Utilization of Time Lapse Three- Dimensional (Four-Dimensional) Ground Penetrating Radar to Determine Subsurface Fluid Migration

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Four-dimensional_4D.or time-lapse three-dimensional_3D.ground penetrating radar surveys can be used to monitor and image subsurface fluid flow. This information can be used to create a model of hydrogeological properties. The massive amount of data, which is present in and can possibly be generated from 4D GPR data sets, precludes a manual interpretation. Consequently, 4D data sets have to be processed and visualized in a way that extracts models and allows for data visualization in a semi-automatic way. The principles behind such an approach are applied to the Borden data set, which is used to demonstrate how advanced visualization can assist in the interpretation of raw and processed data. In the Borden data set, changes in reflectivity between different time-steps unveil areas of fluid migration in three dimensions. The combination of these reflectivity changes between different combinations of the 3D subsets of the 4D data set is used to create a model of hydrogeological properties. While this model does not yield a quantitative description of porosity, permeability or hydraulic conductivity, it is a qualitative proxy for a combination of these properties.