YUCCA
MOUNTAIN
PROJECT

Studies

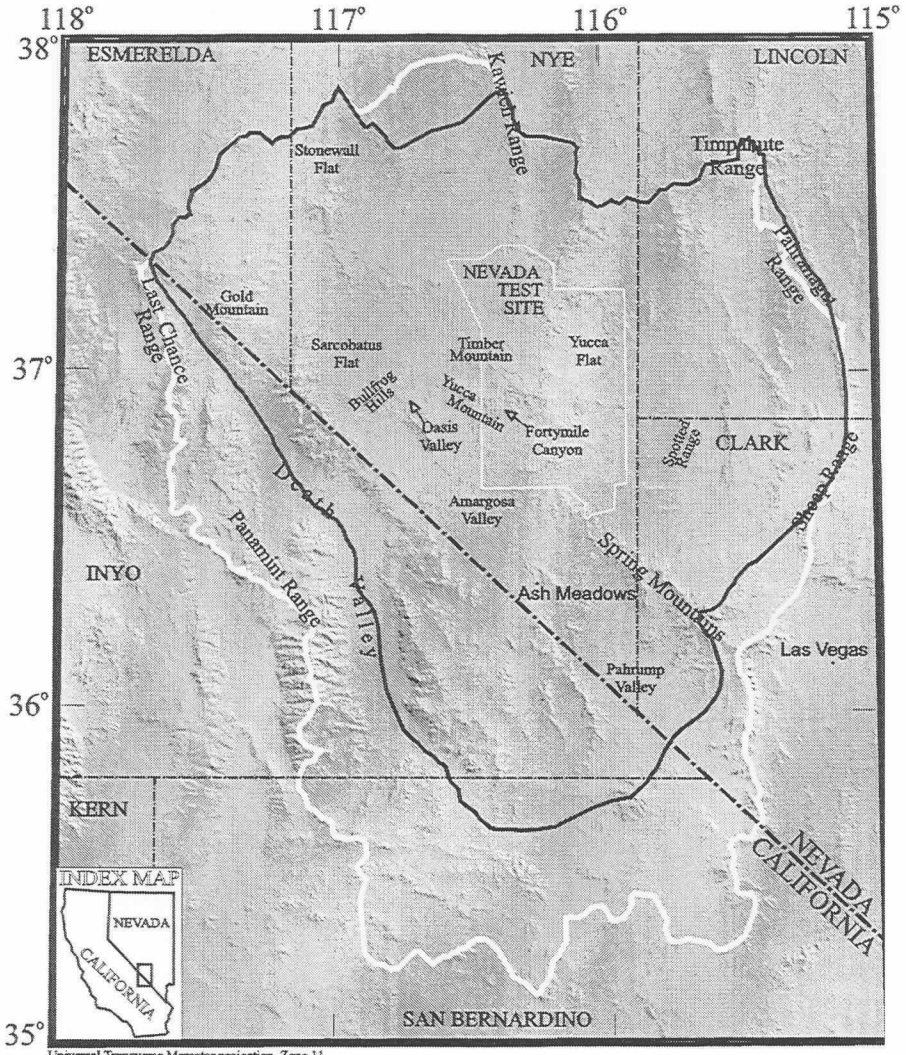
Regional 3D Ground-Water Flow Model of Death Valley Basin

Presented to:
Nuclear Waste Technical Review Board

Presented by:
Frank D'Agnese
United States Geological Survey

January 20-21, 1998

U.S. Department of Energy
Office of Civilian Radioactive
Waste Management



Universal Transverse Mercator projection, Zone 11.
Shaded-relief base from 1:250,000-scale Digital Elevation Model;
sun illumination from northeast at 30 degrees above horizon

25 0 25 50 KILOMETERS

25 0 25 50 MILES

EXPLANATION

Death Valley Regional Flow System Boundary

Death Valley Regional Flow-model Boundary

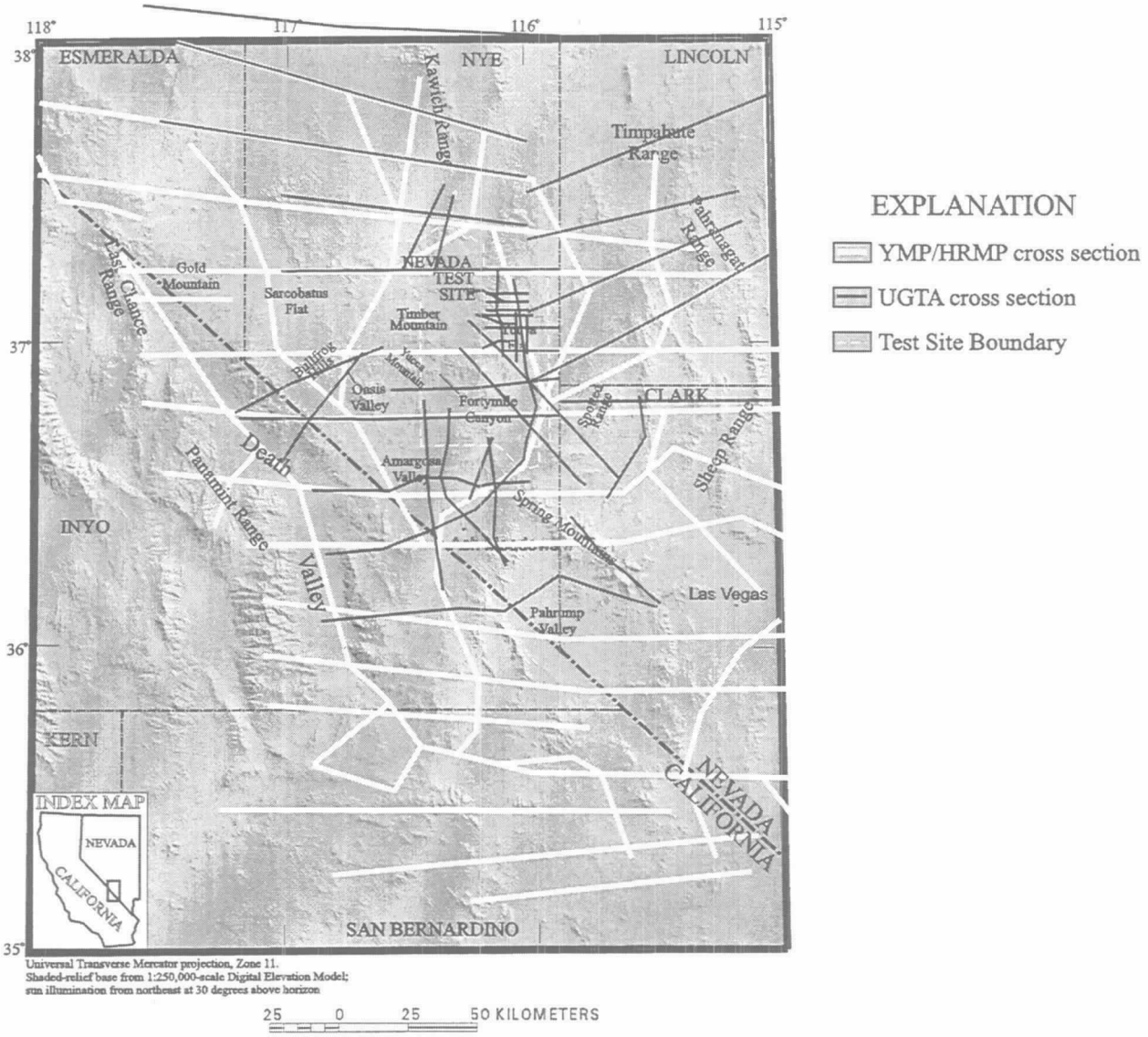
Geographic features of the Death Valley region.

