Minutes of the Hydrogeology PPG Meeting

April 9 and 10, 2000 in Boulder, Colorado, USA

The Hydrogeology PPG held its first meeting at the University of Colorado, Boulder, Colorado, USA on April 9 and 10, 2000.

Participants (no regrets)

Hydrogeology PPG Members
John Bredehoeft (US)
Earl E. Davis (Canada)
Shemin Ge (US)
Steven M. Gorelick (US)
Pierre Henry (France)
Henk Kooi (The Netherlands)
Allen F. Moench (US)
Martin Sauter (Germany)
Peter K. Swart (US)
Tomochika Tokunaga (Japan)
Clifford I. Voss (US)
Fiona Whitaker (UK)

ESSEP Liaison:
Barbara Bekins (US)

Invited Guests:
Kevin Brown (US)
Adam Klaus (US)
Roger H. Morin (US)
Liz Screaton (US)

Graduate Student Assistant
Chereé Stover (US)

Introduction

The first Hydrogeology Planning Group meeting started with brief introductions of all the PPG members and their expertise. Some of the members presented their recent work as relevant to this PPG. Following the PPG member introduction were several presentations by the ESSEP liaison and the invited guests who have been involved in a variety of ODP activities.

Barbara Bekins gave an overview on the ODP Long Range Plan, ODP proposal evaluation process, and the SSEP's role in fostering proposals, a few proposal abstracts in the system that have fluid flow components, and the auxiliary science funding mechanisms by NSF and USSAC. Adam Klaus described the capabilities of the laboratories on board the JOIDES drillship, Resolution, the standard core processing on board the JR during research legs, site survey requirements, and briefly the capability of the new drillship. Earl Davis described the development, capabilities, and advances in borehole seal instrumentation, CORKs (Circulation Obviation Retrofit Kits), and some of the latest CORK monitoring results. Liz Screaton focused on in-situ permeability packer tests and data analysis using fluid flow modeling. Roger Morin updated the group on the activities of the Scientific Measurement Panel and hydrogeologic applications of geophysical logging. Kevin Brown illustrated flux meter instrumentation on the sea floor, its long-term monitoring capability, and how the results are used to infer diffusive fluid flux combining chemical and biological data. Pierre Henry informed the group of the proposed Gulf drilling project in Europe.

We then discussed our working strategy and decided to focus our efforts on identifying major scientific issues and strategies for tackling them within the context of the ODP Long Range Plan and research lag activities. Following is a summary.

Review of Scientific Issues

Hydrologic system as a unifying theme After a brief discussion, we quickly reached a consensus that it is critical to understand hydrogeologic processes in order to understand a variety of processes in submarine environments either near the surface or in the deep interior of the earth. It is understood that fluid flow is an effective agent in transporting heat and solutes and redistributing heat and solute in the earth's crust at all scales. Fluid flow and sediment deformation are closely coupled processes; therefore, fluid flow plays important roles in sediment compaction and erosion. Also intimately linked are fluid pressure state and seiemic rupture processes. Consequently, it is important to consider the hydrogeologic systems as dynamic and as involving coupled processes. The basic state variables describing the hydrogeologic processes include pore pressure, stress and strain, temperature field, and water chemistry fields. These state parameters need to be measured and understood both spatially and temporally.

Driving mechanisms Closely associated with the state of a hydrologic system are the mechanisms that drive fluid flow. We identified the following five mechanisms. First, variations in topography create gravity-driven flow systems. Second, fluid density differences arising from either temperature or solute concentration gradients result in buoyancy forces and cause convection. Third, stress or strain in sediments forces the fluid-matrix to undergo volumetric change in either compression or expansion mode, which induces fluid flow from regions of compression to regions of expansion. Sedimentation, erosion, or tectonic processes can result in stress or strain change. Fourth, internal fluid sources from mineral dehydration or petroleum maturation need to be taken into consideration. Fifth, osmosis has been recognized in some sedimentary basins on land as a driving force for fluid flow. In clay-rich submarine environments, osmosis should not be overlooked. We further noted many fluid flow processes are transitory. This requires studying some geologic settings at different stages of their evolution, and in instances where time scales of variability are likely to be short, this will require continuous monitoring.

Issues of interest We recognized that spatial heterogeneity in sediment parameters continues to present a major challenge to studying hydrogeologic processes in both continental and submarine environments. We noticed the lack of routine hydrogeologic measurements during the past research legs and strongly feel the need for such measurements in the future. In-situ hydrologic testing methodologies were also discussed. Hydro-fracturing tests received much attention for obtaining fracture information and stress tensor data. A better understanding of water budgets and global flux, such as the sources and pathways of fluids, at ocean-continental margins and at global scale is urgently needed. Establishing cost effective hydrogeologic monitoring networks could be potentially invaluable in providing much needed measurements and monitoring of state variables of hydrologic systems. The scale and instrumentation of the hydrogeologic monitoring network need to be further discussed. We also need to better understand the role of fluids in diagenetic processes, gas hydrate and petroleum formation, salt-water intrusion in coastal regions, and in deep biosphere and mid-oceanic ridge environments.

Preliminary Work Plan

To better focus our future discussion, we organized our thoughts in the following work plan, which is preliminary and may be substantially revised in coming months. We expect to communicate our ideas and progress through email prior to the second meeting.

A. Introduction
- Global importance of submarine groundwater flow, societal impact

B. Hydrologic Goals
- Goals from Complex Report w/hydrology
- Land-sea floor connection

C. Review State of knowledge
- Existing marine work
- Lessons from terrestrial

D. Approach
- Template of processes
- Global network
- Choose representative settings
  - extensional middle oceanic ridges
  - active margins, flux and seismogenic zone
  - passive margins
  - carbonate platform
  - ridge flanks
  - ocean islands
  - hydrates
  - glacial margins?
- Variations (heterogeneity) in space and time

Wedge variation along strike
Land/sea, high and low topography, catchment, climate, aquifer connection
Land ocean interaction in the coastal zone

Routine data and targets of opportunities
State and parameters

E. Recommendations

New tools
Modeling approaches
Formalized conceptual
Test analysis
Inverse modeling
Site Survey
Increase number of hydrologist

Future Meeting Logistics

We developed a preliminary partial list of areas or groups from which we would like to invite guests to our next meeting. These areas or groups are: the site survey panel, continental drilling community, and experts in different geologic environments. We agreed that we would like to request to hold the second meeting on September 24 and 25, 2000, in Paris. Pierre Henry has agreed to be the potential host.

Respectfully submitted,

Shemin Ge
Chair of the Hydrogeology Program Planning Group