Using the available data on sediment concentration and P-content, total P-output of the catchment can be estimated to be ca. 2200 kg in Kinderveld and 90 kg in Ganspoel, corresponding to 8 kg/ha/year and 0.6 kg/ha/year respectively. These figures may be compared to those collected in some other studies. Hansen & Nielsen (1995) measured a P-loss varying between 2 and 40 kg/ha/year on erosion plots in Denmark. Scokart *et al.* (1997) estimate average P-loss in Flanders at 1.87 kg/ha/year.

CONCLUSIONS

The data collected in this study show that soil erosion by water contributes significantly to P-losses from arable land in Central Belgium. This high P-export is mainly due to the high soil loss rates occurring in the area. The P-content of the exported sediment is strongly correlated with the sediment's clay content and indirectly with the sediment concentration. However, the relationship with discharge is less clear as there are important variations in the relationship between sediment concentration and discharge.

ACKNOWLEDGEMENTS

This research is part of a project funded by the Fund for Scientific Research Flanders (G0215-96) and by the Catholic University of Leuven (OT 95/15).

REFERENCES

HANSEN, A.C. & NIELSEN, J.D., 1995. Runoff and loss of soil and nutrients. *In* : Correll, A., ed., *Surface runoff, erosion and loss of phosphorus at two agricultural soils in Denmark - plot studies 1989-92*. SP-report No. 14: 149-188.

SCOKART, P.; NYSSEN, P. & DE COOMAN, P., 1997. Developing an expert system for the evaluation of nutrient losses from agriculture to water in Belgium. *In* : Tunney, H.; Carton, O.T.; Brookes, P.C. & JOHNSTON, A.E., eds. *Phosphorus loss from soil to water.* CAB International: 403-406.

SIBBESSEN, E., 1995. Phosphorus, nitrogen, and carbon in particle-size fractions of soils and sediments. *In* : Correll, A., ed. *Surface runoff, erosion and loss of phosphorus at two agricultural soils in Denmark-plot studies 1989-92.* SP-report No. 14: 135-148.

TAKKEN, I. & VERSTRATEN, J.M., 1996. Een verkennend onderzoek naar bepalingsmethoden voor plant-beschikbaar fosfor en organisch fosfor in bodemmonsters uit de Nederlandse kustduinen. Appendix A bij : De rol van fosfor bij de vergrassing in de droge delen van de Nederlandse kustduinen, FGBL-UvA-intern rapport.

QUANTITATIVE PALYNOLOGY OF LATEST FAMENNIAN EVENTS IN THE SAUERLAND, GERMANY

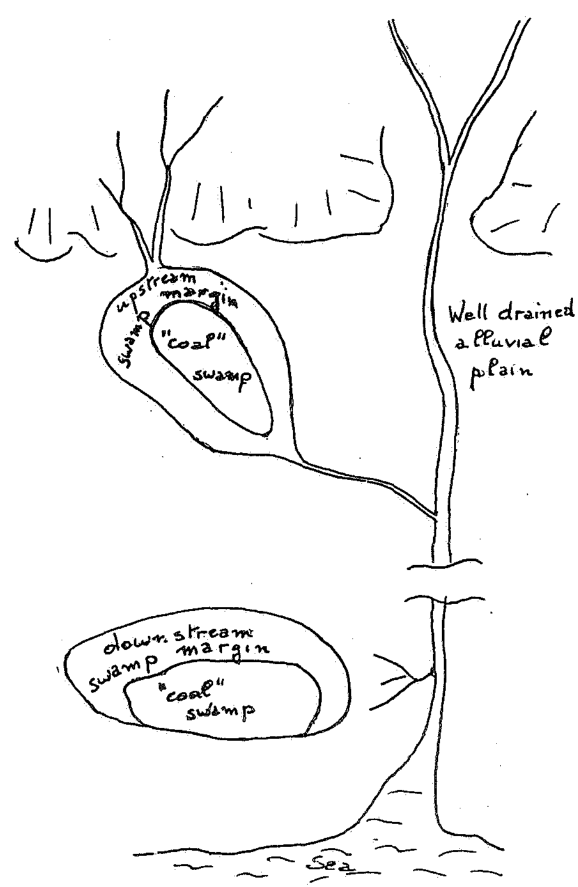
Maurice STREEL[1]

