Section News (cont. from page 230)

contaminant transport in natural systems (C. Degueldre, Paul Scherrer Institut, Villigen Switzerland; and M. Whitbeck, Desert Research Institute, Reno, Nev.) and radionuclide association with groundwater colloids (A. R. Groffman, R. F. Weston, Albuquerque, N. Mex.; S. R. Grace, Department of Energy, Golden, Colo.; and B. Delakowitz, Technical University of München, Germany).

Several papers focused on natural organic matter (NOM), colloid stability, and the transport of contaminants. Adsorption on NOM (B. Gu, Oak Ridge National Laboratory, Tenn.) and model organic polyelectrolytes (A. Amirbahman and H. W. Walker, University of California, Irvine) enhanced the stability and transport of iron oxide colloids. W. P. Johnson of the University of Colorado at Boulder demonstrated that mobile NOM reduced the retardation of polycyclic aromatic hydrocarbon contaminants in laboratory columns. NOM transport in a natural system and the significance of NOM to colloids or contaminants along a flow path can reflect compositional changes in the NOM resulting from differences in the mobility of NOM subcomponents in an aquifer (J. F. McCarthy, Oak Ridge National Laboratory). Bacteria and viruses (biocolloids) can also be mobile in porous media. R. W. Harvey, USGS, Denver, Colo., presented an overview of field-scale bacterial transport, while papers by R. C. Bales, D. J. Moore, and D. G. Jewett, all of the University of Arizona, Tucson, presented more mechanistic analyses of biocolloid transport. L. W. Lion, Cornell University, Ithaca, N.Y., showed that mobile bacteria and their extracellular polymers can increase the mobility of hydrophobic pollutants. Several presentations discussed approaches to modeling colloid-facilitated contaminant transport.

The session titled "Heterogeneity and Stochastic Modeling" included presentations covering several theoretical, characterization, and simulation topics. Silliman, along with several others, discussed the sensitivity of flow and transport processes to specific aspects of idealized models of parameter heterogeneity. E. L. Majer, Lawrence Berkeley Laboratory, discussed progress on the use of geophysical techniques for characterizing subsurface properties, while C. C. Barton, USGS, Denver, gave some interesting perspectives on the fractal description of fractal patterns as a function of formation processes. Both T.-C. Yeh and P. J. Wierenga of the University of Arizona, Tucson, described successful ongoing work in modeling flow and transport phenomena in two well-characterized sites in South Carolina and New Mexico. T. Harter, also of the University of Arizona, Tucson, provided some useful ideas on the efficient simulation of unsaturated flow, as conditioned on measured pressure and conductivity distributions.

The special session, "Effective Constitutive Laws for Heterogeneous Porous Media," had over forty-five contributions. The common theme was the macroscale characterization and modeling of flow and related processes in geologic media that are stratified, fractured, or generally heterogenous in different ways and at various scales (from grain size up to regional inhomogeneity). Processes analyzed in the session included coupled hydromechanical processes; Darcy flow in the saturated, unsaturated, or two-phase regimes; tracer transport, dilution, and dispersion; and effective coefficients and constitutive laws for these phenomena. Many contributions focused on saturated porous media, while a large number of papers addressed hydrodynamic and transport properties for unsaturated or two-phase flow. Many of the presentations reported using probabilistic concepts to model hydrologic processes in the preserve of natural heterogeneity. An extended summary of highlights from this session will be published in a subsequent issue of *Eos*.—*Roger Bales, University of Arizona, Tucson*

Predicting the Movement of Volcanic Ash Clouds

Once volcanic ash is released by an eruption and becomes airborne, its movement is outside the direct jurisdiction of all concerned agencies, including the Federal Aviation Administration, the U.S. Geological Survey, and the National Oceanic and Atmospheric Administration. Soon after the successful prediction of the December 14, 1989, eruption of Redoubt Volcano many hours before it actually occurred, we learned that a KLM Boeing 747 nearly crashed as it encountered the ash cloud over the Alaska Range (see Figure 1). This accident occurred even though all concerned agencies in Anchorage were notified of the predicted and actual eruption by the Alaska Volcano Observatory.

We realized immediately that prediction of a volcanic eruption alone cannot protect aviation safety and that potential disasters can be averted by accurately predicting the movement of airborne ash clouds. Since there are annually about 40,000 747 flights over more than fifty active volcanos along the Kuril Islands, the Kamchatka Peninsula, the Aleutian Islands, and the Anchorage area, the need for prediction is paramount for aviation and other safety issues. The task is to simulate the movement of volcanic ash clouds at certain time intervals, for example, 0.5 hours, 2 hours, 3 hours, etc., after a major eruption.

Thus, the volcanic plume dispersion model was constructed from available pollutant dispersion models, based on the three-dimensional Lagrangian form of the diffusion equation, by taking into account a particular size distribution of ash particles and gravitational settling described by Stokes Law. For the upper-air wind data, one of the most important inputs to the prediction model, we used Unidata, a national atmospheric sciences program that is near real-time meteorological data from around the world; it can be acquired via satellite downlink.

Verifying the accuracy of the results is a crucial issue in prediction. Fortunately, the Advanced Very High Resolution Radiometer (AVHRR) satellite can obtain clear images of the ash plumes more than ten times in 24 hours. A series of eruptions of Spurr Volcano in 1992 provided us with an important opportunity to test and calibrate our method by using the AVHRR images.

