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Quantifying and communicating the uncertainty of mineral resource evaluations

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Three-dimensional subsurface models are increasingly being used to assess the value of sand and gravel mineral deposits. Planners might use this information to decide when deposits should be protected from new developments. The models are generally based on interpretations of relatively sparse boreholes and are therefore uncertain. This uncertainty propagates into the predictions of the value of the deposit and must be quantified and communicated to planners in a manner which permits informed decision-making.

We discuss these issues in relation to a 60 km by 40 km study area in the south of England. We use the interpretations of 630 boreholes to build statistical models of the subsurface. Mineral deposit categories are defined in terms of the ratio of mineral depth to overburden depth and the proportion of fine particles within the mineral. We use a linear model of coregionalization to model the spatial distribution of these parameters. Furthermore, we use stochastic simulation methods to produce maps of the probability of each category of mineral deposit occurring at each location in the study area.

These maps indicate where deposits of suitable sand and gravel might be expected to occur. However, they are only telling us the probability that if a borehole was to be drilled at a location that its contents would satisfy the criteria of each mineral category. Planners require information for areas much larger than a single borehole. Therefore, we demonstrate how the model can be up-scaled to a 1 km2 site. We again use a stochastic simulation method to produce box-whisker plots which illustrate the proportions of gravels, sands, fine sands and fine material that are predicted to occur in the region and the uncertainty associated with the predictions.