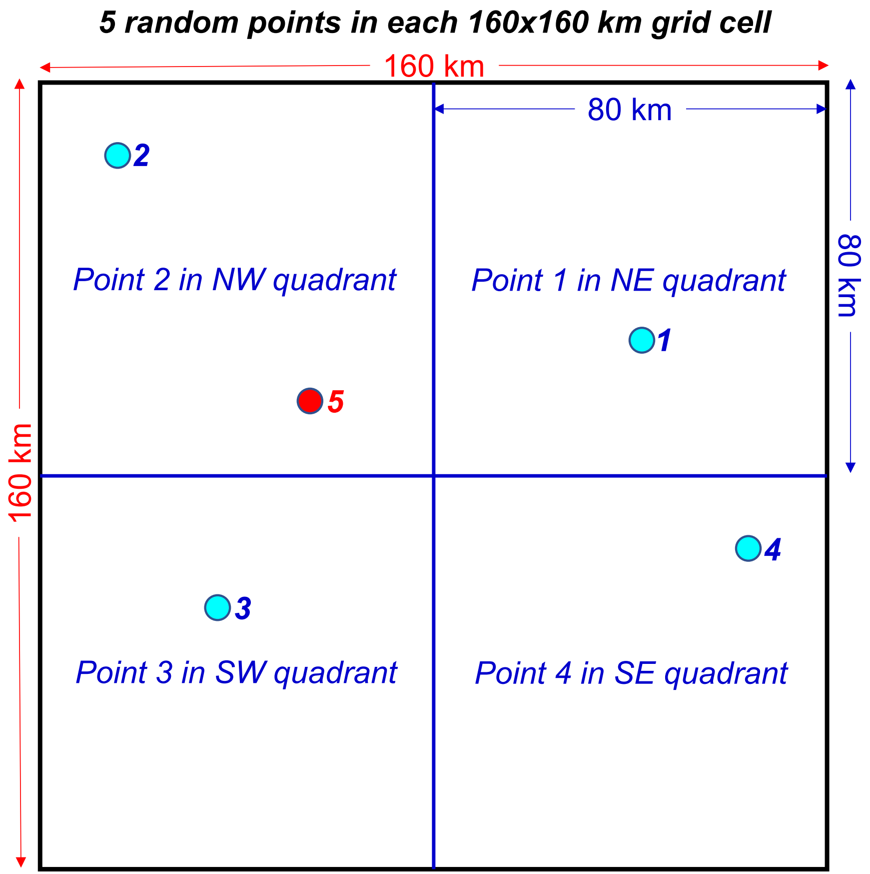
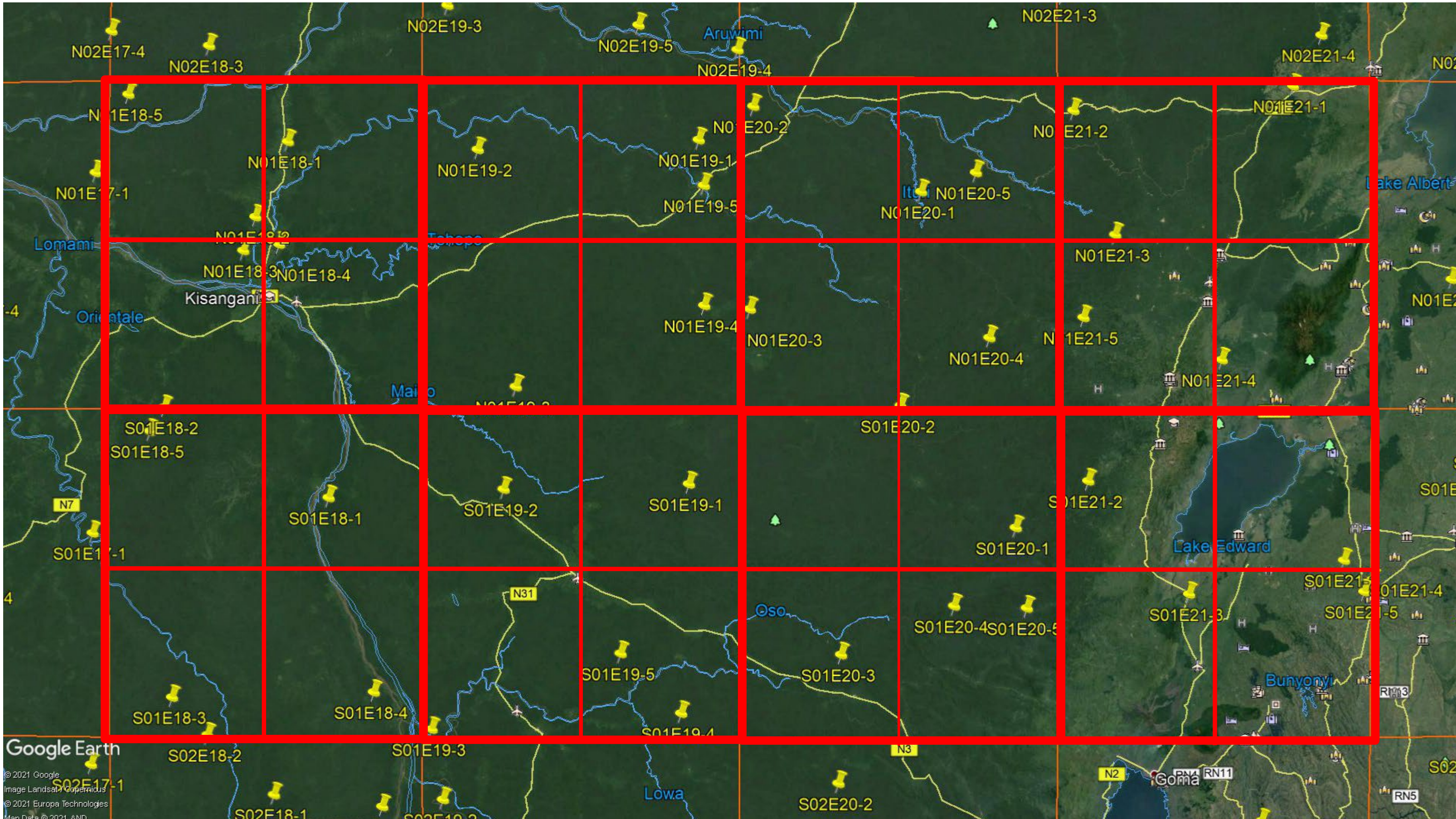
…..Answer 3…..: The 5 random points in each 160x160 km grid cell are generated by an R-script:-



