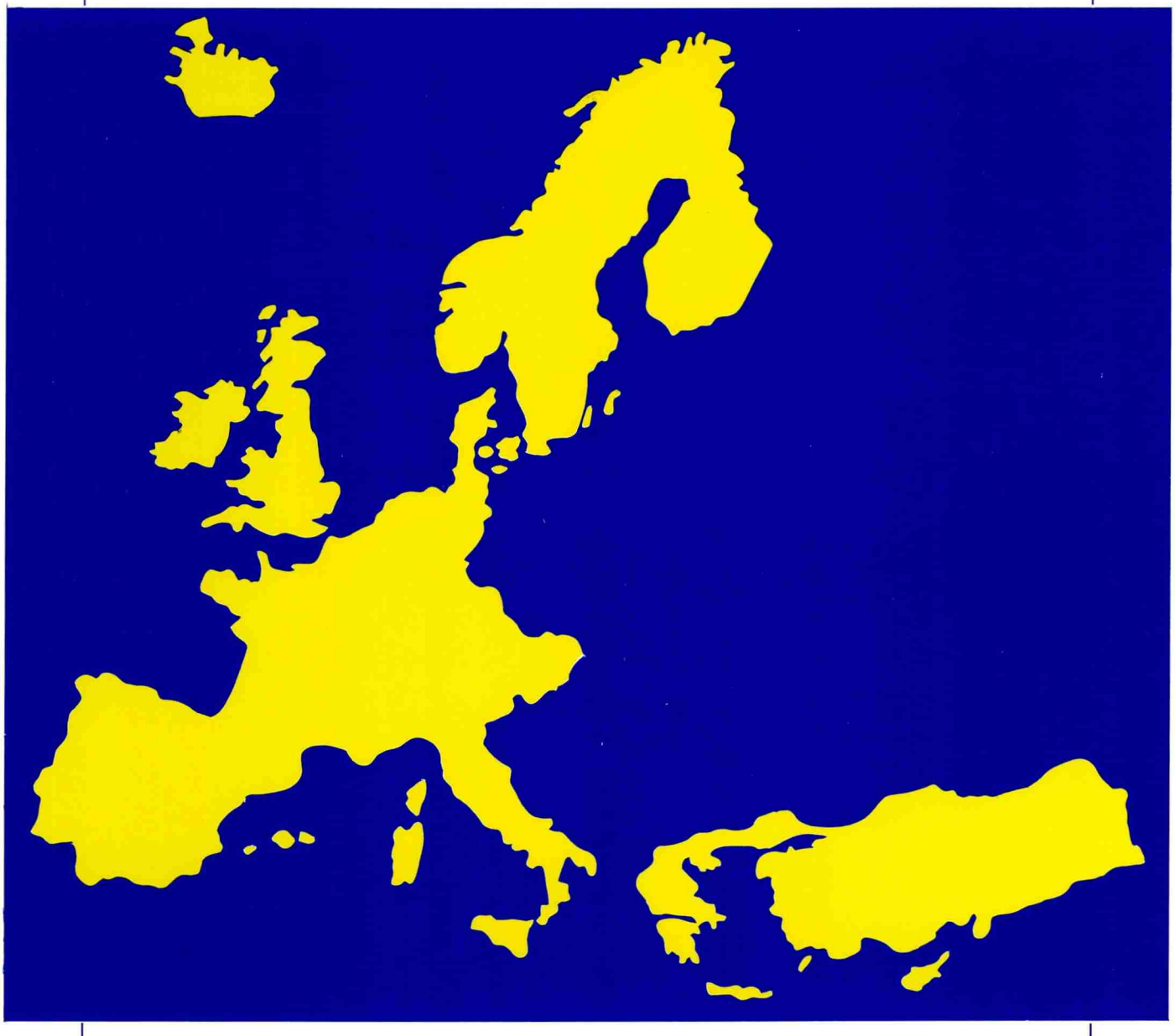
Geochemical Mapping of Western Europe towards the Year 2000.

REPORT No. 4

Minutes from Project Meeting in Heerlen, The Netherlands, 27-28 May 1991



Western European Geological Surveys.

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WESTERN EUROPEAN GEOLOGICAL SURVEYS (WEGS)

Geochemical Mapping of Western Europe
towards the Year 2000

Report No 4

Minutes from Project Meeting in Heerlen, The Netherlands 27-28 May 1991.

Compiled by
A. Demetriades, Greece

With 2 Appendices:

1. Within and between Site Variability in the Composition of Overbank Sediment (J. Plant and J .Ridgway)

2. Excursion to the Geul River Valley, Belgium and The Netherlands (J. Ebbing and R. Swennen)

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Sammendrag:

The WEGS Working Group on Regional Geochemical Mapping held a meeting in Heerlen, The Netherlands, 27-28 May 1991. 18 participants from 10 countries discussed progress reports and plans for further activities in the Project Geochemical Mapping of Western Europe towards the Year 2000.

Emneord	Fagrapport	Regional kartlegging	

Participants:

O. Schermann, Austria
R. Swennen, Belgium
W. de Vos, Belgium
O. Jacobsen, Denmark
E. Pulkinnen, Finland
R. Salminen, Finland
R. Hindel, Germany
A. Demetriades, Greece
M. Branca, Italy
M. Voltaggio, Italy
J. Ebbing, The Netherlands
J. Verbeek, The Netherlands
J. Bogen, Norway
B. Bölviken, Norway
R. Ottesen, Norway
T. Volden, Norway
J. Plant, United Kingdom
J. Ridgway, United Kingdom

CONTENTS

APPENDICES

1. GENERAL

The meeting was held at the regional office of the Geological Survey of The Netherlands in Heerlen. At this meeting there were participants from ten out of the twenty WEGS countries, i.e., Austria, Belgium, Denmark, Finland, Germany, Greece, Italy, The Netherlands, Norway and United Kingdom.

2. AGENDA

The following agenda was agreed:

Monday, 27 May 1991

- Introduction (B. Bölviken)
- Publication of Pilot Project data (A. Demetriades)
- Research project (J. Ridgway and J. Plant)
- Harz Mountains Study (R. Hindel)
- Benelux-Germany Research Project (R. Hindel, J. Ebbing, R. Swennen, J. Verbeek and W. de Vos)
- Lunch
- Excursion to the Geul river valley (Belgium and The Netherlands)
- Report of activities by all representatives

Tuesday, 28 May 1991

- Flood regimes, rate of accumulation etc. (J. Bogen)
- Chemical analyses (R. Hindel)
- Quality control (O. Schermann)
- Databases (J. Ridgway and J. Plant)
- Funding (B. Bölviken)
- Publication of Pilot Project results (A. Demetriades)
- Annual report to the WEGS Directors (B. Bölviken)
- Working Group meetings 1991-93
- Other matters, minutes
- Writing of Guidelines for Research Project
- Benelux-Germany Research Project: a discussion
- Closing of meeting

3. INTRODUCTION (B. Bölviken)

B. Bölviken briefly outlined the work of the WEGS Working Group on Regional Geochemical Mapping for the benefit of first time participants.

The Working Group was created by the WEGS Directors in 1985 and comprises permanent representatives from seven countries, i.e., Austria, France, Germany, Greece, Norway, Spain and the United Kingdom. The Working Group was enlarged in 1990 to include members from Finland and Ireland.

The following are some key dates regarding the work carried out by the Working Group, i.e.,

1986-1988 - Meetings and field excursions
1988-1990 - Pilot Project
Sept.1990 - Pilot Project Report presented to the WEGS Directors at their meeting in Vienna
Oct. 1990 - At the Athens meeting the Working Group discussed
  (a) Extension of Pilot Project or Restricted start of the Main Project in the Benelux countries and other countries wishing to join (i.e., Finland, Germany, Greece, Norway, etc.);
  (b) Research Project, and
  (c) Publication of Pilot Project results.

The results of the Pilot Project were published in one volume of about 600 pages, which was sent to all WEGS countries (Demetriades et al., 1990).

The Regional Geochemical data inventory (Appendix 9, Pilot Project Report) has shown that the available data are inhomogeneous, and it would, therefore, be difficult to make a geochemical map of Western Europe on this basis. The conclusion was to re-sample the whole of Western Europe for the compilation of a common multielement geochemical atlas.

In Norway the use of active stream sediment had been questioned largely because of evidence of point source erosion causing problems in representativity. On the other hand overbank sediment was considered more representative of the whole catchment basin, and pristine samples can be obtained. The field investigations carried out during the Pilot Project showed that overbank sediment exists in at least 95% of Western Europe.

The initial results from Germany show high lead concentrations due to contamination from past and recent mining activities although pristine conditions existed at depth. More recent studies indicated a more complex situation (see later, sections 6 and 7).

Geochemical maps based on a density of 1 sample/500 km^2 can be compiled for the detection of large geochemical provinces. For example, geochemical mapping of Norway using 690 overbank sediment samples has identified large scale elemental patterns elements (e.g., Ba, La, Mo, etc.). Similarly, the radiometric maps of K, Th and U of the United States of America

compiled from closely spaced data shows large scale, continental geochemical patterns, the main features of which could have been detected by much more widely spaced measurements.

In conclusion, it was suggested that a geochemical mapping programme of Western Europe should be established based on low density sampling of overbank sediment complemented with active stream sediment.

The following aims of International Geochemical Mapping were identified, i.e.,

(i) Exploration - major geochemical provinces will be delineated;
(ii) Environment - natural geochemical distribution patterns will be revealed, and pollution documented, and
(iii) Research - this is important for many research projects will be initiated with the data collected during the main project.

The Main Project includes:

(a) Preparation of a geochemical data base for Western Europe
(b) Compilation of a geochemical atlas based on low-density sampling and multielement analysis of overbank and stream sediment, and
(c) Establishment of a long-term storage facility for a geochemical sample archive.

Sampling Plan

One sampling site per 500 km^2. At each site three samples will be taken, i.e.,
- a near surface overbank sediment exposed to pollution,
- a pristine overbank sediment at depth and
- an active stream sediment.

Organization of Main Project

The organization chart of the Main Project was shown and discussed (Appendix 9, p.3, Project Proposal in Bölviken et al. 1990). Phase 1 is concerned with planning and preparation and the publication of the Pilot Project results. Phase 2 comprises seven sub-projects, and phase 3 six research projects.

Cost of Main Project

The total cost for the Geochemical Mapping of Western Europe has been estimated to be approximately 10 million ECU. The WEGS Directors feared that the cost has been underestimated, so the Working Group has undertaken to look into the matter in more detail. This cost is, however, very small compared to the total annual budget of the Geological Surveys, i.e.,

Austria	0.5%	Ireland	1.3%
Belgium	0.2%	Italy	0.2%
Cyprus	0.1%	Luxembourg	0.1%
Denmark	0.1%	The Netherlands	0.1%
Finland	0.2%	Norway	0.7%
France	0.1%	Portugal	2.0%
Germany	0.1%	Spain	0.3%
Great Britain	0.2%	Sweden	0.6%
Greece	0.2%	Switzerland	0.3%
Iceland	0.4%	Turkey	0.2%

Wegs Directors' Meeting in Vienna (September 1990)

At the WEGS meeting in Vienna 17-22 September 1990, the Working Group on Regional Geochemical Mapping presented a Pilot Project Report [Report No 1] and a Project Proposal for "Geochemical Mapping of Western Europe Towards the Year 2000" [Report No 2].

The following points were made by the directors during the discussion after the presentation:

- undisturbed overbank sediments do not occur in all countries;
- sedimentological expertize is needed at each sample site;
- the practical benefits that might flow from the project should be demonstrated;
- funding is a main problem.

The directors concluded that

- the time is not yet ripe for a project involving the whole of Europe;
- any country that wishes to proceed further can do so, and the Working Group should consider making a start in the Benelux countries;
- the progress of the project should be reported to WEGS at appropriate intervals.

4. PUBLICATION OF PILOT PROJECT DATA (A. Demetriades)

At the Athens meeting in October 1990 the following deadlines were agreed:

January 1, 1991: Contents of individual contributions must be sent to A. Demetriades. Guidelines for all authors will be distributed.

There was no response, so tentative contents were compiled and sent to all authors for comments on February 11, 1991. No comments were received. The guidelines were not sent because there was not a definite response from the Institution of Mining and Metallurgy.

February 1, 1991: Introduction to papers 3 to 8 will be sent to all contributors by A. Demetriades. Introductions to papers 1 to 9 were sent to all contributors on February 28, 1991.

May 1, 1991 : Submission of first draft of complete paper from all authors must be sent to A. Demetriades. None received.

May 9, 1991 : Letter sent to all contributors for suggestion of realistic deadlines, after considering very seriously their survey commitments.

The importance of obtaining some sort of working first draft of all contributions was stressed.

Internal referees

Written replies of acceptance were received from Drs. Ashlyn Armour-Brown, Kevan L. Ashworth, Robert G. Garrett, Clemens Reimann and Arthur Y. Smith. Professor Gerry J.S. Govett and Jane Plant also accepted the responsibility of internal referees by verbal communication. Dr. Arthur Darnley would be able for reviewing articles after October, and Professor Robert W. Nesbitt declined to accept due to other pressing commitments.

The internal referees in their letter of acceptance made some interesting comments, i.e.,

Dr. Arthur Darnley (leader of IGCP 259 "International Geochemical Mapping"): "I think it is very important to bring the subject to the attention of a much wider audience (especially the environmental readership)" ..... "I am quite convinced that the main support for international geochemical mapping will come from the environmental community and these are the people we need to inform about the project. I think Elsevier is very much aware of the growing interest in environmental matters, including geochemical mapping, and they could be quite cooperative."