OBJECTIVES

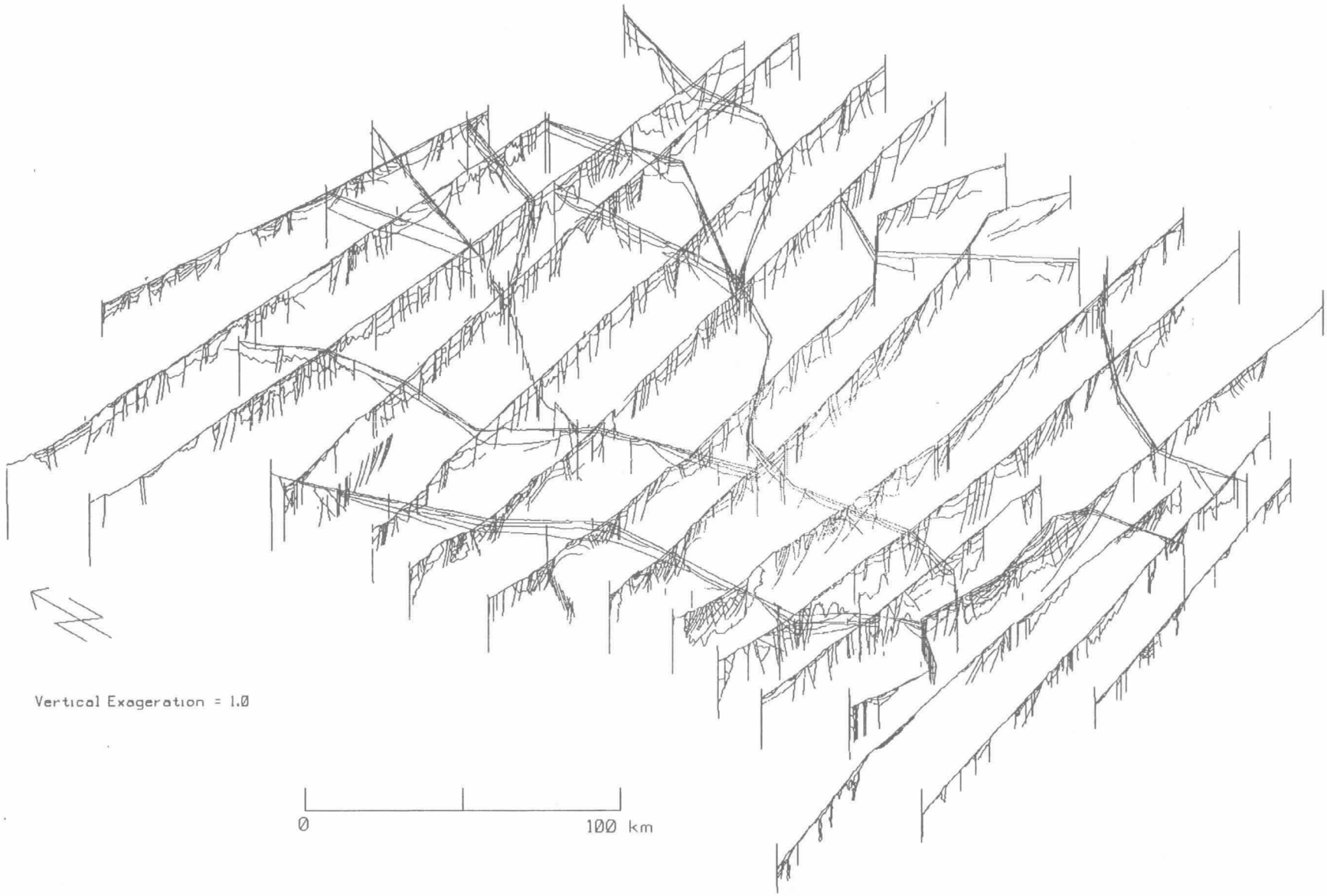
- Define subregional and local boundaries
- Define major regional flow paths
- Locate regional recharge/discharge areas
- Assess effects of carbonate aquifer
- Assess effects of
  - Climate changes
  - Water-use
  - Structural changes

