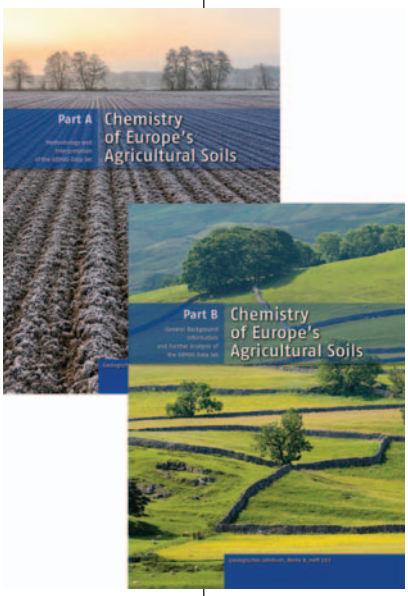
CHEMISTRY OF EUROPE'S AGRICULTURAL SOILS[3]

This two volume set (Parts A and B) arose from a project called the Geochemical Mapping of Agricultural and Grazing Land Soil in Europe (GEMAS). In this project, 2108 soil samples from ploughed land (0–20 cm depth)and 2023 samples of grazing land (0–10 cm depth) were collected in 2008/9 over an area of 5.6 million km^2, at a density of about 1 per 2,500 km^2. This was accomplished by a tremendous consortium of European national geological surveys, geologic institutions, academics, and industry. These groups used the same sampling protocols, with chemical analyses of all samples being carried out at specific labs. This ensured maximum comparability of the results from 33 countries across Europe. Oh, except Albania, Belarus, Malta, Moldova and Romania, which appear as blank spaces on the maps. Others outside Europe were also involved, from Australia, Canada and New Zealand. It was a truly international effort.



I hear you ask, "What chemical analyses did they make on these samples?" Well, quite a lot: too many to list here, in fact. In summary: total elemental analysis for 41 elements, aqua regia extractions for 53 elements, pH, effective cation exchange capacity (eCEC), total carbon, total organic carbon, lead isotopes, magnetic susceptibility, partial extractions for 56 elements, percent clay, and solid–liquid partitioning of elements. A real data-fest! Apparently, the project is not finished: for example, Sr isotope data are now being collected.

You may have noticed that industry was involved, and wonder why. The GEMAS project, and much of the funding, came from the European and international metals industries and industry associations. The chief reason behind this is the European Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation that came into force in 2007. In that same decade, many of us were involved in the collection of biological data on the risks of metals in soils. These studies developed algorithms that relate biological effects to key soil properties, which ultimately control the bioavailability in soils of metals on a continental scale. Hence, the GEMAS project was borne to provide the soil chemical data in order to perform the risk assessments for each substance.

Part A covers the sampling protocols, preparation methods, analyses and quality control of the results in a clear way, followed by the more mathematical aspects, such as the methods used for data analysis and mapping. Multivariate analyses include cluster and principle component analysis of the elemental data. The remaining four fifths of this volume gives detailed information on the distribution of each analyses, followed by a synthetic discussion chapter that looks at the influence of geography, geology, mineralisation, natural processes, anthropogenic influences, soil management (ploughed versus grazed land) and deficiency, and toxicity.

Part B is quite different. The first half provides background information on the soils, geology and mineral deposits in Europe, as well as several chapters on specific materials of interest (e.g. radionuclides, aeolian deposits, the elements As, B, C, Cd, Cl, F, and Se). The second half is divided into two parts: the first on mobility and risk assessment of metals; the second on regional interpretations, which concentrate on Norway, Sweden, Finland, and the Ukraine. Remembering that REACH was a big motivation for the GEMAS project, it is the mobility and risk assessment portion of this volume that really stands out. Furthermore, the methodology for using the data under REACH is excellently described by two industry authors. They use Cu and Mo as examples to illustrate the amazing range of "predicted no (biological) effect concentrations" (PNECs) in European soils. Their specific examples illustrate how the combination of biology (toxicity assays in different soils) and soils data can be used for risk assessment and control of chemicals. In great contrast, the chapter on the use of mobile metal ion analysis (MMI®) sticks out, because the details of this partial extraction are not given and, as a result, we do not know what the extractants are. Furthermore, all of the REACH studies showed that these kinds of partial extractants did not improve the relationships between toxicity bioassays and soils data.

Perhaps the most disappointing finding for the project members was that there were very few differences in any of the measured chemical properties (apart from organic carbon) between ploughed and grazed soils. As these were *agricultural* soils, it may be that grazed soils are not permanent in the sense that they are often tilled and re-seeded. Indeed, the sampling instructions for this survey state that soil should not have been disturbed by ploughing in the last 10 years. How would the surveyors know, and is 10 years long enough time to be considered "undisturbed"? Nevertheless, interactions between climate, geology and substrate on the distribution of many elements shone through, as did the effects of glaciation and aeolian deposits. Both books have a list of abbreviations, and there are particularly useful statistical Appendices in Part B. One omission I feel is that there is no index in either book.

A focus on REACH (i.e. potential toxicity) is not the only use of these volumes. They will be useful for teaching and research in many areas, including environmental, climate (soil carbon), agriculture and food, geological and geochemical processes, amongst others. In this context, Part A includes a DVD with all of the data sets (I am already using them in a research project), graphics and maps, along with additional maps, graphics and tables that are not in the book. These are invaluable resources. At 3.6 kg together, these books are not light reading on the plane. But what they do represent is an unrivalled reference source on the geochemistry of Europe's agricultural soils.

Steve P. McGrath, Rothamsted Research
Harpenden, United Kingdom

3 Reimann C, Birke M, Demetriades A, Filzmozer P, O'Connor P (eds) (2014) *Chemistry of Europe's Agricultural Soils*. Part A: Methodology and Interpretation of the GEMAS Data Set. 538 pages, ISBN 978-3-510-96846-6, €118 and Part B: General background Information and Further Analysis of the GEMAS data set. 352 pages, ISBN 978-3-510-96847-3, €78. Published by Schweizerbart Science Publishers

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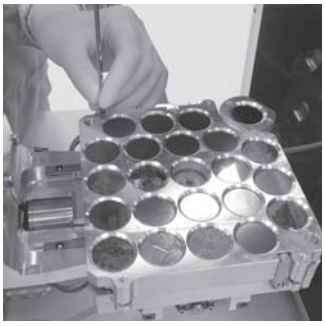

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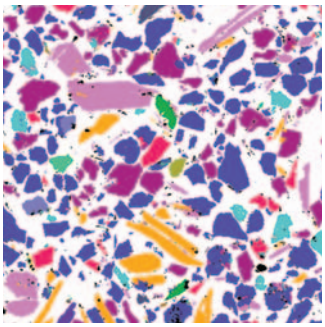

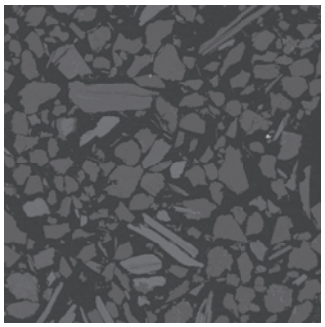

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