Dr. Robert G. Garrett: "The publication will, I hope, have exceptional weight in helping the unconvinced of the value of regional geochemical mapping by virtue of its broad European Geological Survey support and authorship."

Journals for the Publication of Pilot Project data

The Institution of Mining and Metallurgy (London, U.K.) and the Society for Geology Applied to Mineral Deposits were approached, i.e.,

1. IMM Transactions - Section B: Applied Earth Science

- Willing to publish the Pilot Project results, but we must aim at considerably less than 72 pages;
- Colour maps to be sponsored by WEGS, and
- Cost of pages in excess of 72 to be covered by WEGS.

2. Mineralium Deposita

- Open for discussion, but
- Cost of colour maps to be covered by WEGS;
- Some sort of financial arrangement must be made with WEGS for the publication of a special issue of 232 pages long, and
- Suggestion for first draft of all papers to be sent for decision making and formulation of a more concrete proposal.

Other possible journals for publication of Pilot Project data are the following:

- Journal of Geochemical Exploration. Small format, but no problems are anticipated with respect to the number of pages. Possibly our best choice since all of us are members of the Association of Exploration Geochemists.

Suggestions by Dr. Arthur G. Darnley:

- Quaternary Research
- Geochimica et Cosmochimica Acta
- Transactions of the Royal Society of Edinburgh
- Ask Elsevier for Publication in one of their journals
- Ask Elsevier for a special monograph.

Other choices include:

- Earth and Planetary Science Letters
- Chemical Geology
- Applied Geochemistry
- Environmental Geochemistry and Health
- Philosophical Transactions of the Royal Society of London (Series B)

- Journal of the Geological Society of London,
- Geological Magazine, and
- Economic Geology.

Some significant points about the publication of the Pilot Project results

- Publication of all contributions without serious cuts in a single volume (this will be the reference volume);
- Impact of our work and its significance to a wide readership is important. So, a journal with wide distribution is sought.
- Environmental community must be informed. This can be done after the publication of the reference volume by "key" summary papers to be published in other journals (reference will, of course, be made to the contributions in the single volume);
- Setting standards for the International Geochemical Mapping;
- Convince the "unconvinced" about the significance of regional geochemical mapping even at such a low sampling density, and
- Comparison of low and normal density sampling results is important.

Proposal

After taking into consideration the replies from the Institution of Mining and Metallurgy, Mineralium Deposita and the suggestions made by A.G. Darnley about other possible journals for publishing the Pilot Project data the following two proposals were made:

(a) The publication of the Pilot Project results as a special volume of the Journal of Geochemical Exploration, which will be the reference volume of the WEGS Working Group's work, and

(b) The publication of key summary papers in other journals.

Comments

B. Bölviken commented that in his experience the setting of new deadlines will most likely not be observed again, so he proposed the following:

- A. Demetriades to stay and work in Norway for six months, provided funds are found;
- All contributors to meet for a week in a remote area with the purpose of completing at least 50% of the work. Again funds must be found, and
- Setting up of new realistic deadlines.

The members of the Working Group are free to publish anywhere else, although it is advisable to wait till all the Pilot Project papers are published.

R.T. Ottesen and J. Bogen informed the participants that a paper will be presented at the "International Symposium on Erosion and Sediment Transport Monitoring Programmes in River Basins" in Oslo (24-28 August 1992), which is organized by the International Association of Hydrological Sciences and the Norwegian Water Resources and Energy Administration and co-sponsored by UNESCO, WMO, the Norwegian Geophysical Union and the Norwegian Committee for Hydrology.

The viability of publishing the Pilot Project results was also discussed with respect to whether the "Pilot Project Report" could be considered as a publication in view of the number of copies that have been printed, i.e., according to the Austrian librarian a report printed in more than thirty copies is considered a publication.

A similar question was also raised by Dr. Arthur G. Darnley, i.e., "Since the Norwegian Survey issued the two volumes last year as an Open File Report I wonder if it is realistic to expect any journal to accept more than a comprehensive summary article plus selected papers?"

The reply to both questions was that the Pilot Project Report presented all the available data till June 1990, and without any serious interpretation. Since, then more results have been generated, which will be incorporated in the publication. All the results will be presented in a more readable form, better illustrations, and with a good interpretation. So, the publication of the Pilot Project results in a reference volume is considered to be very significant.

Final decisions

(a) An attempt must be made for a pre-draft to be ready by 1 December, 1991. Other deadlines will be adjusted accordingly;
(b) Funding for a meeting in Norway to be investigated by B. Bölviken;
(c) The Pilot Project results to be published in the Journal of Geochemical Exploration, and
(d) The Benelux-Germany research results to be included in the publication.

5. RESEARCH PROJECT (J. Ridgway and J. Plant)

The Research Project is concerned with

- the internal variability within flood plain sediments;
- age dating, and
- costs (i.e., to obtain realistic costs for making a new budget).

The project was designed to compare pristine and contaminated overbank sediment in different terrain types of Western Europe.

(Refer to Appendix 1 for more details about the Research Project).

Analysis of Research Project samples

- The elements to be analysed must be decided upon. A total analytical method such as XRF is considered suitable for the purposes of the Research Project.
- As agreed at the Athens meeting the samples must be analysed at a single laboratory. The problem is to find a single laboratory within WEGS that is prepared to undertake the analysis of all samples free of charge. It appears that at least ten countries will be participating in the Research Project. So, there will be a total of 200 samples for analysis. In the case that all twenty countries participate then there will be a maximum of 400 samples.

Sampling

It is considered that two samples at each site are not enough, for it is difficult to decide what is pristine. So, more samples may have to be taken at each site.

Terrain types

Different terrain types must be sampled.

Comments: It appears that the WEGS laboratories are not able to undertake the analysis of the Research Project samples free of charge.

Decisions: Since, the number of samples is very small (a minimum of twenty samples per country) the cost is relatively insignificant if shared among the participating countries. So, each country should pay for the analysis of its samples. J. Ridgeway was charged with the assignment of finding the cheapest laboratory for the analysis of all Research Project samples.

Deadlines: September 1, 1991. Completion of sampling for Research Project.
October 1, 1991. Despatch of samples to J. Ridgway at BGS for analysis.

Recommendations: Research Project should be dated by Carbon-14, palaeomagnetism or archaeological evidence.

6. HARZ MOUNTAINS STUDY, GERMANY (R. Hindel)

Approximately 4500 stream sediment samples have been collected from the Harz mountains in both parts of Germany. Due to different analytical methods the data are not compatible for all elements.

After the recent unification of Germany a geochemical research survey was carried out in the Harz mountains. Sixteen sites were chosen for overbank sediment profile sampling. A total of 150 overbank and stream sediment samples were taken. The available results were presented.

River Bode

The area is considered as background since there is no mineralization, mining or smelting activities. The present stream sediment sample results compare fairly well with the top one of the overbank sediment profile.

River Selke

This area has Pb-Zn mining activities dating back to the 14th and 15th centuries. The overbank sediment profile was contaminated till the gravel bed (top sample: Pb = 898 ppm, Zn = 1174 ppm). The stream sediment sample also shows high element values (Pb = 880 ppm, Zn = 1378 ppm).

River Ilse

There is no mining, but a Cu smelter is situated in the river valley. Copper values in the overbank sediment profile vary from 31-285 ppm. Even the bottom sample has a relatively high copper value (Cu = 65 ppm). So, it is not representative of pristine conditions. The top sample of the overbank sediment has a Cu content of 285 ppm, whereas the present day stream sediment 4922 ppm Cu.

River Soese

Within the catchment area of this river there occur vein type Pb-Zn mineralization and baryte veins. The total thickness of the overbank sediment profile (2.10 m) is contaminated by Pb, Zn, Cu, As and Ba.

River Zorge

Two sampling sites, 100 metres apart, were chosen. The first an overbank sediment profile near the river, which showed slight Pb contamination up to 125 cm. The second site was in a gravel pit. Only the top 20 cm were contaminated by Pb. So, there is considerable variation in the metal contents of overbank sediment profiles even over short distances in catchment basins polluted by mining activities.

River Oker

It drains a granite and Devonian-Carboniferous rocks. The Rammelsberg mine is situated in this river valley. The sample collected from a gravel pit shows contamination of the upper layers of the overbank sediment.

River Innerste

In the catchment area of this river there occur Pb-Zn vein type deposits. The total thickness of the overbank sediment profile was contaminated. Pristine conditions were not located in the profile.

Conclusion: (a) More research work is necessary to define the exact sampling scheme that must be followed in areas polluted by mining and smelting activities;

(b) The stream sediment samples are always contaminated in such areas;

(c) Pristine overbank sediment samples can be found even at seriously contaminated river basins, and

(d) the presented Harz mountains data are very encouraging, for they show that overbank sediment is the only sampling medium for mapping pristine conditions.

7. BENELUX-GERMANY RESEARCH PROJECT (R. Hindel, J. Ebbing, R. Swennen, J. Verbeek and W. de Vos)

Two months ago representatives from Belgium, Germany and The Netherlands met and decided to sample 32 sites in the valleys of Inde and Rur rivers. The sites are equally divided among the three participating countries. The present Research Project is carried out in greater detail than the one agreed at the Athens meeting in October 1990.

At the end of the Pleistocene gravels were deposited. Directly above the gravels the first overbank sediment begins. Three different overbank sediment sequences can be distinguished.

The oldest overbank sediment is higher by three to four metres from the most recent one. It has been deposited in a three metre wide river channel. It starts with a gravel and is distinguished by non-stratification, higher clay content and drift wood. A period of erosion follows before the deposition of the second succession.

The second overbank sediment sequence accumulated from the 7th to 12th centuries. During this period large forests were cut down, loess eroded and brought into the river basins. The gravel bed varies in thickness from 0.3 to 1.5 m. It has high clay content and drift wood. The upper part of the gravel bed contains relics of bricks from the Roman period. The gravels may have been deposited between 500 B.C. and 9th century A.D.

The overbank sediment comprises re-worked loess, which will not give you the regional variation. So, this overbank sediment section reflects local conditions.

The youngest overbank sediment profile consists of 1.2 m thick sand and gravels with relics of the last 200 years. The overbank sediment comprises young river loams, which again give you a restricted view of the geology.

Conclusion: Overbank sediment samples from the oldest terrace reflect regional background conditions, whereas the younger ones recent anthropogenic influence.

8. EXCURSION TO THE GEUL RIVER VALLEY (Professor R. Swennen and J. Ebbing)

Details of the excursion will be found in Appendix 2.

Comments: The Pb-Zn pollution in the town of Plombieres (Belgium) is similar to what the Working Group has seen in the Lavrion area (Greece). Garden soils are contaminated and the play ground used by the children.

9. REPORT OF ACTIVITIES BY ALL REPRESENTATIVES

Austria: It will participate in the Research Project and there are no problems in funding.

Belgium: Report of activities given above.

Denmark: Most of the rivers are channelized. They are, however, convinced that they can find overbank sediment in at least half the sites. A proposal was made to the Ministry of Environment for funding next year.

Finland: It will participate in both the Research and Main projects. The Kola peninsula pollution from Russian sources will be investigated.

Germany: Report of activities given above.

Greece: According to the decision of the IGME General Director expressed both at the Vienna meeting and the letter to Dr. Heir, Greece will be participating in both the Research and Main Projects. The sampling will be financed by the Institute itself. During 1991 apart from its participation in the Research Project, ill sample the Sperchios River flood plain to check sample variability as agreed at the Athens meeting (Oct. 1990), and will prepare two reference samples, a kaolinite and an overbank sediment as agreed at the Orleans meeting (June 1990).

Italy: At the moment they are participating as observers. They will discuss the whole matter upon their return to Rome, and send a written reply whether they will be participating in the Research Project.

The Netherlands: Report of activities given above.

Norway: An extensive research programme will be carried out during 1991-92, i.e.,

Research Project sampling programme:

- Joint sampling programme in northern Finland and Norway (30-50 sites per country)
- Pollution versus pristine overbank sediments (analysis of variance)

Sedimentological investigations:

- Rate of accumulation
- Major floods
- Relationship between suspended material and overbank sediment
- Mass transport

Airborne pollution investigations:

- Isolate airborne pollution. Cooperation with Russians in 1992 with regard to nickel pollution in the Kola Peninsula.

United Kingdom: Some work has been done in the Research Project. Britain's participation in the Main Project will depend on the results of the Research Project, and the availability of funds.

Other matters: The participants were informed about the activities of the Pentagonale countries (Austria, Czechoslovakia, Hungary, Italy and Yugoslavia), i.e., "... a four year project of geochemical mapping of Pentagonale countries to be performed by their respective national Geological Surveys according to the methodology as proposed by the Western European Geological Surveys (WEGS) in 1990. The territories of the participating countries should be sampled by widely spaced samples (one site per 500 km^2 on the average) of pristine and recent overbank sediment and of stream sediment."

Comments: The terms pristine and anthropogenically polluted samples should be redefined. So, it was agreed that "pristine" should refer to any pre-industrial material and not pre-anthropogenic. Whereas the polluted samples are those polluted by industrial and other anthropogenically induced activities.

The problems of sampling polluted and pristine sediments was discussed extensively. It was suggested to use the Bloom test as a field guide. The proposal was accepted and it will be tested during the Benelux-Germany project. Other countries participating in the Research Project were encouraged to try it as well.

It was finally agreed that for the purposes of the WEGS project the only sampling medium that could possibly give the natural element distribution was overbank sediment, although stream sediment could be used to reflect present day conditions.

10. FLOOD REGIMES, RATE OF ACCUMULATION, ETC. (J. Bogen)

Data were presented with regard to flood regimes and rate of accumulation of sediment. Results were given for on-going international projects, i.e.,

(a) FRIEND: Flow Regimes from International Experimental and Network Data.

