formations. On a plot of 87Sr/86Sr ratios vs Sr concentration, UCH, YK, and PD groundwater generally plots on mixing lines between proposed recharge water and aquifer materials, suggesting that dissolution of, or exchange with, aquifer minerals is gradually moving Sr contents and isotopic ratios towards those of the host aquifer. Water from the UCH influenced by intermixed water from other aquifers and surface water bodies falls off the mixing line.

№ 5314

THE LANDS CREEK DEBRIS FLOW, SWAIN COUNTY, NORTH CAROLINA: AN ENGINEERING GEOLOGIC INVESTIGATION

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Triggered by heavy rains on December 23, 1990 the Lands Creek debris flow obliterated buildings housing water purification chlorinators for the Bryson City, North Carolina municipal water system. Losses totaling over $60,000 also included a destroyed mobile home, and damage to roads and utility lines. Built on alluvial and older debris flow deposits, the chlorinator buildings were constructed in a location vulnerable to debris flow damage.

The area interpreted to be the debris flow initiation zone is a hillslope depression at the head of a steep, first-order drainage where crossed by a logging road. Originating in colluvial deposits derived from kyanite-grade metasedimentary rocks of the Great Smoky Group, the debris flow mobilized over 10,000 m^3 of soil, rock and organic debris. Field observations and calculated velocity estimates in the 4-10 m/sec (9-23 mph) range indicate processes in the hyperconcentrated stream flow and inertial slurry flow regimes at peak velocity.

Site visits over two years allowed construction of a field-developed cross section through the head scarp down to underlying bedrock where exposed by erosion. Field classification and laboratory testing distinguish an upper soil unit (silty sand to sandy silt) from a lower soil unit (clayey silt to silty clay) on the basis of grain size, clay content, and plastic index. Seepage along the contact between the soil units coincident with the failure surface at the head scarp likely played a role in triggering the debris flow. Field observations along with stochastic and deterministic slope stability analyses indicate the initiation zone was marginally stable prior to the flow-triggering rainstorm.

Wunsch, D. R. & Dinger, J. S. (1998): Predicting ground-water movement in large mine-spoil areas in the Appalachian Plateau. – Abstracts with Programs - Geological Society of America, 30 (4): 67; Boulder.

№ 6563

PREDICTING GROUND-WATER MOVEMENT IN LARGE MINE-SPOIL AREAS IN THE APPALACHIAN PLATEAU

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Large quantities of ground water can accumulate in spoil that has resulted from surface mining. This can cause a number of geotechnical or regulatory problems, as well as flood active mine pits. A large (> 1,000 acres), thick (up to 300 feet) spoil body in eastern Kentucky is being studied by the Kentucky Geological Survey to determine important factors that control the storage and movement of water.

Ground-water recharge at the study site occurs along the periphery of the spoil body where surface-water drainage is blocked. Infiltration also occurs along the spoil-bedrock contact, from adjacent bedrock, and to a minor extent, through macropores at the spoil's surface. The spoil stores an estimated 4,200 acre-feet (1.4 billion gallons) of water, based on an average saturated thickness of 21 feet and estimated porosity of 20 percent.

Dye-trace data, discharge measurements from springs and ponds, hydraulic gradients, chemical data, field reconnaissance, and aerial photographs were used to construct a conceptual model of ground-water flow. The model indicates there are three distinct, but interconnected, saturated zones: one in the spoil's interior, and two others in the valley fills that surround the main spoil body at lower elevations. Ground-water movement is sluggish in the spoil's interior, but rapid through the valley fills.

The conceptual model can predict ground-water occurrence, movement, and quality for active or abandoned spoil areas if the following are available: structure contour of the base of the lowest coal seam being mined, premining topography, documentation of mining methods used throughout the mine, overburden characteristics, and aerial photographs of mine progression. Computer tools such as high-resolution, remotely sensed data, digital terrain models, and a geographic information system can greatly enhance the creation of hydrogeologic models of partially saturated mine spoil.

№ 6581

RELATIONSHIP OF ANOMALOUS BARIUM AND FLUORIDE CONCENTRATIONS TO HYDROCHEMICAL FACIES IN THE APPALACHIAN PLATEAU

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Naturally occurring barium and fluoride concentrations in ground water obtained from coal-bearing rocks of the Appalachian Plateau often exceed the U.S. Environmental Protection Agency's maximum contaminant level. Both barium and fluoride can cause adverse health effects for people whose main source of drinking water is ground water.

