DNAPL could pose risks of contamination through enhanced vertical migration of the DNAPL. Surfactant enhanced pump and treat using only solubilization requires pumping for long periods of time when large volumes of DNAPL are present in an aquifer. The use of spontaneously formed mobile emulsions is much faster than solubilization and it poses less of a risk than mobilization because it does not require ultra low interfacial tensions. Large volumes of DNAPL could be rapidly transported to extraction wells as emulsions, thus increasing the effectiveness of surfactants and decreasing the time and cost of remediation.

Surfactants have a tendency to produce spontaneous emulsification. An emulsion forms due to the diffusion and adsorption processes that occur at the interface of two immiscible fluids. The presence of surfactant molecules will displace the DNAPL into the surfactant solution in the form of droplets thus reducing interfacial tension. The reduction of interfacial tension lessens the tendency of the drops to coalesce, thus creating a stabilized emulsion through the use of surfactants.

The objectives of the research are to determine which surfactants form spontaneous mobile emulsions, how these surfactants can be identified, and how mobile are the emulsions in porous media. Experiments include emulsion settling vials, spontaneous emulsification vials, emulsion columns, flow cells, capillary tubes containing porous media, and viscosity measurements. Initial work has determined that a group of amide ethoxylates produce mobile spontaneous emulsions for PCE and TCE.

Nº 11328

CEMETERIES AS SOURCES OF GROUNDWATER CONTAMINANTS

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Fluids used for embalming in the 19th and early 20th centuries commonly contained mixtures of arsenic, zinc, mercury, and lead. We are sampling and analyzing groundwater and soil samples from a cemetery located at Hamilton College, which contains at least 68 graves from before 1910. Stratigraphy at the site is stony clay till over variably weathered shale. Water levels seasonally range from more than 2 m below ground surface to near the ground surface. Upgradient and downgradient wells have been installed near the cemetery. ICP-MS will be used for groundwater analysis for arsenic and lead. Future work will include aquifer characterization, clay mineralogy, and periodic sampling for metals.

Nº 11538

THE CHAMPLAIN THRUST SYSTEM IN THE SHOREHAM-WEST-HAVEN-WHITEHALL REGION, WEST-CENTRAL VERMONT-EASTERN NEW YORK.

HAYMAN, Nicholas W.; KIDD, W.S.F.; GRANDUCCI, Jennifer, Dept. of Geological Sciences, SUNY at Albany, Albany, NY 12222.

New geologic maps provide evidence for continuation of the Champlain thrust system through the Shoreham-Whiting and West Haven areas of west-central Vermont, and beyond, to the Whitehall N.Y. region. The Champlain thrust, which transports the Cambrian through Ordovician shelf sequences, must split into several branches and climb in stratigraphic level near Middlebury, rather than approach zero displacement there. Thus, much of the displacement along the Champlain thrust is transferred to at least four significant thrust fault branches in the area between Middlebury and Orwell. This conclusion is required by outcrop scale structures and the presence and repetition of Potsdam/Danby and overlying Beekmantown group equivalents throughout the "Shoreham duplex structure", the overall structural concept being first proposed by P. Washington (1985). Evidence for the continuity of the Champlain thrust system from the requirement of a large displacement (80-120Km) on it were first given by Rowley (1982). Southwest of Orwell, to near Whitehall, imbricated limestone - black shale thrust slices near the Taconic Allochthon's western boundary show that here, the eastern branches of the Champlain thrust system must climb further in stratigraphic level. In this region the westernmost branches of the Champlain thrust system, within the shelf rocks, are only intermittently traceable, because they are cut by an east-side down normal fault with at least several hundred meters of throw, traceable for 40km from near Orwell to North Granville. This normal fault may be in part a low-angle structure, but its age of activity is not well-constrained, and could be anywhere from late Taconic onwards. Pre-thrusting normal faults (of foreland basin outer slope flexural origin) can be demonstrated to control abrupt changes in the stratigraphic level of detachment of thrusts. We propose that such faults are the primary cause of the abrupt changes in detachment level in and around the Shoreham duplex, and of the southward disappearance of Cumberland Head-Stony Point calcareous shale facies under the Champlain thrust near Benson.

