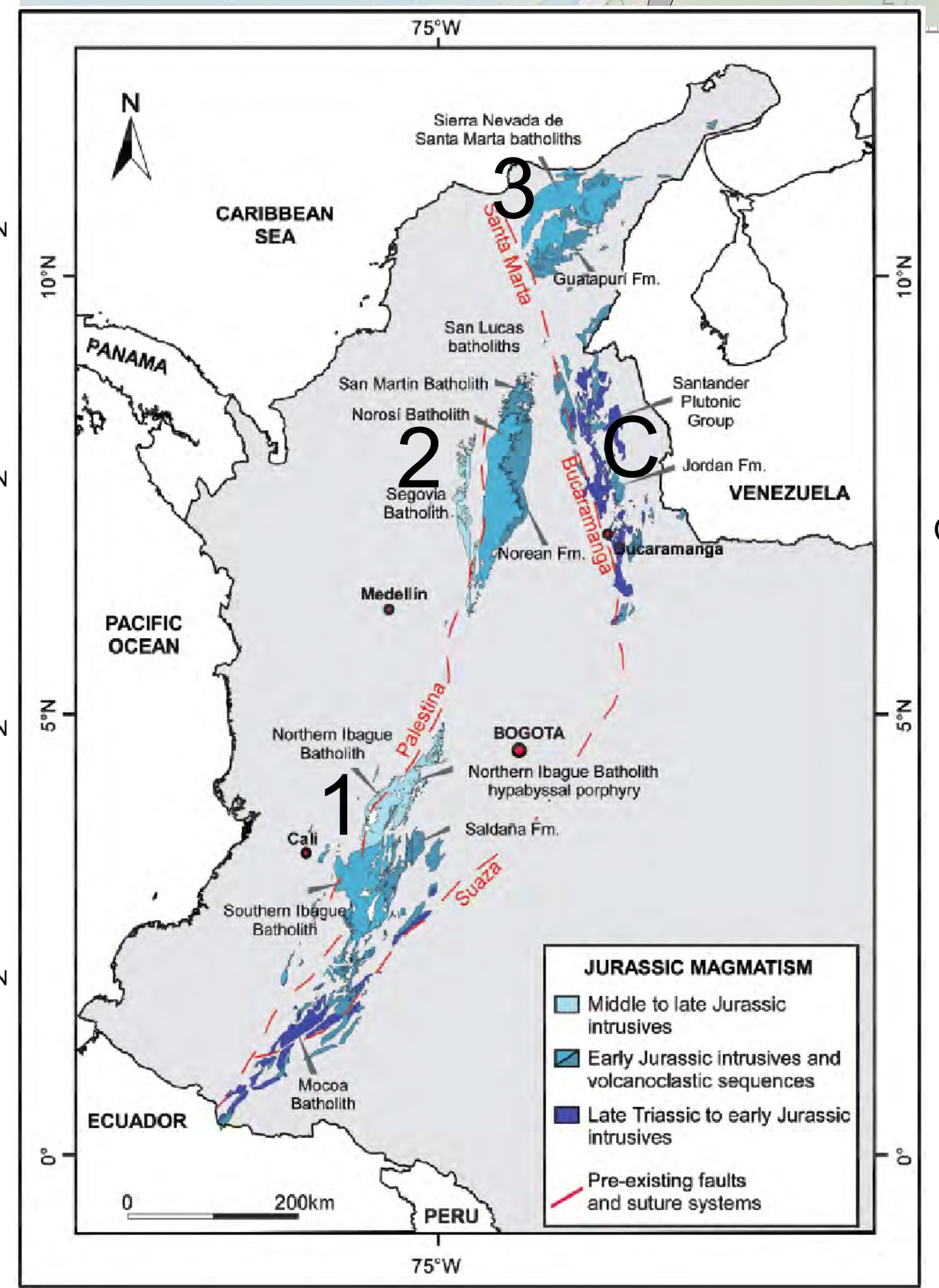
PRESENT LOCATION OF JURASSIC ARCS AND GRABEN STRUCTURES IN THE NORTHERN ANDES AND MEXICO

Nazas arc: (Bartolini et al., 2003); Machique, Uribante, Barquisimeto and Merida: Lugo and Mann (1995); Tablazo and Cocuy (Fabre, 1985; Sarmiento et al, 2006); Apure-Mantecal, Espino and Serrania del Interior (Bartok, 1993; Passalacqua et al.,1995). Base map from: GeoMapApp version 3.3.6



Western and Eastern magmatic belts of Jurassic rocks, with dominance of sedimentary units in the eastern belt (localities A to F) and volcanic units in the western belt (1 to 3).

