

Inyo County, California

DEATH VALLEY REGIONAL GROUNDWATER MONITORING PROGRAM

PROJECT DESCRIPTION

Current as of October 13, 2004

OVERVIEW

The Paleozoic Carbonate Aquifer underlies the proposed Yucca Mountain Nuclear Repository at depth. This aquifer is a potential pathway by which contaminants could be transported away from the repository. The ultimate discharge from the Carbonate Aquifer is thought to be springs in Death Valley. However there are almost no drill holes that penetrate the Carbonate Aquifer in the Amargosa Valley. This project proposes to drill test holes on the east side of the Funeral Mountains in Amargosa Valley to the Carbonate Aquifer. These observation wells should either confirm or refute the presence of the Carbonate Aquifer and the likelihood that groundwater from the aquifer discharges in Death Valley.

BACKGROUND

Yucca Mountain is the site of the only proposed high-level nuclear repository in the United States. The repository was designed using the philosophy of multiple barriers, both engineered and natural, each of which impedes the potential movement of contaminants. The proposed repository would be constructed in the unsaturated zone above the water table in Tertiary tuffaceous rocks. The principal potential transporting mechanism for contaminants is moving groundwater. Underlying the repository, at a depth of approximately 2 km (6,000 feet), is the extensive Paleozoic Carbonate Aquifer that is known to be highly permeable. Various investigators suggest that the points of ultimate discharge from the Lower Carbonate Aquifer are the springs on the eastside of Death Valley, within Inyo County.

Inyo County has participated in oversight activities associated with the Yucca Mountain Nuclear Waste Repository since 1987. The purpose of Inyo County's oversight is to ensure that repository siting and subsequent repository activities do not adversely impact the public health, safety, or welfare of County residents, including Death Valley National Park. A number of investigators suggest that there is groundwater flow in the deep Carbonate Aquifer that underlies Yucca Mountain; groundwater from that aquifer is thought to discharge in Death Valley in Inyo County.

PROJECT DESCRIPTION

This proposed drilling program is designed to evaluate the connection between the Lower Carbonate Aquifer in the area thought to be the discharge zone in the vicinity of Death Valley National Park. Five wells are proposed near the southern extent of the Funeral

Mountain Range in the eastern part of the Death Valley basin. Testing and monitoring in these wells will help to determine the source and movement of groundwater in this area.

The new monitoring wells are to be drilled along and on the eastside of the Furnace Creek Fault to a depth that penetrates the Lower Carbonate Aquifer. The wells will be logged to characterize the lithology, and pump tested to determine hydraulic properties. Water samples are to be collected from each well. The samples are to be analyzed for dissolved concentrations of major cations and anions, and the isotopic ratios of the elements strontium, uranium, oxygen, and hydrogen. Samples will be analyzed for carbon 14 in an effort to determine the age of the water. The results of the geochemical analyses will be compared to 1) the groundwater geochemistry of water from springs and wells at, and near Yucca Mountain, and 2) wells and springs in Death Valley.

The identification of groundwater from the Carbonate Aquifer was based originally on the similarity of the water chemistry of springs in Death Valley to the water chemistry of groundwater in the Carbonate Aquifer. Data from the new observation wells will provide a further comparison of Carbonate Aquifer groundwater chemistry and information on the hydraulic head in the Carbonate Aquifer at the lower end of the Amargosa Desert on the east side of the Funeral Mountains. To confirm that the Carbonate Aquifer extends to Death Valley we would expect to see 1) similar groundwater chemistry to the water from the major springs in Death Valley, and 2) a hydraulic head in the Carbonate Aquifer that would support flow to Death Valley.

PROJECT WORK PLAN

The work plan for the proposed program is fashioned after Nye County's successful Early Warning Monitoring Program. The plan includes four major activities:

1. Geologic mapping of the southern Funeral Mountain range area;
2. Geophysical survey of the southern Funeral Mountain range area,
3. Drilling, completion, and testing of 5 deep monitoring wells; and
4. Development of a comprehensive hydrogeological data base for Death Valley.

Geology of the Southern Funeral Mountain Range

Understanding the structural geology of the southern Funeral Mountain range is critical to the siting of the planned monitoring wells. Previous investigations in the southern Funeral Mountains identified major structural elements related to Mesozoic thrusting of predominantly Paleozoic carbonate and clastic rock units. The degree to which these faults were reactivated in the Cenozoic and the degree to which the faults impart structural controls on the associated basin development are unclear. Our principal need in siting the drill holes is the expected depth of the Lower Carbonate Aquifer in the southern Funeral Mountain range; the geology of the area should provide this insight.