APPROACH

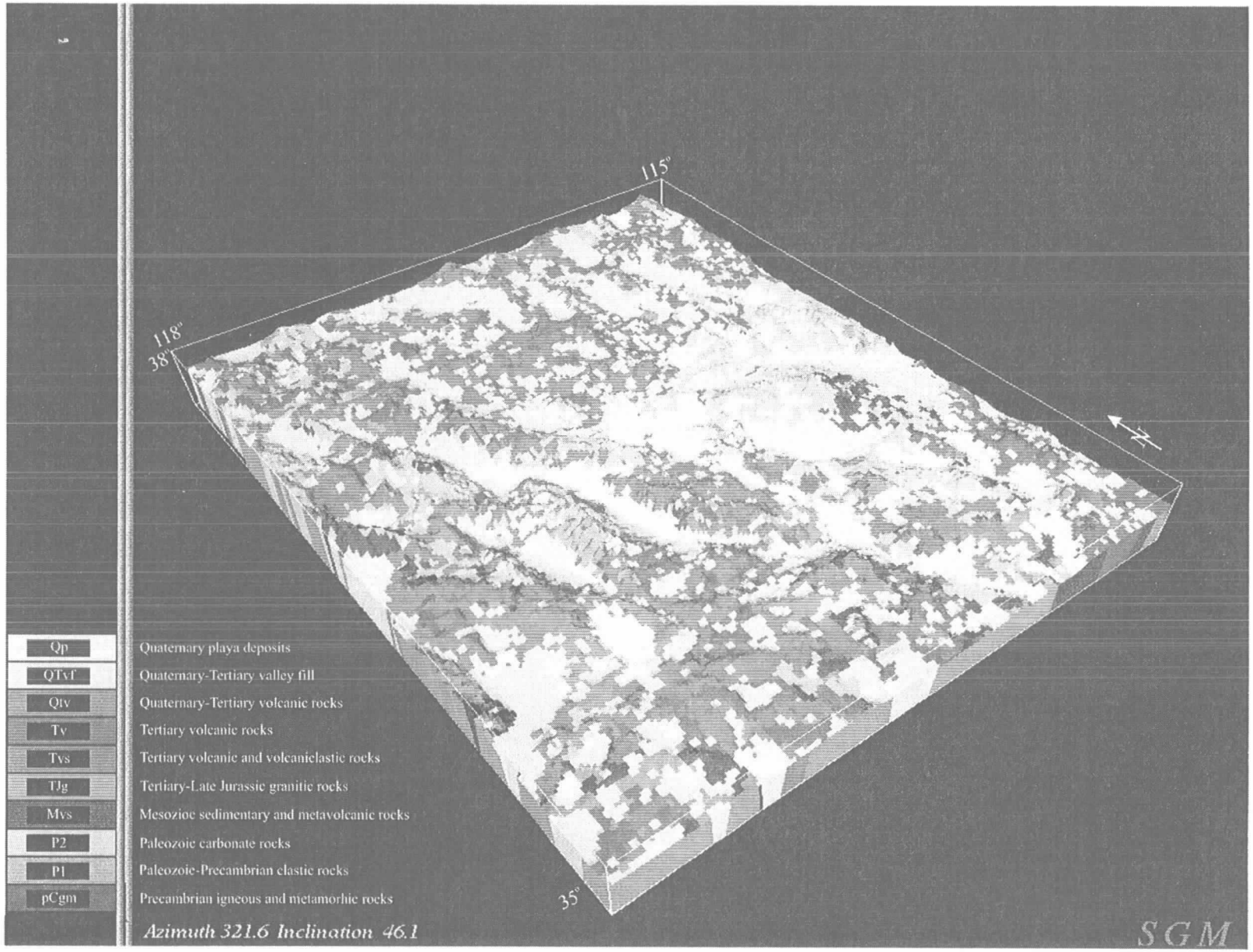
- Hydrogeologic Framework
- System Discretization
- 3D Model Calibration with MODFLOWP
- Conceptual Model Testing
- Flow Model Evaluation and Validation
- Recommendations for Improvement
- Improve Flow Model



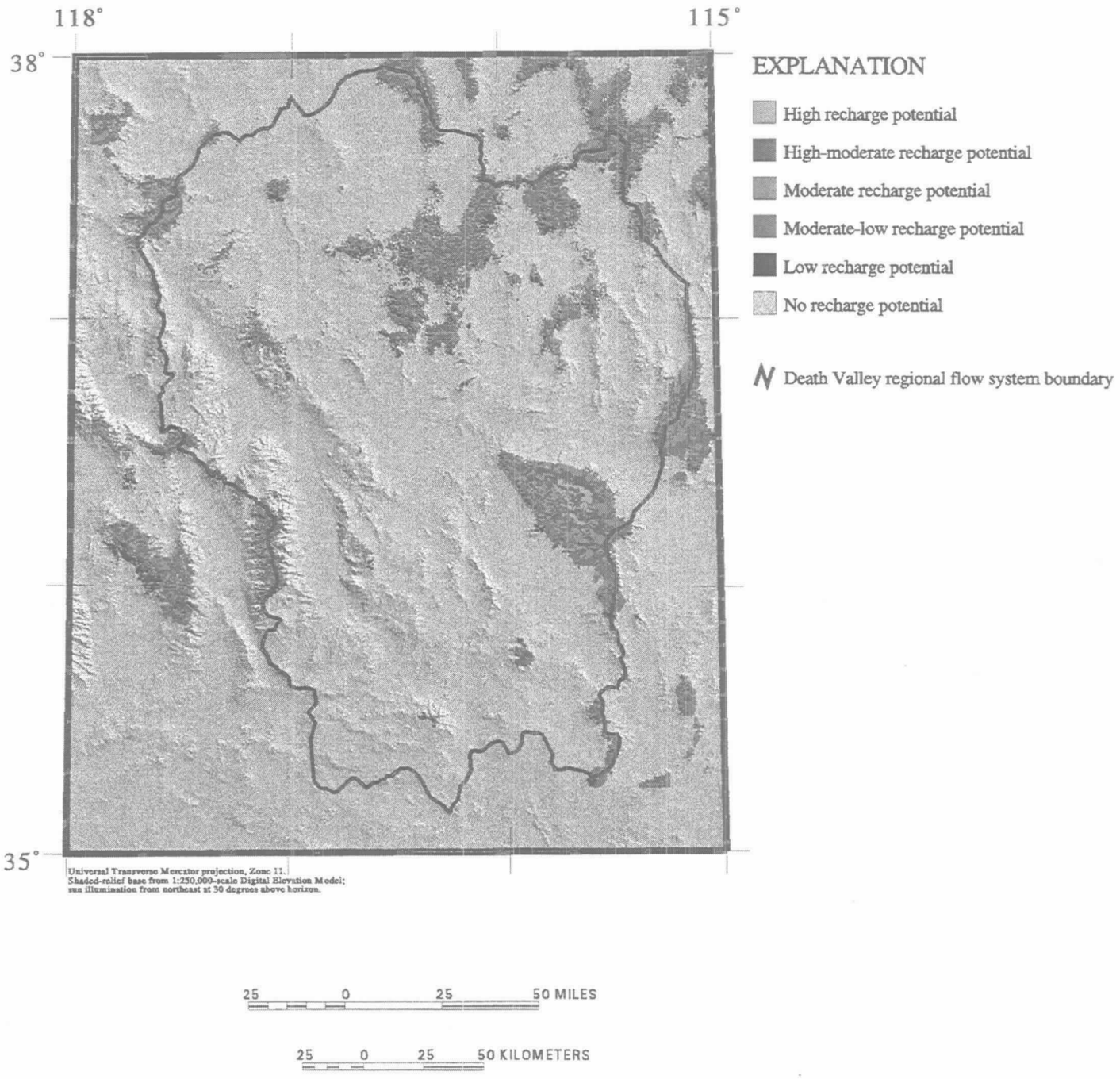
Geographic distribution of UGTA and YMP/HRMP geologic cross sections.