A hydrochemical facies model developed for unmined areas of the Appalachian Plateau revealed the following water types and characteristics: ground water derived from coal seams is typically a Ca-Mg-HCO_3 water type with a slightly acidic pH that ranges from 4 to 6; water derived from shallow, fractured bedrock varied from a Ca-HCO_3 to a Mg-SO_4 water type with a pH near neutral; ground water from the interior upland regions is characteristically a Na-HCO_3 water type with an alkaline pH (> 8); brackish Na-Cl water types were often encountered at shallow depths (less than 100 feet) below the major drainage valley bottoms hosting third-order streams or higher.

High fluoride concentrations are ubiquitous to the Na-HCO_3 facies, and probably result from the weathering of fluoride-containing mica minerals. Fluoride is maintained in solution by anion expulsion along negatively charged clay mineral surfaces. Calcium concentrations are very low (2.0 mg/L) in this facies zone, and do not impart a solubility constraint on fluoride.

High barium concentrations are commonly found in brackish or Na-Cl brine waters encountered in the valley bottoms, although elevated barium concentrations (> 1.0 mg/L) are frequently encountered in the fresh-water–salt-water mixing zone. Sulfate reduction mitigated by sulfate-reducing bacteria and cation exchange appear to control the occurrence of barium in ground water.

№ 9125

ELEMENT MOBILITY DURING GREENSCHIST MYLONITIZATION: AN EXAMPLE FROM THE BREVARD ZONE, NORTH CAROLINA

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The Brevard shear zone (BSZ) at Rosman, North Carolina, consists of unsheared Handerson augen gneiss (HAG) and an increasingly mylonitization zone of proto-mylonite, mylonite, and ultra-mylonite. Petrological observations and microprobe data indicate that retrograde mineral reactions in mylonites include microcline to albite and muscovite, oligoclase to albite, and biotite to muscovite. Fluid-assisted mylonitization led to chemical changes involving 6% to 23% bulk volume losses. In the transition from the protolith gneiss to proto-mylonite, most major elements (e.g. Al, Fe, Mg, Ti, Mn) and trace elements (e.g. V, Sc, Zr, Hf, HREE) were immobile, and the bulk rock volume changes is mainly attributed to Si mobility. In contrast, in the transition from proto-mylonite to mylonite and ultra-mylonite), Fe, Mg, and Ti become mobile indicated by 1) major abundance decreases of these elements in mylonite; 2) modal decrease of biotite that is the only major mafic mineral in the HAG; 3) progressive decrease of Ti in biotite. Calcium, P, Ba, Zr, V, Sc, Sr, Eu, and Hf were also mobile and show significant losses. The mobility of Ca, Ba and Sr is attributed to alterations of microcline to albite and muscovite and oligoclase to albite. During this stage of mylonitization, the HREE were immobile but the LREE were likely mobile. Silica, K, Na, and Rb have only experienced minor net changes in mylonite; this implies that the fluid prior to fluid-rock interaction was relatively saturated with these elements, suggesting a brine origin. Paleozoic shelf sedimentary rocks (SSR) underlying allochthonous crystalline rocks of the Blue Ridge and the Piedmont Province, which were revealed by previous seismic reflection data, provide the most plausible fluid source. The estimated maximum fluid production resulting from dehydration reactions in the SSR is 3×10^8 g/m^2. However, the total fluid amount required to cause SiO_2 loss from mylonitic rocks is in the range of 4×10^{10} — 5×10^{11} g/m^2, which is two to three magnitude higher than the estimated fluid production by dehydration reactions alone in the SSR, suggesting channelized fluid flow.

№ 13049

THE UNKNOWN COOPER CURTICE AND CAMBRIAN FOSSILS OF ALABAMA

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Cooper Curtice, later to become a distinguished veterinarian, for several years was an assistant to Charles Doolittle Walcott. In that capacity in 1885 he was sent to Alabama to collect Cambrian fossils to aide USGS mapping parties. By 1888, Walcott recognized a fundamental mistake in that faunas he had previously determined to be Early Cambrian in age were Middle Cambrian and vice versa. This error was pervasive in theliterature of the time and further complicated interpretations in structurally difficult areas, such as northeastern Alabama. Curtice subsequently worked for the Bureau of Animal Industry.

In 1892, the busy Walcott requested the Secretary of Agriculture to permit Curtice to transfer for a short time to the USGS so that he could make additional fossils collections to correct this error in dating. C. W. Hayes was actively engaged in quadrangle mapping in the region and the additional fossils Curtice obtained were critical to that project. A few newly discovered letters sent from the field by Curtice to Walcott give some insight as to where Curtice collected and some of his own field observations.

These two men both grew up in New York state and had generally similar backgrounds; they had mutual regard, both personally and for each others' professional abilities.