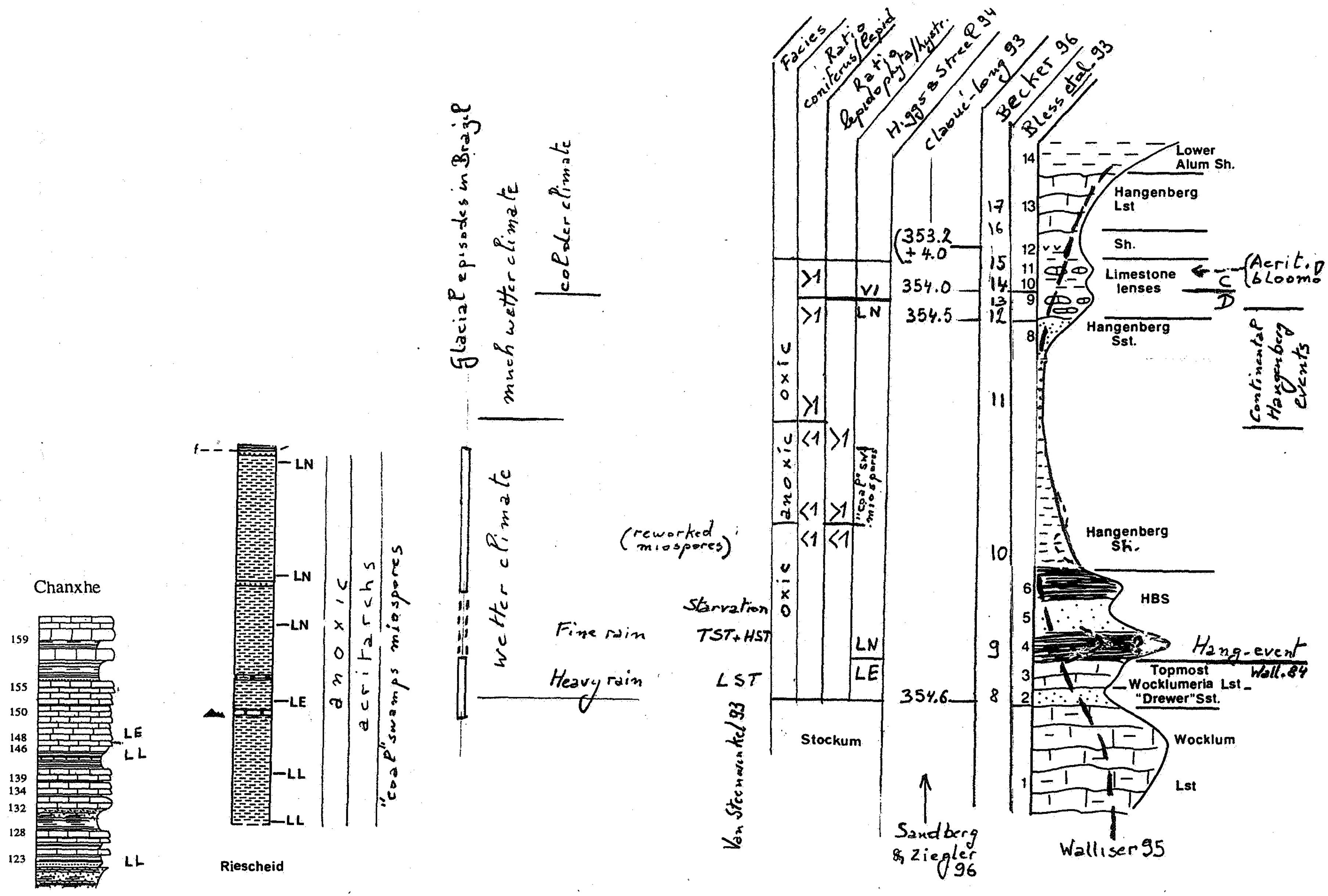
1. Paleontology, University of Liège, Bât. B18, Sart-Tilman, B-4000 Liège 1.

During the late Famennian, quantitative palynology allows to recognise four continental and three marine megaenvironments and two kinds of contrasting palynofacies (oxic / anoxic). Miospore analysis suggests two kinds of cycles:

1) recurrence of high sea-levels developing downstream «coal» swamps;
2) recurrence of wet climates developing upstream swamp margin vegetation.

Applied to a sequence around the Hangenberg Event in Sauerland, Germany, where the changes in sea-level are known to be severe, miospore analysis suggests a high rate of sedimentation and cyclicities involving sea-level and climate changes, probably of the 6th order. Continental vegetation has not been strongly affected




Chanxhe
159
155
150
148
146
139
134
132
128
123
LE
LL
LL
Riescheid
LN
LN
LN
LE
LL
LL
anoxic
acritarchs
"coal" swamps miospores
Glacial episodes in Brazil
much wetter climate
colder climate
wetter climate
(reworked miospores)
Fine rain
Heavy rain
Starvation
TST+HST
LST
Van Steenwinkel 93
Facies
Ratio coniferus/lepid
Ratio lepidophyta/hystr.
Higgs & Streel 94
Claoué-Long 93
Becker 96
Bless et al. 93
oxic
anoxic
oxic
>1
>1
>1
<1
>1
<1
>1
<1
<1
VI
LN
"coal" swamps miospores
LN
LE
Stockum
(353.2 ± 4.0
354.0
354.5
354.6
Sandberg & Ziegler 96
17
16
15
14
13
12
11
10
9
8
14
13
12
11
10
9
8
6
5
4
3
2
1
Lower Alum Sh.
Hangenberg Lst
Sh.
Limestone lenses
Hangenberg Sst.
Hangenberg Sh.
HBS
Topmost Wocklumeria Lst
"Drewer" Sst.
Wocklum Lst
Walliser 95
(Acrit. blooms)
C
D
Continental Hangenberg events
Hang-event
Wall. 84

