Modeling spatial variability of sand-lenses in clay till settings using transition probability and multiple-point geostatistics

Kessler, Timo Christian; Nilsson, Bertel; Klint, Knud Erik; Bjerg, Poul Løgstrup

Published in:
Geophysical Research Abstracts

Publication date:
2010

Document Version
Publisher's PDF, also known as Version of record

Geophysical Research Abstracts
Vol. 12, EGU2010-13276, 2010
EGU General Assembly 2010

Modeling spatial variability of sand-lenses in clay till settings using transition probability and multiple-point geostatistics

Timo Kessler (1,2), Bertel Nilsson (2), Knud Erik Klint (2), and Poul Bjerg (1)

(1) DTU Environment, Technical University of Denmark, Kgs. Lyngby, Denmark (tick@env.dtu.dk), (2) Geological Survey of Denmark and Greenland, Copenhagen, Denmark

The construction of detailed geological models for heterogeneous settings such as clay till is important to describe transport processes, particularly with regard to potential contamination pathways. In low-permeability clay matrices transport is controlled by diffusion, but fractures and sand-lenses facilitate local advective flow. In glacial settings these geological features occur at diverse extent, geometry, degree of deformation, and spatial distribution. The high level of heterogeneity requires extensive data collection, respectively detailed geological mapping. However, when characterising the geology of e.g. a contaminated site, it is not always possible to gather enough information to build a representative geological model. Mapping in analogue geological settings and applying geostatistical tools to simulate spatial variability of heterogeneities can improve ordinary geological models that are predicated only on vertical borehole information. This study documents methods to map geological heterogeneity in clay till and ways to calibrate geostatistical models with field observations.

A well-exposed cross-section in an excavation pit was used to measure and illustrate the occurrence and distribution of sand-lenses in clay till. Sand-lenses mainly account for horizontal transport and are prioritised in this study. Based on field observations, the distribution has been modeled using two different geostatistical approaches. One method uses a Markov chain model calculating the transition probabilities (TPROGS) of alternating geological facies. The second method, multiple-point statistics, uses training images to estimate the conditional probability of sand-lenses at a certain location. Both methods respect field observations such as local stratigraphy, however, only the multiple-point statistics can truly represent every measured point in the model. Thus, it allows more realistic models of the heterogeneity, but is constricted when only vertical borehole data is available. Overall, the integration of stochastic models of sand-lenses distribution was found very useful to enhance the accuracy of ordinary geological models of heterogeneous clay till.