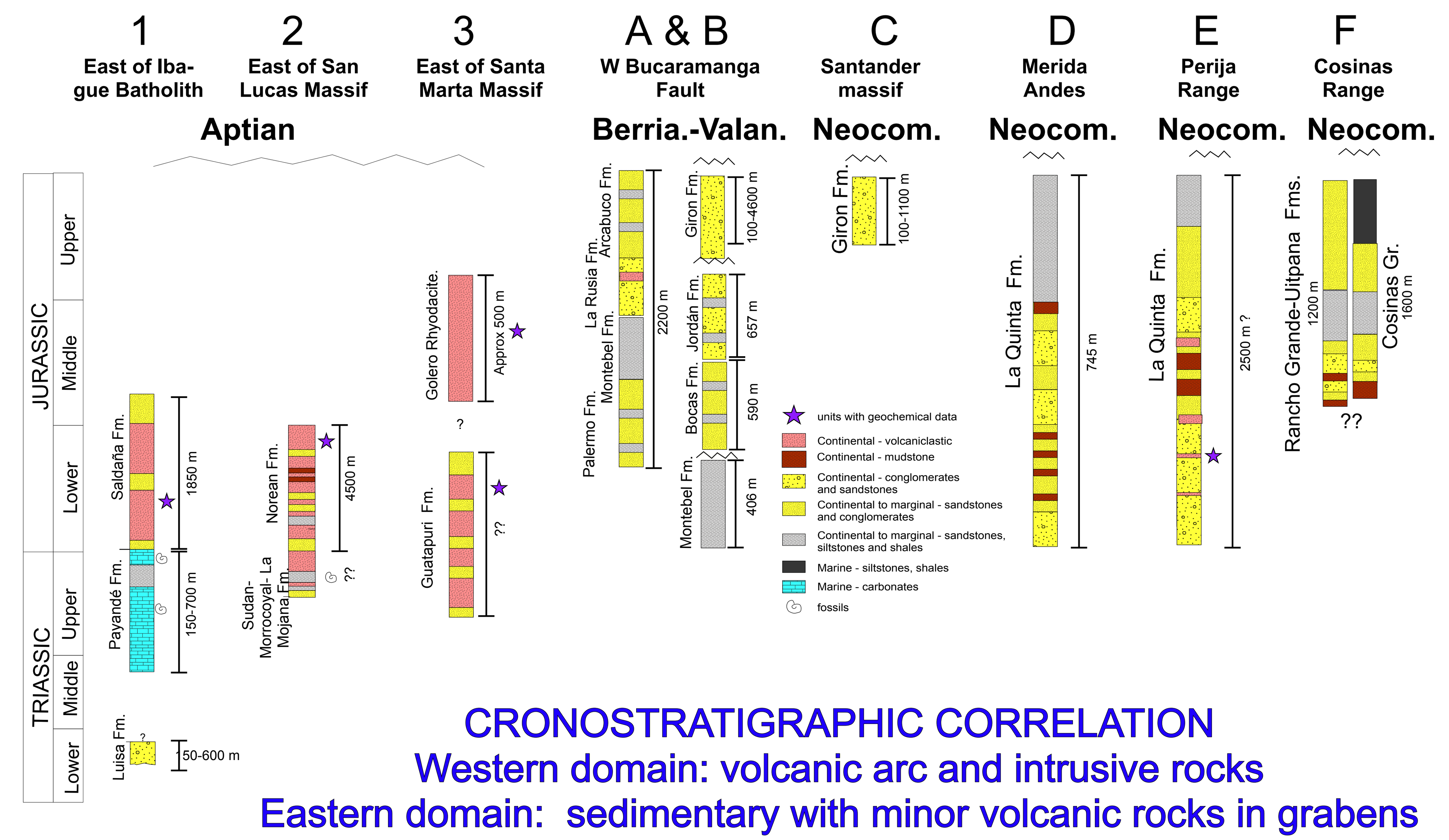




U/Pb ages in Jurassic intrusive rocks in Colombia Andes

Cediel et al. (2011)