The U.S. Geological Survey is currently mapping the surface geology of the southern Funeral Mountains; the mapping is nearly complete. A number of geological profiles

across the Funeral Mountain range will be prepared to assist in the interpretation of the subsurface stratigraphy. Accessible drilling locations will be compared to potential areas that may be underlain by the Lower Carbonate Aquifer. The depth to the Lower Carbonate Aquifer will be considered in siting the wells. Based upon the geologic information final drilling locations will be selected.

Geophysical Survey of the Southern Funeral Mountain Range Area

Recent interpretations of aeromagnetic and gravity data of the central Death Valley region have delineated subsurface structures that are thought to be sub-basins in Death Valley and Pahrump Valley. The resolution of the aeromagnetic and gravity surveys is especially helpful to the ongoing geologic mapping. We propose to reevaluate the existing gravity and aeromagnetic data in the Furnace Creek Wash area, southern Funeral Mountains and adjacent Amargosa Valley region at a more detailed scale in the proposed drilling areas. This should provide better preliminary estimates of the thickness of the basin deposits, as well as the identification of subsurface faults. Gravity data can be used to further constrain the geophysical interpretation. We will do additional gravity surveys assuming we can obtain the necessary NPS permits for work in designated Wilderness Areas. These data will be used in selecting drilling sites.

Drilling, Construction, and Test of Five Deep Monitoring Wells

The five new monitoring wells are to be drilled along and on the eastside of the Furnace Creek Fault to a depth that penetrates the Lower Carbonate Aquifer. The proposed locations of the wells are shown on Plate 1. Two of the wells are located on the southern extent of the Funeral Mountain range along the Furnace Creek Fault. Both of these wells are located within Death Valley National Park. Three of the wells are located on the east side of the Funeral Mountain range. Two of these wells are located just outside the limits of the Bureau of Land Management Wilderness area.

The wells are to be drilled in two one-year phases. The two Death Valley wells are to be completed during Phase I of the project-the first year. The remaining three wells are to be completed in Phase II-the second year. The projected depth of the wells is into the upper 500 feet of the Lower Carbonate Aquifer, or to depths not to exceed:

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| 1. Well-1 | 4,000 feet (Travertine Springs Well-completed 2003) |
| 2. Well-2 | 3,000 feet (BLM #1 Well, projected for completion Oct 2004) |
| 3. Well 3 | 2,500 feet (BLM #2 Well, projected for completion Nov 2004) |
| 4. Well 4 | 2,500 feet (Ogle Well, status uncertain) |
| 5. Well 5 | 2,500 feet (Echo Canyon Well, planned completion Apr 2005) |

The wells will be logged by a well site geologist to characterize the lithology. In order to make stratigraphic correlations of subsurface deposits we will make 1) detailed petrographic analyses of the drill cuttings, and 2) downhole geophysical logs. The petrographic analyses will provide criteria for delineating subsurface geologic units; these will be correlated with studies of surface rock exposures. Additionally, the petrographic

analyses will provide data on physical properties of the rocks. These physical properties impact the hydrologic properties of the rock, a factor that is important in the flow modeling.

The timing of tectonic basin formation can be derived from argon age dating of ash deposits, both basaltic and andesitic lava flows, and pyroclastic rocks present both along Furnace Creek Wash and in the Amargosa Valley. Preliminary investigations suggest that there are numerous undated ash and tuff deposits within the exposed stratigraphic sections. These data are important in understanding the sub-basin geology; the age dating of these exposed deposits can be used to correlate with the stratigraphic section encountered in the drill holes.

The wells will be pump tested for a 72-hour period to determine hydraulic properties. Water samples are to be collected from a number of zones in each well. The samples are to be analyzed for concentrations of major cations and anions, and isotopic ratios of the elements of strontium, uranium, oxygen, and hydrogen. Samples will be analyzed for radiocarbon dates where appropriate. The results of the analyses will be compared to water chemistry data from springs and wells at, and near Yucca Mountain and in Death Valley. Water levels in the wells will be monitored for a two-year period to evaluate the hydrology of the Lower Carbonate Aquifer system. Multiple water bearing zones will be monitored using West Bay well casings.