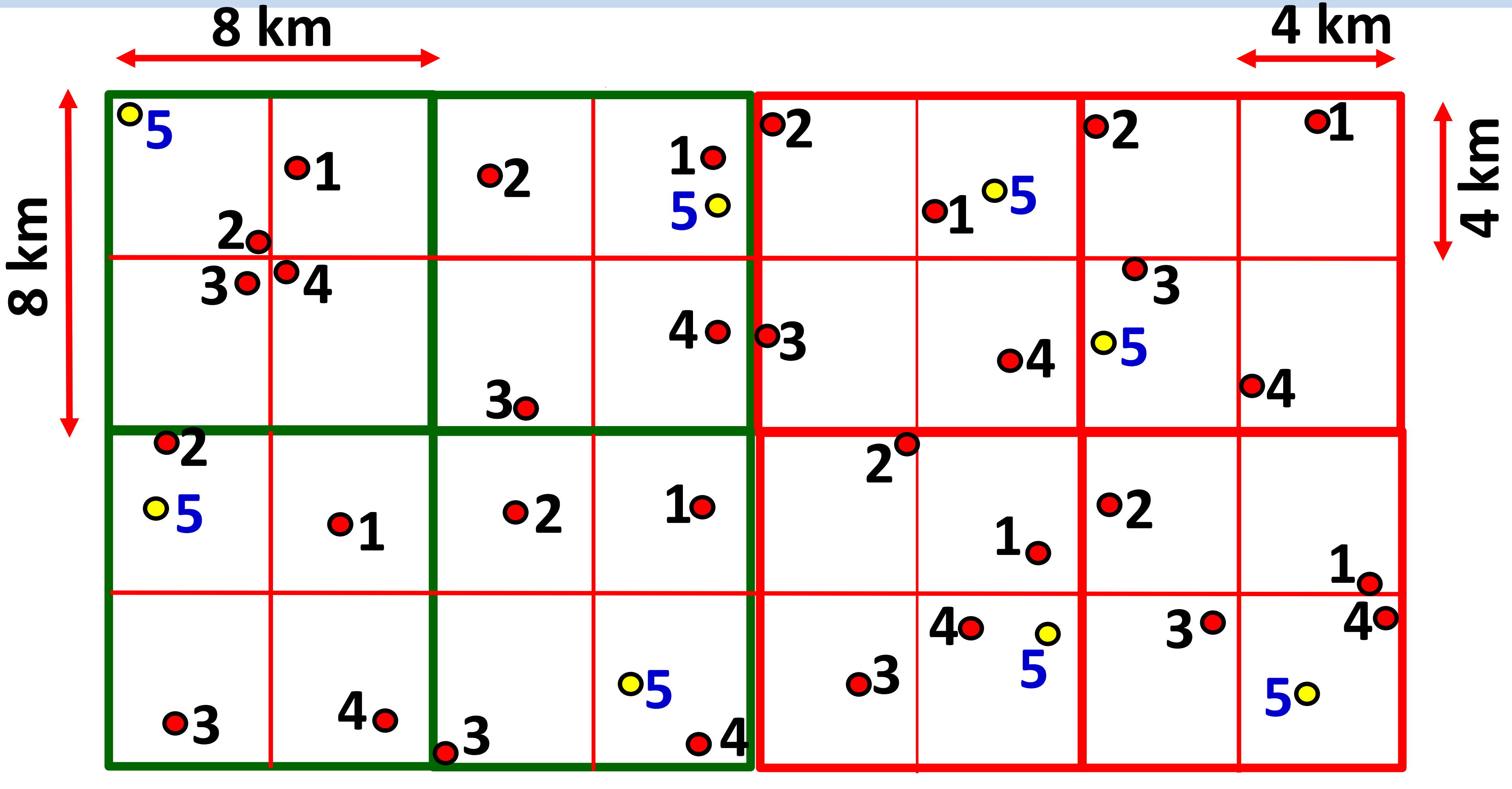
Point 5 is randomly located in the 160x160 km grid cell

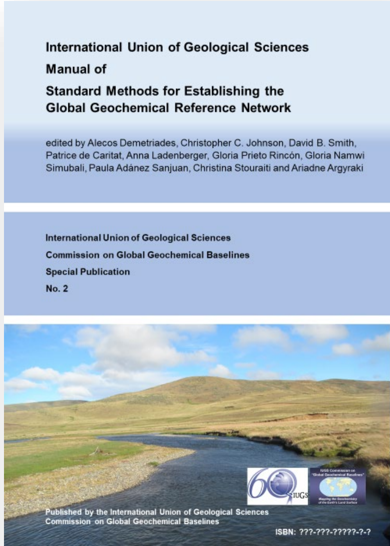
https://www.globalgeochemicalbaselines.eu/content/185/ebook-r-scripts-for-generation-of-5,-8-and-16-random-sampling-points-/

.....Answer 3.....: On this Google Earth image of part of the Democratic Republic of Congo, the 5 random points in each 160x160 km grid cell are shown.



NOTE: For planning your country's geochemical baseline mapping, the size of the grid cells can be modified to suit your budget. *I mean national, not global-scale geochemical mapping*.





"*Everything in and on the Earth - mineral, animal and vegetable - is made from one, or generally some combination of, the natural chemical elements occurring in the rocks of the Earth's crust and the surficial materials derived from them. Everything that is grown, or made, depends upon the availability of the appropriate elements. The existence, quality and survival of life depends upon the availability of elements in the correct proportions and combinations. Because natural processes and human activities are continuously modifying the chemical composition of our environment, it is important to determine the present abundance and spatial distribution of the elements across the Earth's surface in a much more systematic manner than has been attempted hitherto*" (Darnley *et al.*, 1995, p.x). Although such a global database is urgently needed for multi-purpose use, the systematic attempt is still in its infancy because of the non-existence of a manual of comprehensive and standardised methods of sampling and other supporting procedures. The current ***'International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network'*** fills this gap. The Manual follows the concept of 7356 Global Terrestrial Network grid cells of 160x160 km, covering the land surface of Earth, with five random sites within each grid cell for the collection of samples. This allows the establishment of the *standardised Global Geochemical Reference Network* with respect to rock, residual soil, humus, overbank sediment, stream water, stream sediment and floodplain sediment. Apart from the instructions for the collection of samples, the Manual covers sample preparation and storage, development of reference materials, geoanalytical methods, quality control procedures, geodetic and parametric levelling of existing data sets, data conditioning for the generation of time-independent geochemical data, management of data and map production, and finally project management. The methods described herein, apart from their use for *Establishing the Global Geochemical Reference Network*, can be used in other geochemical surveys at any mapping scale.

ISBN: 978-618-85049-1-2

Question 4: *Which procedures should be followed for the production of internally consistent quality-controlled global geochemical databases for multipurpose use?*

THE KEY IS STANDARDISATION OF ALL PROCEDURES FROM SAMPLING, SAMPLE PREPARATION, TO ANALYTICAL METHODS AND INSTALLATION OF A STRICT QUALITY CONTROL PROCEDURE AT ALL STAGES

Production of High Quality Harmonised Geochemical Databases at any mapping scale

Sampling

Sample preparation

- These are the two most crucial stages of any geochemical survey.
- Any errors during these two stages is carried forward, and can result in the failure of the whole survey.

Laboratory analysis

- Errors can be corrected by re-analysis of samples, provided enough sample material is available.

Standardised detailed instructions are given for sampling:

IUGS Commission on "Global Geochemical Baselines"
Mapping the Geochemistry of the Earth's Land Surface

International Union of Geological Sciences
Manual of Standard Methods
for
Establishing the Global Geochemical Reference Network

Chapter 3.5

Overbank and Floodplain Sediment Sampling

Alecos Demetriades[1,8], Rolf Tore Ottesen[2], Jim Bogen[3], Ignace Salpeteur[4], Iván Martín[5,8], Juan Locutura[5,8], Alejandro Bel-lan[5,8], Xueqiu Wang[6,8], Juan Pablo Lacassie Reyes[7,8], Felipe Astudillo[7,8], Pablo Sebastian Oliva Vicentelo[7,8]

[1] Institute of Geology and Mineral Exploration, Athens, Hellenic Republic
[2] Geological Survey of Norway, Trondheim, Norway
[3] Norwegian Water Resources and Energy Directorate, Oslo, Norway
[4] Bureau de Recherches Géologiques et Minières, Orléans, France
[5] Instituto Geológico y Minero de España, Madrid, Spain
[6] UNESCO International Centre on Global-Scale Geochemistry, Langfang, Hebei, P.R. China
[7] Servicio Nacional de Geología y Minería, Valdivia, Chile
[8] IUGS Commission on Global Geochemical Baselines