Western belt / Eastern belt

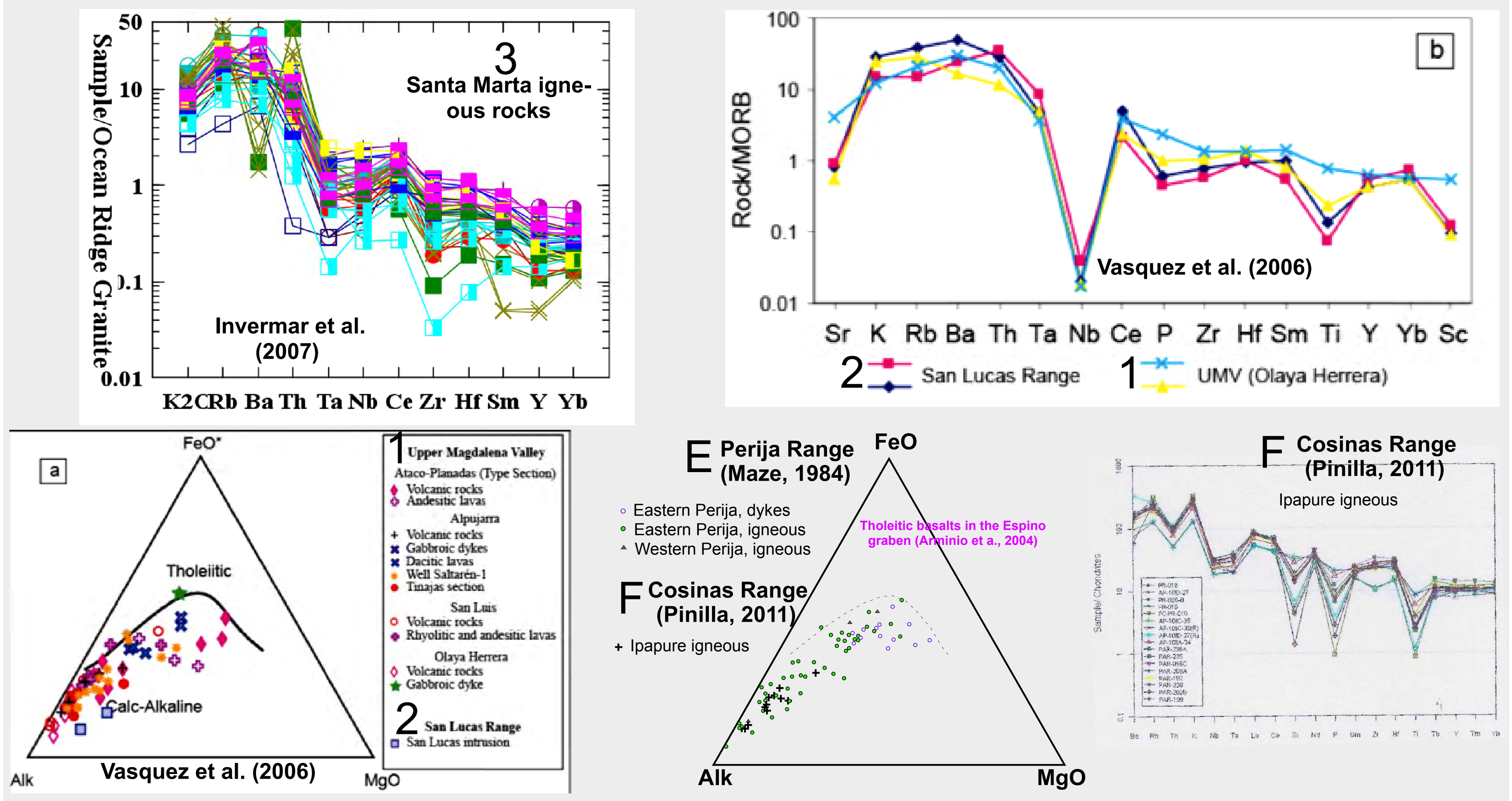


CRONOSTRATIGRAPHIC CORRELATION

Western domain: volcanic