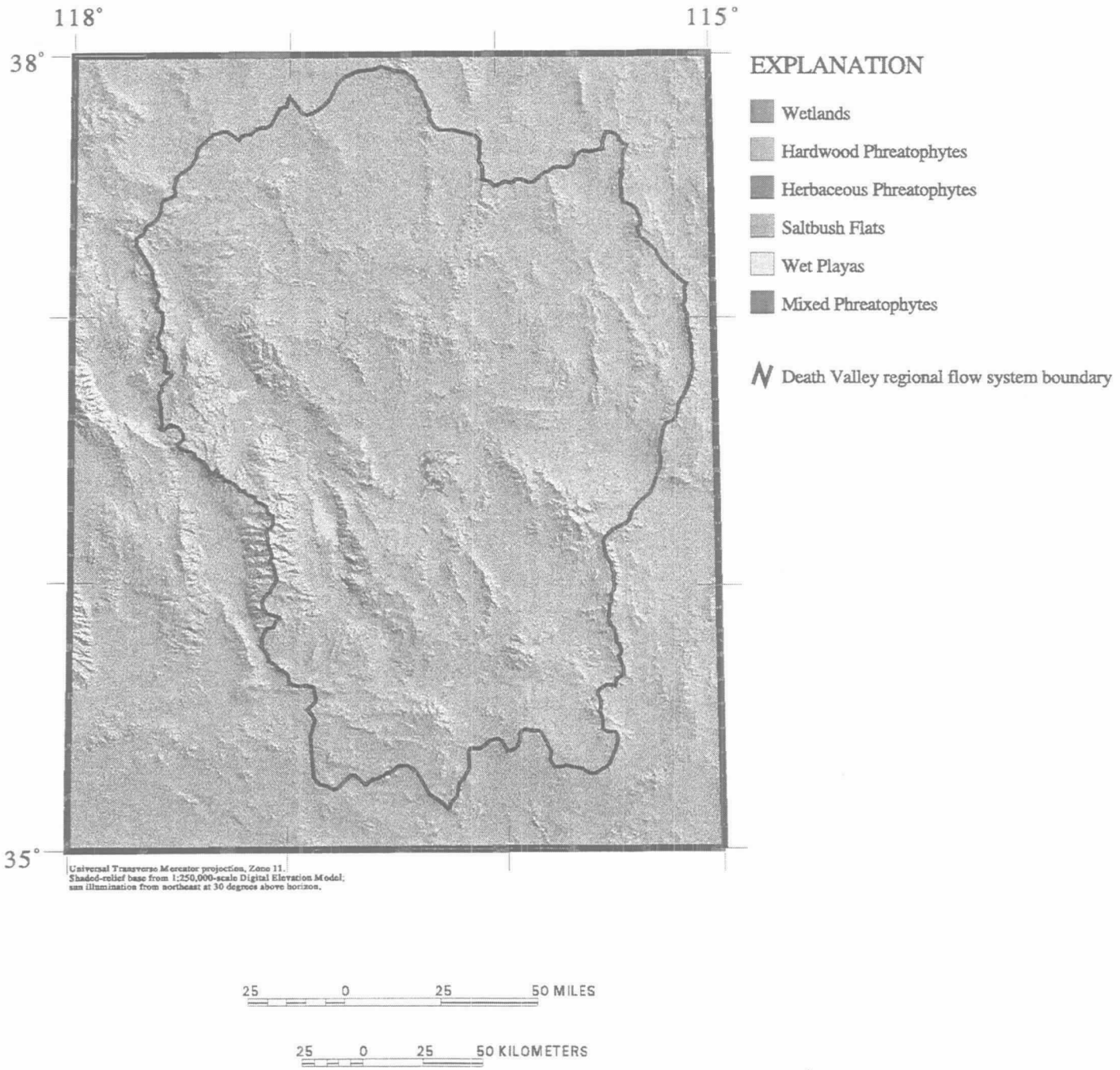
Fence diagram showing hydrogeologic units.



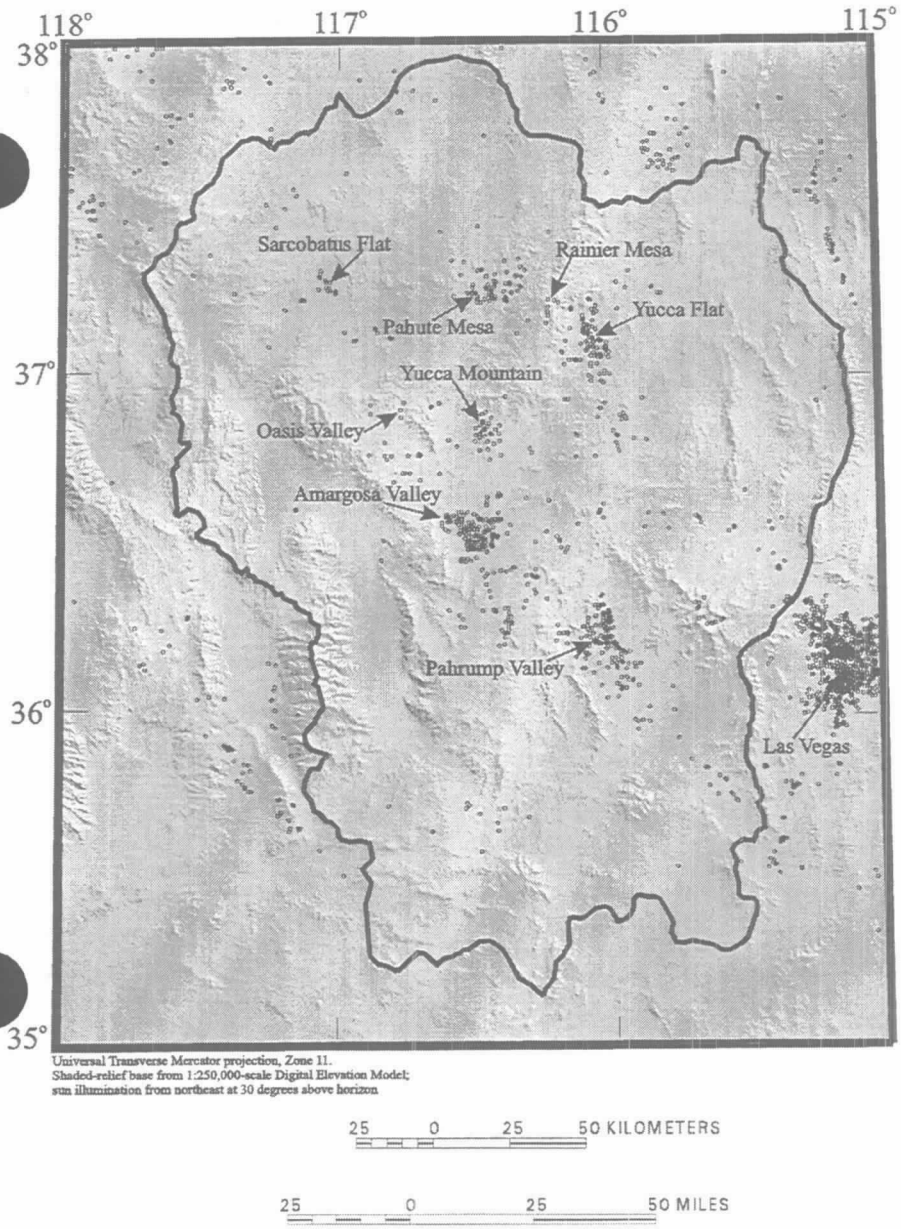
Perspective view of 3D hydrogeologic framework model.