2022
Published by
The International Union of Geological Sciences
Commission on Global Geochemical Baselines

Detailed instructions are given for the collection of each sample type

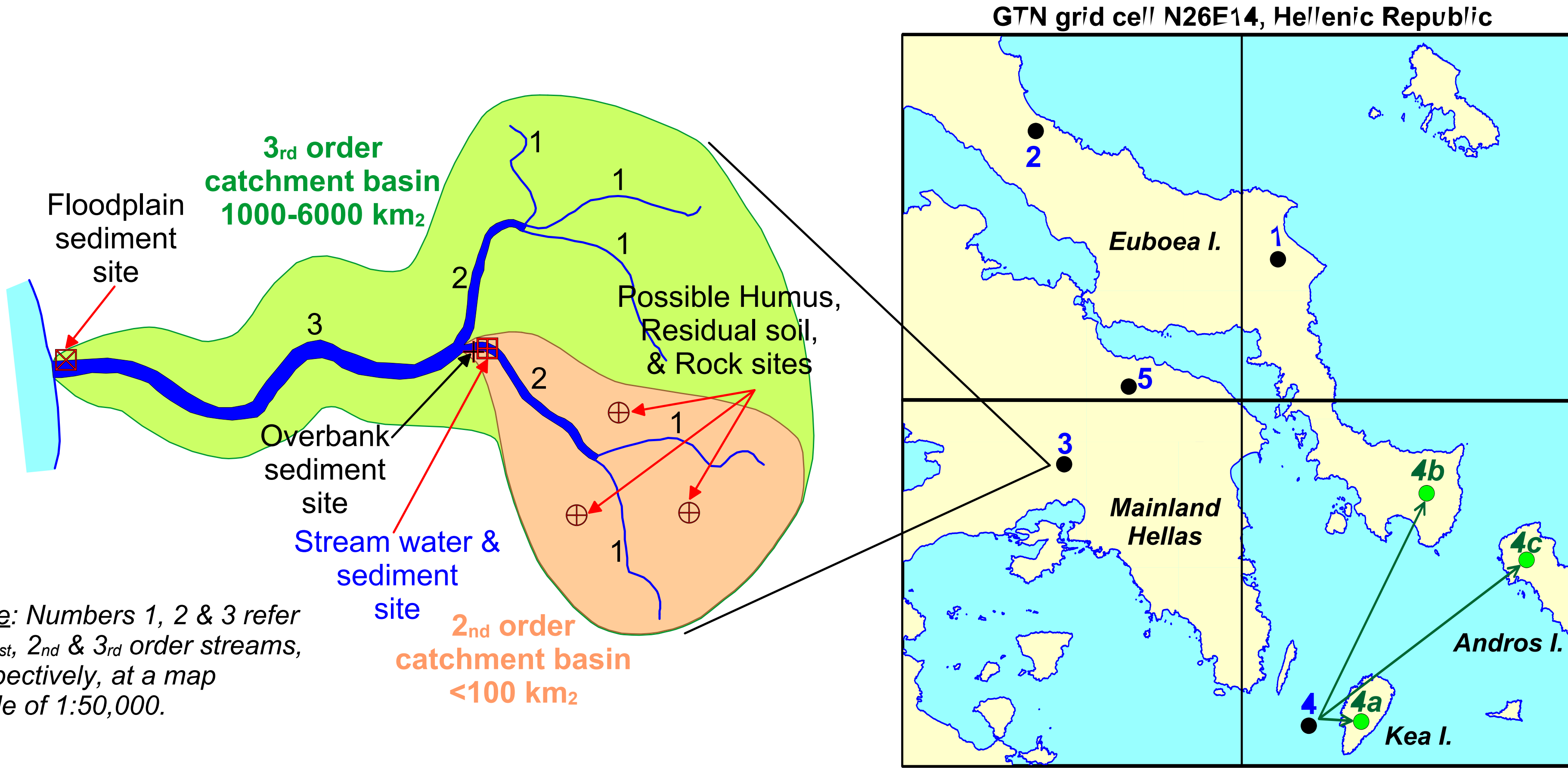
From the five (5) randomly selected catchment basins of each 160x160km grid cell, representative samples of

- **Rock,**
- **Residual soil (top & bottom),**
- **Humus,**
- **Stream water,**
- **Stream sediment, and**
- **Overbank sediment (top & bottom)**

are collected from the 2nd order catchment basin, and

- **Floodplain sediment (top & bottom)**

is collected from the 3rd order catchment basin.



Samples to be collected from 2nd order catchment basin:

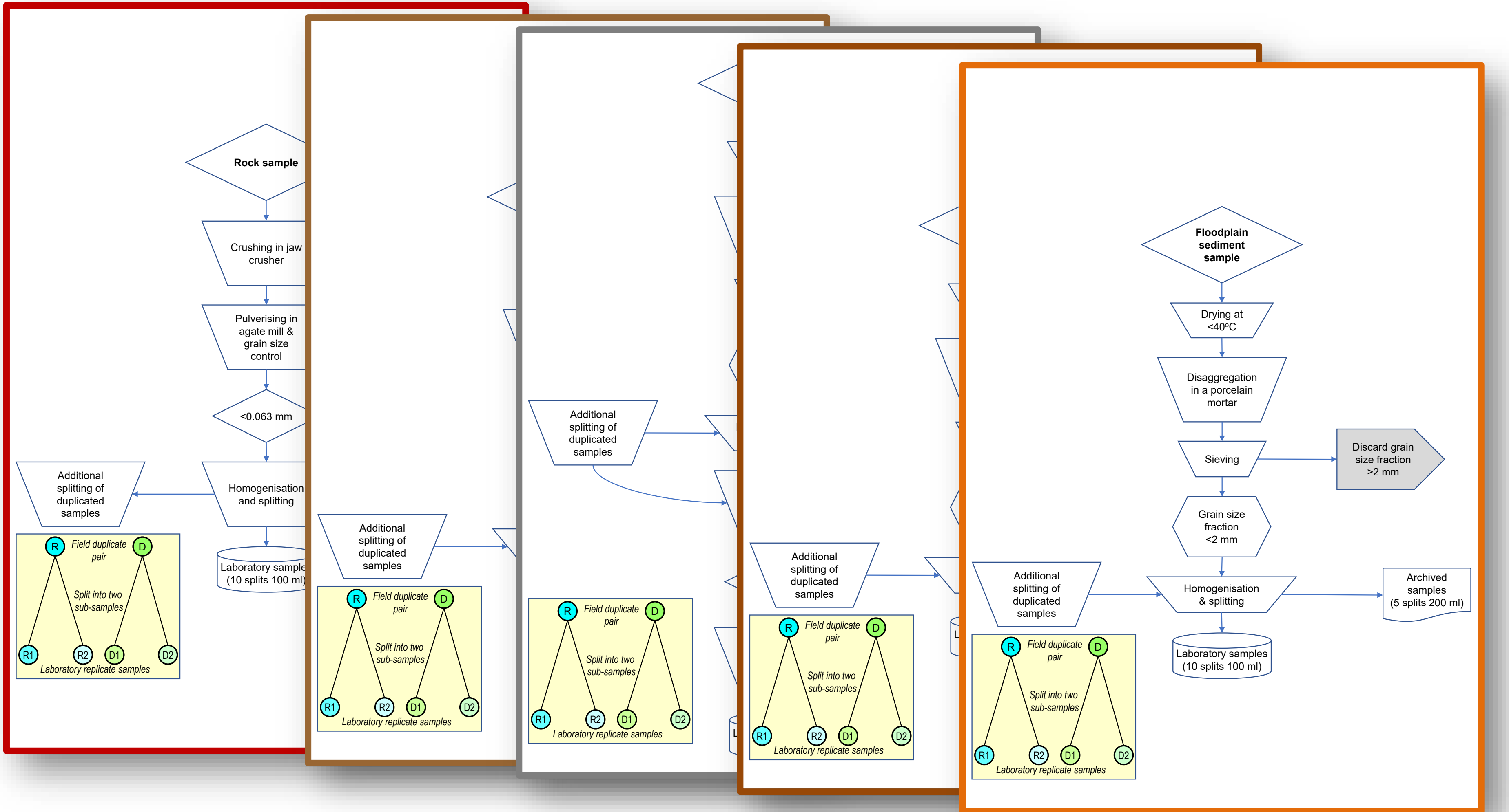
Rock: N26E14**R**3
Residual topsoil: N26E14**T**3
Residual bottomsoil: N26E14**C**3
Humus: N26E14**H**3 (where available)