arc and intrusive rocks

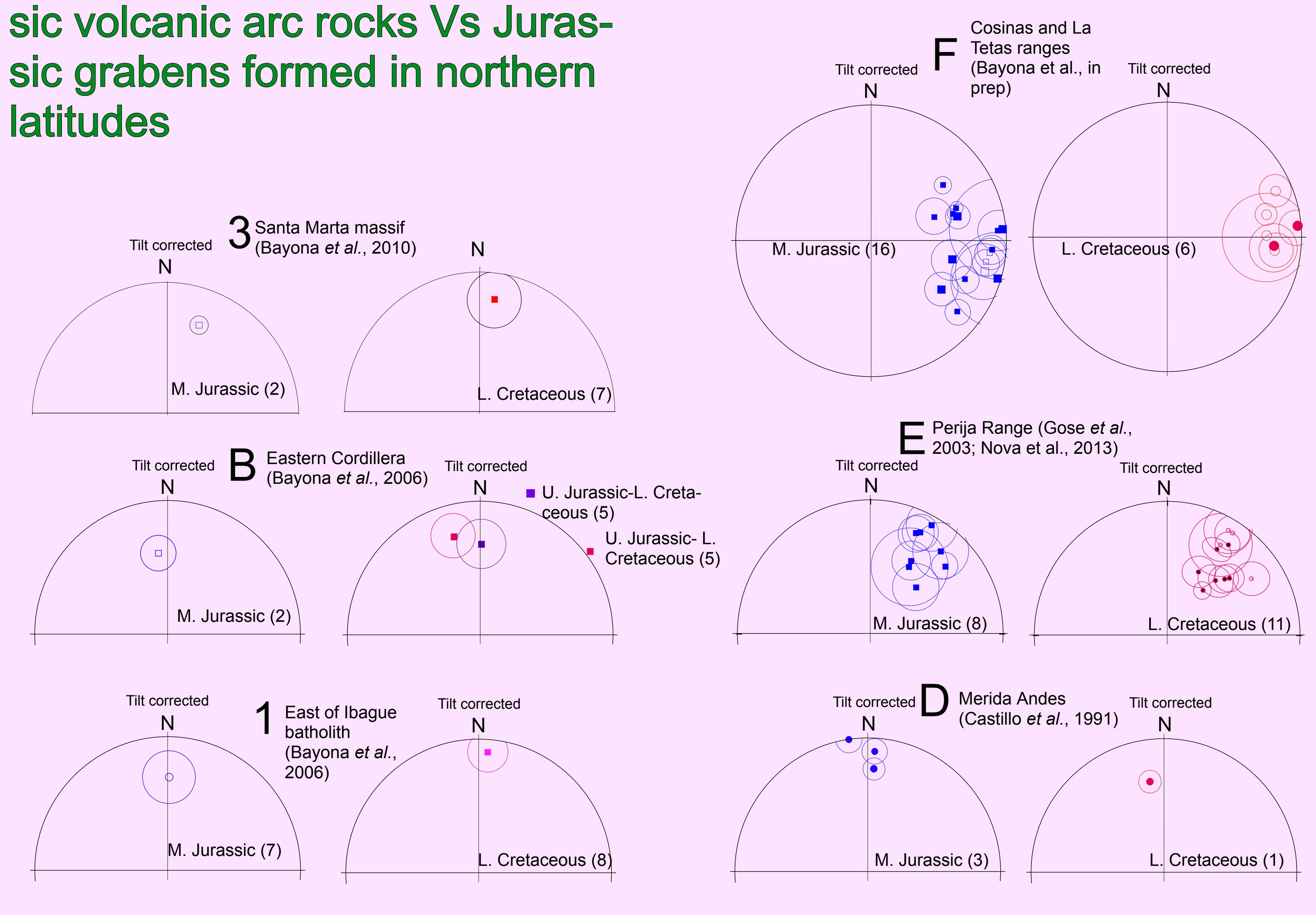
Eastern domain: sedimentary with minor volcanic rocks in grabens