Figure 2 shows a three-dimensional simulation of the ash cloud 2 hours and 48 minutes after the Spurr eruption at 00:42 UT on August 19, 1992, and the corresponding AVHRR image. The comparison between the simulated clouds and the corresponding images is quite encouraging. Such a comparison can be made as part of the routine calibration of the simulation. We believe that if the simulation method can be developed fully, prediction of cloud movement is possible. This would significantly improve aviation safety.—*H. L. Tanaka, K. G. Dean, and S.-I. Akasofu, Geophysical Institute, University of Alaska, Fairbanks*

Fig. 1. Simulated ash clouds released from the 1989 eruption of Mt. Redoubt Volcano. The three-dimensional image is part of a new computer program, developed by scientists at the Geophysical Institute and the Arctic Region Supercomputing Center at the University of Alaska, Fairbanks, that will help make flying safer in Alaska. The program, designed for use in aviation control towers, can display a three-dimensional image of an ash plume immediately after eruption, that can be viewed from any altitude and in any kind of weather. Given wind and weather parameters the program depicts the direction in which the ash plume will travel and effectively predicts where the highest densities of ash will move. The ash plume is displayed as if it were being viewed from the cockpit of a plane flying northwest of Anchorage toward Mt. Redoubt Volcano.

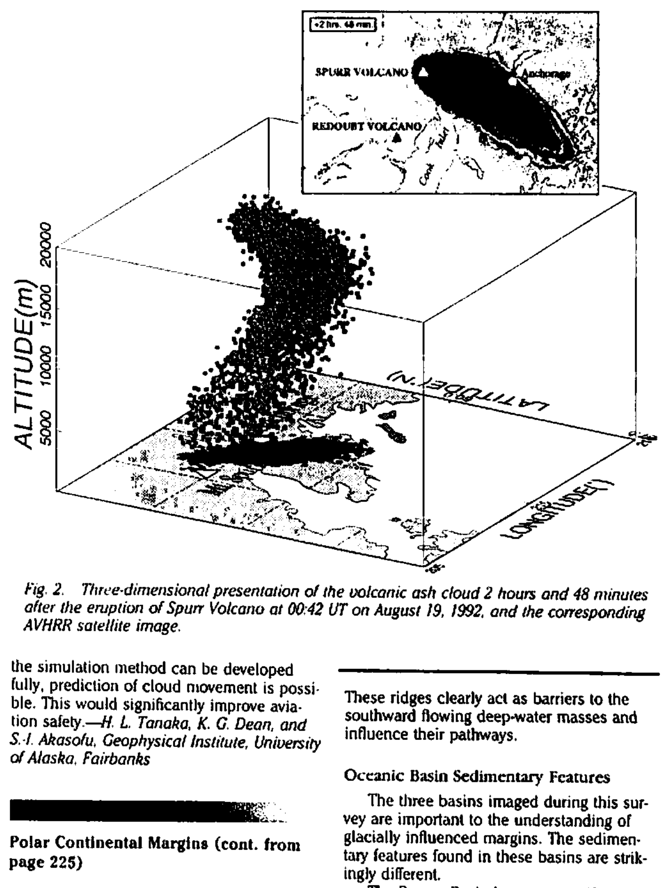

Fig. 2. Three-dimensional presentation of the volcanic ash cloud 2 hours and 48 minutes after the eruption of Spurr Volcano at 00:42 UT on August 19, 1992, and the corresponding AVHRR satellite image.

Polar Continental Margins (cont. from page 225)

Oceanic Basement Transform Ridges

In general, the Greenland Sea basin structure is linked to major fracture zones and ridges [*Vogt*, 1986]. The transform ridges divide the area between Fram Strait and Jan Mayen into three basins: the small northwest-southeast oriented 3200-m deep Boreas Basin, the large northeast-southwest aligned 3600-m deep Greenland Basin, and the small east-west oriented 2400-m deep basin just north of Jan Mayen. There are flat-sedimented tops on the transform ridges, like those seen on parts of the ridge to the north of Jan Mayen Fracture Zone and the Hovgaard Fracture Zone Ridge. These plateaus are at respective depths of about 500–1000 and 1400 m. It is presumed that the plateaus were planed off near sea level, but it is not known whether they were planed at the ridge axis and subsided or if the plateaus were uplifted after they had started down the subsidence curve. The steep sides of the ridges are gullied, and gullies are especially well-developed around these submarine plateaus. They are almost parallel and north-south directed toward the currents. These ridges clearly act as barriers to the southward flowing deep-water masses and influence their pathways.

Oceanic Basin Sedimentary Features

The three basins imaged during this survey are important to the understanding of glacially influenced margins. The sedimentary features found in these basins are strikingly different.

The Boreas Basin has a very uniform, medium- to low-level of backscatter apart from a single, weakly backscattering feature that looks like a channel. This channel is discontinuous and is thus believed to be inactive and perhaps filled by a fine-grained abandonment facies. There is an outstanding acoustic artifact on all of the sonographs across this basin that is believed to be interference fringes caused by multiple sound paths taken through the uppermost layers of soft sediment. This implies that there is some acoustic penetration into the seafloor and that the sediment layers have different acoustic properties and are fine-grained. The separation of the interference fringes increases progressively nearer to the Greenland Margin, which is believed to indicate an increase in layer thickness away from the margin [*Huggett et al.*, 1992]. Characteristic circular patches of high backscatter are present at the margin, including some with positive relief. The patches are equidimensional and up to half-a-kilometer across, and they

Polar Continental Margins (cont. on page 234)