Hydrogeologic Data Collection for Water-Resources Evaluation in Bedford County, Virginia

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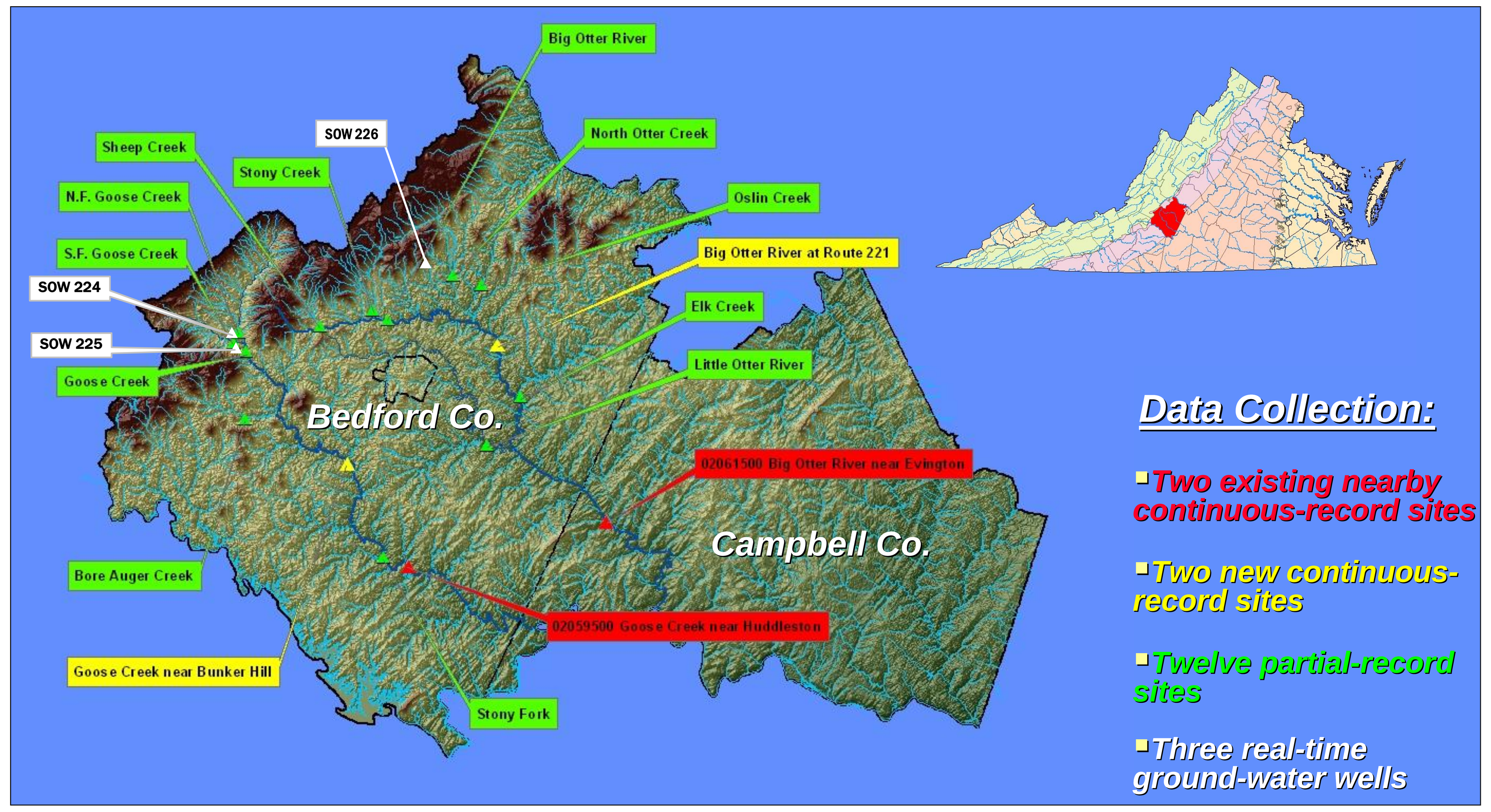

Figure 1: Map showing study area and configuration of the data-collection network.