GEOCHEMISTRY: Jurassic volcanic arc rocks & volcanic rocks in Jurassic grabens formed in subduction zone settings



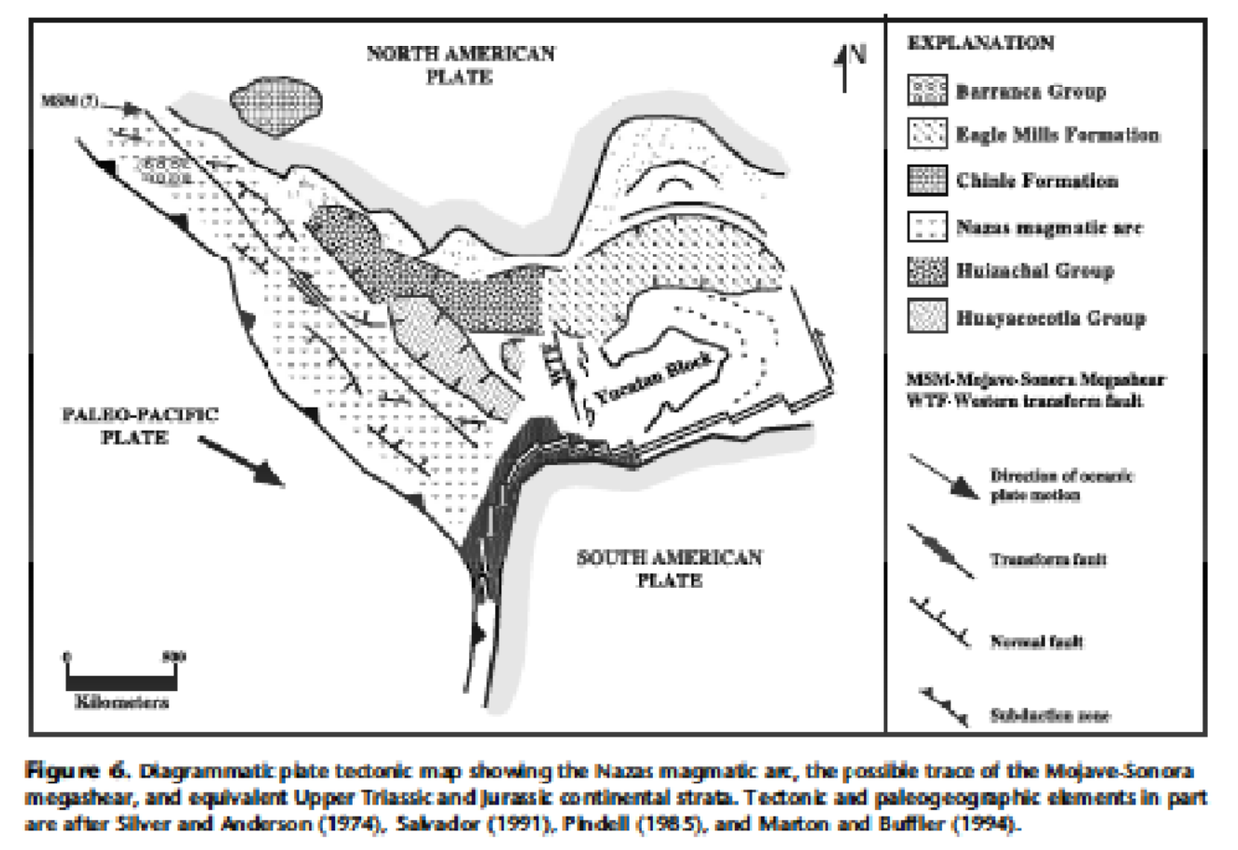
Northern translations of Jurassic volcanic arc rocks Vs Jurassic grabens formed in northern latitudes

PALEOMAGNETIC DATA



END-MEMBER MODELS

Dominantly rifting (Bartolini et al., 2003)



Subduction, magmatic arcs and ortogonal extension (Pindell and Kennan, 2009)

