Bulletin de la Société belge de Géologie	98-2	pp.231-234	Bruxelles 1989
Bulletin van de Belgische Vereniging voor Geologie	98-2	pp.231-234	Brussel 1989

PRE-OROGENIC SHALLOW STRETCHING TECTONISM WITHIN THE NAMURIAN BEDS IN THE NORTHERN FRANCE

by

Francis MEILLIEZ [1]

ABSTRACT

Inverted, previous synsedimentary fault zones might be recognized by mapping the thickness and facies variations within a given time interval. This criterium is applied to the Namurian Beds of the french northern Coal Basin.

KEY WORDS

tectonic inversion, Namurian, Coal Basin, synsedimentary faulting.

Among other imortant contributions, Dr. E. Paproth has stimulated and enlivened interdisciplinary work groups. Biostratigraphic revision of the Carboniferous (Paproth *et al.*, 1983a, b) is a powerful tool for structural geologists. It allows their imagination to fly with the wings of quantitative stratigraphic data. I try to make clear that on the accurate description of the Namurian Beds made by Chalard (1958) in the Northern France.

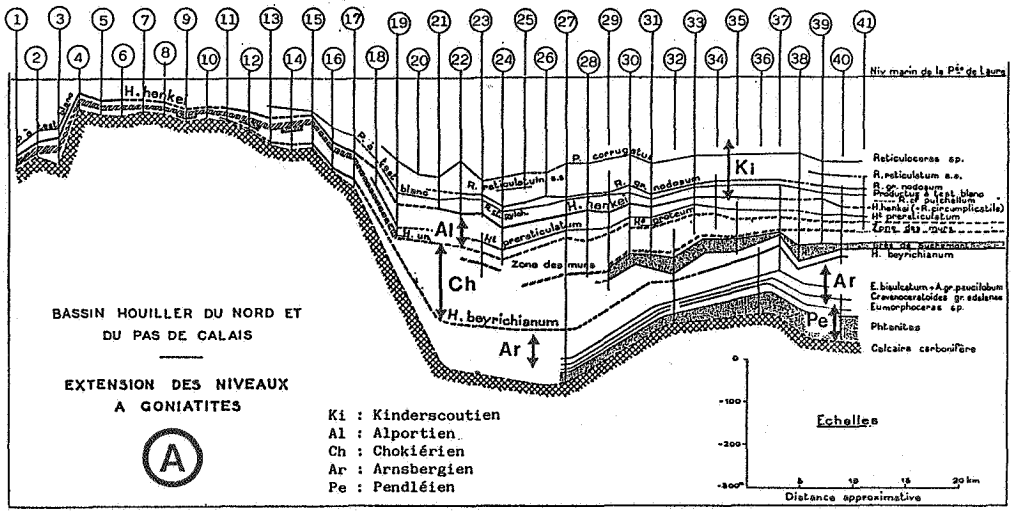
By reporting these well-documented data on a synthetic diagram makes two contrasted areas to be distinguished (fig. 1). A reduced series covers the Artois on the west while a thick series accumulates on the Hainaut in the east. Minor differentiation could be achieved within each domain, they will be neglected here. Many bio- and lithostratigraphic markers show that the series as a whole accumulated upon both domains. Only the basal strata taper from east to west and delineate a westwards onlap. So, the differential sedimentary accumulation has to be explained from the top of the Arnsbergian to the "Passée de Laure" (fig. 1).

The usual geological explanation is the effect of a diffcrential subsidence. But lateral variation of the rate of subsidence is itself an effect of several mechanical processes that might cumulate. Roughly, some are superficial processes that are linked to sediment consolidation through burial, differential compaction and water escape (Jones & Addis, 1986 ; Davison, 1987). Others are deep processes which are related to a stretching of the lithosphere (e.g. McKenzie, 1978 ; Gibbs, 1984 ; Wernicke, 1985 ; Barr, 1987 ; Axen, 1988).

As long as the lithologies are similar the structural effects of both types of processes must have operated in the past as they do within the present margins. The most obvious effects are the brittle ones (fractures) as they occur within the uppermost structural level. Soft-sediment deformation may be triggered as a subsequent effect. Fractures linked to consolidation processes might be observed on the outcrop scale, while those linked to the up-to-date investigatory tool. It should be noted that the former fractures might be induced by the latter. This is a different problem.