The U.S. Geological Survey (USGS) Virginia Water Science Center and Virginia Department of Environmental Quality (DEQ) are collecting and evaluating streamflow and ground-water level data in Bedford County, Virginia that can be used to help guide development of the water resources within the County. In addition to two existing continuous-record, surface-water gaging stations, twelve partial-record and two continuous-record surface-water gaging stations have been established by USGS in cooperation with Bedford County to acquire county-wide stream-discharge measurements in the Big Otter River and Goose Creek Watersheds (fig.1). Three bedrock ground-water state observation wells (SOWs) were installed by the USGS and DEQ to acquire detailed geologic and real-time ground-water level information (fig.2).

Figure 2: DEQ staff and Bedford Well Drilling evaluate the yield of Otterville SOW 226 during an air-lift test shortly after completion . The well was completed in Proterozoic granitic gneiss (Suck Mountain Pluton) estimated yield during air-lift test was 60 gal/min.

Rates of effective ground-water recharge (a vital and elusive component of water budgets) can be estimated using streamflow data from continuous-record, surface-water gaging stations and hydrograph-separation techniques that separate streamflow into ground-water (base flow) and surface-water components (figs. 3 and 4). Data from partial-record gaging stations can often be correlated to discharge at nearby continuous-record gaging stations, allowing for the estimation of discharge statistics and effective ground-water recharge at the partial-record gaging stations.

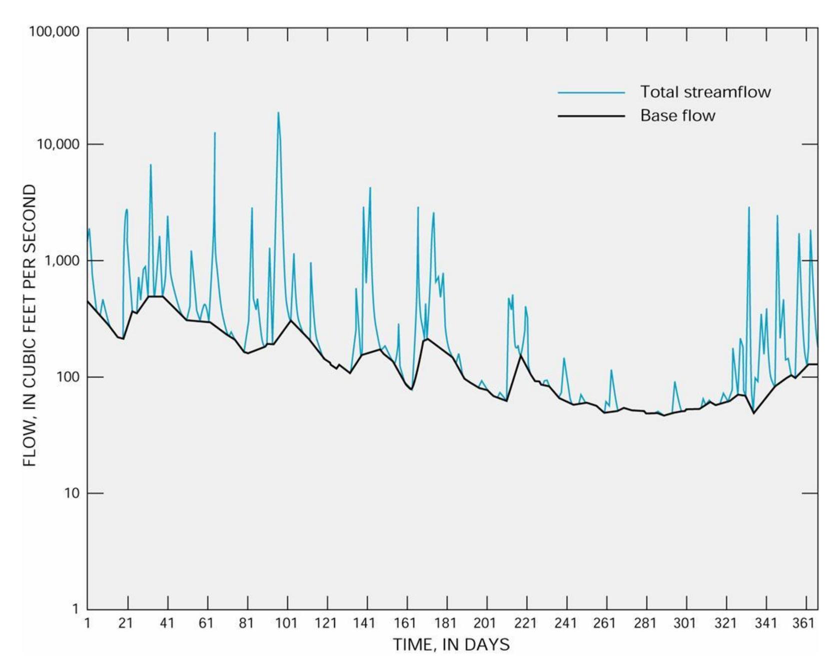

Figure 3: Hydrograph separation is a method employed to differentiate and quantify the base-flow (ground-water discharge) component of total streamflow for the estimation of effective recharge.

