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Release of clay particles from an unconsolidated clay-sand core: experiments and modelisation.

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The aim of this work is to identify the main phenomena that control the transport of clay particles in a sand core.
A chromatographic column is initially filled with a clay-sand mixture. It is known that clay can be dispersed into small particles in an aqueous solution of low ionic strength. This is used to generate clay particles in the unconsolidated sand core. The column is flushed by a NaCl solution of slowly decreasing concentration. This decrease allows the control of transport of the particles without plugging of the porous medium. This experimental set-up and this methodology are used to show that, in a column of a given length, the amount of clay particles available to transport depends on NaCl concentration, and that the transport is mainly dependent on the hydrodynamic characteristics of the porous medium that vary during the salinity decrease.
A phenomenological modelisation is proposed using these results. A generation of particles term, P_d, depending on NaCl concentration, is coupled with an adapted nonequilibrium transport solute model. A characteristic time of mass transfer between mobile and immobile water phases is attributed to the particles, as for the solute. Physical meaning of the parameters of the model is discussed. The values of the parameters are determined by independent experiments. Finally, the breakthrough curve of clay particles is predicted when a column of a given length, is flushed by a salinity gradient of NaCl.