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The deep structure of the Ardennes Variscan thrust belt from structural and ECORS seismic data: Discussion

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IN AN overview of the Ardenne Variscan external zone combining surface and subsurface data, Le Gall (1992) presents an interpretation that is not in accord with our observations. In this interpretation the author suggests that the contact between the lower Palaeozoic rocks and the overlying Devonian rocks is tectonic, implying that the Rocroi and Stavelot massifs correspond to tectonic windows beneath a N-directed thrust nappe.

By suggesting that the Devonian rocks have been detached and transported northwards, Le Gall (1992) removes any possibility of reconstructing the early Devonian intracontinental basin and its subsequent inversion (Meilliez & Mansy 1990, Fielitz 1992). As a further consequence his model does not allow any estimate of the Caledonian deformation to be made, nor can wide regional correlations be made with the Brabant and Midlands Cratons (Woodcock 1991).

The Ardenne Eo-Variscan unconformity

The Givonne, Rocroi, Serpont and Stavelot massifs of the Ardenne area consist of strongly folded, alternating, thinly-bedded, fine- to medium-grained Cambrian to upper Lower Ordovician siliciclastics. These massifs constitute inliers of basement which are surrounded by early Devonian rocks. In many localities along the cover–basement contact, the lower Palaeozoic rocks can be seen to exhibit metric scale folds that are truncated by the flat-lying basal beds of the Devonian cover. Such a contact is an unconformity (Bates & Jackson 1980). Meilliez (1984) and Delvaux & Laduron (1984) have convincingly demonstrated that the Devonian rocks cover a notable palaeo-relief. The surface of this palaeo-relief is not disturbed by any décollement plane.

The cover–basement relationships are best observed in the Fépin area on the northern flank of the Rocroi massif. Here the basal Devonian rocks are characterized by a wedge shaped (0–20 m thick), conglomeratic unit interdigitated with and succeeded by coarse sandstone and pebble beds with occasional red shales. These rocks are folded into an open, asymmetric, NNW-verging syncline with a 400 m long flat limb and a fanning, pressure-solution cleavage. The axis of the fold plunges less than 10° to the ENE. At several sites in the Fépin area the folds affecting the lower Palaeozoic basement siliciclastics can clearly be seen to be truncated by the conglomeratic basal Devonian unit. The folds in the basement are tight to isoclinal with plunges to the SSE or SSW, roughly perpendicular to the folds in the Devonian cover. Nowhere have we observed any detachment of the cover from the basement and the erosional character of the Eo-Variscan unconformity is preserved intact.

Variscan shortening

Many authors, including Le Gall (1992), have demonstrated that a well-developed, S-dipping, pressure-solution cleavage occurs across the unconformity. The dip and spacing of the cleavage depends on the arrangement of lithologies and in some localities it can be seen to be strongly refracted across the unconformity. On an outcrop scale this cleavage can be related to the rotational plane strain that characterizes the folds and related faults exhibited by the Devonian cover rocks around the lower Palaeozoic basement inliers (Meilliez & Mansy 1990). This cleavage defines a local finite flattening plane associated with the Variscan shortening. Whether this cleavage is superimposed on an earlier Caledonian cleavage in the basement rocks (Delvaux & Laduron 1984) remains disputed. While it can be shown that there is no detachment along the cover–basement contact, it is evident that there are décollements above the unconformity. The lower Devonian shales which succeed the Fépin Formation contain several such slip surfaces and they have made possible a strong internal simple shear.

It should be noted that the accumulated field data and acquired seismic profiles do not allow the construction of the staircase fold and thrust geometries presented by Le Gall (fig. 7, 1992). While synsedimentary faults can be observed, they cannot be shown to have been directly inverted. However these faults have been interpreted to have located low-dip ramps from which most of the major thrust faults were propagated (Meilliez & Mansy 1990).

Le Gall (1992) has used the NdF-ECORS seismic data to construct his sections and we question this choice. Importantly this profile is not parallel to the main transport direction. Our detailed field work has shown that combinations of folding and strike-slip faulting do not support the simple cylindrical model for the Variscan front west of the Meuse–Lesse valleys. The DEKORP profiles are closer to the Variscan shortening direction and one of these crosses the Stavelot massif which is similar in structure and composition to the Rocroi massif (Fielitz 1992). This is more amenable to the discussion on the Meuse section and shows that to the east the cylindrical model is again questionable.

Consequences for Variscan and Caledonian palaeogeography

The coarse clastics of the Fépin Formation which encroached on the post-Caledonian erosional surface (Meilliez 1984) provides an excellent marker bed for the character of the Variscan deformation on a regional scale. The character of this unit and the preservation of its unconformable contact with the lower Palaeozoic rocks allow us to discuss both the pre- to early Variscan extension and sediment dispersal patterns as well as the later shortening. The bulk simple shear accompanying this shortening was located in the incompetent series of shales and sandstones which overlie the Fépin Formation and not within the basal unit as maintained by Le Gall (1992). By removing the possibility of Variscan detachment along the unconformity it is now possible to characterize the Caledonian deformation and test the structural correlations with the Brabant and Midlands areas.

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