Nº 1345

DEPOSITIONAL ENVIRONMENTS OF BIVALVE-BEARING STRATA OF THE NEWARK SUPERGROUP BASINS OF PENNSYLVANIA

HEATH, Ted J., and GOOD, Steven C., Geology Department, SUNY-College at Cortland, Cortland, NY 13045

Two bivalve localities have been reported from the Newark Supergroup of Pennsylvania: Black Rock Tunnel in Phoenixville (western Newark Basin), and Little Conewaga Creek near Manchester (eastern Gettysburg Basin). These localities were visited in order to collect observations of the depositional environments. Outcrops in the vicinity of Gettysburg were also examined.

The Phoenixville locality was collected in 1884, and specimens were described in 1944. This locality contains three species of *Antediplodon*. The molluscs occur near the top of the Stockton Fm (Carnian). Below the mollusc-bearing beds, the Stockton consists of trough-crossbeds grading upward to ripple laminations, medium- to fine-grained sandstone with lateral accretion surfaces. The mollusc-bearing strata consist of thick-bedded mudstone to thin- to medium-bedded, very fine-grained sandstone. Overlying the mollusc-bearing beds are black shales of the basal Lockatong. The mollusc strata are interpreted to represent transitional environments between the underlying fluvial and overlying lacustrine depositional environments.

The Little Conewaga Creek locality was collected and described in the 1921 and 1927, and include seven species of unionid bivalves and two species of freshwater myalinid bivalves. This locality occurs in the New Oxford Formation (Carnian). The outcrop consists discontinuous mudstone and siltstone, separating medium-scale trough-crossbedded, fine to medium-grained sandstone. The sandstone beds occur in sandbodies that are separated by lateral accretion surfaces. Bivalve fossils came from the uppermost sandbody, and co-occur with rare leaves. The mollusc-bearing strata are interpreted to have been deposited in a meandering fluvial system.

Outcrops of the Gettysburg Formation (Norian) were examined in the vicinity of the town of Gettysburg. No molluscs were found. Alternating beds of shale, mudstone, siltstone and fine-grained sandstones contain mudcracks, burrow trace fossils and small blebs of gypsum. The depositional environment is interpreted to represent fluctuating hypersaline lacustrine to terrestrial facies, suggesting a playa environment.

Nº 38468

THE USE OF SOIL GAS DATA FOR THE STUDY OF SUBSIDENCE IN THE CUYLERVILLE, N.Y. AREA SINCE MARCH 1994

HEGARTY, Denis A., Geology Department, University at Buffalo, 876 Natural Science and Mathematics Complex, Box 603050, Buffalo, NY 14260-3050
JOY, Michael, FOUNTAIN, John, all addresses the same.

After the March 12, 1994 collapse of a portion of the Akzo-Nobel Retsof salt mine, near Cuylerville, N.Y., high concentrations (>10 ppm) of methane and ethane gas were detected in the soil in areas adjacent to the collapse. The methane/ethane ratios of the gas suggest it originates in the Onondaga Limestone or shales of the Hamilton Group, which overlie the mine. It is known that light hydrocarbons, such as methane and ethane will migrate vertically along the preferential pathways provided by faults and fractures. Thus, the presence of gas anomalies at the surface suggest the existence of fractures in the underlying rock units. The trend of the original anomalies closely corresponded to the zone of surface fractures along which subsidence occurred. These anomalies have remained relatively constant in magnitude. Other anomalies have developed to the east and west of the area of initial collapse, subsequently these areas developed subsidence and surface fracturing. Thus soil gas appears to have potential for detection of areas of future subsidence.

Soil gas samples are collected by pounding a hollow stainless steel probe into the ground to a depth of 60 cm. Syringes are the used to gather a 60 cc sample of gas from the soil. The soil gas is then analyzed for the presence of methane and ethane using a portable OVA/GC. Sample traverses were established locally around the collapse and on a larger scale across sections of the Genesee Valley floor.