Overbank sediment - top: N26E14**K**3
Overbank sediment - bottom: N26E14**N**3
Stream sediment: N26E14**S**3
Stream water: N26E14**W**3

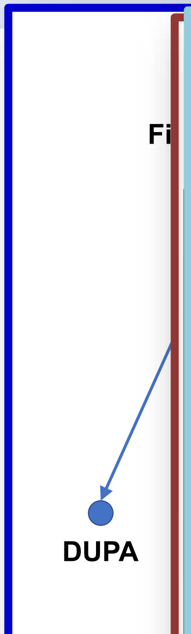
Samples to be collected from 3rd order catchment basin:

Floodplain sediment - top: N26E14**F**3
Floodplain sediment - bottom: N26E14**L**3

Detailed instructions are given for sample preparation:



Detailed instructions are given for sample homogenisation, splitting, archiving, and randomisation of samples with insertion of duplicate-replicate sample splits, and external secondary reference materials for submission to the analytical laboratory



(a) Random number list

RANDOM NUMBER LIST 1

Project Code ....

Number Range ....

59		8		37		64	
38		44		100		61	
10		91		73		99	
86		79		60		96	
98		68		16		77	
3		65		6		35	
76		89		58		97	
9		52		12		66	
78		27		1		83	
50		42		19		54	
24		62		31		11	
30		40		26		46	
5		94		20		15	
67		70		29		49	
71		56		95		28	
85		25		22		17	DUPA
32		84		92		21	REPA
93		47		69		75	DUPB
55		90		48		13	REPB
72		53		39		41	SRM 1A
80		2		4		88	SRM 1B
34		45		81		7	SRM 2A
82		43		63		74	SRM 2B
14		51		18		87	Blank 1A
33		36		23		57	Blank 1B

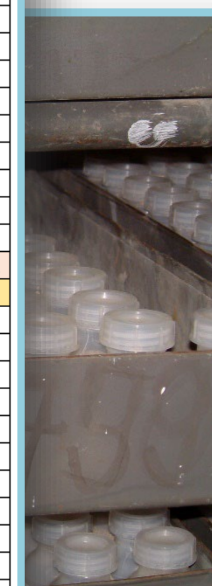
(b) Random number list sorted from smallest to largest number

RANDOM NUMBER LIST 1

Project Code ....

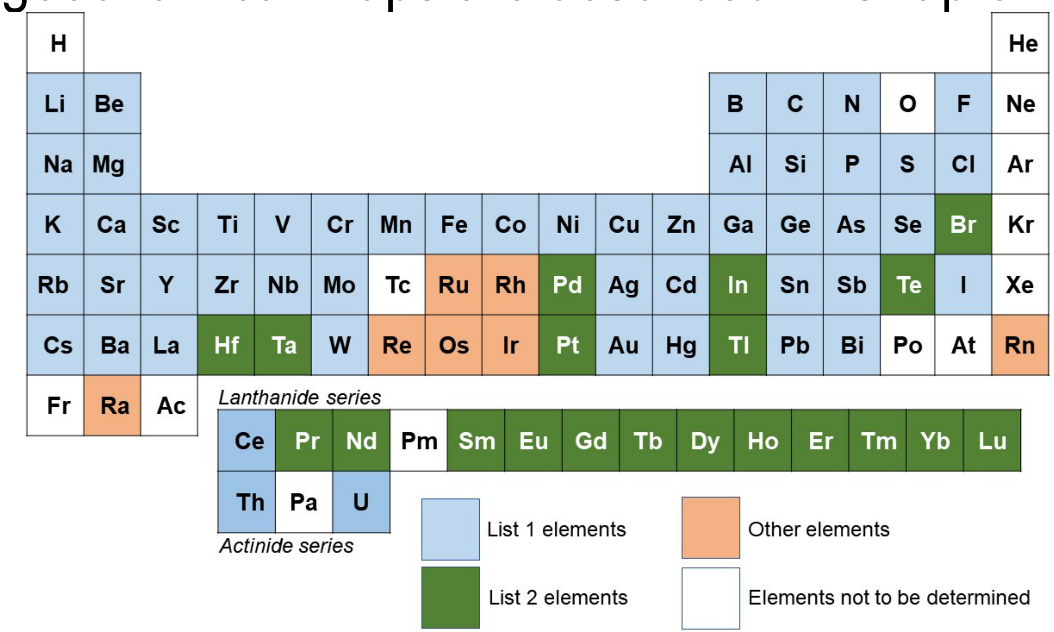
Number Range ....

1		26		51		76	
2		27		52		77	
3		28		53		78	
4		29		54		79	
5		30		55		80	
6		31		56		81	
7	SRM 2A	32		57	Blank 1B	82	
8		33		58		83	
9		34		59		84	
10		35		60		85	
11		36		61		86	
12		37		62		87	Blank 1A
13	REPB	38		63		88	SRM 1B
14		39		64		89	
15		40		65		90	
16		41	SRM 1A	66		91	
17	DUPA	42		67		92	
18		43		68		93	
19		44		69		94	
20		45		70		95	
21	REPA	46		71		96	
22		47		72		97	
23		48		73		98	
24		49		74	SRM 2B	99	
25		50		75	DUPB	100	



Standardisation is the key to harmonisation of geochemical databases

Laboratory analysis of collected samples: All samples of each medium type **MUST BE analysed** by the **<u>same analytical method</u>** at the **<u>same laboratory</u>** and, if possible, within a short time period. If the project runs for a long time, then other conditions must be followed by using the project reference samples to level the data. Methods of data conditioning for producing seamless geochemical maps are described in Chapter 8.



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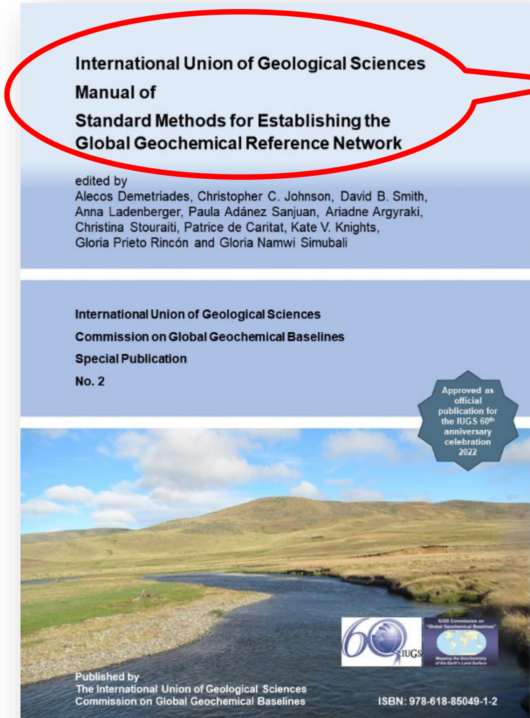
Standardisation is the key to harmonisation of geochemical databases