by the Hangenberg Event itself. On the contrary, younger «continental Hangenberg events», corresponding to the peak of the regression, have strongly affected the contemporaneous «upland» and «coastal» vegetations. These vegetations have not recovered after that peak, probably as a consequence of a colder climate. Latest Famennian climate was probably unstable with quick oscillating glacial and interglacial phases in the high latitudes.

Miospores dominating a specific continental environment during the late Famennian (after Streel & Scheckler 1990, Jarvis 1992, Dreesen *et al.,* 1993)

Well drained alluvial plains:
Aneurospora greggsii
(probably *Archaeopteris* microspores)

«Coal» swamps:
Diducites plicabilis-Auroraspora varia Complex
(Rhacophyton isospores)

Upstream swamp margins:
Grandispora gracilis
Apiculiretusispora coniferus

Downstream swamp margins:
Vallatisporites hystricosus
A uroraspora asperella
Retispora lepidophyta

COMPARISON OF INDUCTIVE AND NUMERICAL MODELS OF VARISCAN FLUID FLOW IN EASTERN BELGIUM

Philippe MUCHEZ[1] & Britta LÜNENSCHLOSS[2]

1. *Fysico-chemische Geologie, K.U.Leuven, Celestijnenlaan 200C, B-3001 Heverlee*
2. *Geoforschungszentrum Potsdam, Telegrafenberg A51, D-14473 Potsdam*

The ideas about fluid flow in compressional regimes remain controversial. Numerous papers highlight the importance of major fluid flow during folding and thrusting as others favour a closed system behaviour of the fluids. In a first instance a subdivision should be made between compression leading to orogenies and the compressional environment of accretionary prisms. Major fluid flow has been recorded along thrust, normal and strike-slip faults in accretionary prisms (Moore & Vrolijk, 1992). Fluids originate from sediment consolidation, mineral dehydration and methane and carbon dioxide generation from organic matter. Sediments incorporated within tectonic belts, however, often underwent a complex diagenetic evolution during burial and most waters have already been expelled before tectonic deformation. Within such a setting fluids are mainly derived from diagenetic and especially metamorphic reactions. High fluid fluxes are only attained when synorogenctic faults intersect the metamorphic basement. Flow regimes evolve from conditions of high P-T with locally derived fluids during initiation of the structures, to high fluxes of metamorphic fluids as the structures propagate and intersect the fluid reservoirs (Kerrich *et al.*, 1984). The aim of this study is to document the palaeofluid flow at the Variscan thrust front in Belgium and western Germany. The criteria and techniques used to distinguish open from closed fluid flow systems are presented together with numerical simulations of the temperature field within an open fluid flow system.

The Variscan Front Complex is made up of a series of thrust sheets at the Variscan thrust front. In eastern Belgium and western Germany, this thrust front is characterised by a strongly imbricated zone and a greenschist metamorphic area to the south. Associated with this imbricated zone, locally anomalous high coalification values occur in the Upper Carboniferous sediments. This anomaly is also suggested by the high homogenisation temperatures (up to 210°C) of low salinity H_2O-NaCl fluid inclusions in Variscan quartz veins (Stroink, 1993). Similar H_2O-NaCl fluids are present as inclusions in quartz veins associated with large thrust faults within the metamorphic area to the south. Chlorite geothermometry indicates similar high precipitation temperatures (>300°C) of cements in shear veins over a vertical distance of more than one km at the thrust front. These thermal anomalies, which show a close relation to the tectonic setting, indicate that fluid flow in an open system caused these elevated temperatures and the strong spatial differences. The fluids could have originated from the metamorphic zone to the south. To test this model, the palaeotemperature field has been simulated numerically. This 2D modelling of the thermal field incorporates heat transport by fluid flow and by thermal conduction. It confirms the significance of long distance fluid migration along high permeable fault zones at the Variscan thrust front in eastem Belgium and western Germany.

Variscan veins, which formed during folding, at other parts of the Variscan thrust front formed from a fluid which was geochemically buffered by the host-rock (Muchez *et al.*, 1995) and in thermal equilibrium with it. This indicates a closed system, with fluids and components derived from the adjacent wall-rocks. The presence of the metamorphic basement and the frontal thrust splay in eastern Belgium and western Germany seem to provide the necessary fluids and migration pathways.