(b) UNESCO project: Hydrology and Water Resources for Sustainable Development in a Changing Environment.

Sub-projects: 1. Data base
2. Low flow
3. Europe
4. Extreme floods-estimation
5. Processes of run-off generation.

The WEGS regional geochemical mapping results can be used in connection with the chemistry of particulate matter carried by the rivers. The argument was that these data will be useful in the interpretation of the WEGS project results. This connection will also be useful for getting external funding. So, this is an interesting spin off research project (Research Project 4 of Main Project, Bölviken et al., 1990).

It was stressed that the armouring of rivers prevents the transportation of pollution on the one hand, but it stops or diminishes the input of important nutrients into the sea and ocean on the other. So, this research project will give some indication of the possible effects to marine life.

Interesting data were presented about the periodicity of large (maximum) floods, and the doubling of the sedimentation rate during the periods 1954-1985 and 1986-1990 from 2.4 cm/year to 4.3 cm/year respectively.

Finally, it was shown that Caesium-137 with a half life of 30.1 years could be a useful indicator of age. The Bikini atoll atomic bomb tests began in 1954; in 1962 there is a maximum of atomic bomb tests, and in 1986 we have the Chernobyl accident. These events can be mapped by the determination of Caesium-137 in overbank sediment profile samples. Such data are presented in Appendix 2.

Comments: One of the comments made was that although this project was very significant, its requirements were such that the work involved could be assigned to a new WEGS Working Group. It was stressed, however, that this is Research Project 4 "Budgets of Sediment Transport" of the Project Proposal (Appendix 8, Bölviken et al., 1990), and is considered to be an inherent part of the whole project.

11. CHEMICAL ANALYSIS (R. Hindel)

It was stressed that the number of elements to be analyzed in the Main Project is only a matter of cost. The 60 elements proposed in the Project Proposal (Appendix Report 3, Bölviken et al. 1990) have been estimated to cost between 3,000,000 ECU and 5,670,000 ECU. A proposal was made to include chlorine in the list of elements to be analyzed for, if the WEGS project is to be linked to the environment.

Fig. 1a and Tables 2 and 3 from Appendix Report 3 (Project Proposal, Bölviken et al., 1990) were discussed. Similar tables should be compiled by other Surveys such as BGS.

The Benelux-Germany Project will have more data for discussion about analytical methods to be used for the Main Project. It has been estimated that a maximum of 400 samples will be collected in this project. Since, it was considered important to carry out a number of different chemical attacks, it was decided that Germany will undertake the analysis of all samples for total element contents, Norway for nitric extractable elements as well as Hg, and Finland will select a method for the determination of bio-available elements.

Regarding the Research Project (sample variability project) it was considered that XRF analysis is sufficient. Some people expressed the opinion that easily extractable elements should also be determined by a suitable analytical method (HNO_3, aqua regia, EDTA, DTPA, acetic acid, $CaCl_2$). This is, however, beyond the scope of the Research Project, which was designed to test only the sampling variability. In the case that the samples are analyzed by a partial analytical method then the problem of analytical variability should be accounted for as well. The range of elements must include, except the ones indicative of pollution, others that are related to terrain types.

Comments:
- Samples should be carefully stored if they are going to be analysed by EDTA and DTPA. Extremely large variations were observed in samples that were not stored properly.
- Extractions by EDTA/acetic acid give different results.
- Each of the three institutions (GTK, BRG, NGU), use their own routine methods for analysis.

12. QUALITY CONTROL (O. Schermann)

The Quality Control report (Appendix 4 in the Project Proposal, Bölviken et al., 1990) outlines the work that must be done. The significance of standardization of sample preparation was stressed. The same equipment must be used by all Surveys. The < 125 microns material should be sent to the Project Manager who is going to be responsible for the splitting.

During the sample preparation at least 3 reference samples must be used, i.e., 2 kaolins and a field duplicate.

10% of reference materials must be included in the analytical batch at random. One reference sample should be rich in calcareous material. The ring test is an important part of the standardisation of the reference materials. These samples should be analyzed by various methods and at different WEGS laboratories.

Austria will undertake the preparation of one kaolin and one carbonate rich overbank sediment sample (at least 600 kgs each); Greece one overbank sediment sample, and possibly a kaolinite if the tailings are of suitable grain size, and the Benelux-Germany joint project an overbank sediment.

The kaolins should include <125 and $+125$ fractions for testing the sample preparation of the laboratories.

Comments: It was recommended to include sample replicates in the analytical batches besides the reference materials.

Otmar Schermann must sent detail instructions regarding the preparation of the reference materials.

13. DATABASES (J. Ridgway and J. Plant)

- Since the project maps are going to be produced by Finland, its database structure must be known in order to develop compatible databases in each participating country.

Fields that may be required for the different records apart from the analytical data, are:

- Sample number
- Country
- Grid reference (local + longitude and latitude)
- Depth of Sample (top and bottom)
- Age
- % of grain sizes
- Collection date
- Analysis date
- Drainage basin lithology, etc.

Since, Finland has undertaken the map production for the Main Project it was recommended to undertake also the responsibility of development of the databases. It was, therefore, decided for a computer expert from Finland to be present at the next meeting of the Working Group so as to give information about the Finnish database structure.

14. FUNDING (B. Bölviken and W. de Vos)

Regarding the EEC there are two Directorates for possible funding, i.e., Directorate XI - Environment, and Directorate XII - Science R. & D. Programmes.

Drs. Calvez and Donato from Directorate XII did not show any interest for such a project. They suggested that the Working Group should carry out a more detailed study in one relatively small area. This project must be sponsored by at least two European Mining Companies.

The Directorate XI appears to be more suitable for funding.

The following items must be reported at the next meeting

1. Funding from Environmental organisations within each country;
2. Informal inquiries in Brussels by W. de Vos. If fruitful then a letter will be sent and a meeting arranged, and
3. Roland Hindel to follow the Athens meeting decision of finding information about the European Environmental Agency.

15. ANNUAL REPORT TO WEGS DIRECTORS (B. Bölviken)

B. Bölviken will compile a short report about the work carried out by the Working Group, and will present available data at the annual meeting of the WEGS Directors, which will be held in Bernt, Switzerland (2.-6. September 1991). In his talk data will be presented from the Harz and Benelux-Germany Research Project, and the Sampling variability Research Project will be mentioned. **Information must, therefore, be sent to B. Bölviken by August 1, 1991.**

16. WORKING GROUP MEETINGS 1991-93

(a) 1991 meetings

An informal meeting will be arranged in September 1991 to coincide with the 2nd International Symposium on Environmental Geochemistry and the 9th European meeting of the Society for Environmental Geochemistry and Health, which will be held in Uppsala (Sweden) between 16-19, 1991.

Regarding the meeting in Norway for the Pilot Project Publications this will depend on the availability of funds. This could take place either in late autumn 1991 or early 1992. The contributors must pay their own air fares.

(b) 1992 meetings

- A formal Working Group and Research Project meeting in Keyworth (BGS) in April 1992. A joint one day meeting will be arranged with IGCP project 259 "International Geochemical Mapping." The Working Group members and the contact persons of the other WEGS countries must budget for a meeting of three days duration.

- An informal meeting will be arranged in August 1992 to coincide with the "International Symposium on Erosion and Sediment Transport Monitoring Programmes in River Basins", which will be held in Oslo, Norway, 24.-28. August 1992.

(c) 1993 meetings

- A possible formal Working Group meeting in Rome, Italy, to be held in the Spring of 1993 (two days duration).

17. OTHER MATTERS

B. Bölviken to present data from the WEGS Pilot Project at Workshop 2 in Uppsala (September 1991).

It has been decided for a general poster to be produced by Norway for presentation at all key meetings and symposia. The poster must be designed in such a way as to make a good impact.

A poster should also be produced with the Benelux-Germany Research Project data for presentation at the Keyworth April 1992 symposium.

The Geochemical Mapping project should be presented to Environmental Agencies and Institutions in each country, and get a statement about its value. These statements will undoubtedly influence decision makers.

Popular articles to be in written in key environmental magazines.

Norway will supply covers for project reports to all WEGS countries, so that all project reports to have the same cover.

18. IMPORTANT DEADLINES

The following deadlines have been agreed, and the Working Group members are asked to observe them:

1 August 1991 :	Material from the Benelux-Germany project, must be sent to B. Bölviken.
1 September 1991:	Sampling of the Research Project (sampling variability) must be completed.
1 October 1991 :	A 100 gm split of Research Project samples must be sent to John Ridgway.
1 December 1991 :	First draft of Pilot Project contributions must be sent to A. Demetriades.

19. MATTERS TO BE REPORTED AT NEXT MEETING

At the next project meeting in Keyworth (April 1992) the following must be reported:

- Progress in the publication of the Pilot Project results (A. Demetriades)
- Research Project results (J. Ridgway and J. Plant)
- Benelux-Germany Research Project results (R. Hindel, J. Ebbing, R. Swennen, J. Verbeek and W. de Vos)
- Overbank sediment sampling variability in the Sperchios River delta, Greece (A. Demetriades)
- Preparation of reference materials for Main Project O. Schermann, A. Demetriades, R. Hindel, J. Ebbing, R. Swennen, J. Verbeek and W. de Vos)
- External funding (B. Bölviken and W. de Vos)
- Information regarding the European Environmental Agency (R. Hindel)
- Possibilities of funding from Environmental Organizations within each WEGS country.
- Finnish expert to give information about database structure, etc.

REFERENCES

Bölviken, B., Demetriades, A., Hindel, R., Locutura, J., O'Connor, P., Ottesen, R.T., Plant, J., Ridgway, J., Salminen, R., Salpeteur, I., Schermann, O. and Volden, T. (eds) 1990. Geochemical Mapping of Western Europe towards the Year 2000. Project Proposal. NGU Report 90-106, 12 pages and 9 appendices.

Darnley, A.G. and Garrett, R.G. (eds) 1990. International Geochemical Mapping IGCP Project 259. J. Geochem. Explor. 39 (1/2), 253 pages.

Demetriades, A., Ottesen, R.T. and Locutura, J. (eds) 1990. Geochemical Mapping of Western Europe towards the Year 2000. Pilot Project Report. NGU Report 90-105, 9 pages and 10 appendices.

WESTERN EUROPEAN GEOLOGICAL SURVEYS (WEGS)

Geochemical Mapping of Western Europe towards the Year 2000

REPORTS

For the purposes of registration, storage and retrieval the reports are also numbered in the Open File Report Series of the Geological Survey of Norway, (NGU).

No 1. Demetriades, A., Ottesen, R.T. and Locutura, J. (eds.), 1990: Geochemical Mapping of Western Europe towards the Year 2000. Pilot Project Report. NGU Report 90-105, 9 pages and 10 appendices.

No 2. Bølviken, B., Demetriades, A., Hindel, R., Locutura, J., O'Connor, P., Ottesen, R.T., Plant, J., Ridgway, J., Salminen, R., Salpeteur, I., Schermann, O. and Volden, T. (eds.), 1990: Geochemical Mapping of Western Europe towards the year 2000. Project Proposal. NGU Report 90-106, 12 pages and 9 appendices.

No. 3. Bølviken, B., Demetriades, A., Ebbing, J., Hindel, R., Ottesen, R.T., Plant, J., Ridgway, J., Salminen, R. and Stavrakis, P., 1991: Minutes from meeting in Athens, Greece 15.-18. October 1990 with an appendix by Demetriades, A.: Publication of Pilot Project Results. NGU Report 91-202.

No. 4. Demetriades, A., B. Bølviken and R.T. Ottesen, 1991: Minutes from Project meeting in Heerlen, The Netherlands 27-28 May 1991, with 2 Appendices. 1) Ridgway, J. and Plant, J.: Within and between site variability in the composition of overbank sediment. Project Proposal. 2) Ebbing, J. and Swennen, R.: Excursion to the Geul River Valley, Belgium and The Netherlands. NGU Report 91-203.

No. 5. Bølviken, B and Ottesen, R.T., 1991: Activities and Plans 1991-92. NGU Report 91-204.

No. 6. Bogen, J., Hasholt, B., Jacobsen, O. and Ottesen, R.T., 1991: On the occurrence of overbank sediment in Denmark. NGU Report 91-205.

No. 7. Bølviken, B., 1991: Annual Report 1990 - 91. NGU Report 91-206.

WESTERN EUROPEAN GEOLOGICAL SURVEYS

Geochemical Mapping of Western Europe towards the Year 2000

Report No. 4

APPENDIX 1

J. Ridgway and J. Plant:

Within and between site variability in the Composition of Overbank Sediment.

INTRODUCTION

After performing an inventory of Western Europe and field and laboratory work in 9 countries (Austria, Finland, Germany, Greece, Iceland, Ireland, Norway, Spain and Sweden) the following was concluded (Demetriades et al., 1990).

(1) Regional geochemical surveys have been carried out in most countries of Western Europe. With few exceptions, however, the coverage is partial and the surveys are not scheduled for completion until well into the next century. Moreover, sampling and analytical methods vary considerably.

(2) Overbank sediment is a suitable sampling medium for geochemical mapping in Western Europe because it is (a) representative of large drainage areas, allowing for low sampling density, (b) available in all WEGS countries, (c) suitable for mapping pristine as well as polluted environments, (d) relatively easy to sample and prepare, (e) useful for linking other geochemical data sets prepared at the national level, and (f) able to provide a European input to international work such as IGCP Project 259 "International Geochemical Mapping" (Darnley and Garrett 1990).

(3) A geochemical mapping programme of Western Europe should be established in order to prepare a systematic database and a multielement geochemical atlas based on low density sampling of overbank sediment, complemented with active stream sediment.