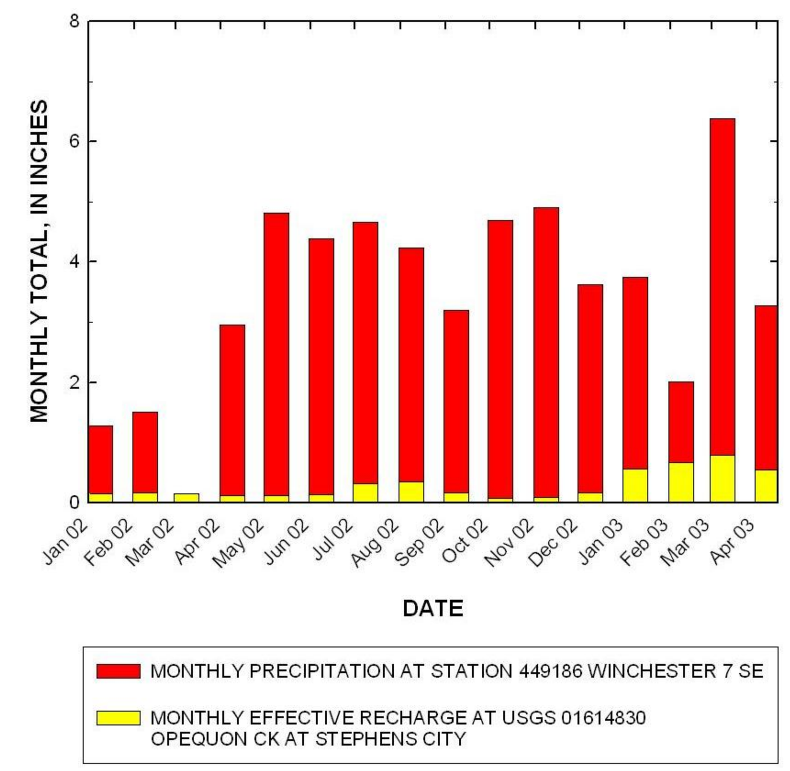

Figure 4: Monthly totals of effective recharge and precipitation for a basin in Frederick County, VA illustrate seasonal variability in effective recharge.

Each of the continuous-record, surface-water gages has been equipped with a specific conductance/temperature probe funded through USGS and DEQ to facilitate a study focusing on the ground-water contribution to streamflow for drainage basins throughout Virginia. This study will use conductance data to determine the ground-water component of flow through mass balance of chloride in surface and ground-water (which shows a linear relation to specific conductance), and will serve as a point of comparison to the hydrograph-separation technique for the continuous- and partial-record stations.

