“Introduction to the Theory and Practice of Sampling”

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It is interesting to observe how the science of analysis is continually developing more and more precise methods that can analyse smaller and smaller amounts of a target compound. Historically determinations obtained from analytical laboratories were first in percent, later in ppm, followed by ppb, and most recently in ppt. However, these scientific and technical advancements were not followed up by thoughts and demonstrations on how we can obtain *reliable* results of concentrations in the large amounts of original material, the so-called lots.

Kim Esbensen’s book is presenting a new, valuable introduction in the form of a comprehensive overview of the principles and unit operations behind documentable, representative sampling from heterogeneous lots typically 1:103 – 1:106 larger than the primary samples, and far larger still of the analytical aliquots. This book introduces the Theory of Sampling (TOS) in a novel didactic fashion, which will be of wide interest.

My first encounter with Kim Esbensen was several years ago when he invited himself to give a presentation of Theory and Practice of Sampling (TOS) in the department Economic Geology of the Geological Survey of Denmark and Greenland where I worked then. Together with my colleagues I listened politely to his presentation, but found that this whole Theory of Sampling (TOS) approach to sampling was way too time consuming and thus not really appropriate for our work as practical field geologists (but yes, *perhaps* in the sample-processing stages in the laboratory, which was, luckily, “somebody else’s problem”).

However, some years after this presentation, I embarked on a project where I realised that TOS was in fact the only way to obtain scientifically reliable results. I participated in a global project finding ways to clean millions of tons of tailings from small-scale gold mining. These tailings contain large amounts of mercury and gold, but contents are in the very low ppm range, e.g. 3-150 ppm, while tailings tonnages are enormous, 3-5 tonnes. Mercury released from these tailings account for 37 percent of the global mercury pollution! In order to evaluate the efficiency of a newly developed mobile processing plant, I had to know the exact ultra-trace concentrations in the tailings. This was crucial for evaluating the efficiency of success extraction these two metals from the overwhelmingly large tailing tonnages. This was when I suddenly found that the usual geological sampling approach was totally inadequate for this purpose, but where only the TOS could outline a valid procedure. The results of this project, and others, have been published (1), where the details of this “barefoot sampling” approach can be found.

This new introductory book has many excellent chapters explaining why and how to obtain proper *representative results* of the content of a particular element or group of elements in significantly heterogeneous materials, rocks, ores and tailings (typical lots in my line of work), but one of the book’s strongpoints is that is shows the common nature of proper sampling. For example, TOS is equally important in investigating the pollution impacts from mining operations or from dumping of industrial tailings of various sorts. In fact, at first it was shocking to read that “from the point of view of sampling, all materials are *identical*, it is only a matter of whether their heterogeneity is small, medium or large”, after which TOS’ claimed *universal* principles made much more sense. I am now slightly embarrassed over my first dismissal of TOS, which sadly, is rather typical within geology. Take notice!

Thus my subsequent work using TOS was really an eye-opener. Upon reflection, and the above critical use of TOS in practice, this book should be compulsory in educating not only geology students at universities, but also scientists and technicians in a number of other disciplines, not least analytical chemistry (there is a whole world outside the four walls of the laboratory). All will benefit fundamentally from addressing this book.

1. <https://www.impopen.com/download.php?code=S09_9999>