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Updating an Expert Elicitation in the Light of New Data: Ten Years of Probabilistic Volcanic Hazard Analysis for the Proposed High-Level Radioactive Waste Repository at Yucca Mountain, Nevada

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The U.S. Department of Energy (DOE) considers volcanism to be a potentially disruptive class of events that could affect the safety of the proposed high-level waste repository at Yucca Mountain. Volcanic hazard assessment in monogenetic volcanic fields depends on an adequate understanding of the temporal and spatial pattern of past eruptions. At Yucca Mountain, the hazard is due to an 11 Ma-history of basaltic volcanism with the latest eruptions occurring in three Pleistocene episodes to the west and south of Yucca Mountain. An expert elicitation convened in 1995-1996 by the DOE estimated the mean hazard of volcanic disruption of the repository as slightly greater than 10^{-8} dike intersections per year with an uncertainty of about two orders of magnitude.

Several boreholes in the region have encountered buried basalt in alluvial-filled basins; the youngest of these basalts is dated at 3.8 Ma. The possibility of additional buried basalt centers is indicated by a previous regional aeromagnetic survey conducted by the USGS that detected approximately 20 magnetic anomalies that could represent buried basalt volcanoes. Sensitivity studies indicate that the postulated presence of buried post-Miocene volcanoes to the east of Yucca Mountain could increase the hazard by an order of magnitude, and potentially significantly impact the results of the earlier expert elicitation. Our interpretation of the aeromagnetic data indicates that post-Miocene basalts are not present east of Yucca Mountain, but that magnetic anomalies instead represent faulted and buried Miocene basalt that correlates with nearby surface exposures. This interpretation is being tested by drilling. The possibility of uncharacterized buried volcanoes that could significantly change hazard estimates led DOE to support an update of the expert elicitation in 2004-2006. In support of the expert elicitation data needs, the DOE is sponsoring 1) a new higher-resolution, helicopter-borne aeromagnetic survey, completed in mid-2004, and 2) drilling of selected anomalies based on the aeromagnetic survey results to better characterize the number, location and age of buried volcanoes, which began in mid-2005. The new aeromagnetic survey detected the presence of 33 anomalies interpreted as possible buried volcanoes or faulted tuff bedrock. A program to drill ten of the anomalies has begun, with the selection of drill holes prioritized based on their potential impact on the hazard assessment.