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Evaluation of the US DOE's conceptual model of hydrothermal activity at Yucca Mountain, Nevada

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Dr. Dublyansky,

Regarding your emails of June 8, 2012, as I replied to you on July 10, the report discussing the details of the modeling effort that was applied to the thermal history of the Timber Mountain caldera is in progress and will likely be published early in 2013. However, because the results of a single simulation were published in the Whelan et al. (2008)[1] paper, I can answer your questions regarding the parameters that were used in that simulation.

First, as stated in the paper, the simulation results plotted in Figure 8b were calculated at depths of 100 and 200 m at a distance of 8 km from the projected magma chamber edge. The model was a 2D simulation with a grid size of 120 by 120. A grid spacing of 0.25 km was used, resulting in a model domain of 30 by 30 km. A mirror plane was invoked on the right-hand (magma chamber) side of the domain. As stated in the paper (section 6.3), the magma chamber was initially at 1000 °C at 12.8 Ma and was replenished (also at 1000 °C) at 11.6 Ma. Convection in the magma chamber was allowed. Table 1 lists the parameters, locations, and convective flow information for the model rock units.

Table 1. Rock units used in published Timber Mountain thermal simulation.

Rock Name	Rock Type	Density (kg/m3)	Heat Capacity (J/kg °)	Thermal Conductivity (W/m °)	Coordinates (x,z of upper left and lower right)
Magma 1, 2	andesitic	2475	1100	1.3	61,11 120,38
Rock 1	metamorphic	3300	980	2.0	1,81 120,120
Rock 2	mafic igneous	2850	980	3.0	1,41 120,80
Rock 3	carbonate	2650	980	1.0	1,21 120,40*
Rock 4	volcanic	1750	980	1.3	1,3 20,20
Rock 5	UZ	1900	980	1.0	1,1 120,2
Rock 6†	volcanic	1750	980	1.3	21,11 60,20
Rock 7‡	volcanic	1750	980	1.3	21,3 120,10

*Rock unit coordinates ignore overlap of magma chamber coordinates.
†Convection allowed, porosity of 0.10; at 10 Ma unit becomes conductive.
‡Convection allowed, porosity of 0.10; at 10 Ma porosity reduced to 0.05; at 9 Ma porosity reduced to 0.02; at 8 Ma unit becomes conductive.

[1] Whelan, J.F., Neymark, L.A., Moscati, R.J., Marshall, B.D., and Roedder, E., 2008, Thermal history of the unsaturated zone at Yucca Mountain, Nevada, USA. Applied Geochemistry, v. 23, p. 1041-1075.

Present-day depths were calculated assuming that 100 m of overburden, emplaced at 11.6 Ma, was eroded at a constant rate. The initial thermal gradient was specified at 30 °C/km.

These parameters should allow you to reproduce the model using the HEAT3D code. This simulation was performed using HEAT3D version 4.10.0517, but I think the currently available code (version 4.11.0533) would yield similar, if not identical, results.

Sincerely,

Brian D. Marshall
U.S. Geological Survey