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Contractional deformation of the late Paleocene-middle Eocene foredeep and the iniciation of an arc-trench system in Southwestern Ecuador

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Protracted and diachronous accretion/collision of Oceanic terranes from Late Cretaceous to Early Paleocene in Ecuador accounted for the development of a series of fold and thrust belts and their corresponding foredeep not only along the Western Cordillera (W.C) but also in western Ecuador. While the accretion of the Guaranda Terrane caused a bivergent fold and thrust belt (FTB) and paired foredeep at both sides of the W.C. suture zone, the last stage of terrane collision of the Piñón Arc prompted the development of the Santa Elena Foredeep. Because of the collision coupling, sediment source and basin subsidence, this foredeep was restricted to southwestern Ecuador. The northern limit is constrained by diffuse normal foredeep shallowing south of the Montañita Riedel, however, the southern limit was clearly marked by the Machala right lateral Fault that generated the clockwise rotation of the Amotape-Tahuin Uplift as well as the exhumation of the Raspas Eclogite. The Machala Fault also denoted the southernmost limit of oceanic crust. The easternmost limit was the suture zone itself, which unfortunately, was obscured by the foredeep onlapping sequences as well as by some later fault reactivation. Nevertheless, in our opinion, the evidence for a suture has been documented by the widespread distribution of highly sheared olistoliths that were eroded and reworked by gravitational process.

Flysch deposition in this foredeep was chronicled by the deep water facies of Azúcar and Ancon groups deposited from Late Paleocene to Middle Eocene. The quartz-rich composition of the sandstones and the NE directed paleocurrents in the Azúcar Group was sourced from the uplifted Amotape-Tahuín Mountains in the south. In addition, indication of the partially uplifted Chongón-Colonche High was recorded in the significant amount of volcanic rock fragments and plagioclases in the flysch sequences. Because of the absence of currents to rework, there was an overwhelming occurrence and preservation of air-fall tuffs in the distal parts of the Ancón Group. These air-fall tuff beds were deposited by pervasive wind transport from the subaerial volcanism outburst located in NE Peru, which was associated to the Eocene/Oligocene Calipuy Formation calderas developed along the long-lasting Peruvian margin subduction (Navarro et al, 2010).

The contractional deformation that caused the NE vergence of the fold and thrust belt was prompted by far-field stresses associated with the uplift of the Amotape-Tahuin Mountains as documented by detail 2D seismic mapping and fault as well as fold kinematic studies. The old paradigm, that proposed a forearc setting since the Paleocene not only overlooked the foredeep development sub-parallel to the accreted Piñón Arc as well as the NE vergence compelling evidence of the Santa Elena Fold and Thrust Belt, but also neglected the importance of reliable 43.5 Ma oldest age for the Macuchi Arc in their quest to push for an older subduction initiation. Indeed, the Middle Eocene age of this arc-trench system evidently coincided with the 43-47 Ma change in orientation of the Hawaii-Emperor seamount; therefore, it is an induced subduction initiation following Stern (2004) terminology.