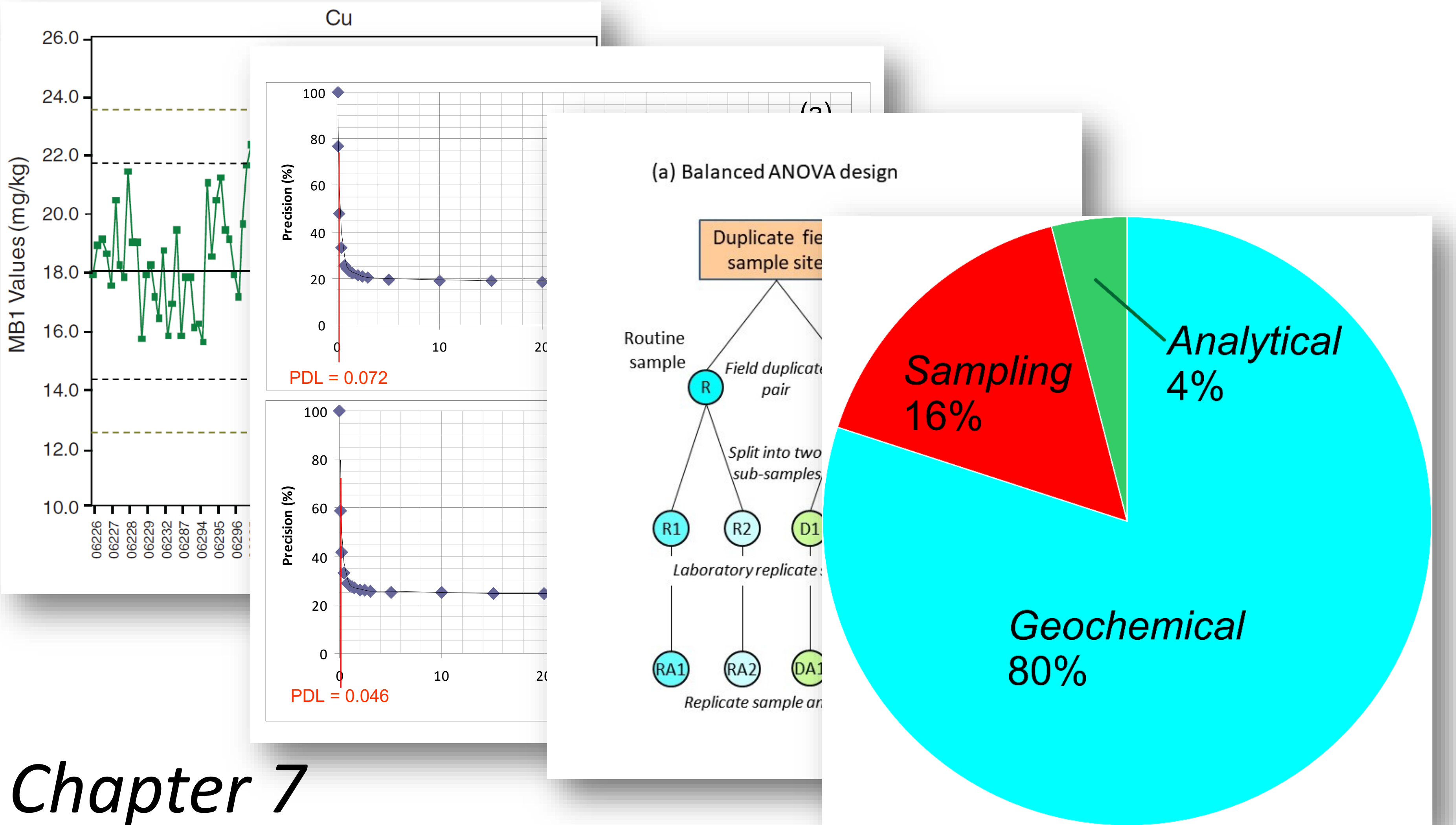


Checking of analytical data: Detailed instructions are given of how to conduct a thorough check of the received analytical data, and in case errors are identified, the particular batches should be reanalysed, and in the worst-case scenario it may be necessary to demand the reanalysis of the whole sample suite.

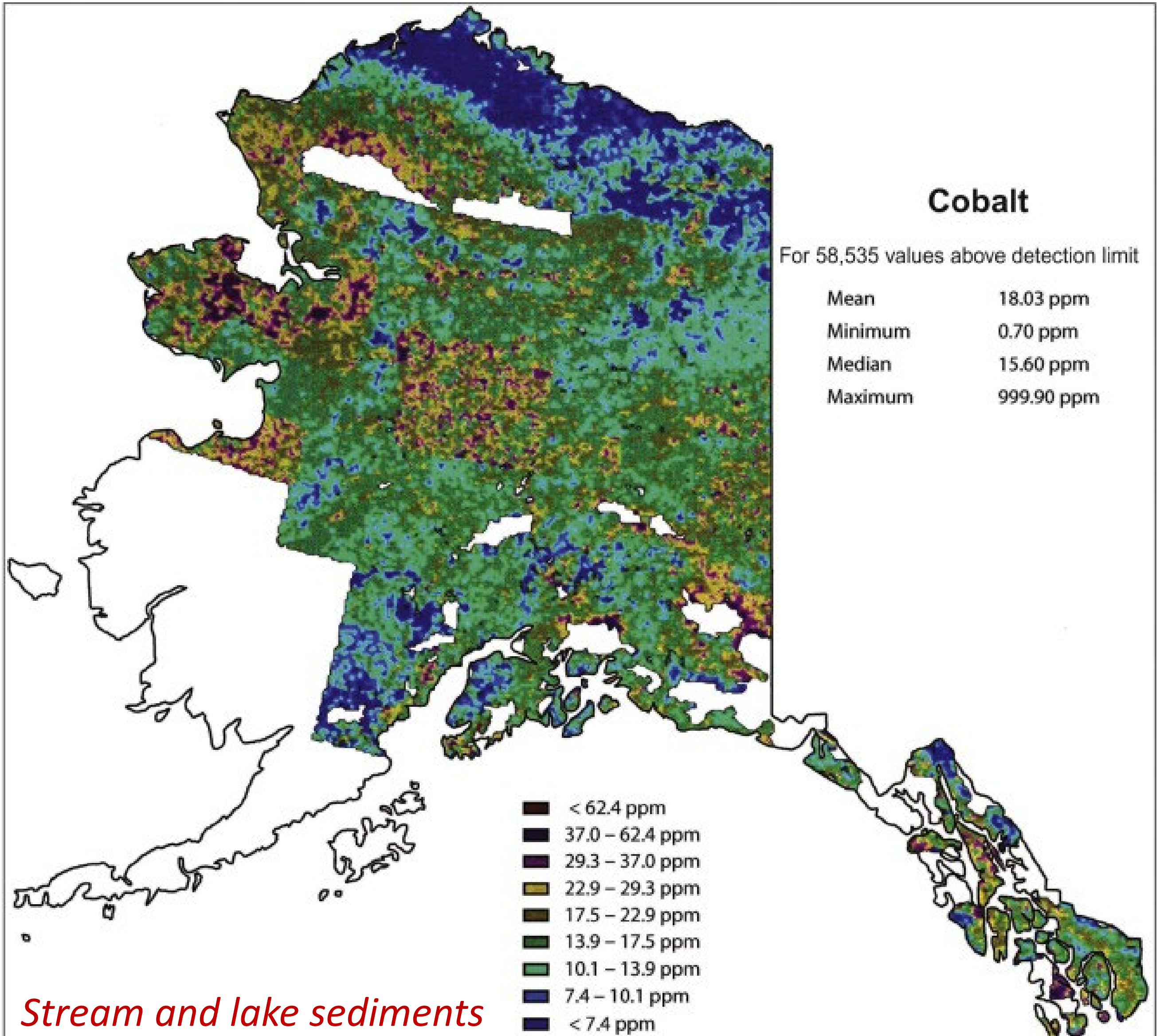
Chapter 7 - Quality Control Procedures
Alecos Demetriades, Christopher C. Johnson, Ariadne Argyraki

Quality control report: For each set of analytical data, it is stressed that a well-documented quality control report should be written, and problems encountered and solutions given must be clearly mentioned.

