

ZONFLO Fluid Sampling System

Background. Fine resolution discrete ground water sampling allows for mapping of natural and anthropogenic contaminant distributions. In many parts of the United States, such sampling is problematic in fractured-rock aquifers due to complicated patterns of fluid flow.

Fluid sampling in open boreholes tapping fractured-rock aquifers is particularly challenging because of vertical mixing of fluid within the borehole from flow from multiple fractures. The use of downhole pumps to pump water or other fluid from long, open-hole bedrock wells or long-screen sections of wells is problematic because the well bore acts as a conduit and induces vertical flow and mixing of fluid from multiple fractures at different zones (depths) throughout the entire well opening based on the transmissivity of each fracture. The source of the pumped fluid in an open borehole is a mixture of the well bore fluid and the flow-weighted contribution of fluid from multiple fractures. The unknown source origin of the resultant fluid sample is less than ideal for the identification of natural and anthropogenic contaminant pathways.

Packers that straddle the pumps have been used to isolate flow from discrete fractures to reduce capture of well bore fluid. However, the use of packers can be time consuming and logistically difficult in some cases.

Abstract. The present invention is a sampling system and method for sampling fluid from a target zone within a well bore without commingling fluid from other zones in the well. The sampling system includes a hydraulic flow control system and a differential flow logging system. The hydraulic flow control system has a plurality of multi-level, vertically disposed pumps with fluid extraction rates set to generate hydraulic zones above and below a center one of the pumps. The hydraulic zones isolate fluid flow in a target zone surrounding the center pump, and the center pump collects a sample from the isolated target zone without mixing fluid from other zones of the well. The differential logging system has a plurality of flow devices. Each of the

plurality of flow devices is disposed near one of the hydraulic zones to monitor vertical flow in the well and confirm isolation of the target zone.

Opportunity. The ZONFLO (ZONAL FLOW) allows for discrete sampling through hydraulic containment of flow in long open boreholes or long screen wells. In wells where physical isolation of discrete zones is not possible due to the inability to seal packers, hydraulic containment is an effective alternative. ZONFLO does not require packers or associated equipment. Instead, a multilevel pumping system is used to contain flow. The most significant cost savings is a reduction in equipment, such as a packer truck, needed to deploy packers. Other savings include quicker deployment and the ability to hydraulically profile the well using different zones of the well. In long screen wells with sandpack, hydraulic containment is the only method effective in isolating zones of the aquifer.

This technology can be applied in geographic regions similar to that of the northeast United States.

Keywords

- Fractured Rock Aquifer Sampling
- Fluid Sampling in Long Screened Wells
- Hydraulic Containment

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This technology is protected under issued U.S. patent 9,181,799. The U.S. Geological Survey is looking for a partner to further the commercialization of this technology through a license or a collaborative agreement. Interested parties should contact:

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