Nº 16953

^{40}Ar/ ^{39}Ar Geochronology and Petrology of the Siluro-Devonian Goshen Formation, Western Massachusetts

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Southwestern New England has been subjected to three major orogenic events, the Taconian, Acadian, and Alleghenian, each with a complex metamorphic and deformation record. By using laser ^{40}Ar/ ^{39}Ar ages from muscovite, the thermochronolgy of these events can be examined. Ordovician through Permian cooling ages for white micas from pre-Devonian, high-alumina schists in western New England have been obtained through previous work (Hames, Cheney, and Armstrong, 1993). Coarse muscovite crystals may retain ^{40}Ar from previous metamorphic events, providing a series of ages identifiable with different metamorphic episodes (Hames and Hodges, 1993). The Acadian Orogeny is manifest by at least two geographically distinct metamorphic styles, an eastern (andalusite-sillimanite) type and a western (kyanite-sillimanite) type. Each is associated with several phases of recrystallization and deformation. By focusing on the Siluro-Devonian Goshen Formation, we hope to constrain the thermochronologic and tectonometamorphic character of this western Acadian event. This will provide a baseline for studying metamorphosed and deformed portions of the terrane that have been effected by more than one orogenic event.

Samples of pelites were collected from the Goshen Formation along both north-south and east-west transects. Metamorphic grade ranges from garnet zone in there north to sillimanite zone in the southeast. These pelites have textures indicative of complex P-T paths. For example, porphyroblasts of staurolite, aluminosilicate, biotite, garnet, and muscovite cross-cut a pervasive crenulation cleavage in the matrix, composed of significantly smaller grains of biotite, muscovite, and quartz. Fibrolite and kyanite occur together in many high grade rocks, and in lower grade rocks both garnet and staurolite are systematically pseudomorphed by chlorite Laser ^{40}Ar/ ^{39}Ar age dates for white micas in samples of varying metamorphic grade and textural habit are being obtained to better constrain the intricacies of this western Acadian metamorphism and subsequent cooling.

20 Swenson, Lara M.*, Dunn, Steve R., Savoy, Lauret E.: COMPARISON OF CONODONT COLOR ALTERATION INDEX WITH GARNET-BIOTITE GEOTHERMOMETRY, NEW HAMPSHIRE AND MASSACHUSETTS [16276]

21 Henderson, W. D.*, Cheney, J. T., Hames, W. E.: 40Ar/39Ar GEOCHRONOLOGY AND PETROLOGY OF THE SILURO-DEVONIAN GOSHEN FORMATION, WESTERN MASSACHUSETTS [16953]

22 Morgia, Nicholas D.*, Darling, Robert S.: A QUARTZ+CORUNDUM ASSEMBLAGE FROM THE WESTERN ADIRONDACKS [2274]

23 Cunningham, Betsy*, Willis, William: THE EVOLUTION OF LYON MT. GNEISS, ASSOCIATED QUARTZ-SILLIMANITE NODULES, AND FLUID INCLUSIONS AT LYONSDALE, NY [12320]

24 McHone, J. Gregory*: BROAD-TERRANE JURASSIC FLOOD BASALTS ACROSS NORTHEASTERN NORTH AMERICA [1504]

25 Trimbur, Holly K.*, Senters, Gregory J., Beiersdorfer, Raymond E.: METAMORPHISM OF THE CATOCTIN FORMATION, SHENANDOAH NATIONAL PARK, CENTRAL APPALACHIANS, VIRGINIA [24513]

26 Dondero, Anna C.*: THE GEOCHEMISTRY OF MASON HILL ROAD GREENSTONE, PINNACLE FORMATION, CENTRAL VERMONT [12193]

27 Bundy, Maria E.*, Oreskes, Naomi, Foord, Kristin: DIFFERENTIATION OF THE META-SEDIMENTARY AND INTRUSIVE UNITS OF NEW HAMPSHIRE USING CATHODOLUMINESCENCE SPECTROGRAPHY: QUANTITATIVE USE OF CL SPECTROGRAPHY [4062]

28 Tastle, William J.*: PETROLOGIC INFORMATION DISTANCE: A THEORETICAL CLASSIFICATION TOOL FOR AMBIGUOUS ROCK TYPES [13605]

