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Variscan olistostromes and the geological history they tell… unraveling the tectonic evolution of the Pangea supercontinent

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Mass transport deposits or olistostromes, carrying large-sized blocks or olistoliths, are related to active and passive margin tectonics. Information on how they are produced is critical to understanding the tectonically driven topographic dynamics in the source areas, and the tectonic evolution of sedimentary basins and their shoulders. The geological record of these mass transport deposits is commonly well preserved onshore, in orogenic regions where continental margins uplift was influenced by the gradual movement of continents.

The Iberian Massif is one of the World's key areas for studying ancient orogenies, like the Late Paleozoic Variscan belt, to understanding the formation of olistostromes, and developing provenance studies on such complex tectonic fold and thrust belts. Structural relations between the basement and overlying Mississippian synorogenic marine basins were recently examined in the lower plate (Gondwana side) of the Variscan collisional orogeny in Iberia. The stratigraphy of these Variscan synorogenic basins is quite complex and includes: a) sedimentary melánges (e.g., related to submarine mudflows and turbidites) that carried or were formed by different-sized blocks of different age metamorphic, volcanic, siliciclastic and carbonated rocks derived from the nearby pre-Mississippian basement; b) partially or completely dismantled Devonian and/or Mississippian carbonate platforms; and c) syn-sedimentary bimodal calc-alkaline volcanism. Geochronology data show that Mississippian sedimentation and volcanism occurred simultaneously with regional high temperature-low pressure metamorphism, associated with the formation of gneiss domes, bounded by extensional shear zones and faults, during crustal thinning and plutons emplacement. Mapping of shear zones and faults on the Iberian Variscan basement provided crucial information for better comprehending Mississippian synorogenic basin architecture. Our study demonstrates that there is a spatial and temporal relationship between the generation of olistostromes (including large olistoliths) and the development of first-order extensional structures in the pre-Mississippian basement.

Given that the collision between Laurussia and Gondwana had already occurred, it seems that

these Mississippian synorogenic basins were not formed in a foreland, backarc, or forearc setting related to the subduction of the Rheic oceanic lithosphere, and thus, other geodynamic hypotheses need to be set. Two tectonic models have been discussed to explain the occurrence of a significant thermal anomaly beneath the lower plate (Gondwana side) and the formation of the Mississippian synorogenic basins in Iberia: Model A) considers that the roll-back of the lower plate was responsible for the formation of an orogenic plateau, the lateral flow of partially molten orogenic roots, and peel-back tectonics, after the subduction of the Rheic Oceanic lithosphere under the upper plate (Laurussia side) and the subsequent continental collision. In this case, the Mississippian synorogenic basins would be of peel-back type; Model B) invokes the subduction of the Paleotethys oceanic lithosphere beneath the Variscan collisional orogen, and the Mississippian synorogenic basins would be of backarc type but developed later than the Rheic Ocean closure.

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