Regional 3D Ground-Water Flow Model of Death Valley Basin

Presented to:
Nuclear Waste Technical Review Board

Presented by:
Frank D’Agnese
United States Geological Survey

January 20-21, 1998
Geographic features of the Death Valley region.
OBJECTIVES

- Define subregional and local boundaries
- Define major regional flow paths
- Locate regional recharge/discharge areas
- Assess effects of carbonate aquifer
- Assess effects of
  - Climate changes
  - Water-use
  - Structural changes
APPROACH

- Hydrogeologic Framework
- System Discretization
- 3D Model Calibration with MODFLOWP
- Conceptual Model Testing
- Flow Model Evaluation and Validation
- Recommendations for Improvement
- Improve Flow Model
Geographic distribution of UGTA and YMP/HRMP geologic cross sections.
Fence diagram showing hydrogeologic units.
Perspective view of 3D hydrogeologic framework model.
Refined potential recharge areas for the Death Valley region.
Final evapotranspiration areas in the Death Valley region.
Locations of water-level data in the Death Valley region.

EXPLANATION
- Death Valley Regional Flow System Boundary
- Wells representing regional water levels
The three subregions of the Death Valley regional ground-water flow system. The three subregions encompass the area modeled in this study.
EXPLANATION

- Subregion boundary
- Ground-water basin boundary
- Ground-water section boundary
- Arrows designate dominant regional flowpath associated with ground-water section discussed in text
- Location of spring
- Location of populated-place

Ground-water basins and sections

1. Pahute Mesa-Oasis Valley Ground-Water Basin
   a. Kawich Valley Section
   b. Oasis Valley Section

2. Ash Meadows Ground-Water Basin
   a. Pahranagat Valley Section
   b. Tikaboo Valley Section
   c. Indian Springs Valley Section
   d. Emigrant Valley Section
   e. Yucca-Frenchman Flat Section
   f. Specter Range Section

3. Alkali Flat-Furnace Creek Ground-Water Basin
   a. Fortymile Canyon Section
   b. Amargosa River Section
   c. Crater Flat Section
   d. Funeral Mountains Section

The Central Death Valley Subregion.
The Northern Death Valley Subregion.
The Southern Death Valley Subregion.
HYDROGEOLOGIC FRAMEWORK CONFIGURATIONS

- NE - SW trending high K zones
- NW - SE trend low K zones
- Eleana formation (shale confining unit)
- Paleozoic clastic confining unit (Funeral Mountains, Spring Mountains)
- Precambrian basement rocks in Bullfrog Mtns.
- Configuration of carbonate aquifer
Piper Diagram for Grapevine Springs (proper) flowpaths
MAJOR RESULTS

- 3D representation
- Regional, subregional and local boundaries
- Major regional flow paths
- Regional recharge/discharge areas
- Importance of Death Valley discharge
- Significance and complexity of framework
- Critical role of carbonate aquifer
SCOPE OF CLIMATE CHANGE SIMULATIONS

- Utilize current regional steady-state model
- Simulate flow system at 21 ka
  » compare discharge points to observed paleodischarge sites in region
  » evaluate “reasonableness” of past system representation
- Simulate flow system at 2X CO₂ (global warming)
PAST SIMULATION -
POTENTIOMETRIC SURFACE

- Recharge 5.4x higher over domain
  » 7% of recharge rejected
- Water levels rise over entire domain
- Most dramatic rise in layer 1
- Large gradients more pronounced
- Yucca Mountain  -60 m rise at repository
                   -150 m rise N. of LHG
FUTURE SIMULATION - POTENTIOMETRIC SURFACE

- Recharge 1.5x higher
  - parts of domain see constant or decrease
    » 1.2% of recharge rejected
- Water levels rise and fall
- Most dramatic rise in layer 1
- Large gradients slightly more pronounced
- Yucca Mountain -15 m rise at repository
  -40 m rise N. of LHG
COMBINED REGIONAL MODELING EFFORT FOR DOE

- Combine resources, data, and interpretations from all DOE-Nevada Programs
- Develop comprehensive 3D regional model for Yucca Mountain site characterization and other NTS activities
- Cooperate with other federal, state, and local agencies
- Develop regional ground-water resources analysis and management tool
Geographic distribution of YMP/HRMP and UGTA models.
PLAN FOR REGIONAL FLOW MODEL

- 1998: Combine data bases
- 1999: Calibrate combined steady-state model
- 2000: SS model evaluation/review
- 2001: Develop transient model
- 2002: Calibrate transient model
- 2003: Transient model evaluation/review