Based on these Pilot Project results the WEGS Working Group on "Regional Geochemical Mapping" presented a Proposal for a Main Project of geochemical mapping of Western Europe (Bolviken et al., 1990) at a meeting of the WEGS Directors in Vienna 17-22 September 1990. The Directors then asked the Working Group to consider a start of the Main Project in the Benelux countries with participation of any other country that may wish to proceed further. However, some concern was expressed about (1) the budget and funding of the project and (2) certain scientific aspects of the use of overbank sediment as a sampling medium.

These points were discussed by the Working Group at a meeting in Athens 15-18 October 1990, with the following conclusions:

(1) The problems of budget and funding will be further treated by the Working Group.

(2) Research projects beyond those of the Pilot Project will be initiated in order to (a) study large scale variations (between countries) versus regional variations (between drainage areas within countries) and small scale variations (within sample sites) in

the chemical composition of samples of overbank sediment, (b) compare data obtained by low density overbank sampling with those from traditional stream sediment surveys, and (c) provide sedimentological data for a suitable selection of sample sites in each country.

The present proposal outlines a one year research programme with these aims.

Methods

Initially 5 or more geological terrain types from different countries across Europe will be selected, preferably from regions previously mapped using stream sediment sampling. Within each participating country a minimum of two catchment basins of similar geology should be selected to include either polluted and unpolluted or mineralised and unmineralised drainage systems. Each catchment basin should have an area of 60-600 km^2 within which a detailed study area should be selected on the basis of fluvio-geomorphological criteria. In each study area at least 5 individual overbank sediment profiles should be randomly selected for detailed sampling from sites which would be suitable for inclusion in the main survey (Bolviken et al. 1990). Composite samples of material considered to represent pre- and post-anthropogenic sediment should be collected from each profile.

A number of graphical and statistical methods, including, for example, box and whisker plots, "t" tests, analysis of variance (ANOVA) and multiple comparisons, can be used to examine the relative importance of several sources of variation.

1. In each study area (A and B in Fig. 1), within profile variation between pre- and post-anthropogenic sediment compared with between profile variation (Test 1 in Fig. 1). This test assesses the ability of overbank sediment sampling to detect pollution within a single floodplain.

2. For post-anthropogenic sediment in catchment basin pairs of similar geology (A and B in Fig. 1), within study area variation compared with between drainage basin variation (Test 2 in Fig. 1). This test examines the ability of the overbank medium to distinguish between unpolluted and polluted basins.

3. For pre-anthropogenic sediment in catchment basin pairs of similar geology (A and B in Fig. 1), within study area variation compared with between drainage basin variation (Test 3 in Fig. 1). This test examines the ability of the overbank medium to distinguish between unmineralised and mineralised catchment areas.

4. For post-anthropogenic sediment in unmineralised/unpolluted catchment basins (A1-A5 in Fig. 1), within study area variation compared with between geological terrain variation (Test 4 in Fig. 1). This test studies the ability of post-

anthropogenic sediment to distinguish different geological terrain types. The results of this test can be compared with those of the next to see if subtle pollution effects can be identified.

5. For pre-anthropogenic sediment in unmineralised catchment basins (A1-A5 in Fig. 1), within study area variation compared with between geological terrain variation (Test 5 in Fig. 1). This test studies the ability of pre-anthropogenic sediment to distinguish different geological terrain types.

SAMPLING INSTRUCTIONS

In the foregoing discussion a profile is considered to mean an age profile from the oldest available material through to the youngest. This may include sections from old terraces as well as from recent riverbanks. Profile separation cannot be precisely defined and depends on site conditions. In general seperations should not exceed a few hundred metres.

Within each profile a minimum of two samples should be taken. One, a composite from the oldest recognisable overbank sediment unit and the second a composite from the youngest unit below the level of soil development and agricultural disturbance (if any). Where the youngest unit is thick it is recommended that no more than the uppermost 50 cm is sampled. A thinner unit can be sampled in total. Organic rich, conspicuously oxidised or high-energy coarse-grained sedimentary horizons should be avoided.

Ideally, pre-anthropogenic is taken to mean material deposited before man began to influence the environment through agricultural and mining or industrial practices. It may not always be possible to find such sediment and the oldest pre-mining/industrial material then should be sampled. As far as possible all profiles should be dated using any means available from radiometric dating to archaeology.

All samples should be accompanied by a location map and as full a description as possible including grid reference (using both local system and longitude and latitude), date of collection, collector, position in the profile, river system, drainage basin area, elevation and position in the floodplain, colour, grain size, relationship to dateable artefacts, sedimentary structure, bioturbation, drainage basin lithology, groundwater level, presence of iron and manganese oxides, carbonates, organic components etc.. Current land use should also be noted and photographs of both profile and flood plain taken. International codes and conventions should be adhered to wherever possible in sample and location descriptions.

SAMPLE PREPARATION

For the purposes of the research project it is not necessary to follow precisely the instructions regarding the amount of sample to be collected as outlined in the main Project Proposal (Bolviken et al., 1990) although this may be a useful exercise for estimating real costs if carried out at one or two sites.

The research project requires approximately 100 gm of < 125 micron material for each sample. It is recommended that samples are dried in the laboratory at 80 degrees C, disaggregated if necessary, and sieved using nylon mesh sieve cloth. 100 gm splits should then be sent to J. Ridgway at the British Geological Survey, Keyworth, Nottingham NG12 5GG, U.K. for further processing and analysis.

Analysis will be by XRF after assignment of random numbers. Loss on ignition will be determined as a guide to the proportion of metals held in the organic fraction.

GEOLOGICAL TERRAIN TYPES

The project requires that drainage basins covering a variety of distinct terrain types are sampled. At the time of writing the following geological terrains have been incorporated into the programme:

Carboniferous sandstones and limestones with dolerite intrusions and lead-zinc mineralization (U.K.).

Metamorphic basement and Tertiary volcano-sedimentary sequences with granodioritic intrusions and lead-zinc-copper mineralization (Greece).

Glacial moraine, Quaternary outwash plain and elevated Littorina sea bed (Denmark).

Palaeozoic Ardennes type, clastic/calcareous succession with industrial pollution (Belgium).

Plio-Pleistocene, mainly marine sands with metallurgical pollution (Netherlands).

Palaeozoic Schiefergebirge (similar to Ardennes type) with lead-zinc mineralization (Germany).

Additional terrains in other participating countries (Austria, Finland, Norway, etc.) should be chosen to encompass as wide a variety of different geological environments as possible.

Some comments on the research programme

ANOVA techniques test the hypothesis that the samples under consideration all come from the same population, i.e., there is no significant statistical differences between the groups of samples being tested. The method is normally regarded as being robust provided a number of basic assumptions have been fulfilled. As in all hypothesis test, however, there is the possibility of making an error. The probability of rejecting the "null" hypothesis when it is in fact correct can be accurately assessed and stated as a confidence level. The probability of accepting the hypothesis when it is incorrect is more difficult to quantify and depends in part on the number of groups and samples involved, being greater when the number of samples is small (Koch and Link, 1970, p. 143). In the case of this project this is not considered to be a serious difficulty because the concern is with rejection of the "null" hypothesis and the demonstration of significant differences between groups of samples. If the WEGS project is to proceed on a viable basis, each drainage basin will be sampled by only one profile. The sampling proposed in this research project is designed to examine whether the degree of variation within a floodplain is too large to justify this single sample representation. Thus acceptance of the "null" hypothesis when real differences are present means that the overbank method has failed. Demonstration that it is valid when large numbers of samples (profiles) from a single floodplain are involved serves no useful purpose.

In test 4 and 5 rejection of the "null" hypothesis indicates only that one group of samples is significantly different to the rest. The actual differences between groups could be illustrated graphically (e.g., with box and whisker plots) by a statistical method such as multiple-comparisons.

In the case of tests 4 and 5 it is essential that for particular suites of elements samples from different countries are all analysed using the same high precision method in the same laboratory.

Details of the sampling methods for this research project are given above.

Practical low-cost age-dating methods such as palynology and archaeology will be investigated as a means of distinguishing between pre- and post-anthropogenic overbank material.

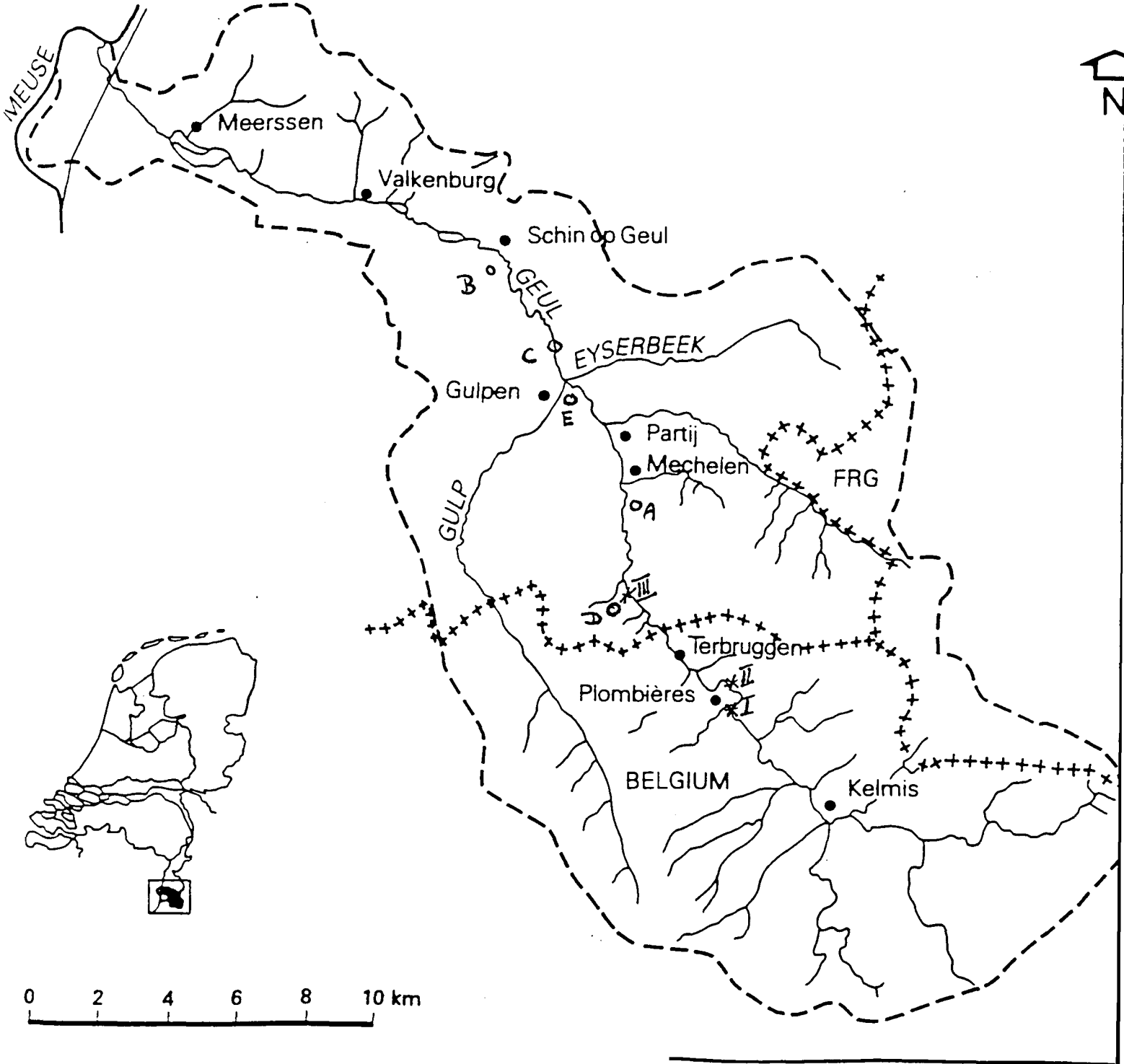
The relationship between sedimentology and geochemistry will be investigated in each study area as part of the overall programme.

