



## **Mid-Carboniferous conglomerates in southwestern Europe record early Variscan intracontinental convergence: evidence that channels were exhumed before thermal weakening of the lithosphere**

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The early part of the intracontinental geodynamic evolution of the Variscan chain in southwestern Europe is recorded by polymict conglomerates found in flysch basins paired with exhumed crystalline massifs. The conglomerates contain pebbles and cobbles of deformed granite and mid- to lower-crustal metamorphic rock, and in southern France and northeastern Spain have been assigned a Visean-Namurian age based on biostratigraphy. In the Catalan Coastal Ranges, where Alpine deformation and metamorphism are absent, conglomerates are deformed, cross-cut by granite, and contact metamorphosed to andalusite-cordierite grade. Foliation in the pebbles and cobbles is not coplanar with foliation in their pelitic matrix: the conglomerates record exhumation of crust that was already deformed, metamorphosed, and exhumed before the Visean. In the Guillerics massif of NE Spain, gneisses were exhumed  $\approx 10$  km before 324 Ma. Conglomerate samples from eight flysch basins, from north to south: Montagne Noire, Mouthoumet massif, SE Pyrenees, and five localities in the Catalan Coastal Ranges, were collected for detrital zircon age determinations using the USGS/Stanford SHRIMP-RG. The flysch basins have principal sources of pre-Cadomian, Cadomian, Cambro-Ordovician, Devonian, and Carboniferous ages. The dominance of Paleozoic ages indicates local orthogneiss and Variscan granite as primary sources, implying intra-Carboniferous exhumation rates as high as 5-10 mm/a. The maximum depositional age of each flysch conglomerate may show a trend of younging to the south [330 Ma (Montagne Noire) - 340 Ma (Mouthoumet) - 324 Ma (Poblet) - 328 (Perinet)], suggesting deposition in front of advancing thrust nappes. In the Pineda basin, a dike of undeformed granite which cross-cuts conglomerate is  $304 \pm 2$  Ma (SHRIMP U-Pb zircon data), providing a minimum age constraint on the time of deposition. In the Montagne Noire and the Mouthoumet massif, flysch basins are deformed by structures related to nappe emplacement, not due to late-orogenic extension of Late Carboniferous age. The Variscan chain may offer an example of lithospheric deformation being partitioned into discrete crustal shear zones that help exhume massifs of middle crust before thermal weakening of the lithosphere leads to tectonic extension and orogenic collapse.