Quality control, and data conditioning when necessary

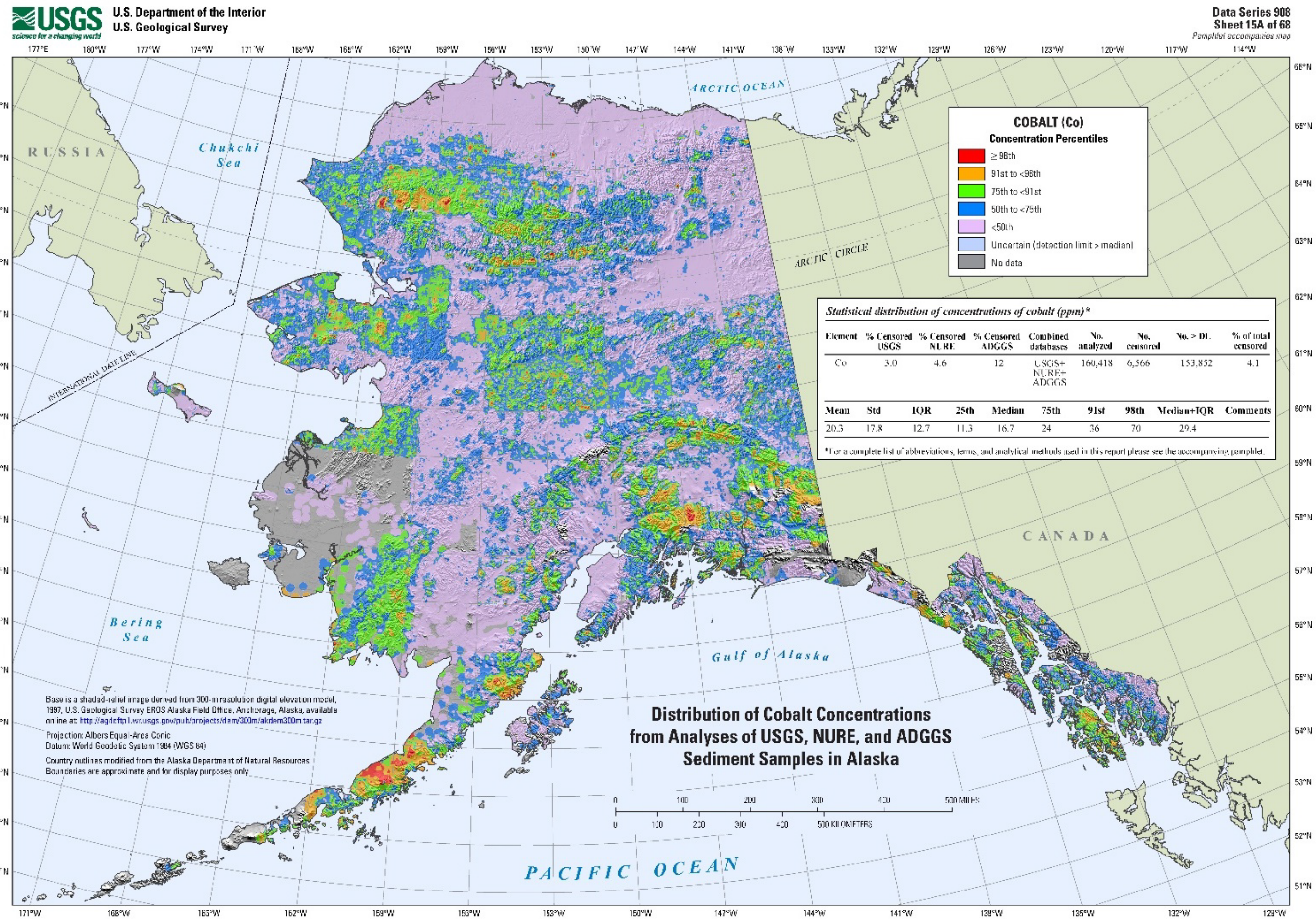


Chapter 7



Chapter 8

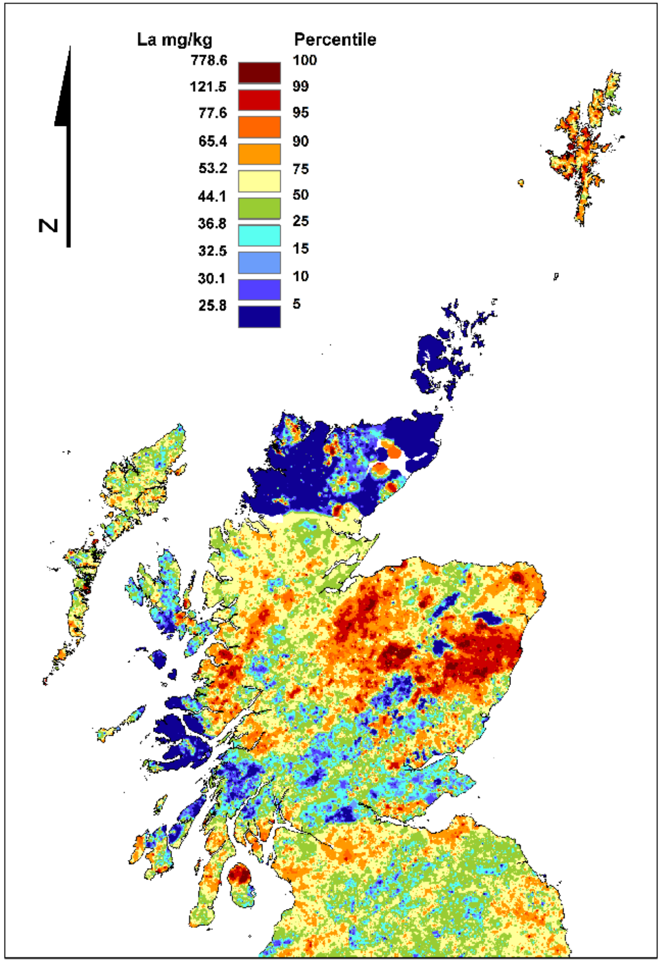
Figure 8.1 on page 433. Cobalt distribution map from the original Geochemical Atlas of Alaska (Weaver *et al*., 1983) modified by Smith *et al.* (2013, Fig. 4, p.172). Large blocks of unlevelled data, identifiable by their straight-edge boundaries (map sheet boundaries), show the effects of uncorrected bias in the analytical results.