ENCLOSURE 1

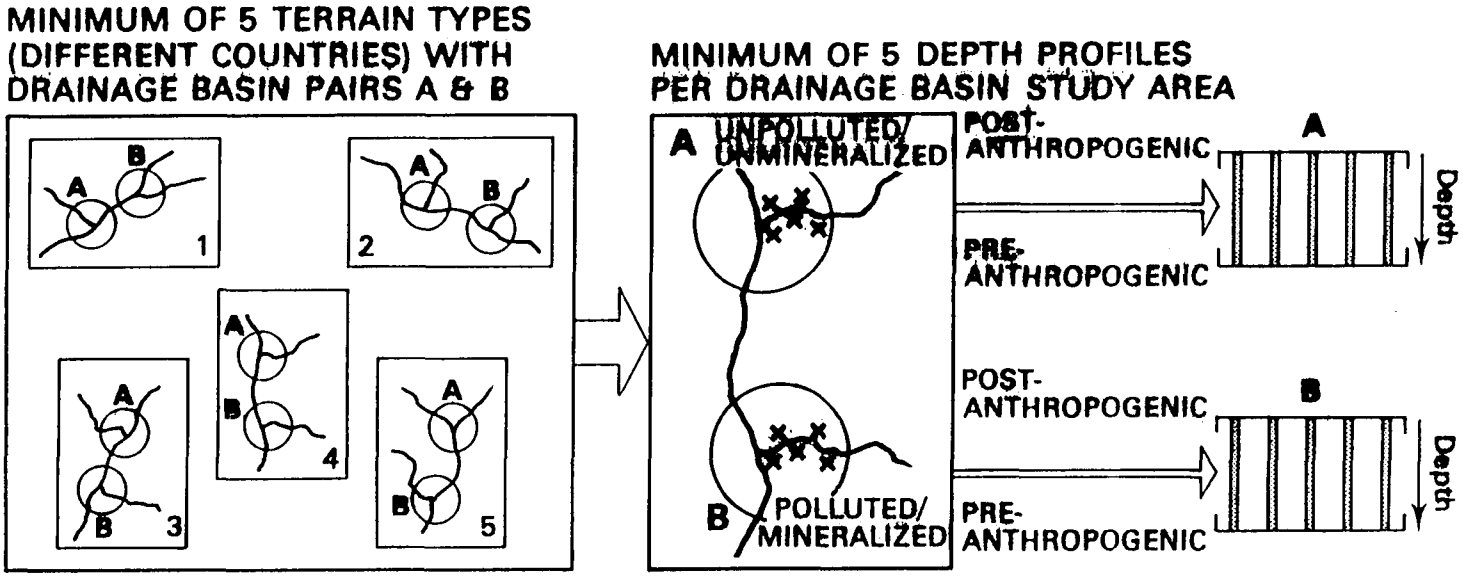
I. Dumpsite for mine waste (Belgium)
II. Pointsource of redeposited mine waste (Belgium)
III. Example of overbank in the Geul valley (The Netherlands)

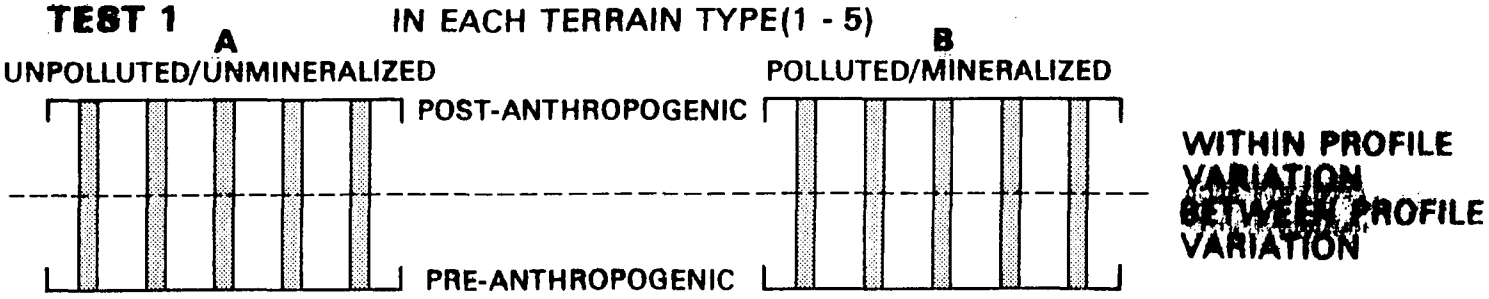
A, B, C, D and E are sampling locations, where analyses on sediment profiles were carried out by Leenaers (1989), see for the results enclosure 3.

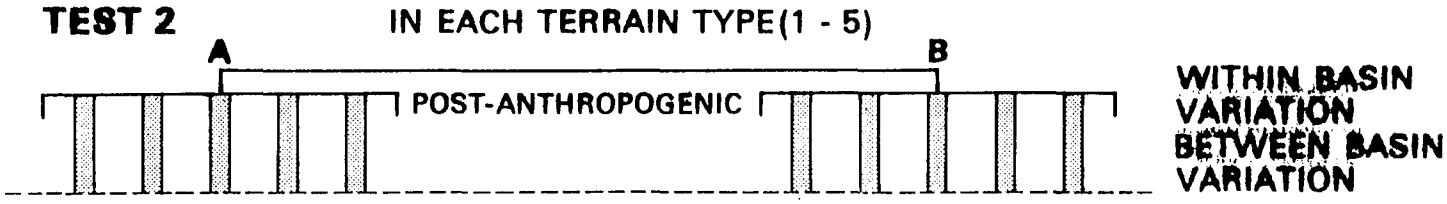
Ref: Leenaers, H., 1989. The dispersal of metal mining wastes in the catchment of the river Geul (Belgium - The Netherlands). Phd study: Netherlands geographical studies, Geografisch Instituut Rijksuniversiteit Utrecht.

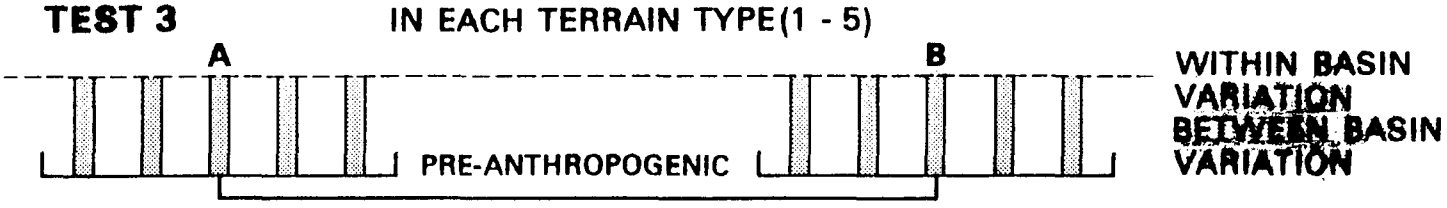


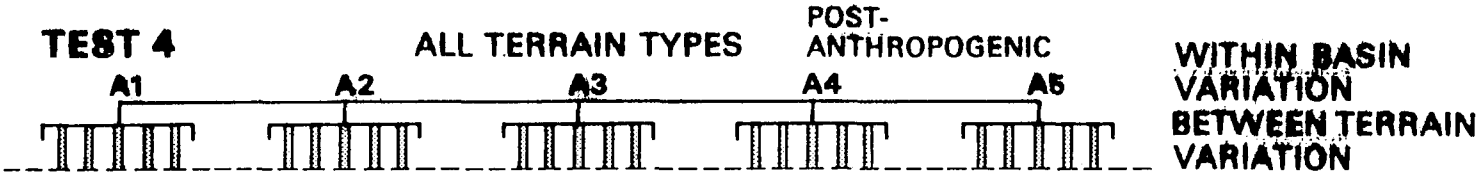
SAMPLING STRATEGY FOR WEGS RESEARCH PROJECT

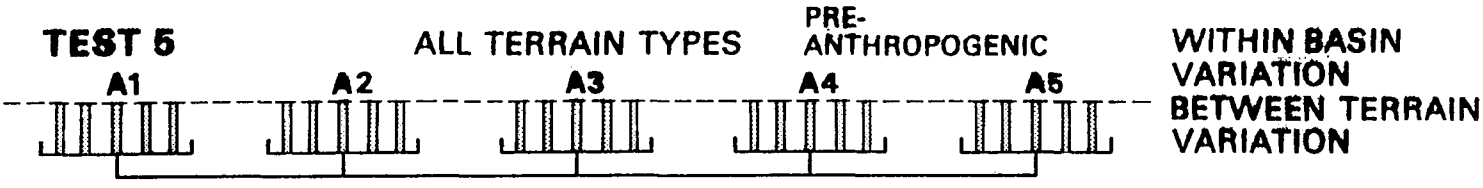












The excursion will start in belgium in the town of Plombières, where Prof. Swennen will show the Pb/Zn contamination and talk about the problems involved with it. In Belgium we will visit two different sites and then we will move to The Netherlands where an other site will be visited. This last site has been chosen as a sampling site for the research project involving Germany, Belgium and the Netherlands. Drs. Ebbing wil show an example of an overbank deposit in The Netherlands.

ENCLOSURES

- enclosure 1: location map of the excursion points,
- enclosure 2: map and profile with an outline of the Geology in the Geul valley,
- enclosure 3: Caesium as a tool to estimate sedimentation rates,
- enclosure 4: Average Pb, Zn and Cd concentrations in a part of the Geul valley.

WESTERN EUROPEAN GEOLOGICAL SURVEYS

Geochemical Mapping of Western Europe towards the Year 2000

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APPENDIX 2

J. Ebbing and R. Swennen:
Short excursion to the Geul Valley during the WEGS Meeting in Heerlen 27-28 May 1991

Minimum number of samples should be

2 x 5	= 10 per study area (5 pre- + 5 postanthropogenic)
2 x 5 x 2	= 20 per country
2 x 5 x 2 x 5	= 100 for whole project.

References

Bölviken, B., Demetriades, A., Hindel, R., Locutura, J., O'Connor, P., Ottesen, R.T., Plant, J., Ridgway, R., Salminen, R., Salpeteur, I., Schermann, O. and Volden, T., 1990. Geochemical mapping of Western Europe towards the Year 2000. Project Proposal. NGU-Report 90-106, 12 p plus 9 appendices.

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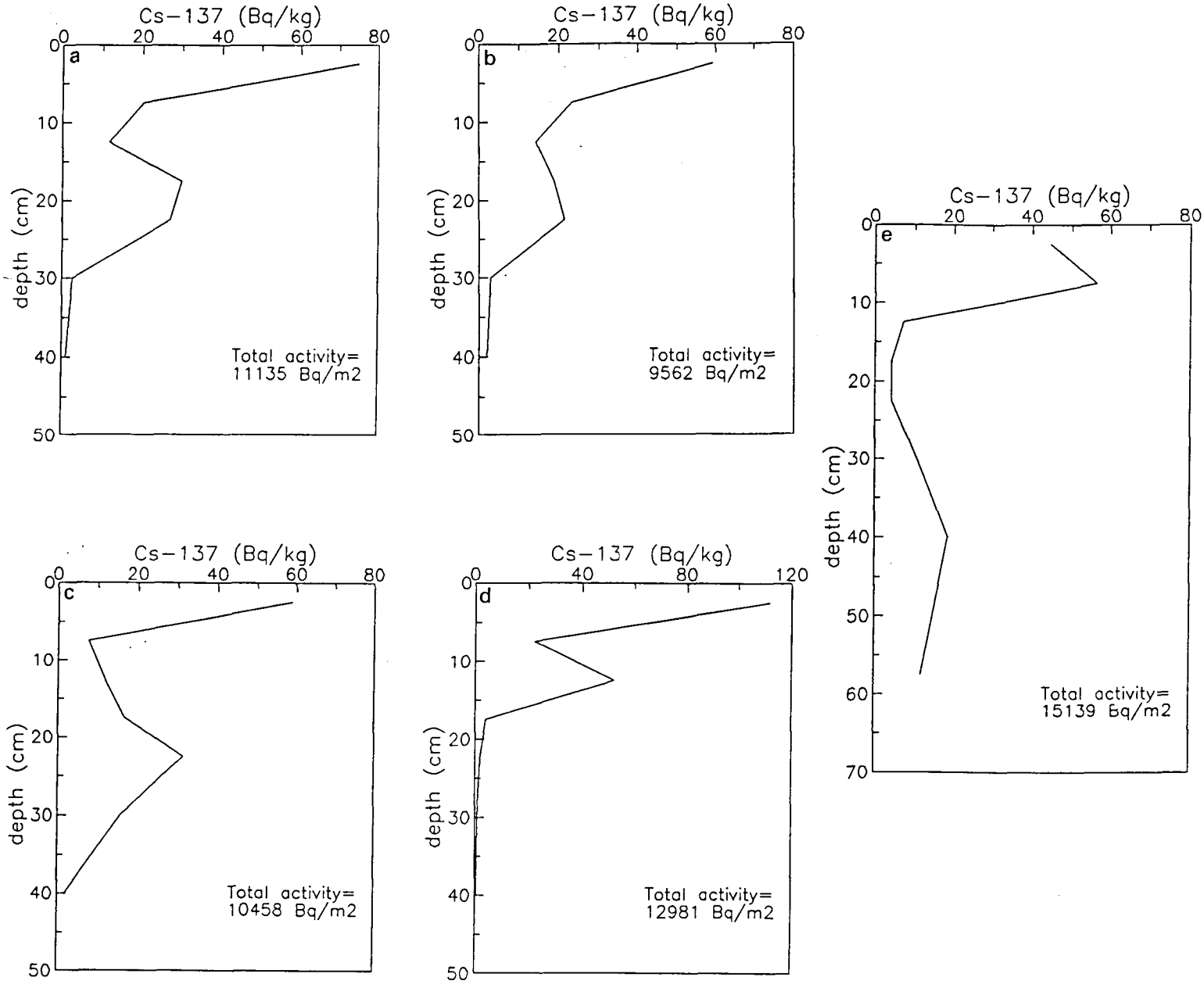
Koch, G.S. Jr. and Link, R.F., 1970. Statistical Analysis of Geological Data. Wiley, New York, 375 p.