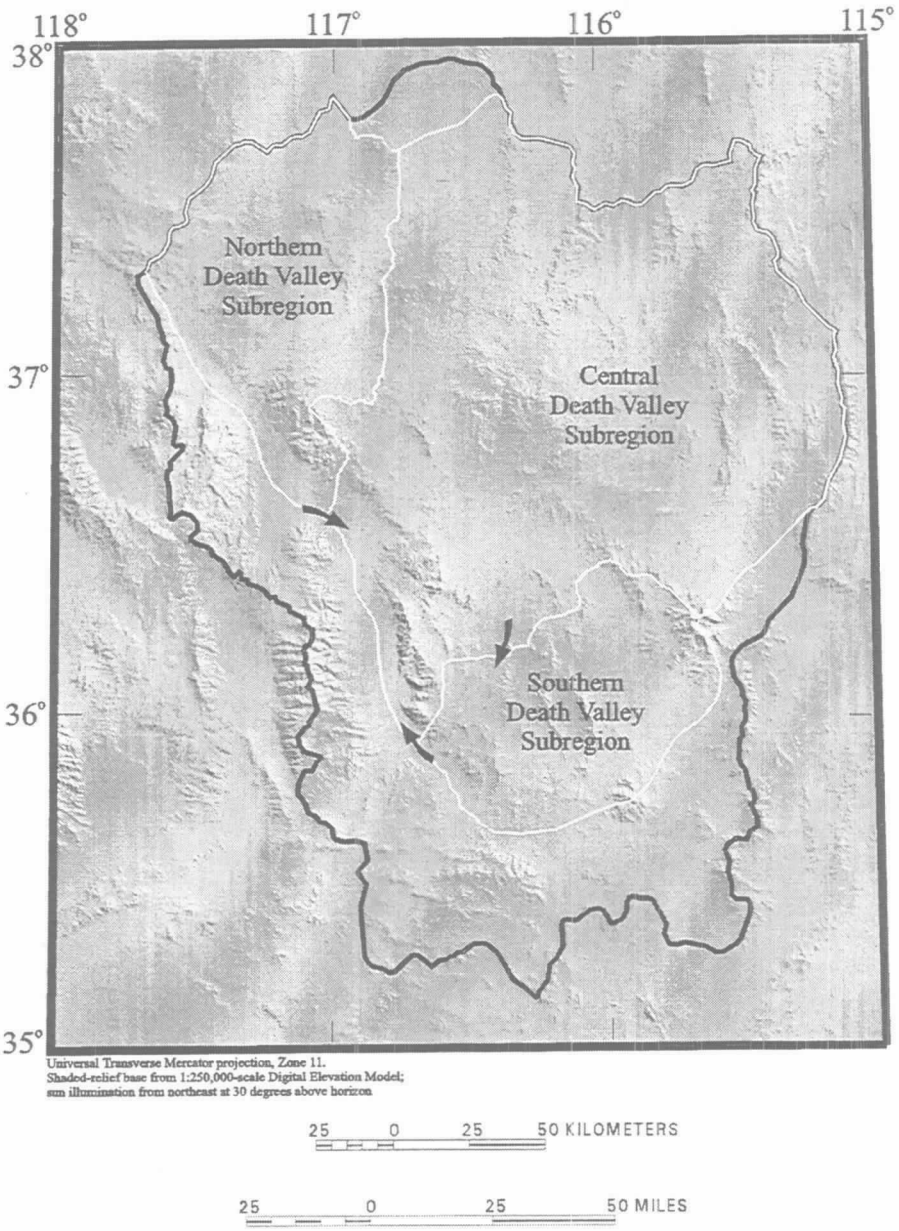
Refined potential recharge areas for the Death Valley region.