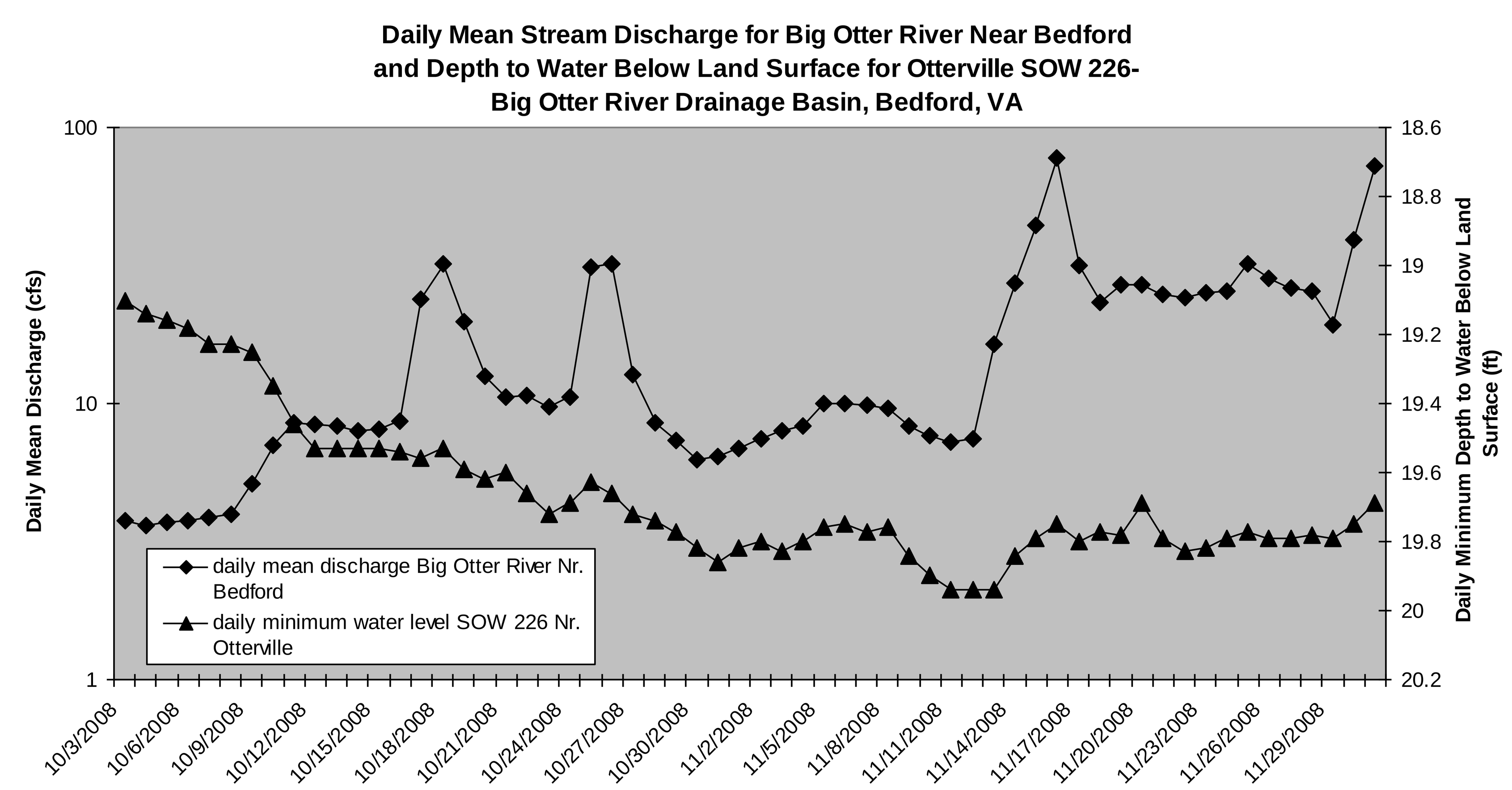

Figure 5: Daily mean discharge and daily minimum depth to water for Big Otter River near Rt. 721 and SOW 226. Preliminary observations suggest a favorable correlation between changes in ground-water storage and stream discharge.

The hydrologic (figs. 5 and 6) and geologic (figs. 7-9) information collected from the SOWs will provide valuable data regarding local geologic controls on the occurrence, movement, and storage of ground-water in the Big Otter River and Goose Creek Watersheds. These data will also be used for part of a larger state-wide initiative to characterize the ground-water resources of the Commonwealth.

References

Henika, W.S., 1997, Geologic Map of the Roanoke 30X60 Minute Quadrangle, Virginia: Virginia Division of Mineral Resources Publication 148.

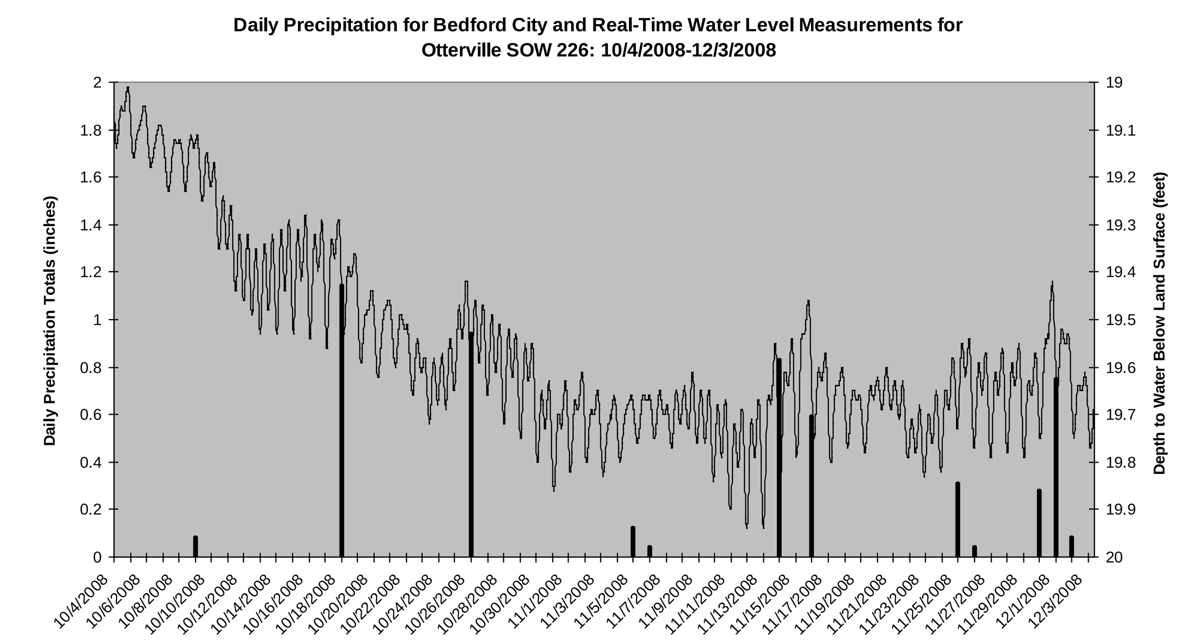

Figure 6: Real-time water-level measurements for SOW 226 and daily precipitation totals for Bedford City. Earth tides and barometric response in the hydrograph from this fractured rock aquifer may provide clues about storage and degree of confinement.

