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Thermal variation, tectonic segmentation and seismic rupture zones along the N Ecuador – S Colombian margin.

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On the North Ecuador – South Columbian (NESC) convergent margin (0˚ - 4˚N), three megathrust events occurred in 1942, 1958 and 1979; the rupture zones of these events abut one another. The margin comprises four transverse segments (called, from south to north, the Esmeraldas, Manglares, Tumaco and Patia segments) showing clearly different tectonic and structural patterns. The central Manglares and Tumaco segments are separated by the newly discovered NW trending Manglares fault that matches the boundary between the 1958 and 1979 rupture zones. Off the Tumaco segment, intense normal faulting in the trench strongly increases the dip of the underthrusting Nazca plate in comparison with the Patia and Manglares segments where the top of the oceanic crust displays no normal faults.

To investigate the relationships between seismogenesis and thermal structure along the plate boundary, we conducted thermal modelling constrained by heat flow measurements and by heat flow derived from Bottom Simulating Reflectors (BSRs) on multichannel seismic lines collected during the SISTEUR and AMADEUS cruises. These finite-element thermal models carried out for each segment show that:

(1) Each tectonic segment has a specific thermal regime characterized by the heat flow values just landward of the deformation front. The heat flow values are anomalously low in the region of the Tumaco segment. These along-strike heat flow variations are produced by the southward increasing age of the Nazca plate and by the dip steepening of the oceanic crust beneath the Tumaco segment. From a previously published geodynamical model we propose that a reactivated fracture zone currently subducting beneath the Tumaco segment generates this steepening of the downgoing crust.

(2) The hypocenters for both the 1958 and 1979 earthquakes occurred at a depth on the interface where the temperature is $\sim$160°C. The updip limit of the seismogenic zone, for the 1942 and 1979 earthquakes, reaches the deformation front where our thermal models indicate temperatures of $\sim$60°C, suggesting that the updip limit is controlled by very low temperature processes. However, the seismogenic zone of the 1958 event, associated with the Manglares segment, is restricted to a region landward of a prominent basement high where temperature appears to be $\sim$100°C. This suggests that structural features in the upper plate may alternatively influence the location of the seismogenic updip limit.