SESSION NO. 27

SYMPOSIUM 5—NEW 1:100,000 BEDROCK GEOLOGICAL MAP OF VERMONT: PROGRESS AND PRELIMINARY MAPS

Hyatt Regency, Grand Ballroom B, 7:00 PM

Authors will be present from 7:00 to 9:00 PM

Booth #

1 Ratcliffe, Nicholas M.*, Stanley, Rolfe S., Becker, Laurence: STATUS OF THE NEW BEDROCK GEOLOGIC MAP OF VERMONT [12903]

2 Ratcliffe, Nicholas M.*, Armstrong, Thomas R., Walsh, Gregory J.: 1:100,000 BEDROCK GEOLOGIC MAP OF THE VERMONT PART OF THE CLAREMONT N.H.-VT. 30'X60' SHEET [7733]

3 Stanley, Rolfe*, Gale, Marjorie: COMPILATION OF THE MONTPELIER 1 DEGREE SHEET IN CENTRAL VERMONT: NEW FINDINGS [7827]

4 Doolan, Barry*, Gale, Marjorie: COMPILATION OF BEDROCK GEOLOGY OF THE MOUNT MANSFIELD 1 DEGREE SHEET, NORTHERN VERMONT: A PROGRESS REPORT [14028]

5 Mehrtens, Charlotte*, Boore, Mary, Gale, Marjorie, Hadley, Ann, Dorsey, Rebecca: A NEW BEDROCK GEOLOGIC MAP OF THE CHAMPLAIN NORTH ONE DEGREE SHEET [14029]

6 Hayman, Nicholas W.*, Kidd, W. S. F., Granducci, Jennifer: THE CHAMPLAIN THRUST SYSTEM IN THE SHOREHAM-WEST-HAVEN-WHITEHALL REGION, WEST-CENTRAL VERMONT-EASTERN NEW YORK [11538]

Saturday, March 23, 1996

SESSION NO. 28

SYMPOSIUM 2—TOWARD A NEW GENERATION OF SEISMIC HAZARD MAPS AND ENGINEERING IMPLICATIONS FOR NORTH AMERICA

Hyatt Regency, Grand Ballroom A, 8:00 AM

K. Jacob and A. Dargush, Presiding

8:00 AM Kimball, J. K.*, Hunt, R. J., Nordenson, G. J. P.: BUILDING SEISMIC SAFETY COUNCIL PROJECT '97 [11997]

8:20 AM Perkins, David M.*, Frankel, Arthur D., Mueller, Charles S., Leyendecker, E. V., Hanson, Stanley L., Hopper, Margaret G., Safak, Erdel: NEW U.S. GEOLOGICAL SURVEY PROBABILISTIC GROUND MOTION MAPS FOR THE EASTERN UNITED STATES [38872]

8:40 AM Jacob, Klaus H.*, Armbruster, John: FROM MAPPED SEISMIC HAZARDS ON REFERENCE GROUND CONDITIONS TO DESIGN MOTIONS ON ACTUAL SITES: OPTIONS AND CODE ISSUES [38876]

9:00 AM Power, Maurice S.*, Buckle, Ian: NATIONAL SEISMIC HAZARD REPRESENTATION ISSUES FOR THE DESIGN OF HIGHWAY AND BRIDGE STRUCTURES [2277]

9:20 AM Hough, Susan E.*: LONG-TERM SEISMIC HAZARD EVALUATION IN NORTHEASTERN NORTH AMERICA: LESSONS FROM CALIFORNIA? [38868]

9:40 AM Seeber, Leonardo*, Armbruster, John G.: A HIGH RATIO BETWEEN SEISMICITY AND CUMULATIVE DISPLACEMENT ON INTRAPLATE FAULTS: IMPLICAITONS FOR TECTONICS AND HAZARD [18969]

10:00 AM Wheeler, Russell L.*: EARTHQUAKE DEPTHS AND TECTONIC SETTINGS IN THE NORTHEASTERN UNITED STATES AND CANADA [1834]

10:20 AM Daly, Julia F.*, Sayer, Suzanne: BRIEF HISTORY OF SEISMICITY IN DELAWARE [38874]

10:40 AM Kafka, Alan L.*, Walcott, Jessica R.: CAN THE SPATIAL DISTRIBUTION OF SMALL EARTHQUAKES BE USED

1996 ABSTRACTS WITH PROGRAMS

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