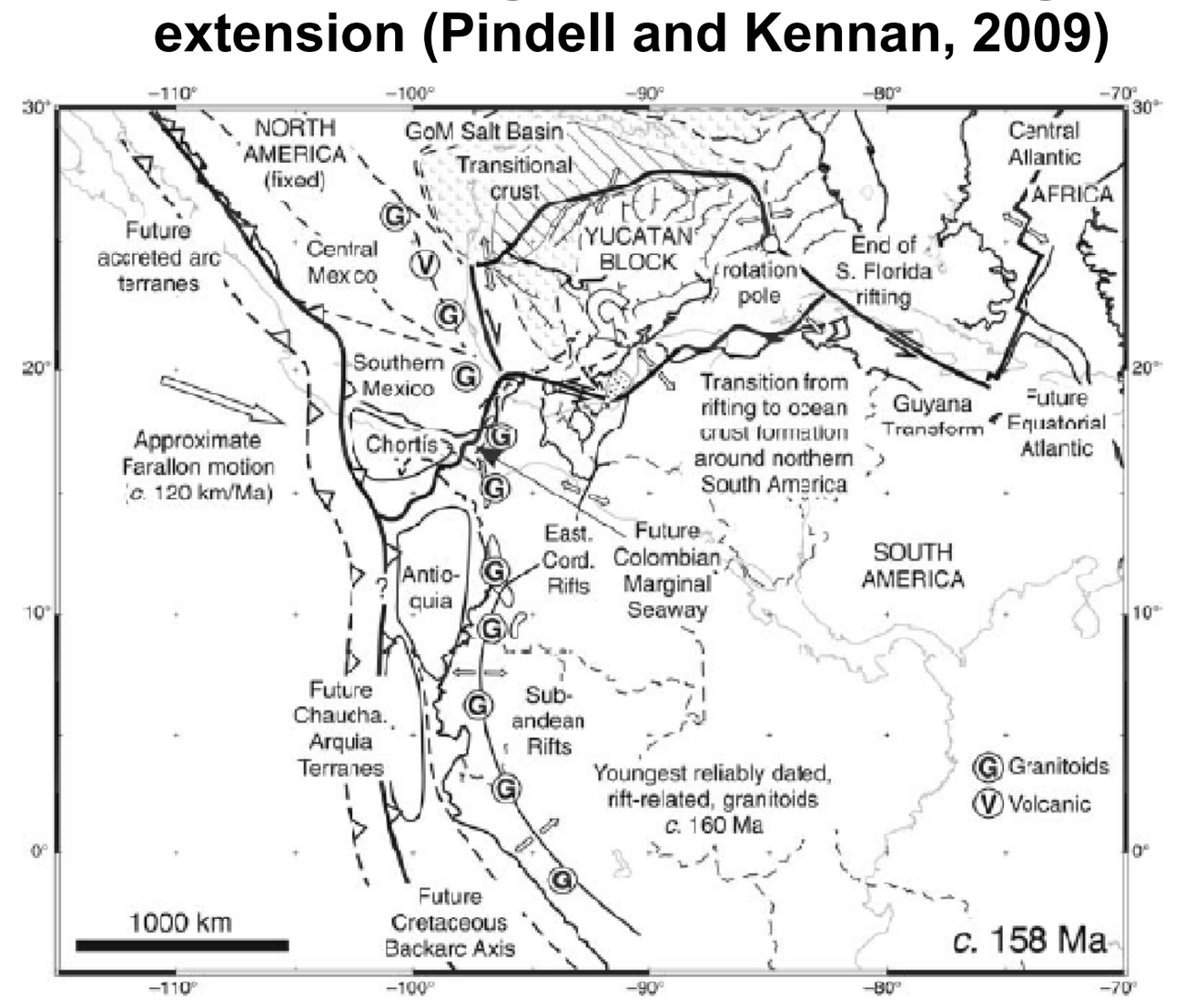


Fig. 4. A 158 Ma reconstruction of the circum-Gulf of Mexico region; Atlantic palaeopositions are interpolated between the Blake Spur Magnetic Anomaly fit of Pindell et al. (1988) and M25 of Roest et al. (1992). Pangaea breakup has reached incipient oceanic crust formation in the Gulf of Mexico, the Proto-Caribbean Seaway between Yucatán and Venezuela, and possibly between Colombia and Chortís. Rifting is active and there is a continuous belt of granitoids approximately 500 km from the trans-American trench, some of which are associated with rifting or extensional arc tectonics. Chortís and Antioquia are inferred to be in a forearc position relative to these granitoids and associated Jurassic volcanic rocks.

