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Regional Stress and Seismotectonics in Northern South America

We have integrated in situ stress and GPS data from northern South America (SA) to investigate the complex interaction between the South American, Caribbean, and Nazca plates and to examine the tectonic setting of the oil basins in the region. Our stress compilation consists of data from the World Stress Map database (after removing unreliable data), and new data from earthquake focal mechanisms and wellbore failure analyses. We define three stress provinces based on the direction and relative magnitudes of the principal stresses. The Ecuadorian Andes stress province exhibits strong E-W compression resulting from the subduction of the Nazca plate beneath the South American plate. In northwestern SA, the Upper Andes stress province shows NW-SE compression, possibly resulting from the negative buoyancy of subducted Caribbean plate beneath northwestern SA or from the ongoing collision of the Costa Rica-Panama microplate with northwestern SA. In northern Venezuela, the San Sebastian-El Pilar (SS-EP) stress province shows NE-SW extension. These stress provinces allow us to define active stress regimes in the oil basins of the region. The Oriente basin (Ecuador) is under strong E-W compression, whereas the direction of maximum compression in the Llanos, Maracaibo, Guajira, Catatumbo, Barinas and Apure basins is NW-SE and the Maturin basin in eastern Venezuela is under NE-SW extension. Overall, the stress field in northern SA is most compressive in the Ecuadorian Andes province (reverse faulting), less compressive in the Upper Andes province (reverse and strike-slip faulting) and least compressive in the SS-EP stress province (strike-slip and normal faulting).