On a regional scale, the effect of lithospheric stretching is the rupture along a high-angle normal fault, and further slipping down it (e.g. Lin & Parmentier, 1988). A surficial depression allows fresh sediments to be entrapped as a result of the forward tilting of the bottom. Iterative evolution of the device leads to a triangular basin in section (fig. 2). It must be noted that the high-angle normal fault has little chance to be expressed as a single plane since it encompasses a zone of most soft sediments (e.g. Jones & Addis, 1986). The surficial expression of the half-graben is related to an equilibrium between sediment influx, subsidence rate and eustatic variations, as illustrated by Vail *et al.*, 1987). So an active half-graben does not need to be morphologically expressed on the sea botttom.

[1] Université des Sciences et Techniques de Lille - F.A., SN5 - F-59655 Villenveuve d'Ascq Cedex, France.



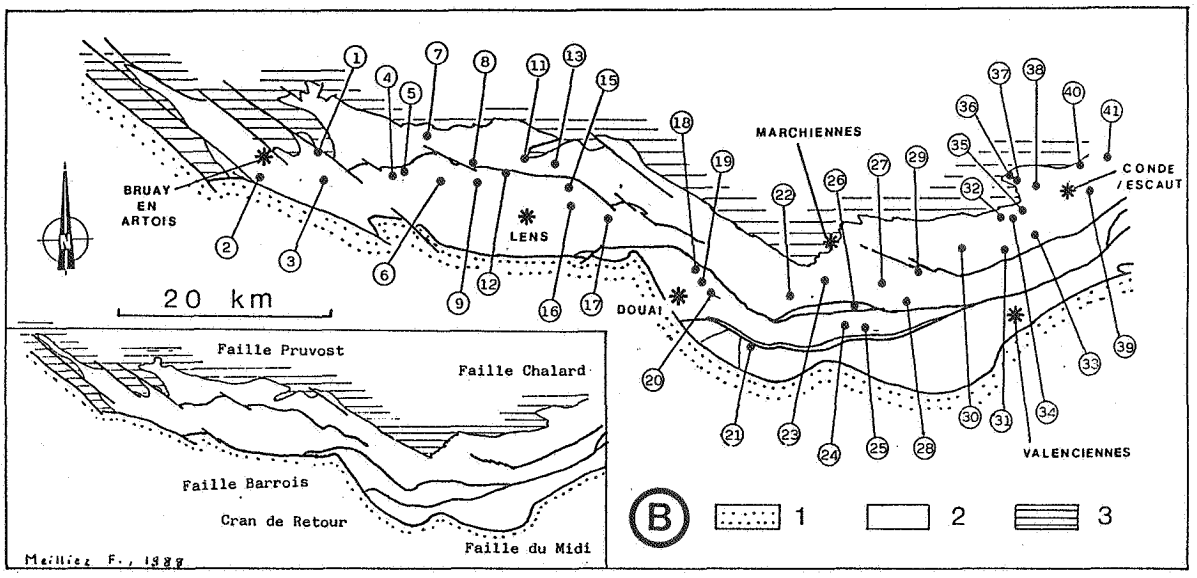


Figure 1. : The Namurian of the northern France.

A : Synthetic stratigraphic diagram (from Chalard, 1958)
B : Map distribution of the sections, established from the data gathered by Chalard (1958). 1 - Devonian ; 2 - Silesian ; 3 - Dinantian

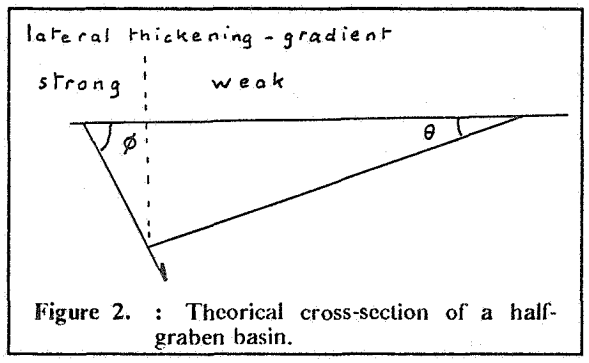


Figure 2. : Theorical cross-section of a half-graben basin.