ENCLOSURE 3



Estimating sediment deposition rates using Cs-137

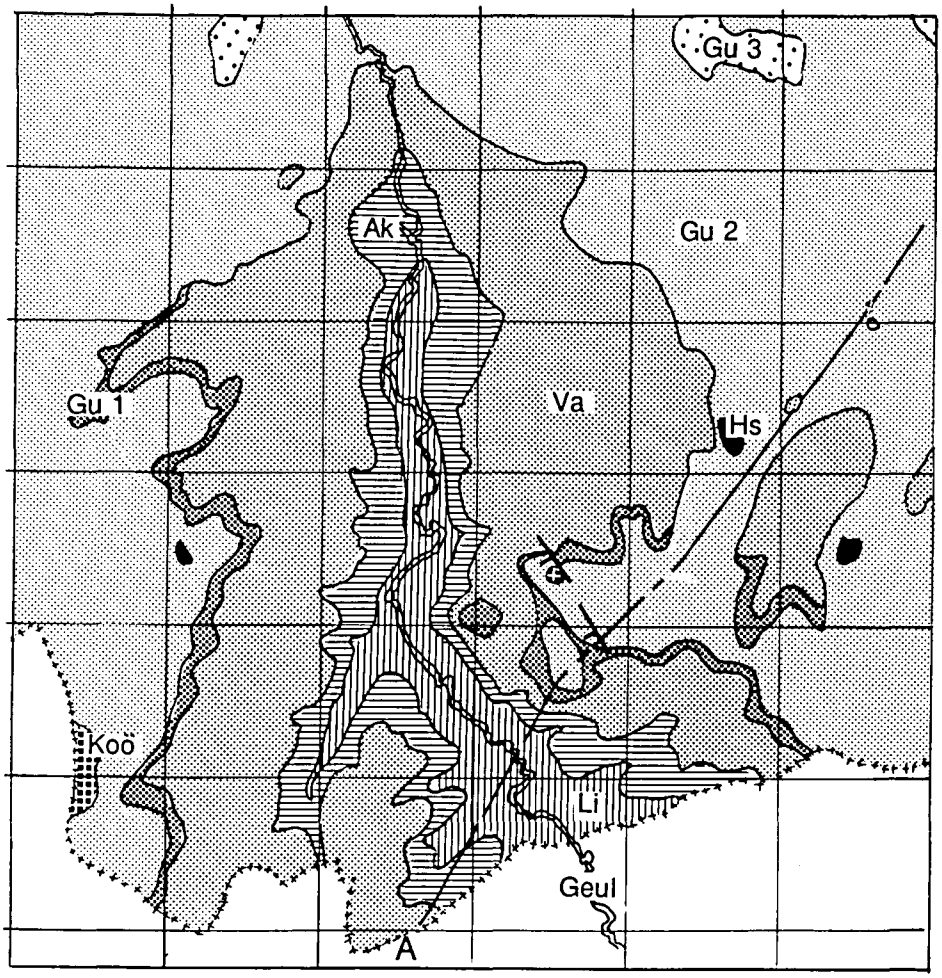
The profiles show two distinct peaks, one caused by the nuclar testing in the early sixties and one caused by Chernobyl (1986). From these profiles one can estimate sedimentation rates (*) as given below.

profile no:	1963-1986	april'86-june'88
A	0.43	2.70
B	0.87	0.90
C	0.87	0.89
D	0.65	1.43
E	1.41	2.33

* sedimentation rates given in cm/yr.

Ceasium-137 has an half-life of 30.1 years.