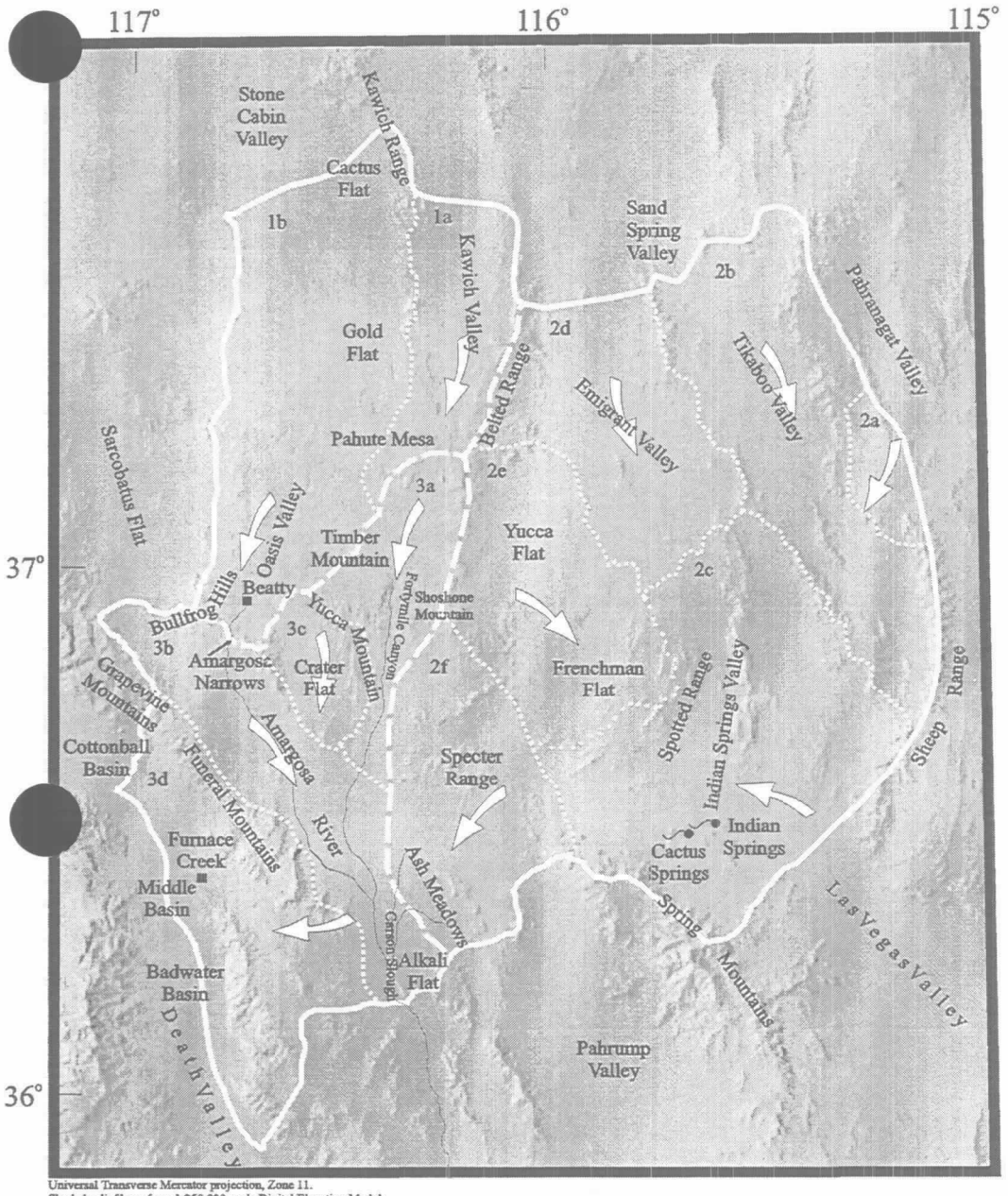
Final evapotranspiration areas in the Death Valley region.



Locations of water-level data in the Death Valley region.



The three subregions of the Death Valley regional ground-water flow system. The three subregions encompass the area modeled in this study.



Universal Transverse Mercator projection, Zone 11.
Shaded-relief base from 1:250,000-scale Digital Elevation Model;
sun illumination from northeast at 30 degrees above horizon

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

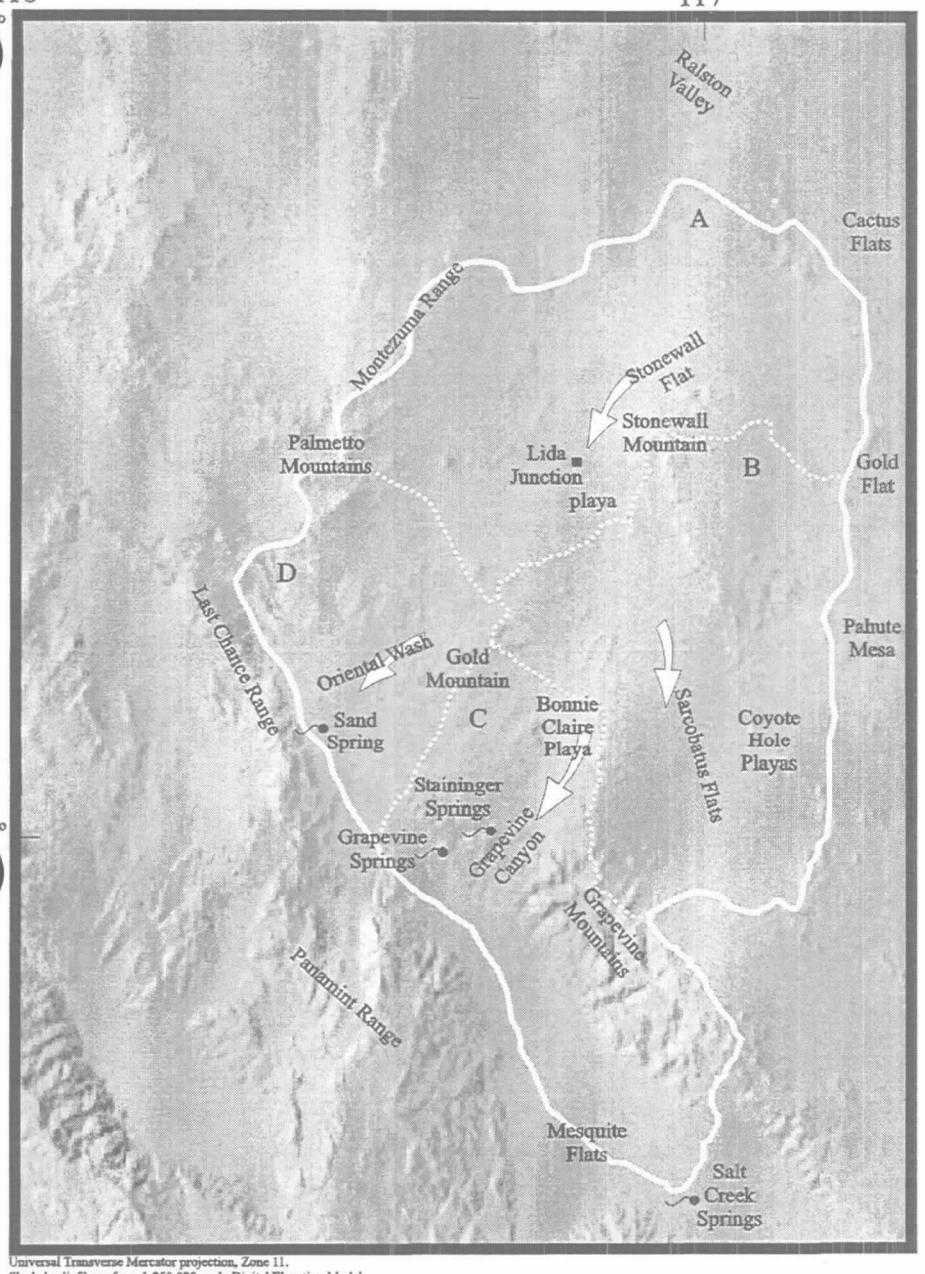
(2) Ash Meadows Ground-Water Basin
- a. Pahranagat Valley Section
- b. Tikaboo Valley Section
- c. Indian Springs Valley Section
- d. Emigrant Valley Section
- e. Yucca-Frenchman Flat Section
- f. Specter Range Section

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

25 0 25 KILOMETERS

25 0 25 MILES

The Central Death Valley Subregion.