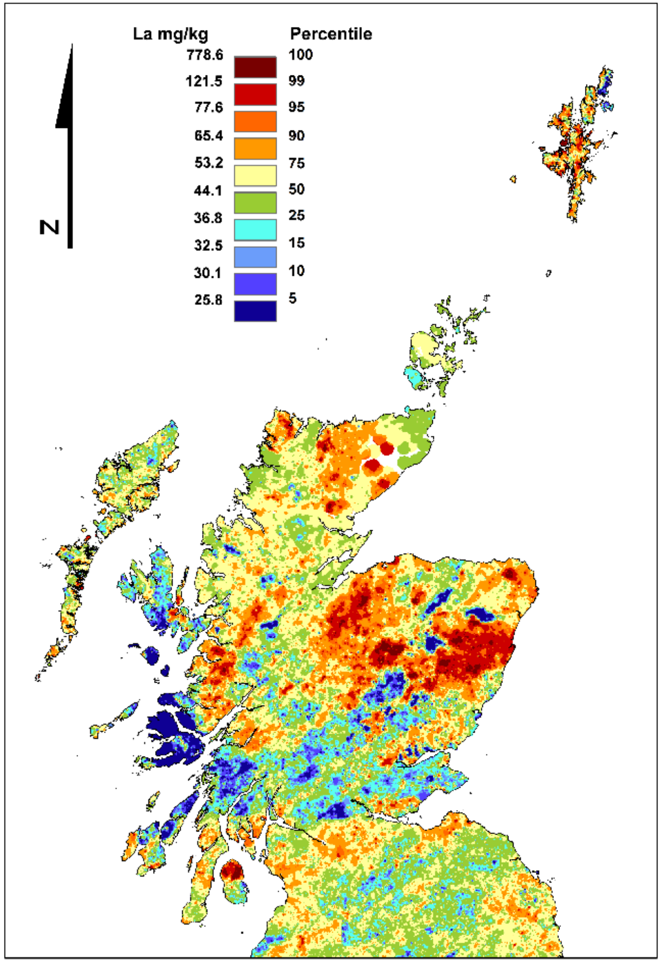


Cobalt distribution map from the new compilation of the stream and lake sediment geochemical data set of Alaska (Wang *et al*., 2020). As you can observe the large blocks of unlevelled data are still identifiable by their straight-edge boundaries (map sheet boundaries).

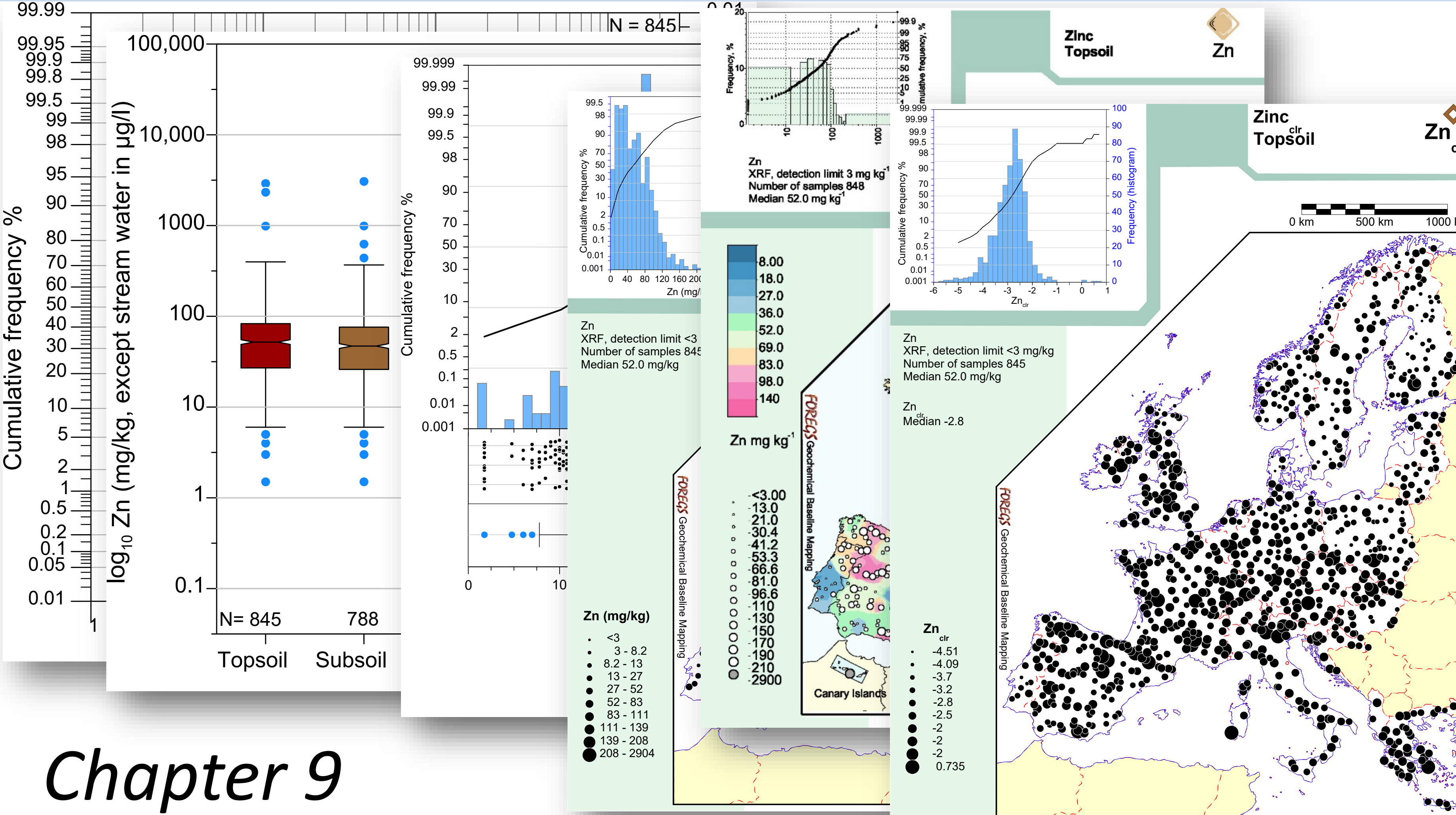
Quality control, and data conditioning when necessary

Chapter 8





Data management, maps, statistics



Chapter 9

Data management, maps, statistics

Chapter 9

Google Earth image showing the spatial distribution of total Zn concentrations in topsoil, determined by X-ray fluorescence, FOREGS Geochemical Atlas of Europe (Salminen *et al.*, 2005). The orange squares indicate the 160x160 km GTN grid cells.

Photograph archive displayed on Google Earth

Chapter 9

As you may appreciate, it is impossible in one lecture to present in detail the 515 pages of the ***International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network.*** Therefore, I urge you to download it and study it at your leisure. We are certain that you will find something to help you in your work. If you have any questions you can contact me at: alecos.demetriades@gmail.com or any other co-author.

All the Chapters describing the procedure of sampling Rock, Residual soil, Humus, Stream water, Stream sediment, Overbank sediment and Floodplain sediment start with an Introduction, Required equipment, Cautions where necessary, and the sampling procedure is well-illustrated. As sampling of residual soil is the most difficult, the next few slides will show you an overall view.

International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network

IUGS Commission on "Global Geochemical Baselines"

Mapping the Geochemistry of the Earth's Land Surface

Chapter 3.2

Residual Soil and Humus Sampling

Maria João Batista[1,10], Alecos Demetriades[2,10], Christopher C. Johnson[3,10], Timo Tarvainen[4,10], Igor Savin[5], David B. Smith[10], Edith Haslinger[6,10], Reijo Salminen[4], Virgilija Gregorauskienė[7,10], Zomenia Zomeni[8,10], Juan Pablo Lacassie Reyes[9,10], Felipe Astudillo[9,10] and Pablo Sebastian Oliva Vicentelo[9,10]

[1] Laboratório Nacional de Energia e Geologia, Amadora, Portugal
[2] Institute of Geology and Mineral Exploration, Athens, Hellenic Republic
[3] GeoElementary, Derby, United Kingdom
[4] Geological Survey of Finland, Espoo, Finland
[5] V.V. Dokuchaev Soil Science Institute, People's Friendship University of Russia, Moscow, Russian Federation
[6] Austrian Institute of Technology GmbH, Centre for Energy, Vienna, Austria
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[8] Geological Survey Department, Lefkosia, Cyprus
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[10] IUGS Commission on Global Geochemical Baselines