ENCLOSURE 2



Schaal 1:50.000

Gu 1 Gulpen Formation Zeven - Wegen chalk

Gu 2 Gulpen Formation Vylen-and Beutenaken chalk

Gu 3 Gulpen Formation Ianaye - and Lixhe chalk

Va Vaals Formation

Koö Kiezeloöliet Formation

Hs Holset Deposits

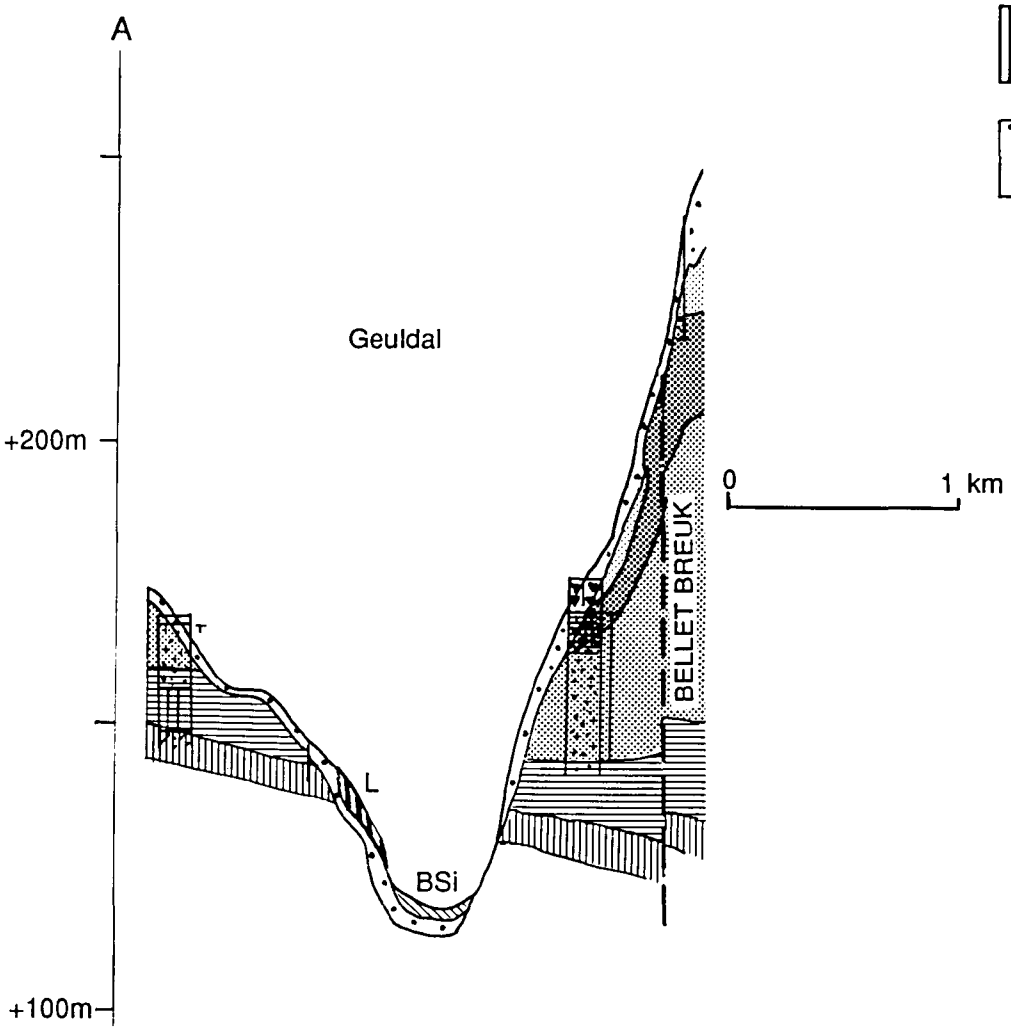
Ak Aken Formation

Li Limburg Group

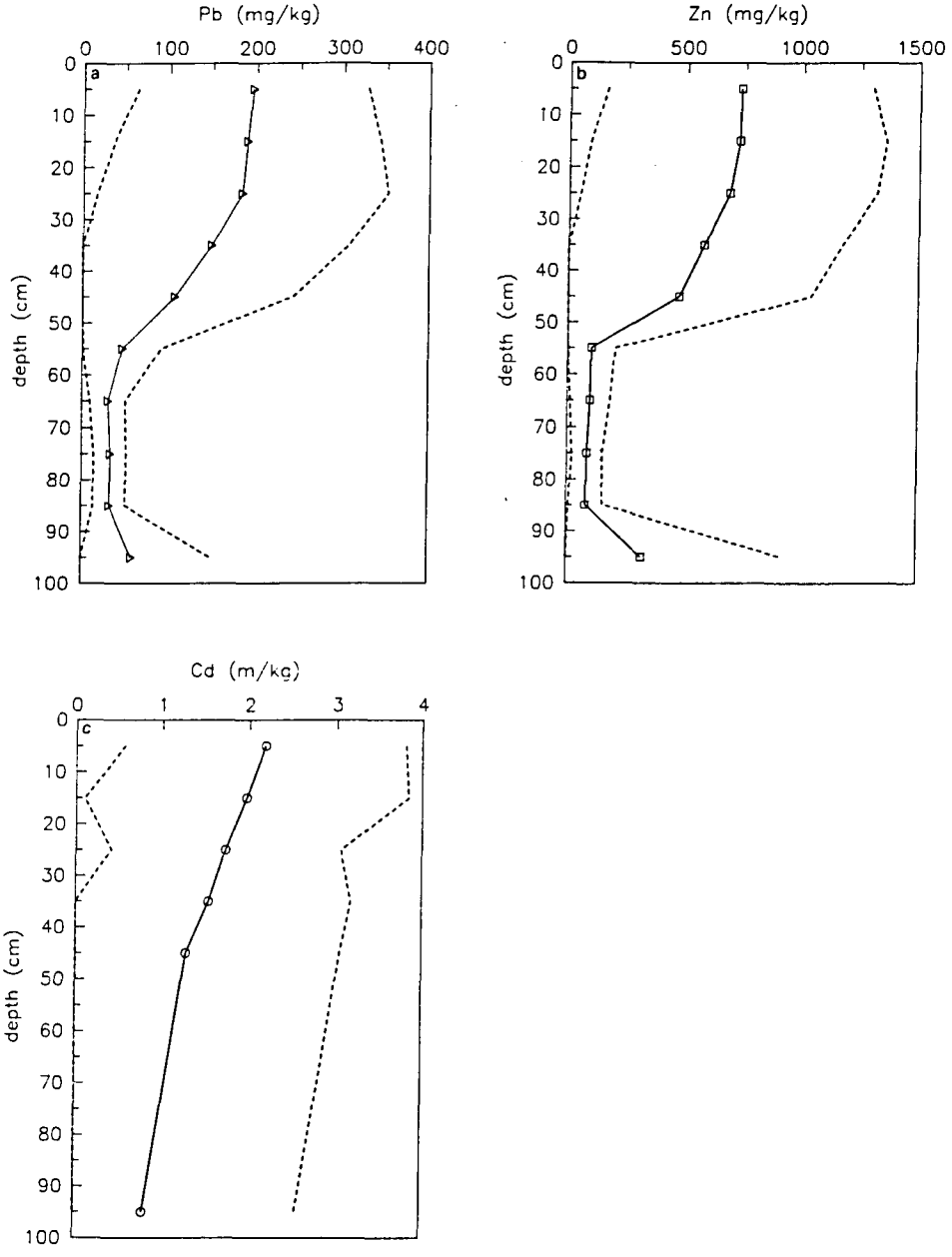
BSi Singraven Formation

L Twente / Eindhoven

Slope deposits from evuvial deposits

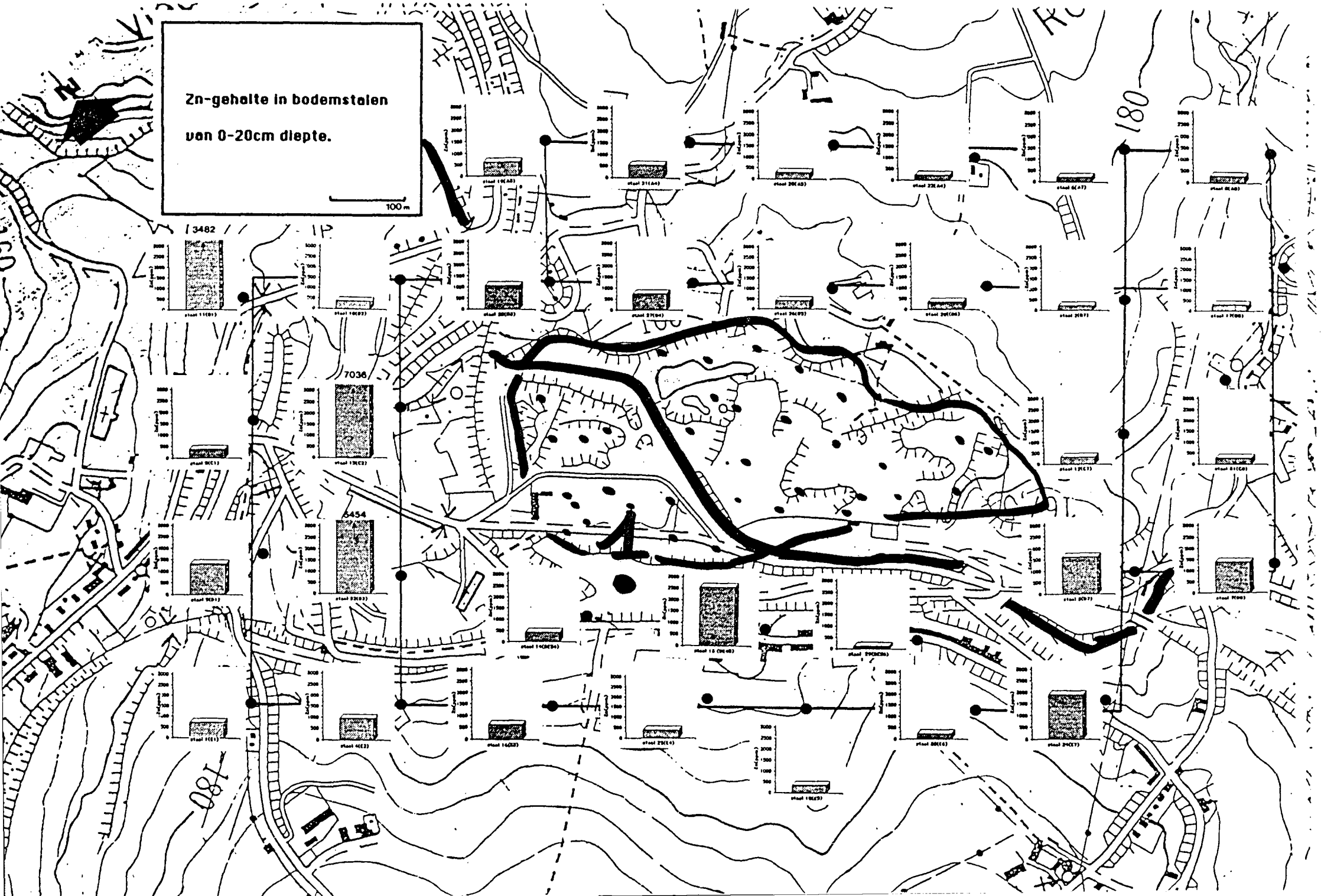


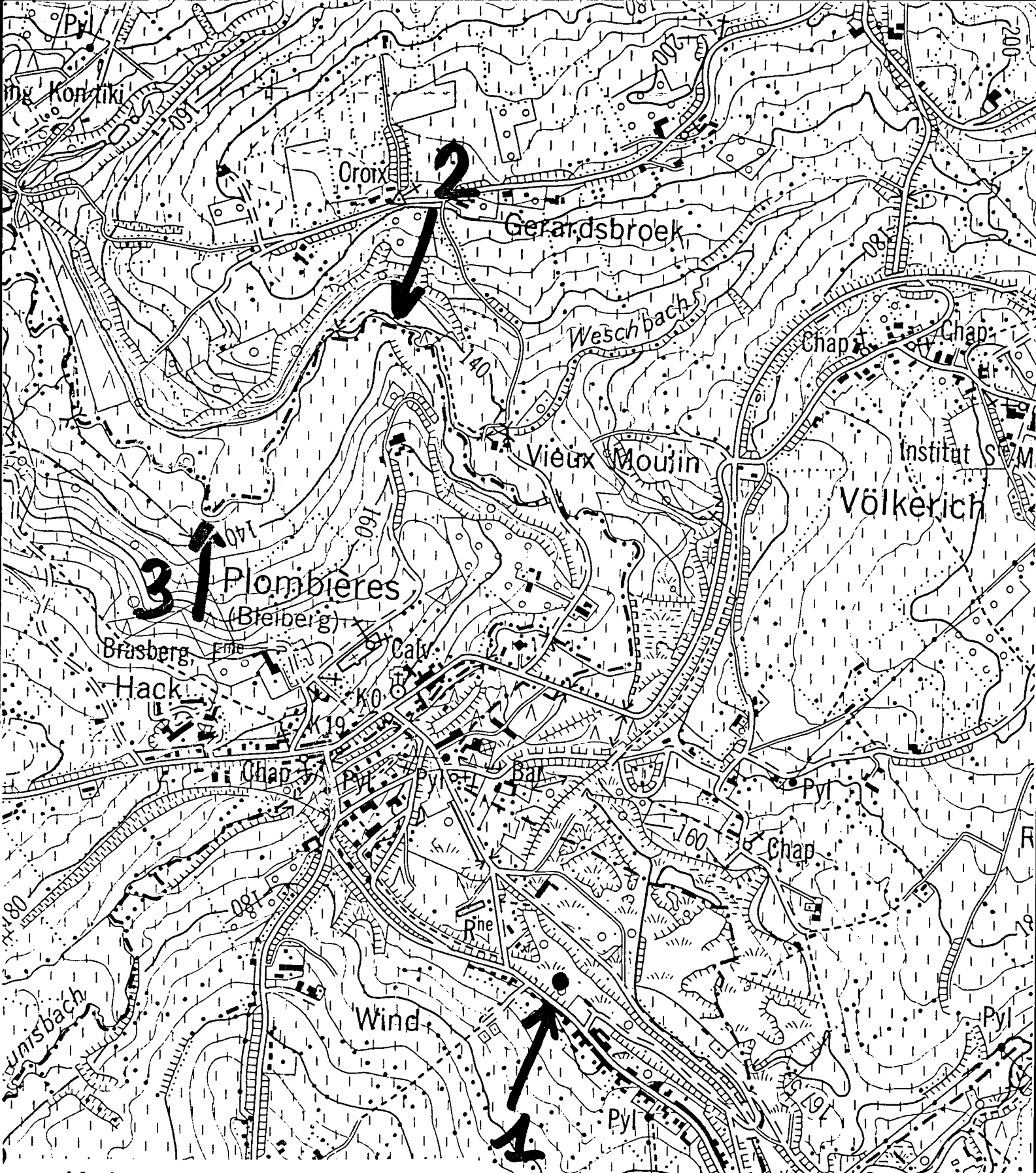
ENCLOSURE 4



Average concentrations (solid line) and standard deviations (dashed lines) of a) Pb, b) Zn and c) Cd (mg/kg) in soils in the study area (depth intervals 0-50 cm and 90-100 cm: n=65 per 10 cm interval; 50-90 cm: n=11 per 10 cm interval).

Average concentrations of Pb, Zn and Cd for 11 profiles.


Zn-gehalte in bodemstalen
van 0-20cm diepte.
100 m
3482
7036
6454
180
180



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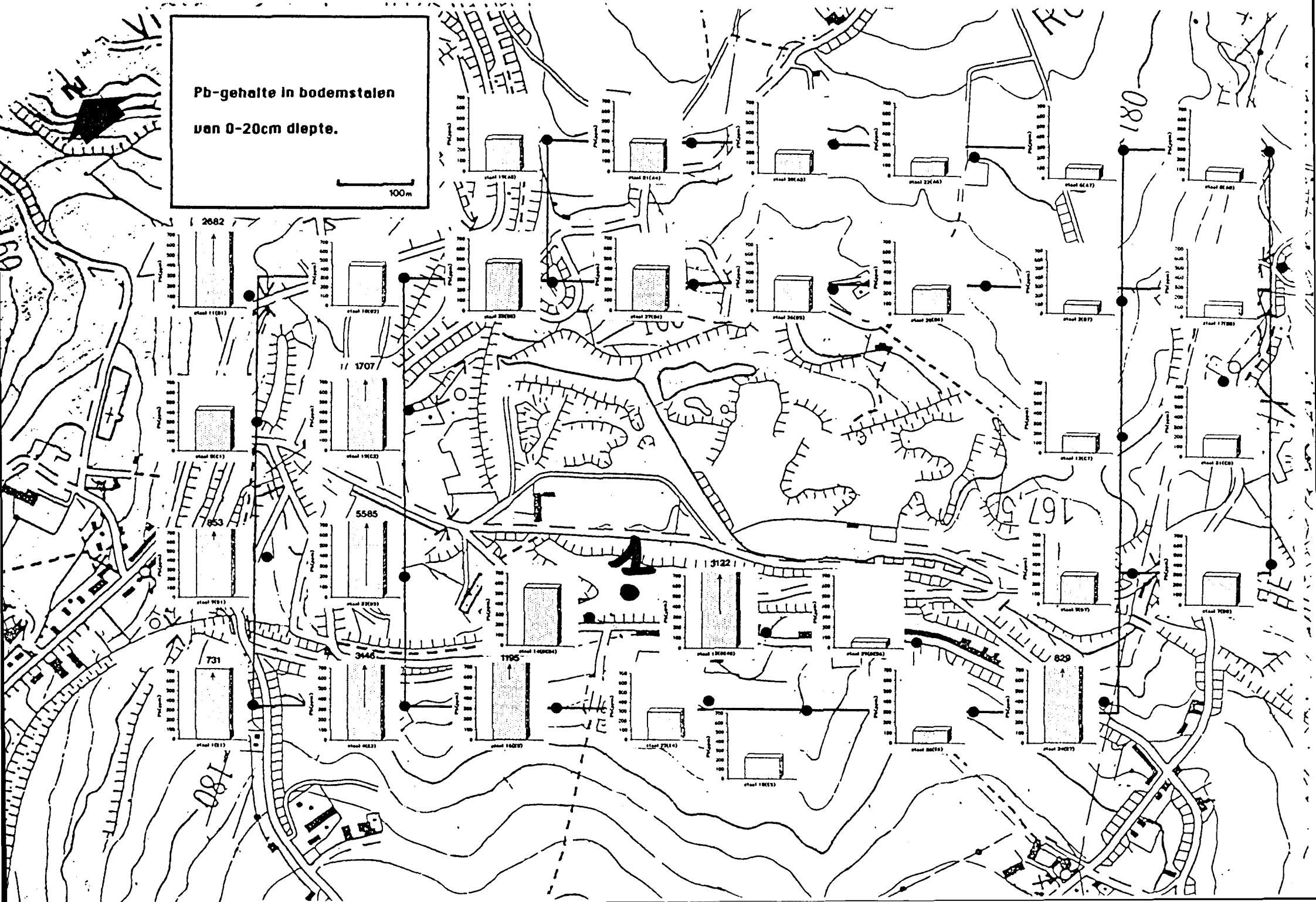

Pb-gehalte in bodemstalen
van 0-20cm diepte.
100m
2682
1707
5585
853
731
3446
1195
3122
829

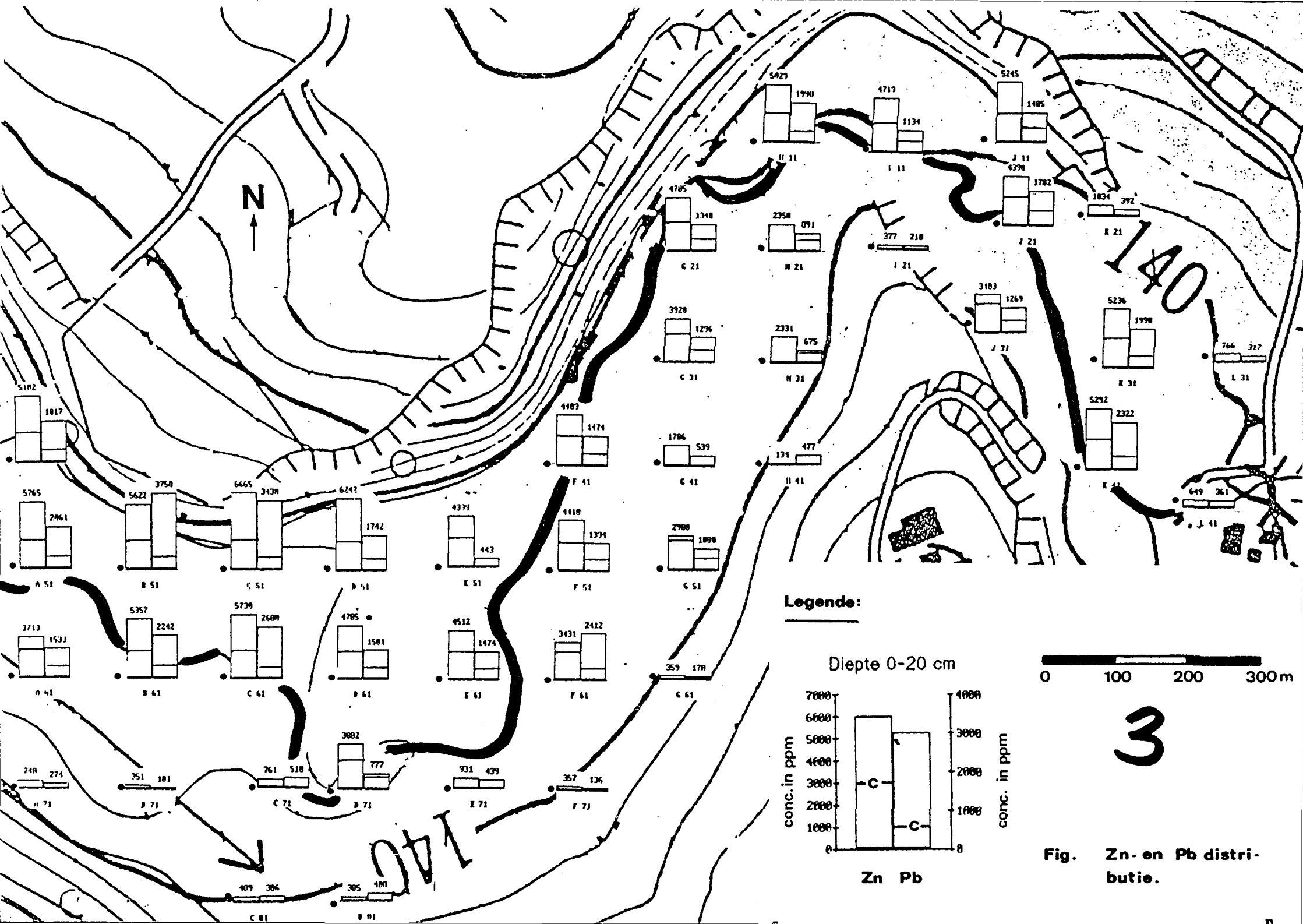


Fig. Zn- en Pb distributie.

