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# Can multifractals be used for mineral resource appraisal?

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## Abstract

Most models for worldwide mineral or hydrocarbon resource appraisal assume either a lognormal or a Pareto model for the size-frequency distribution. Here it is argued that the lognormal often provides a good fit to all sizes except for the giants and super-giants that satisfy the fractal/multifractal Pareto. In the newly proposed Pareto-lognormal model for metal deposit size-frequency distributions, a basic lognormal distribution is flanked by two Pareto distributions with different parameters. These Pareto's are separated from the central lognormal by two bridge functions with parameters that ensure continuity. The model differs from other Pareto-lognormals in that upper tail deposit size frequencies for the Pareto mostly are less than those for the central lognormal. Uranium has lognormal distribution without Pareto tails. A new variant of the model of de Wijs is introduced as partial explanation of the fact that the basic lognormal probably is a mixture of regional lognormals with different parameters. Because so many size data are available, a non-parametric approach can be used for prediction of future metal resources as will be illustrated for worldwide copper resources. For spatial point occurrence distribution of mineral deposits, fractal-multifractal point distribution models can be assumed to provide better results than models assuming that mean ore deposit point concentration is independent of size of area used for measuring deposit density.

*Keywords:* Multifractals; Mineral resources; Size-frequency distributions; copper; zinc; uranium; Pareto-lognormal distribution