Universal Transverse Mercator projection, Zone 11.
Shaded-relief base from 1:250,000-scale Digital Elevation Model;
sun illumination from northeast at 30 degrees above horizon

25 0 25 KILOMETERS

25 0 25 MILES

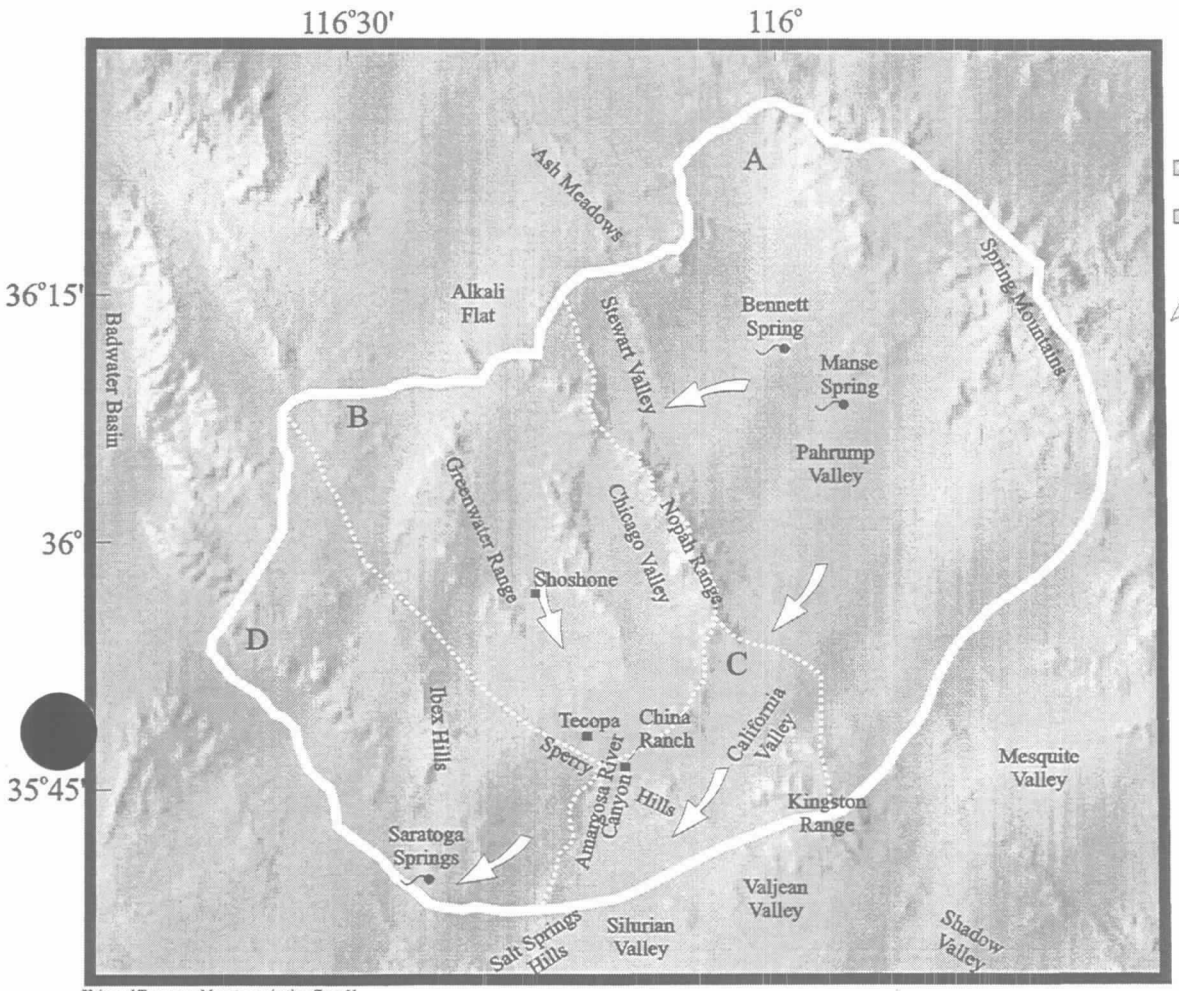
EXPLANATION

- Subregion 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 sections

A. Lida-Stonewall Section
B. Sarcobatus Flats Section
C. Grapevine Canyon Section
D. Oriental Wash Section

The Northern Death Valley Subregion.



Universal Transverse Mercator projection, Zone 11.
Shaded-relief base from 1:250,000-scale Digital Elevation Model;
sun illumination from northeast at 30 degrees above horizon