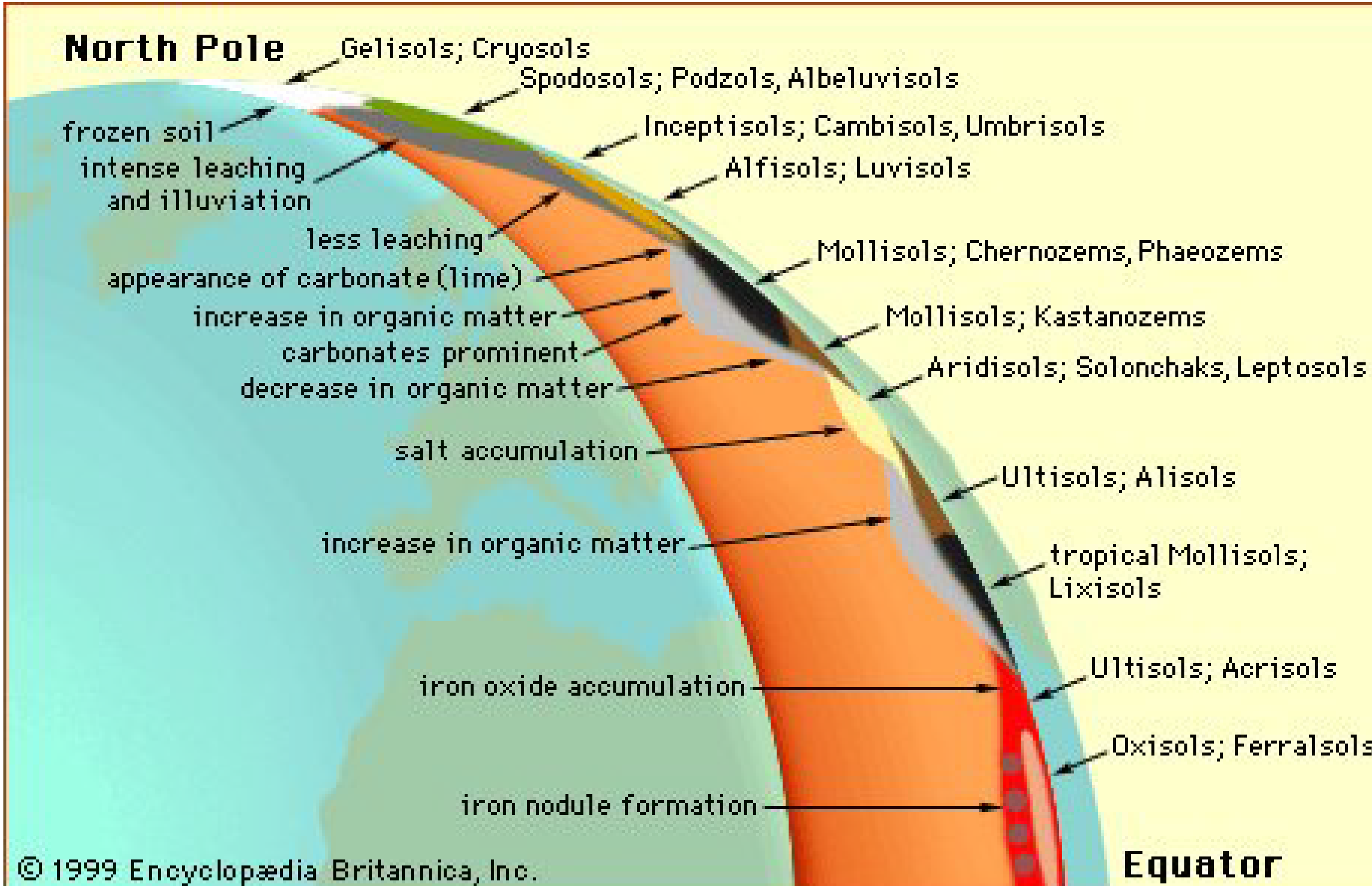

Figure 3.2.1 on page 95. The effects of climate on soil worldwide (Britannica, 2012).

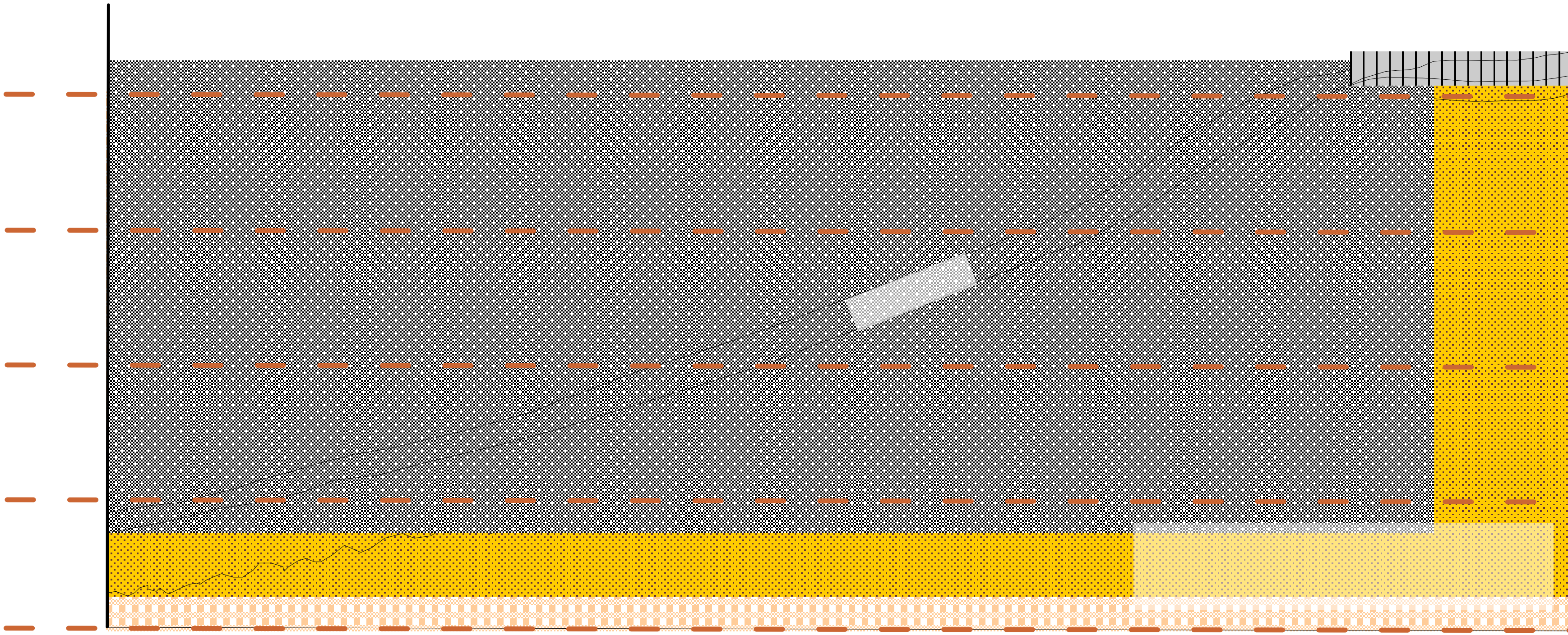

Figure 3.2.2 on page 95. Schematic diagram showing the gradation of soil types from a dry steppe-climate basin (left) to a cool, humid climate (right) as one ascends the west slope of the Bighorn Mountains, Wyoming, USA (after Strahler, 1969, Fig. 19.6, p.317; redrawn with minor modifications by Alecos Demetriades, Hellenic Institute of Geology and Mineral Exploration (IGME) & IUGS Commission on Global Geochemical Baselines (IUGS-CGGB) with Golden Software's MapViewer™ v8).

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(a)

(b) **(c)**

Figure 3.2.7 on page 111. Photographs **(a)** Residual soil sample site number. **(b)** General landscape. **(c)** Surface of sample site taken from a height of 1 m. Photographs: Alecos Demetriades (IGME/IUGS-CGGB).....Continued.....