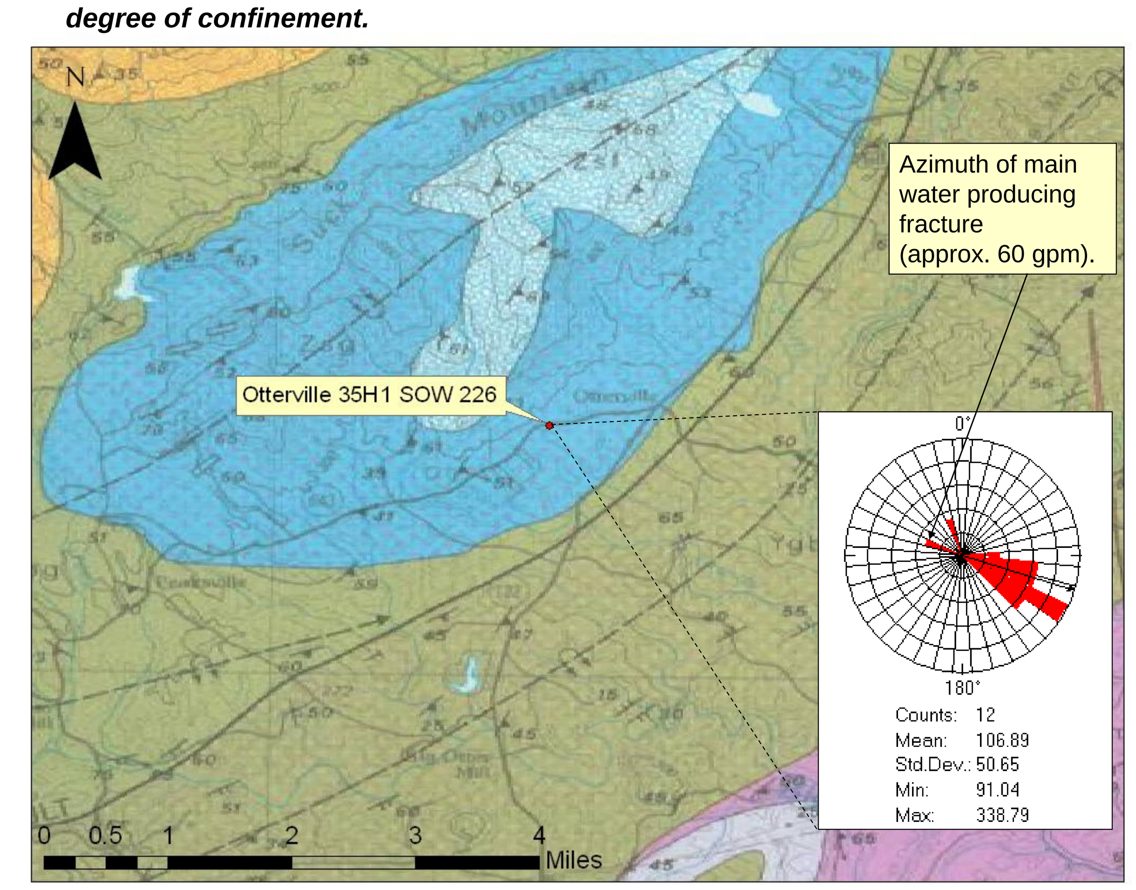

Figure 8: Section of 30x60-minute Virginia Division of Geology and Mineral Resources geologic map of the Roanoke Quadrangle (Henika, 1997) with superimposed percent-of-log azimuth rose diagram of noted fractures and foliations from acoustic televiewer log of Otterville SOW 226.

