

Using Tectonic Information to Refine Volcanic Hazard Estimates for Yucca Mountain, Nevada, U.S.A.

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Simple spatio-temporal patterns of rare geologic events usually are too sparse to develop robust estimates for likelihoods of future events. Nevertheless, such estimates often are needed to support societal decisions. For example, the proposed Yucca Mountain nuclear waste repository is located in a generally E-W extensional basin that postdates cessation of nearby caldera volcanism around 13 Ma. Detailed structural and geophysical data from 20+ years of site characterization investigations define the spatial extent of this extensional basin. Approximately 15 small-volume ($<1 \text{ km}^3$) basaltic volcanoes erupted in this basin at 0.07–11 Ma, including one event $<1 \text{ km}$ from the proposed site. Consequently, volcanism represents a low-probability, high-consequence hazard considered in repository performance models. Basic spatio-temporal probability models for volcanic events (e.g., Connor and Hill, 1995, doi10.1029/95JB01055) capture past patterns of volcanic activity, but do not consider tectonic information directly. Without tectonic considerations, the probability of volcanic eruption at the proposed site is estimated at $1 \times 10^{-8}/\text{yr}$ to $5 \times 10^{-8}/\text{yr}$. These probability models were refined with a Bayesian approach that included degree of basin extension as a prior function (Connor et al., 2000, doi10.1029/1999JB900353). Thus, the probability models honor the observation that the proposed repository site is located on the diffuse eastern boundary of the extensional basin. The resulting probability estimates show the proposed site is located on a distinct gradient in spatial probability, which decreases to background values of $<10^{-8}/\text{yr}$ approximately 10 km to the east. At the proposed repository site, the probability of volcanic eruption is estimated between $10^{-8}/\text{yr}$ and $10^{-7}/\text{yr}$ when tectonic information is abstracted into the probability model.

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