This type of localized sedimentation area is well-known within the present margins seismic data might contribute as well. Where they do not stratigraphic data might give a valuable insight. As long as further shortening can be overcome within a major structural unit, it is quite easy to look at the lateral thickening gradients. An actual half-graben is a strongly asymetric structure. So the mapping of the lateral thickening gradients may led to characterize the high-gradient side that would overlie upon the high-angle normal fault.

I tentatively applied this technique to the Namurian strata from the northern France (fig. 3). Most of the sections belong to the northern slightly-deformed domain. So they might be compared with confidence on this scale. After a carefull reading of the structural synthesis by Bouroz *et al.* (1962), I have choosen to interpret the Chalard and Pruvost Faults as a relay rather than a single fault (fig. 1A). Thence, lateral-thickening gradients lead to a regional structural framework (fig. 3). This needs to be more precisely studied by gathering specific data.

However, if this essay has to be confirmed, it would explain many regional structures, primary and secondary as well. The step-by-step subsidence Pruvost (1930) expressed in the cylothem concept is clearly related to the local adjustment of blocks. The Marchiennes structure (Pruvost & Bertrand,

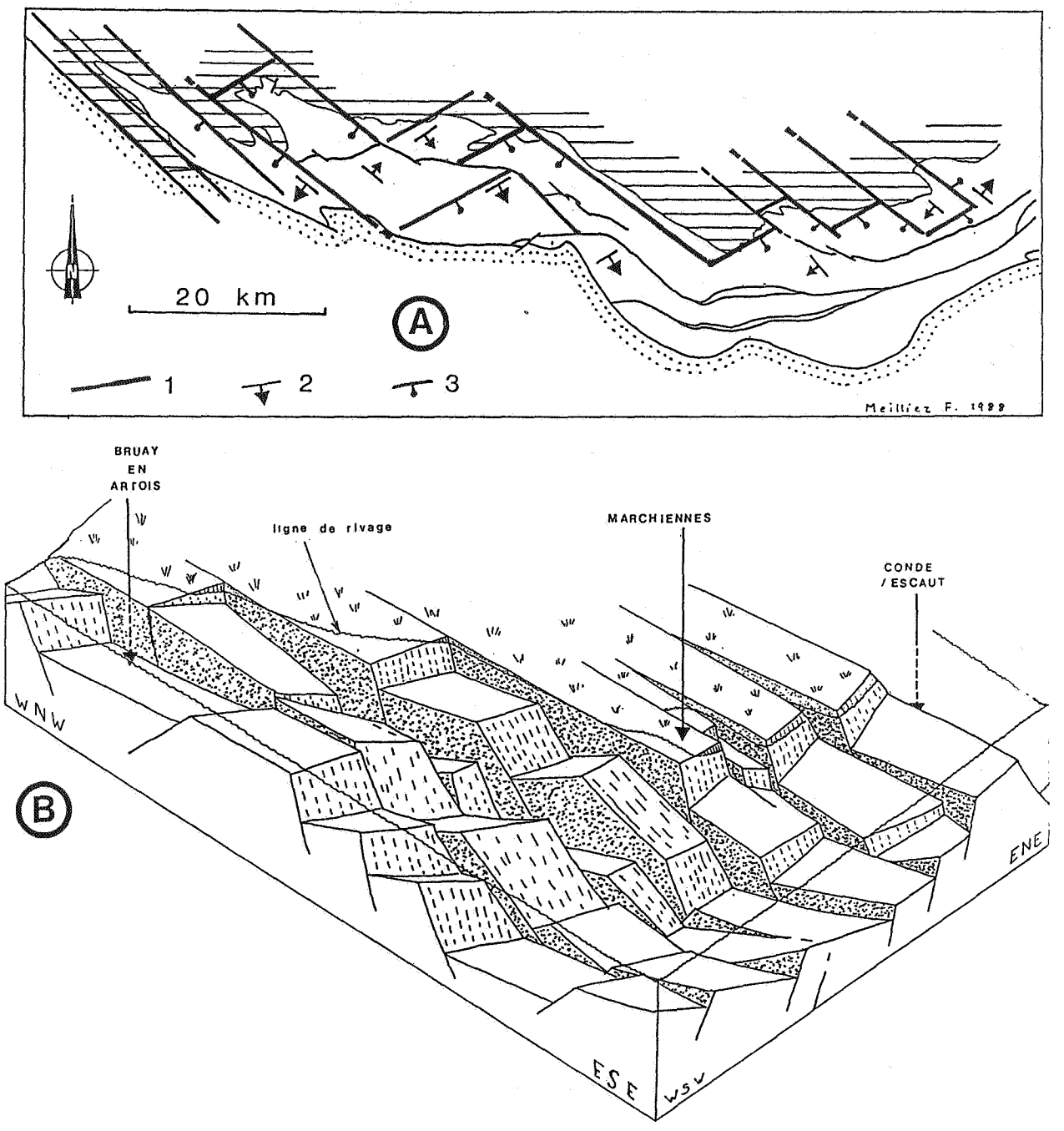


Figure 3. : Hypothetical map distribution of synsedimentary faults within the parautochtonous namurian beds of northern France (A). Tentative block-diagram (B).

1932) is clearly the effect of a relative low-subsiding rate of subsidence ratther than a compressive structure.

Most synsedimentary faults appear to have accommodated further Westphalian shortening. It seems to me that the most important conclusion is the continuity of regional stretching at least up to the onset of Westphalian time. This needs to be tested independantly of the present approach.

REFERENCES

AXEN, G.J., 1988 - The geometry of planar domino-style faults above a dipping basal detachment. *J. Struc. Geol.*, *10*: 405-411.