EXPLANATION

- Subregion 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 sections

A. Pahrump Valley Section
B. Shoshone-Tecopa Section
C. California Valley Section
D. Ibex Hills Section

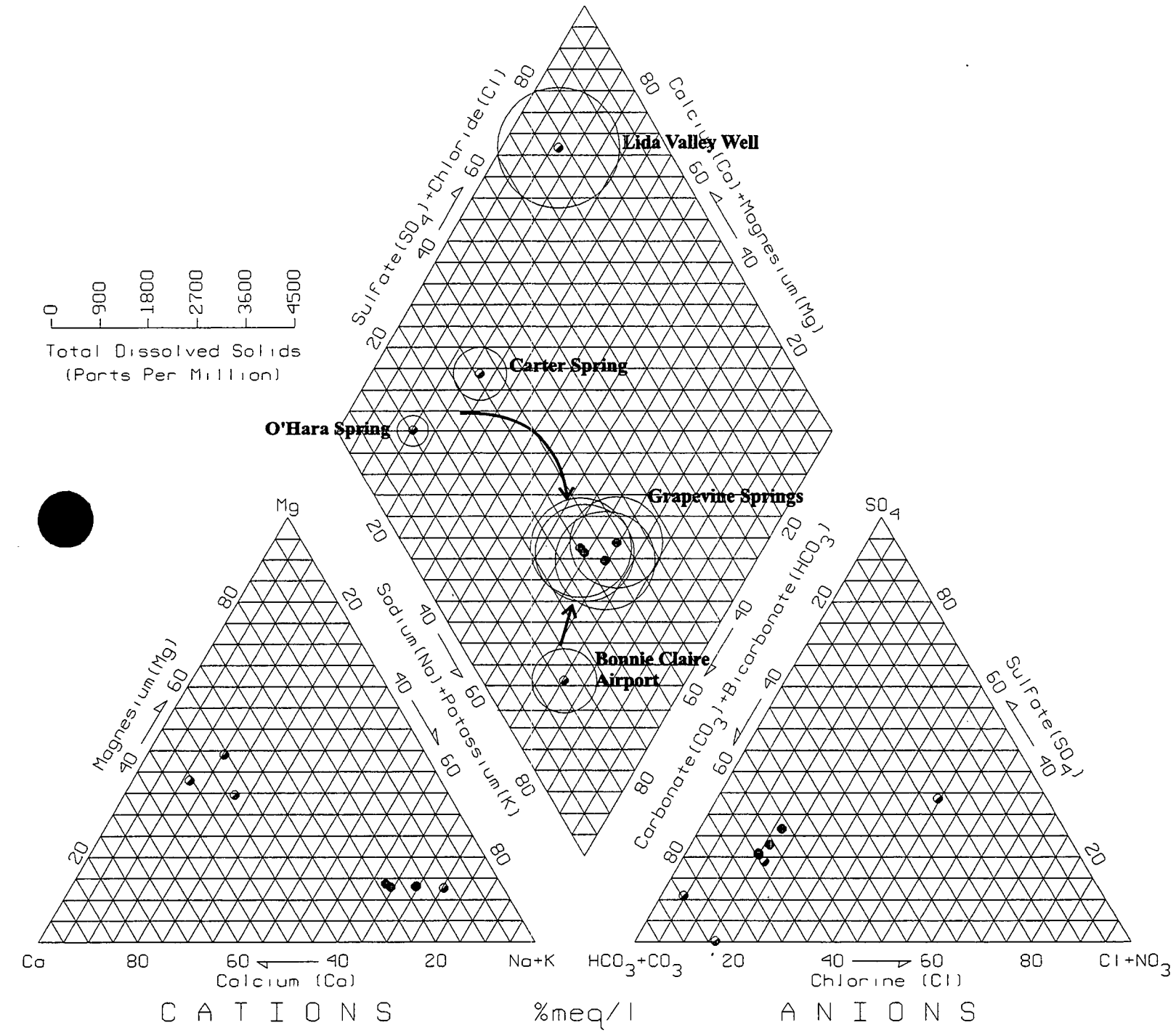
25 0 25 KILOMETERS

25 0 25 MILES

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 CO_2 (global warming)

PAST SIMULATION - POTENTIOMETRIC SURFACE

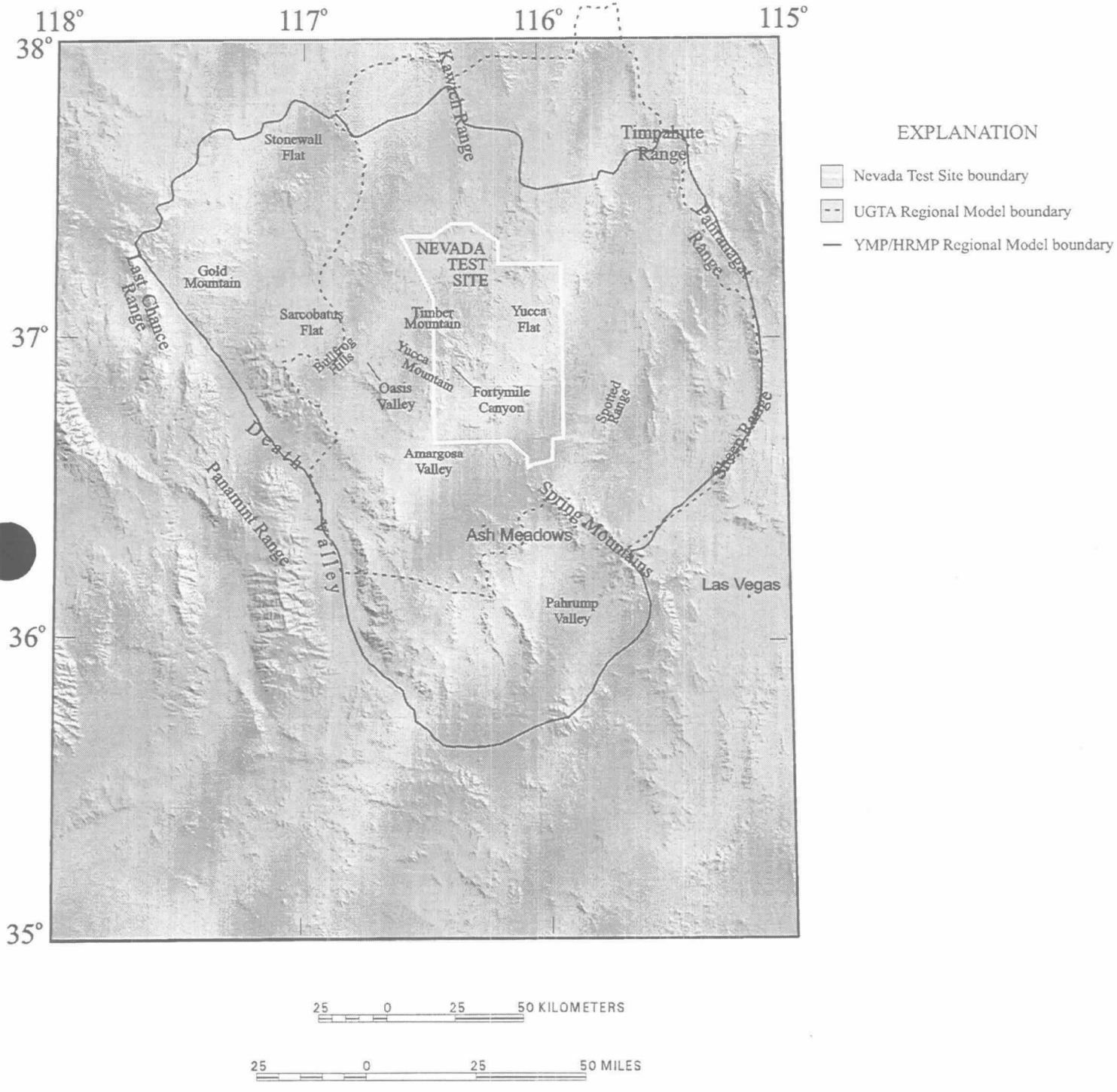
- Recharge 5.4x higher over domain
  - » 7% of recharge rejected
- Water levels rise over entire domain
- Most dramatic rise in layer 1
- Large gradients more pronounced
- Yucca Mountain -60 m rise at repository
  -150 m rise N. of LHG

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