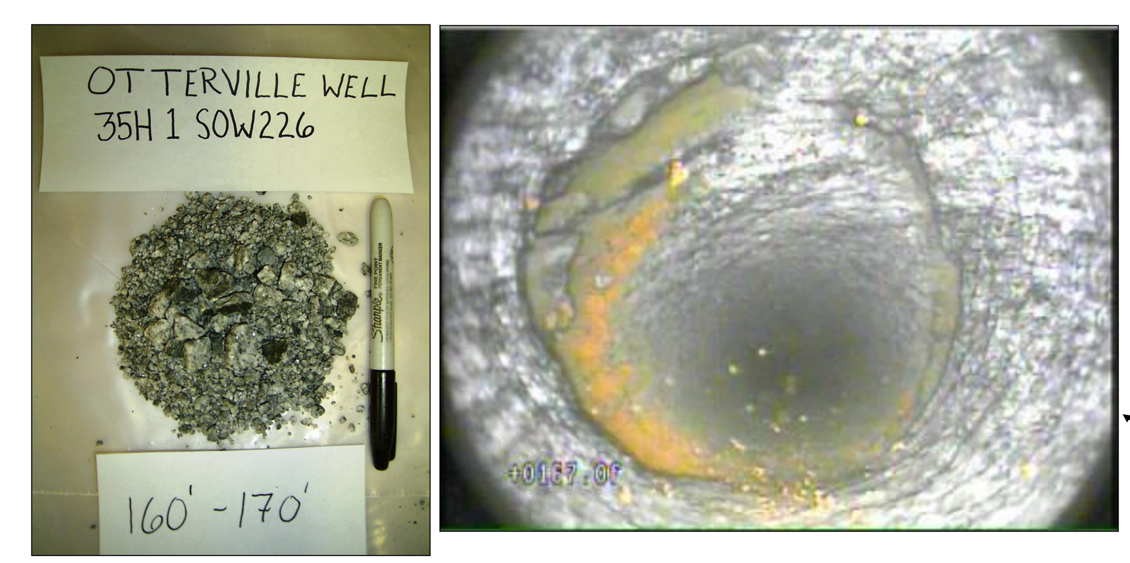

Figure 9: Photo of well cuttings taken from the 160 – 170 feet interval of SOW 226. Larger chips with chloritic(?) coating are coincident with water producing zone (left) and borehole camera image of main water producing zone in SOW 226 (right).

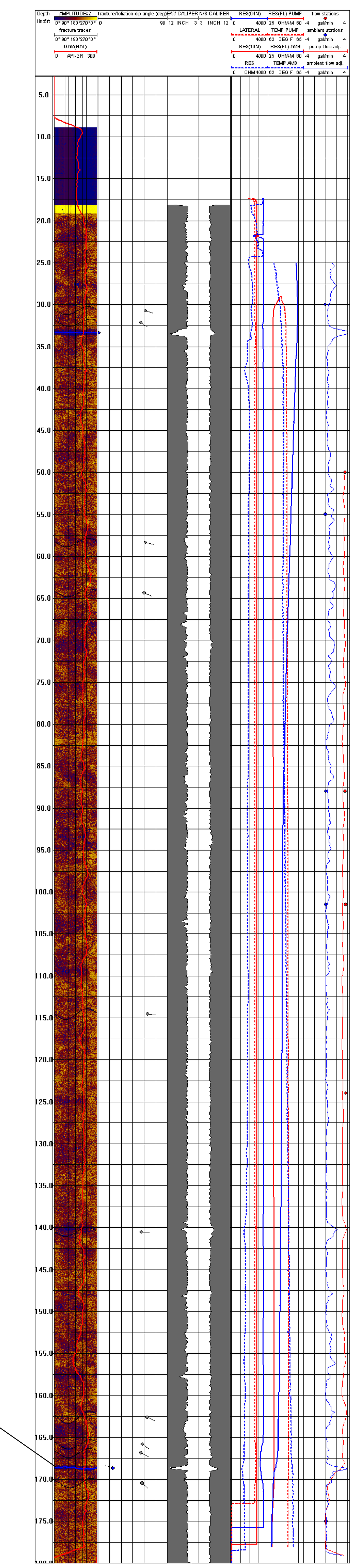

Figure 7: Suite of borehole geophysical logs from Otterville SOW 226.