Direct Ground Water Flow Direction and Velocity Measurements Using the Colloidal Borescope

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The colloidal borescope is an *in situ* instrument capable of directly observing suspended colloidal size particles (1 to 10 µm) and determining ground water flow direction and velocity in an open borehole or monitor well in real time. The borescope can be used to investigate ground water flow direction and velocity, colloid mobilization during well sampling, and the influence of pumping, tides, and subsurface drains. The colloidal borescope consists of two charge-coupled device (CCD) cameras, a ball compass for orientation, an optical magnification lens, an illumination source, and a stainless steel housing. The borescope is lowered to the desired depth, and suspended colloids are magnified 140X and observed on a video monitor. A Video Image Analysis System (VIAS) utilizes a video frame grabber that can recognize and track up to 256 particles, with updates every six seconds. A video software program then analyzes the digitized video images and calculates number, size, flow direction, and flow rate of the colloids. These data are recorded on computer files.

The Environmental Restoration Division at Lawrence Livermore National Laboratory is using the borescope to aid in characterizing local ground water flow patterns, siting monitor and extraction wells, and assessing the efficiency of ground water extraction well fields. Recent measurements indicate that potentiometric surface maps may not accurately reflect local ground water flow vectors, and ground water flow velocities (seepage velocity) in permeable zones can be significantly higher than predicted by gradient, conductivity, and porosity data. Also, local effects of intermittent pumping of offsite irrigation wells were observed.

*Presenting author at conference (see page 2).

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