BARR, D., 1987 - Structural/stratigraphic models for extensional basins of hal-graben type. *J. Struc. Geol.*, *9*: 491-500.

BOILLOT, G., MONTADERT, L., LEMOINE, M. & BIJU-DUVAL, B., 1984 - Les marges continentales actuelles et fossiles autour de la France. Masson, Paris, 342 p.

BOUROZ, A., CHALARD, J., DALINVAL, A. & STIEVENARD, M., 1962 - La structure du bassin houiller du Nord de la région de Douai à la frontière belge. *Ann. Soc. géol. Nord, Lille, LXXXI*: 173-220.

CHALARD, J., 1958 - Contribution à l'étude du Namurien du Bassin Houiller du Nord de la France. Thèse Dr. Etat Univ. Lille, 2 vol., 300 p. Imp. Hollande, Valenciennes.

DAVISON, I., 1987 - Normal fault geometry related to sediment compaction and burial. *J. Struct. Géol., 9/4*: 393-401.

GIBBS, A.D., 1984 - Structural evolution of extensional basin margins. *J. geol. Soc. London, 141*: 609-620.

JONES, M.E. & ADDIS, M.A., 1986 - The application of stress path and critical state analysis to sediment deformation. *J. Struct. Geology, 8*: 575-580.

LIN, J. & PARMENTIER, N., 1988 - Quasistatic propagation of a normal fault : a fracture mechanics model. *J. Struc. Geol., 10*: 249-262.

McKENZIE, D., 1978 - Some remarks on the development of sedimentary basins. *Earth Planet. Sci. Lett., 40*: 25-32.

PAPROTH, E. *et al.*, 1983a - Bio- and lithostratigraphic subdivisions of the Dinantian in Belgium. A review. *Ann. Soc. Géol. Belgique, 106/2*: 185-239.

PRUVOST, P., 1930 - Sédimentation et subsidence. *Liv. Jub. Soc. Géol. France*, Paris.

PRUVOST, P. & BERTRAND, P., 1932 - Quelques résultats des récentes explorations géologiques du Bassin Houiller du Nord de la France. *Rev. Ind. Minérale*, 365-379.

VAIL, P.R., COLIN, J.-P., du CHENE, J., KUCHLY, J., MEDIAVILA, F.& TRIFIFIEF, V., 1987 - La stratigraphie séquentielle et son application aux corrélations chronostratigraphiques dans le Jurassique du Bassin de Paris. *Bull. Soc. géol. France, 8/III*: 1301-1321.

WERNICKE, B., 1975 - Uniform normal-sense simple shear of the continental lithosphere. *Can. J. Earth Sci., 22*: 108-125.