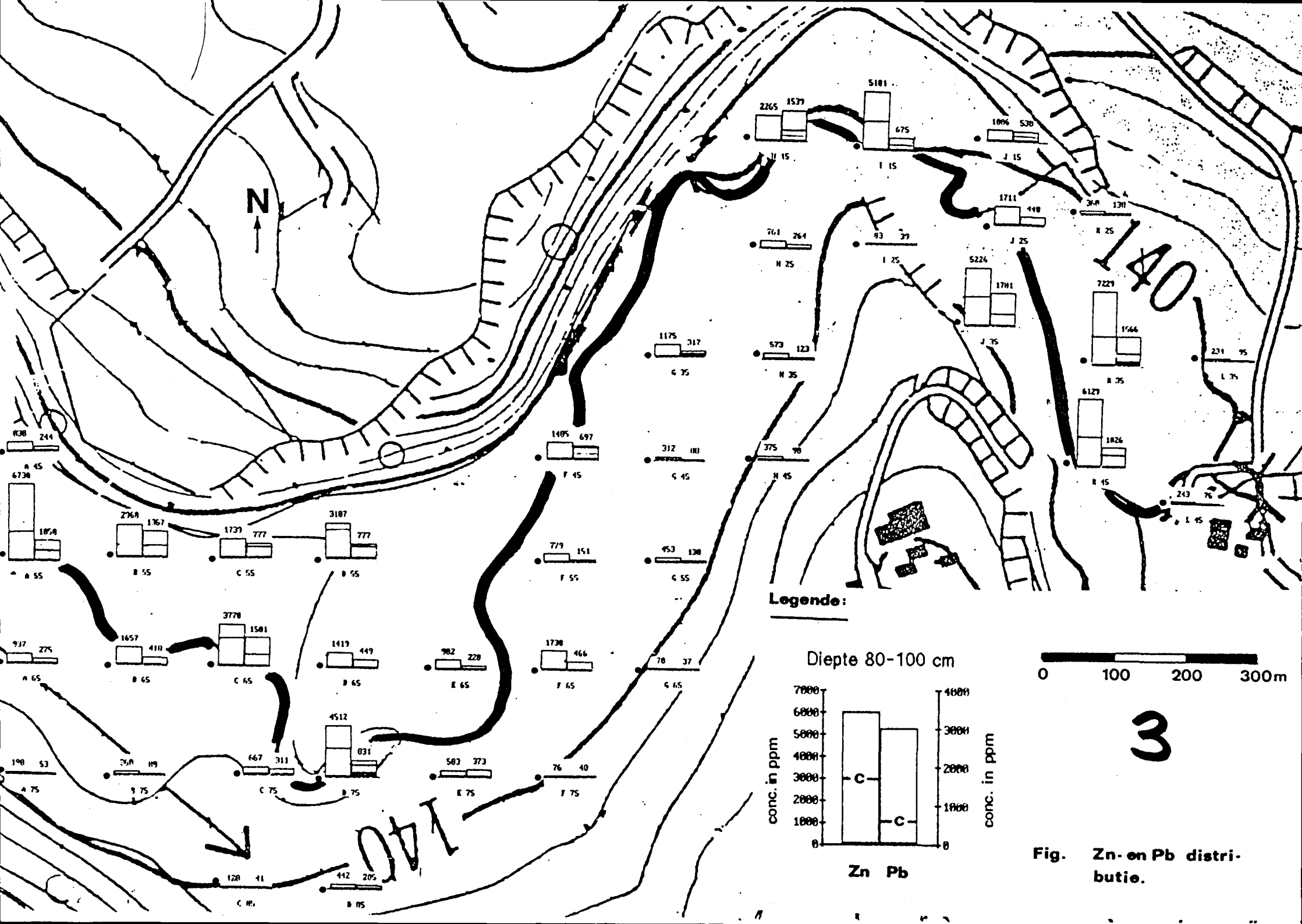


Fig. Zn- en Pb distributie.

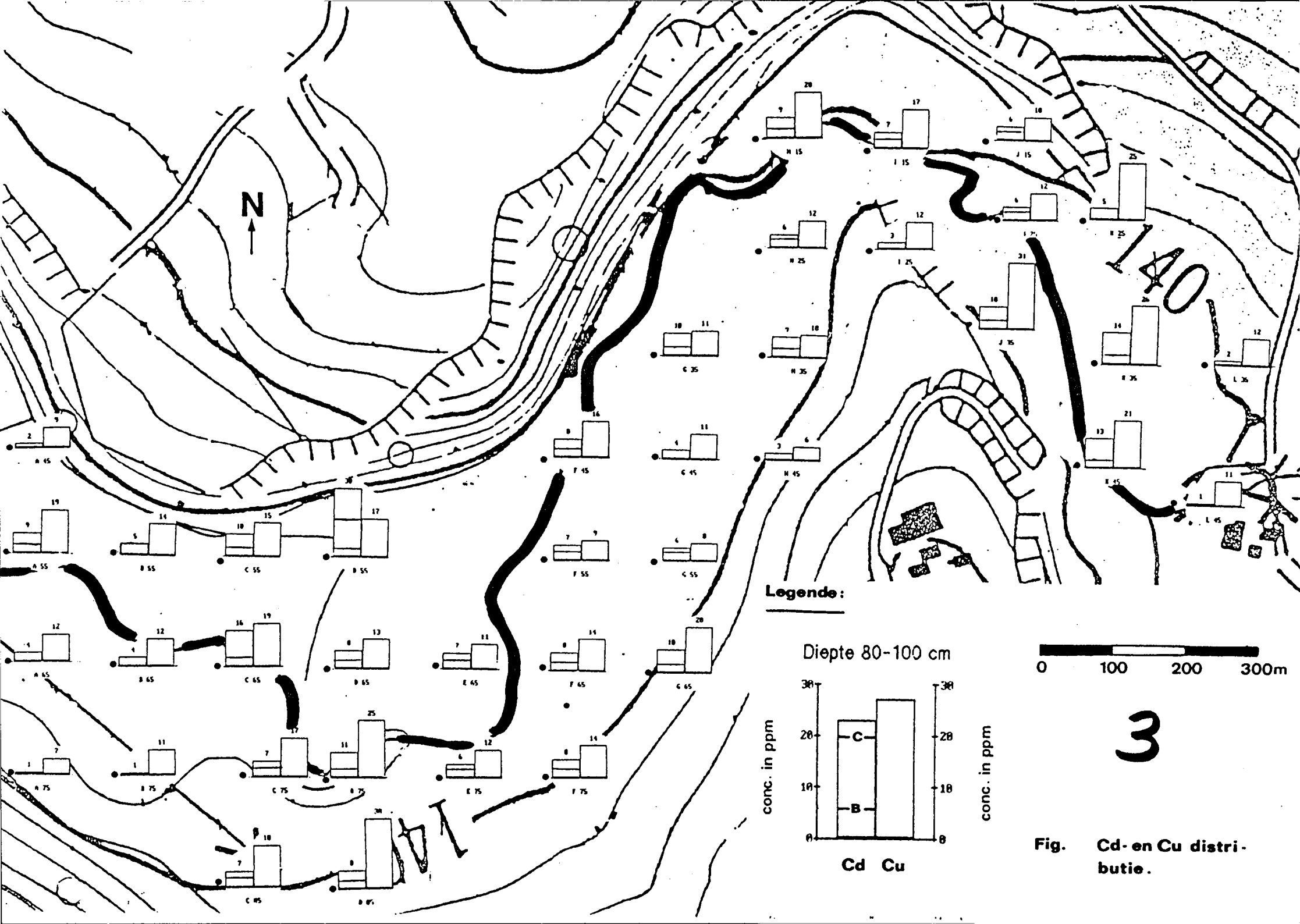
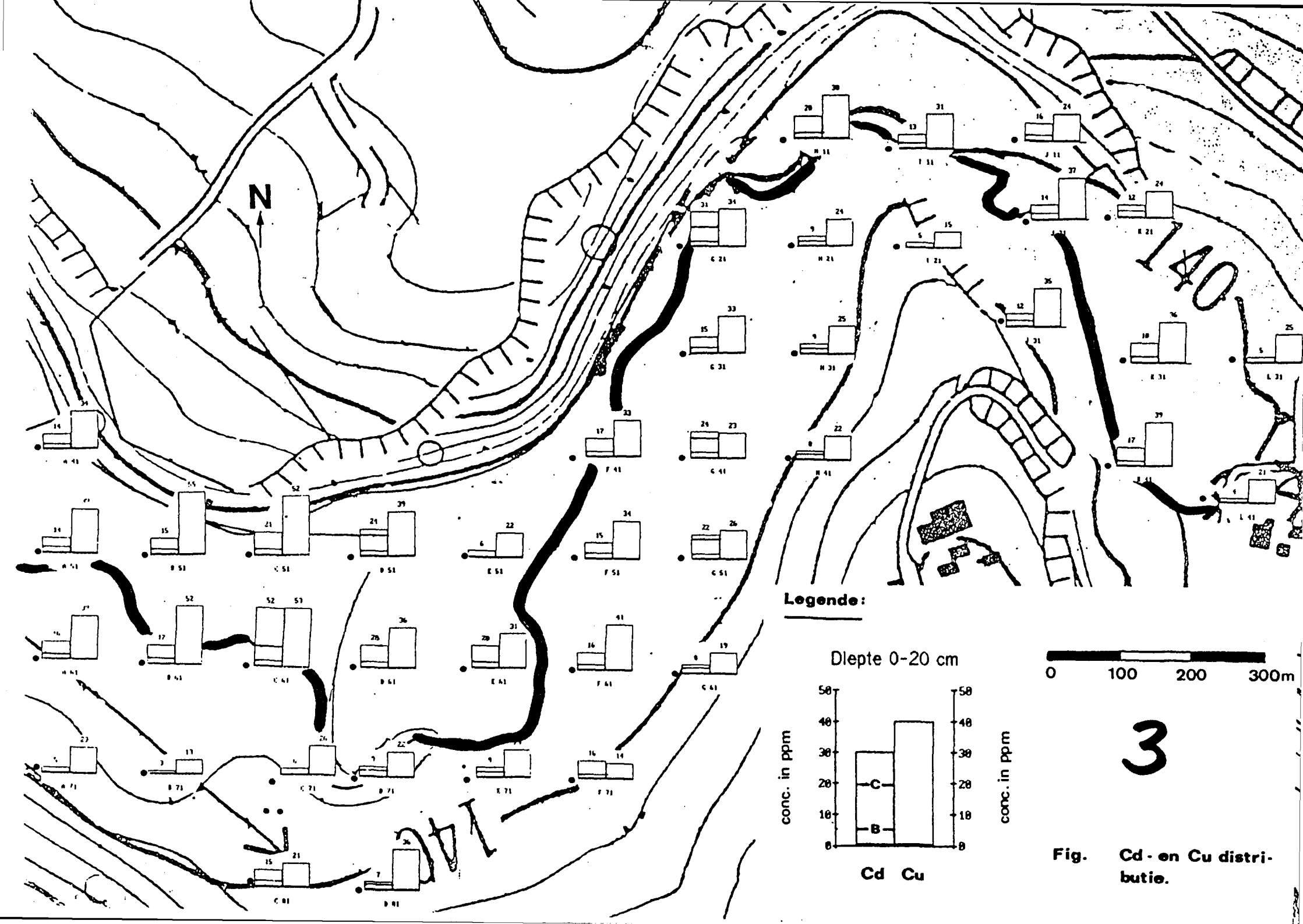
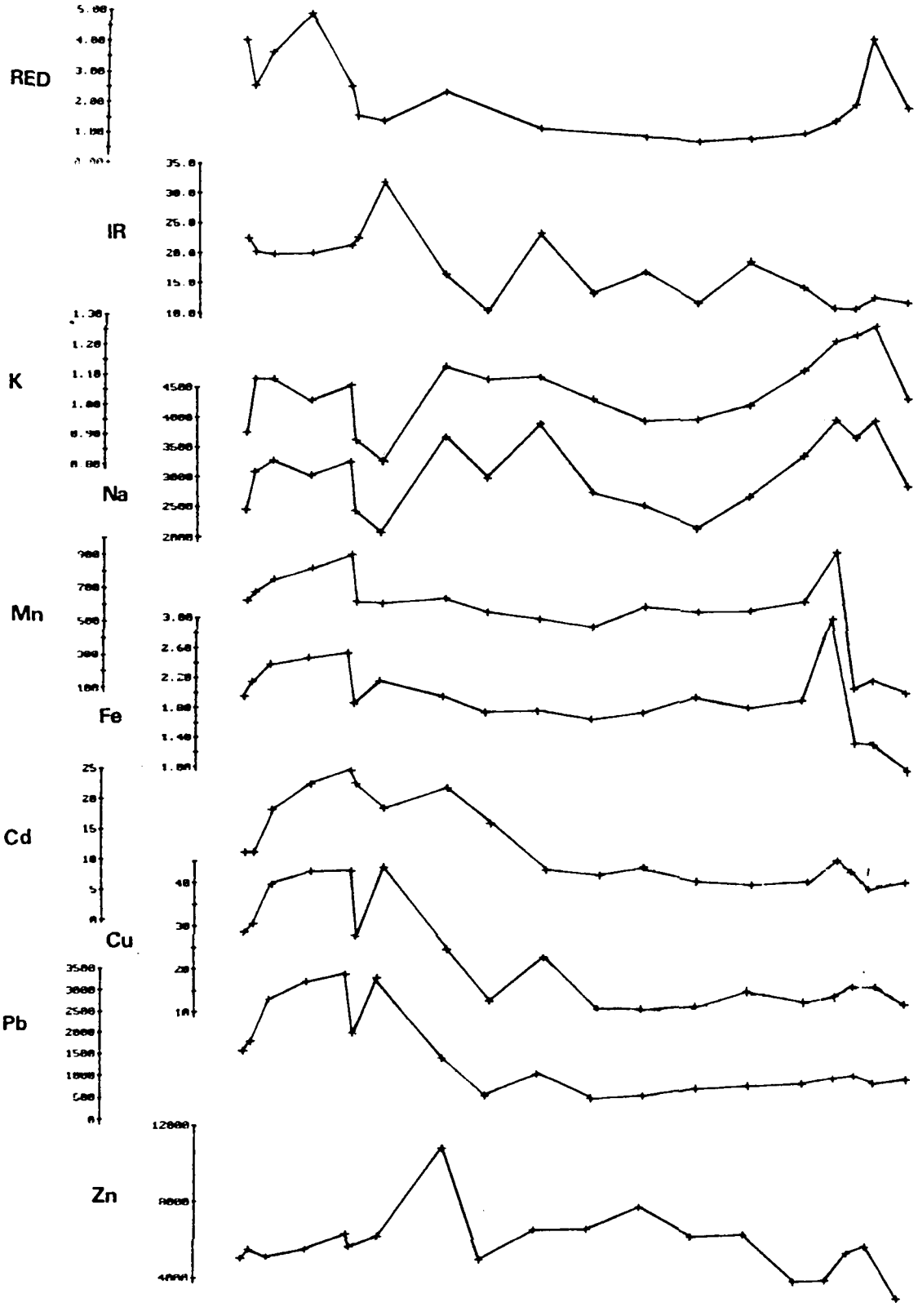


Fig. Cd- en Cu distributie.



3

Fig. Cd - en Cu distributie.


RED
IR
K
Na
Mn
Fe
Cd
Cu
Pb
Zn