Akrotiri (Santorini, Greece)

Description: Akrotiri is a Minoan settlement located on the island of Santorini in Greece. A large volcanic eruption approximately 3600 years ago covered the island with a thick deposit of silicic volcanic ash, which inundated the local Minoan settlements causing them to be abandoned (Miller et al., 2000).

Relevance: The silicic volcanic ash which was deposited on the settlement is quite similar to the volcanic rock at Yucca Mountain (Murphy and Pearcy, 1994). Ongoing archaeological excavations at Akrotiri have uncovered artefacts made of many different materials in contact with the ash deposit. Various metal artefacts, especially bronzes, in the upper unsaturated layers were considered somewhat analogous to metal canisters in the Yucca Mountain repository. The bronze artefacts were found to be fairly heavily corroded and estimated to have lost approximately one third of their original mass. A quantitative corrosion rate was not given by Murphy and Pearcy (1994) but it is evident, from comparison with other analogue observations, that metal corrosion at Santorini occurred considerably faster than corrosion in other burial environments. The metal lost by corrosion was observed to form a contaminant plume in the adjacent volcanic ash and this information has been used to test trace elemental transport codes (Murphy et al., 1997). Since the boundary conditions for system initiation are well constrained, in terms of location, timescale, chemistry etc., this archaeological system provided a good opportunity to test the performance assessment models for trace metal migration in tuffs that could be applied to the Yucca Mountain repository.

Position(s) in the matrix tables: Near-field matrix, mechanical integrity of barriers, corrosion, waste package, copper

Limitations: Differences between the porosity and permeability ash at Santorini and the tuffs at Yucca Mountain exist and consequently interpretation of this analogue must be done with care.

Quantitative information: Rates of corrosion and contaminant transport.

Uncertainties: The implications of differences in the properties of the ash at Santorini and the tuffs at Yucca Mountain.

Time-scale: Archaeological.

PA/safety case applications: Comparison between measured contaminant distribution and model predictions gave some degree of success (Murphy and Pearcy, 1996; Murphy et al., 1997), raising confidence in the performance assessment models.

Communication applications: None known

References:

Murphy WM, Pearcy EC, Green RT, Prikryl JD, Mohanty S, Leslie BW and Nedungadi A (1997) A test of the long term, predictive, geochemical transport modeling at the Akrotiri archaeological site. Journal of Contaminant Hydrology, 29, 245-279.

Murphy WM and Pearcy EC (1994) Performance assessment significance of natural analog studies at Peña Blanca. Mexico and at Santorini, Greece. In: von Maravic H and Smellie J (editors) Natural analogue working group, fifth meeting, Toledo, October 1992. CEC Nuclear Science and Technology Report, 219-224, EUR 15176, CEC, Luxembourg.

Murphy WM and Pearcy EC (1996) Natural analog support for unsaturated transport modelling using data from the Akrotiri archaeological site. Materials Research Society Symposium Proceedings, 412, (Scientific Basis for Nuclear Waste Management, XIX), 817-822.

Added value comments: None to add.

Potential follow-up work: None suggested.

Keywords: near-field, copper, corrosion rates

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