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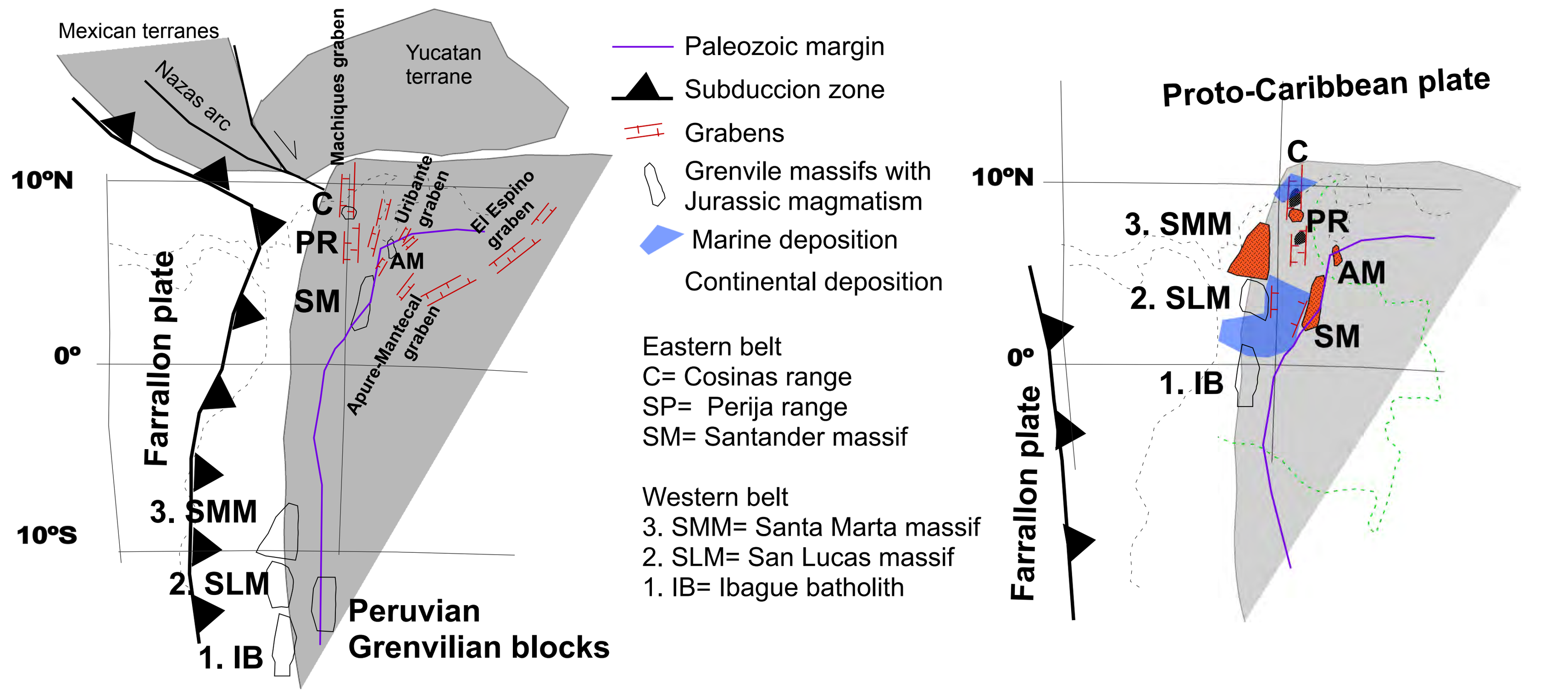
TECTONIC SETTING

PROPOSED MODEL

WESTERN BELT MAGMATIC ARC FORMED IN SOUTHERN LATITUDES, parallel to the subduction zone

FAN-LIKE GEOMETRY OF GRABEN SYSTEMS, formed at the place in change of strike of subduction zone to the west, and bounded by the northward separation of Yucatan and other Mexican blocks in late Jurassic - Early Cretaceous time (opening of proto-Caribbean plate)

MIDDLE - LATE JURASSIC (175-155 Ma) / EARLY CRETACEOUS (140-130 MA)



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